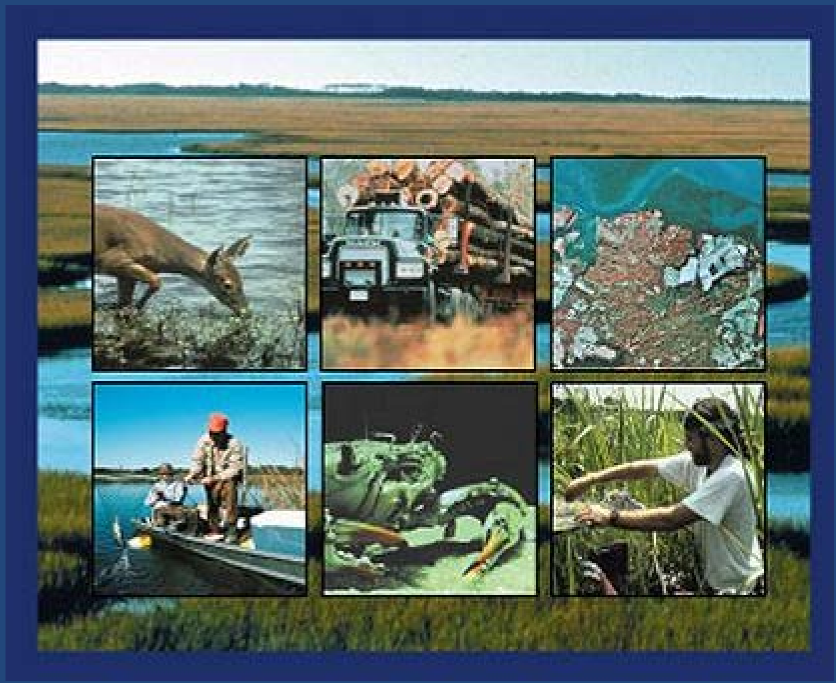
CHARACTERIZATION OF THE
ASHEPOO-COMBAHEE-EDISTO (ACE) BASIN, SOUTH CAROLINA



Executive Summary | Introduction | About This CD-ROM | Site Map | Acknowledgements | Video Tour

Executive Summary

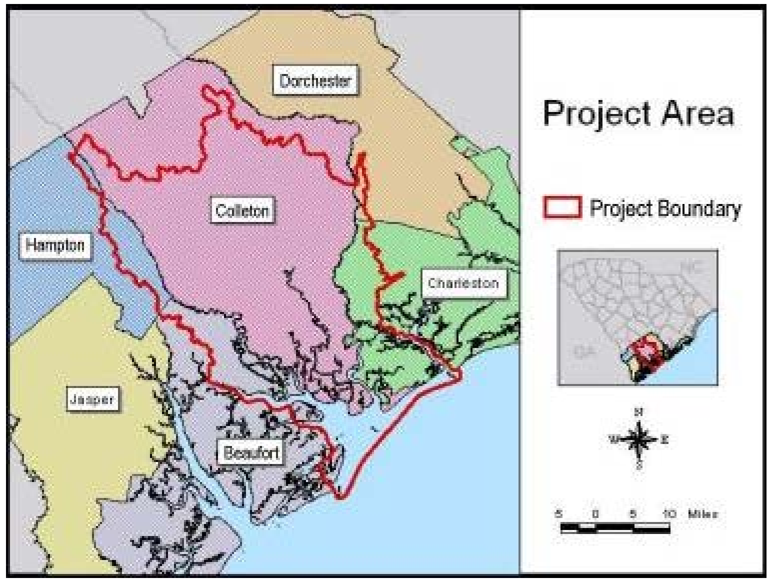
Introduction

Newly constructed homes on Edisto Beach

People are being drawn to South Carolina's coast in ever increasing numbers. Between the years 1960 and 2010, the population of coastal counties in the United States is projected to grow from 80 to 127 million people. Population growth creates a number of environmental problems, including nonpoint source pollution, nutrient enrichment, resource depletion, and habitat loss or fragmentation. Coastal zone managers are aware of the potential for increasing human-induced stress in our coastal ecosystems. They need information, in an accessible form, to determine how present and future land use can affect the conservation and protection of various habitats and their associated biological resources.

The Ashepoo-Combahee-Edisto (ACE) Basin of South Carolina has a largely undeveloped landscape consisting of extensive, diverse habitats, such as saltwater and brackish-water marshes, maritime forests, upland pines, and bottomland hardwoods. These ecologically important attributes, coupled with management goals that balance conservation of natural resources with economic development and population growth, have made the ACE Basin the focus of national attention. A number of organizations and local citizens have been instrumental in the conservation of the ACE Basin; these include the South Carolina Department of Natural Resources (SCDNR), The Nature Conservancy (TNC), Ducks Unlimited (DU), Colleton County, and the U.S. Fish and Wildlife Service (USFWS). Through these and other organizations, nearly 10 percent of the upland and wetland habitats in the Basin have been permanently protected by purchase and conservation easements. Local community leaders have been responsive to this effort and created the ACE Basin Economic Forum with these goals: establish a framework for responsible growth, enhance awareness and appreciation of the Basin, and promote environmentally compatible business development in the area. This is particularly important considering that a population increase in the ACE Basin will undoubtedly lead to human-induced stress on its ecosystem.

Residential and urban land use in the ACE Basin study area



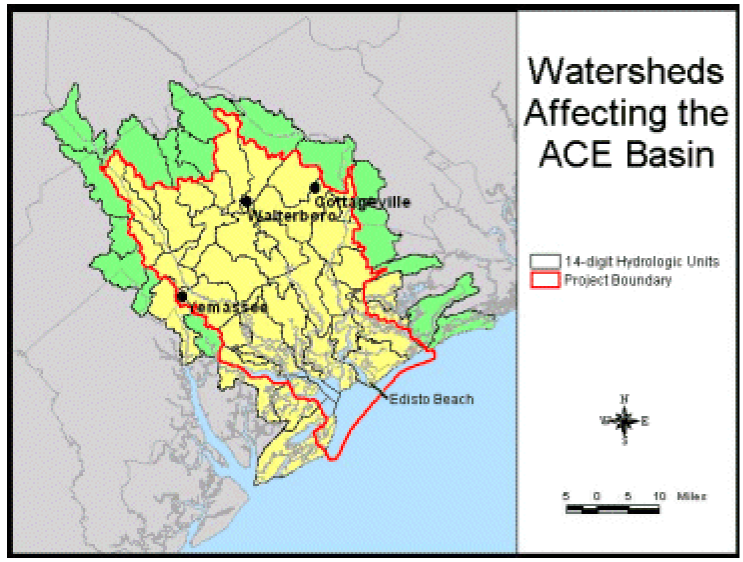
increased by over 4,940 ha (2,000 ac) between 1989 and 1994. Colleton County, in which the majority of the ACE Basin study area is located, is expected to increase from a 1990 population of 34,377 people to over 47,500 people by the year 2010. Stressors associated with population growth include habitat loss, resource depletion, nonpoint source pollution, and nutrient loadings to estuaries and coastal waters. Areas of rapid population growth are centered within an hour's drive north (Charleston) and south (Beaufort) of the ACE Basin study area, creating the potential for rapid urbanization within the area. People are attracted to the mild climate, rural character, affordable land prices, recreational opportunities, and natural settings available in the vicinity of the ACE Basin, yet population growth and urbanization may affect the very things that attract people to the area.

Back to Top

The Characterization Project

The ACE Basin Characterization Study is a joint effort between the SCDNR and the National Oceanic and Atmospheric Administration's Coastal Services Center (NOAA CSC), with contributions from numerous other agencies. The study was developed to provide agencies, land managers, resource managers, conservation groups, scientists, and private citizens with an interdisciplinary synthesis of information about this ecologically important area of South Carolina. In particular, this study was designed to present technical information in a format that is understandable to resource managers and educators. The primary goal is to facilitate management and resource allocation in the ACE Basin and surrounding areas by assembling into one information resource much of the environmental, socioeconomic, and resource management information necessary to make cogent decisions. A major emphasis of the ACE Basin Ecological Characterization is to explore the linkages between land use within a watershed and the ecological and sociological changes that result.

The ACE Basin Characterization study area consists of approximately 320,000 ha (790,000 ac) and extends approximately 72 km (45 mi.) in a northwest to southeast orientation with an approximate width of 40 km (25 mi). The study area encompasses the Ashepoo, Combahee, and Edisto River basins from the Atlantic Ocean upstream to approximately 8-11 km (5-7 mi) northwest of



Walterboro with portions located in Colleton, Charleston, Beaufort, and Hampton Counties. The boundaries of the study area are primarily based on Natural Resource Conservation Service hydrologic units or watersheds. This use of watershed units to define boundaries is consistent with an ecosystem approach to resource management and reduces emphasis on political boundaries such as those used to define cities or counties. Management activities that are planned and implemented from an ecosystem and watershed perspective are much more effective in protecting and restoring habitats and resources than strategies that are isolated from the watershed approach (Shabman, 1996).

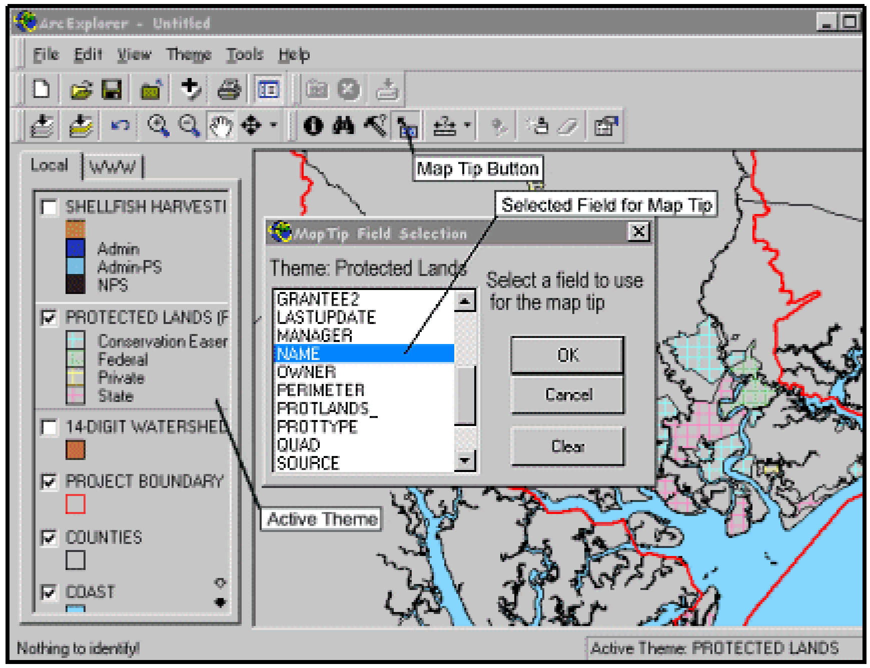
Over the last 20 to 30 years, scientists and resource managers have begun to combine a wide variety of once independent disciplines into concepts of landscape ecology, ecosystem evaluation, and integrated resource management (Kineman and Parks 1996). Using this approach, habitats are now managed as a complex, integrated system based on assorted characteristics such as sediment type, water quality, water flow, contaminants, weather patterns, and social and economic factors. The renewed interest in managing natural resources using a comprehensive ecosystem-based framework recognizes humans as a dependent and integral component of the functioning ecosystem, rather than separate and independent of it (Meffe and Carroll 1994; Kineman and Parks 1996).

Back to Top

The Characterization Product

Existing information and data on the ACE Basin and its resources is largely fragmented, specific to certain technical disciplines, and not readily available. This characterization integrates and summarizes available information for the ACE Basin, providing both data and descriptive text in an accessible and understandable format. The characterization is published as a "Web page" on Compact Disk (CD-ROM) and the World Wide Web utilizing a digital, hypertext environment. Such a format allows navigation within and among components and facilitates updating of the product as new issues arise or new information becomes available. Combining information from a number of disciplines in an interactive format with analytical capabilities enhances the user's ability to access and manipulate data for temporal, spatial and thematic comparisons. Users of this product are encouraged to review the "About this CD-ROM"; and "Introduction" chapters in the General Information section to learn more about the purpose and structure of this product (including navigation tools).

Information is presented in three main components: (1) spatial data, (2) narrative text on specific aspects of the Basin, and (3) synthesis modules (these are described briefly in the introduction and more extensively elsewhere in the Executive Summary).



Spatial (geographic) data relevant to the ACE Basin Characterization are included in the digital characterization. Approximately 100 data layers include topography, wetlands, land use, wildlife populations, hypsography, hydrography, and census information and may be viewed independently or superimposed to compare relative spatial properties. Tabular data, such as water quality or sediment contaminants, are associated with some spatial data layers. The ability to display and manipulate spatial and tabular data provides a powerful tool for managers who must evaluate potential changes affecting resources in an area. The data can be displayed and manipulated using geographic information systems (GIS) software. ArcViewâ project files and shape files are included for those users with Environmental Systems Research Institute's (ESRI) ArcView software. ESRI's viewing tool, ArcExplorerâ is also available on the CD-ROM for those users without ArcView.

The narrative text provides the reader with a synthesis of the physical setting, biological setting, socioeconomic resources, and important ecosystem interactions in the ACE Basin and nearby coastal areas. Historical activities including land clearing for agriculture, impounding wetlands for rice cultivation, and harvesting timber resources are discussed to provide a record of past resource use. Descriptions of the environmental conditions in the ACE Basin include its geology, geomorphology, hydrology, climate, water quality, soil characteristics, biogeochemistry, and hydrochemistry and pollution. Information on the ecological community includes descriptions of representative ecosystems, faunal assemblages, and ecosystem processes within the study area. Current resource uses including agriculture, forestry, commercial and recreational fisheries, hunting, and upland development activities are described. A section on the socioeconomics of the ACE Basin provides information on its present and potential future social and economic makeup. Management of natural resources including both the wildlife and habitat is discussed in the resource management section. Tables, figures, and pictures are included in each text section to help summarize and display information.

The synthesis modules, the third major component of the ACE Basin Characterization, provide integrated summaries of two major concerns in the Basin: water quality and land use. The water quality and land use modules summarize relevant ecological and socioeconomic information (with links to narrative text sections) and discuss issues and management options.

In addition to the main components, supporting information and navigation tools are provided to enhance the ability of the audience to access, comprehend, and utilize the information contained in the product.

- The **ACE Contacts** section provides a list of local, state, and regional agencies and organizations that are considered stakeholders in the ACE Basin. For each, contact information and a brief description of relevancy to the ACE Basin are provided.

- The **Bibliography** section provides two bibliographic databases, one unique to this product and one derived from a previous characterization product, and ProCite® software to search the databases by author, title, and key words.

- A **Glossary** provides definitions for nearly 700 technical terms that are used in the product, with links from the text to the glossary.

- A **Video Tour** of the ACE Basin provides twelve brief, aerial, video clips, mostly of the Ashepoo River basin.

- The **Community Perspectives** section presents the insights of scientists, citizens, and policy makers on water quality, land use, and tourism issues in the ACE Basin.

It is the goal of this characterization that it be a tool that agencies, local governments, land managers, conservation groups, and private citizens use to understand and conserve the unique character of the ACE Basin. By providing an overview of the ecosystem dynamics and issues of the ACE Basin, this characterization is also a valuable research, teaching, and educational tool. Finally, by providing insight into the past, present, and future of the ACE Basin, it is hoped that this characterization will contribute to science-based decision making within the Basin's watershed. (See related section: Introduction .)

Back to Top

Spatial Data Sets

The ACE Basin Characterization includes a geographic information system (GIS) component. GIS is a computerized system for the collection, organization, analysis, and display of data with a spatial (geographic) reference. A GIS organizes spatial information for display as maps, tables, or graphs and empowers people to analyze the information for spatial relationships among multiple layers of data. The information in this product is provided to allow environmental professionals, land use planners, and the public to visualize and assess spatial relationships among important attributes of the ACE Basin.

A decision was made at the start of the ACE Basin Characterization project to base evaluations of the status and management options for the ACE Basin ecosystem on a comprehensive watershed approach. Much of the data collected in the ACE Basin extends beyond the boundaries agreed upon using the watershed approach. Because of this, all of the spatial data layers were clipped to the watershed boundaries, thus eliminating any data not contained within the project boundary. Data layers included on this product were chosen based on their integral relationships to the ACE Basin ecosystem. Spatial data sets available in this characterization are provided as ArcView shapefiles and accompanying data tables. The shapefiles include point, line, and polygon vector coverages representing a variety of spatial data themes. Examples include sediment sampling locations (point), elevation contours (line), and National Wetlands Inventories from 1989 and 1994 (polygon). These data layers can be viewed with the ArcExplorerÒ software provided on the CD-ROM or with ArcViewÒ software if it is available to the user.

There are many advantages to putting data into a GIS: It allows the user to investigate the spatial array of data; data can be manipulated by overlaying data layers and performing queries; the panning and zooming functions of GIS software allow the user to focus on particular areas of interest; additional, specialized customizations of the software allow the user increased analytical techniques and abilities. GIS software also provides the user with the ability to create maps displaying any combination of the data layers desired. These maps can be saved in digital form or can be printed out as hard copy. In addition, the user can modify the provided ACE Basin ArcViewÒ Project by adding or removing data layers, creating new views or layouts, and organizing view coverages or similar subject matter in a single view.

GIS will facilitate learning by allowing students of all levels to manipulate data in queries. Land use managers can use it to make management decisions. Scientists can use it to look for areas where historical studies have been done and where new studies are most needed. The GIS database can be added to existing databases or can be supplemented in the future to make a more comprehensive database. The dynamic qualities of a GIS open up numerous possibilities to its users.

For more information about using the spatial data provided on this CD-ROM, see the GIS Data section.

Please use the links provided at the TOP of this section to access specific sections of the Executive Summary.

Next Section: Executive Summary: History

Authors

E. Wenner, SCDNR Marine Resources Research Institute
D. Sanger, SCDNR Marine Resources Research Institute
S. Upchurch, SCDNR Marine Resources Research Institute
M. Thompson, SCDNR Marine Resources Research Institute

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Introduction

The ACE Basin Characterization

•What is the ACE Basin?
•Geographic Boundaries and Watersheds

People are being drawn to South Carolina's coast in ever increasing numbers. Increased population levels intensify many existing environmental problems such as habitat loss, resource depletion, non-point source pollution, and nutrient loading in our coastal waters. Resource managers are aware of the potential for increased human-induced stress in areas such as the ACE Basin, but frequently lack the data and information necessary to successfully manage and balance habitat conservation and economic growth. Because much of the development in the ACE Basin is occurring adjacent to rivers and estuaries, there is a clear need for a comprehensive watershed-level approach to evaluating the status of, and management options for, the ACE Basin ecosystem.

The South Carolina Department of Natural Resources (SCDNR), in cooperation with the National Oceanic and Atmospheric Administration (NOAA), Coastal Services Center (CSC) has developed this environmental characterization to provide a source of information useful to natural resource managers, scientists, educators, and the general public. The goal is to facilitate management and resource allocation in the ACE Basin and surrounding areas by assembling into one interactive information product much of the ecological, socio-economic, and resource management information required to make cogent decisions about resource management in the ACE Basin. A major emphasis of the characterization is to explore the linkages between land use within a watershed and the ecological and sociological impacts that result from changes in land use.

Balancing the quality of resources in the ACE Basin with the economic and social pressures brought on by development is essential to maintaining the integrity of the Basin. As the population in coastal areas increases, the pressures on natural resources also increase. Resource managers must foresee the impacts on natural areas and provide options for managing resources in those areas. This characterization was developed to facilitate resource management in the ACE Basin. Contributors include scientists and resource managers from the SCDNR and its divisions of Marine Resources; Land, Water and Conservation; and Wildlife and Freshwater Fisheries. Also, NOAA's Coastal Services Center; the SC

Department of Parks, Recreation and Tourism; the Corporation for Enterprise Development; and the United States Fish and Wildlife Service (USFWS) . Planners from Colleton County, the Lowcountry Council of Governments, and the City of Walterboro identified issues pertinent to the ACE Basin and provided guidance on information needs. In addition, private organizations such as The Nature Conservancy, Ducks Unlimited, and Westvaco provided information and guidance on the development of this product.

What is the ACE Basin?

The Ashepoo-Combahee-Edisto (ACE) Basin, one of the few relatively pristine habitats remaining on the Eastern Seaboard, may be defined by a combination of hydrological, ecological and political boundaries. Three ways to delineate the ACE Basin are: (1) ACE Basin watershed - based on the physical boundaries of the Ashepoo, Combahee, and Edisto River watersheds as well as all their tributaries; (2) ACE Basin Task Force boundary - based on land use and administrative boundaries as determined by the ACE Basin Task Force; and (3) ACE Basin Characterization Study - based on a combination of watersheds and the Task Force boundary. This boundary was created by the characterization study to encompass an area greater than that of the Task Force boundary, but not as large as the full watersheds. This product focuses primarily on the area within the characterization boundary and the term ACE Basin within the context of this product is used to mean this area.

Salt marsh habitat

The ACE Basin Characterization study area encompasses the Ashepoo, Combahee, and Edisto rivers from the open ocean upstream to approximately 5-7 miles northwest of Walterboro . The Basin is located in portions of Colleton, Charleston, Beaufort, and Hampton counties and consists of approximately 320,000 hectares (790,000 acres) that include a multitude of habitats in a largely undeveloped landscape. Extensive acreage of a diversity of habitats, such as salt and brackish water marshes, maritime forest, upland pine, and bottomland hardwoods , make the ACE Basin an ecologically important region.

Because of its unique and unspoiled landscape, the ACE Basin has been the focus of a national effort to balance conservation of natural resources with population growth and economic development. Many landowners, conservation groups, and government entities have joined together to conserve the land and natural resources within the ACE Basin. Organizations that have been instrumental in conservation of the ACE Basin include the SCDNR, The Nature Conservancy (TNC), Ducks Unlimited (DU), Colleton County, and US Fish and Wildlife Service (USFWS). The successes of the partnership are evident in recognition of regions within the ACE Basin as a Bioreserve, a National Estuarine Research Reserve, a National Wildlife Refuge, and a "flagship" project of the Atlantic Coast Joint Venture portion of the North American Waterfowl Management Plan. Through these and other conservation efforts, more than 28,000 hectares (70,000 acres) of upland and wetland habitats have been permanently protected. The challenge of management within the ACE Basin region is to balance these conservation efforts with economic growth. Community leaders have been responsive to this challenge and have created the ACE Basin Economic Forum to establish a framework for responsible growth, enhance the awareness and appreciation of the ACE Basin, and promote environmentally compatible business development in the area. People are an integral part of the dynamic and diverse ACE Basin landscape, and management of this system must incorporate the human dimension. (See related section: Protected Lands .)

Geographic Boundaries and Watersheds of the Characterization Project Area

Overall, the characterization project area extends approximately 45 miles in a northwest to southeast orientation and is about 25 miles wide. The boundaries of the characterization project area are primarily based on Natural Resource Conservation Service (NRCS) hydrologic units or watersheds. This use of watershed units to define boundaries is consistent with the ecosystem approach to resource management and reduces emphasis on political boundaries such as cities or counties. Management activities that are planned and implemented from an ecosystem and watershed perspective are much more effective in protection and restoration efforts than strategies which are isolated from the watershed approach (Shabman 1996 in Vernberg et al. 1996).

A watershed is defined as a geographic area into which water and accumulated materials and dissolved chemicals drain. Watersheds are composed of a mosaic of different land types that are connected by a network of rivers and streams. In turn, the aquatic environment is composed of diverse habitats through which materials and energy are transferred and connected by food webs (Doppelt et al. 1993). The edges of a watershed, and those of the adjoining watershed, are defined by topographic ridges, peaks, and other characteristics of land relief.

There are three major watershed units in South Carolina SE Watersheds . These watershed units (basins) are defined by the Natural Resource Conservation Service (NRCS), formerly the US Soil Conservation Service, using standardized watershed delineation methods to describe the edges of the hydrologic units that make up the basins. Each watershed is identified by a name and a hierarchical 8- to 14- digit hydrologic unit code (HUC) to identify the basin (8 digits), watershed (11 digits), or a sub-watershed (14 digits) within the larger region. The boundary of the characterization project area is primarily based on NRCS hydrologic units and includes all or part of 35 sub-watersheds .

Back to Top

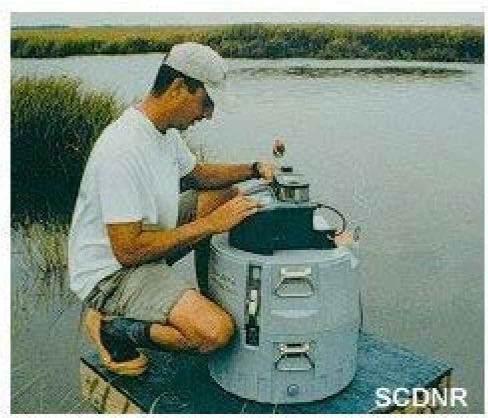
An Evolving Approach to Natural Resource Management

Efforts to manage natural resources have a long history. Most of the early efforts were motivated by single-species issues that focused on short-term yield and economic gain, rather than on recognition of the need for long-term sustainability. The concept that resources were unlimited guided management for extraction and maximum use. These practices were limited only by relatively primitive harvest technology and the smaller size of the human population. As technology advanced and the human population grew, there were increased demands for space, commodities, and amenities from ecosystems. The rapid depletion of resources once thought to be unlimited and a greater understanding of the interconnectivity of ecosystems launched an awareness that the emphasis of resource management should shift from one focused on a single species to emphasis on entire systems.


Aerial view of Edisto Island

Over the last 20 to 30 years, scientists and resource managers have begun to combine a wide variety of once independent disciplines, into disciplines of landscape ecology, ecosystem evaluation, and integrated resource management (Kineman and Parks 1996). Using this approach, habitats are now managed as a complex, integrated system based on characteristics such as sediment type, water quality, water flow, contaminants, weather patterns, and social and economic factors. This change in management practices requires resource managers to have information from a diverse array of disciplines. Managing natural resources using a comprehensive ecosystem-based framework now emphasizes that humans are a dependent and integral component of the functioning ecosystem rather than being separate and independent of it (Kineman and Parks 1996; Meffe and Carroll 1994).

The ecosystem management concept incorporates inter-generational sustainability as a pre-condition so that future generations will not be denied the continued production of commodities and maintenance of services that ecosystems provide (Christensen et al. 1996; Peterson and Lubchenco 1997). A large number of ecosystem functions and services (Ecosystem functions and services) have been identified. All are critical to human welfare and the life-support systems of Earth (Costanza et al. 1997; Peterson and Lubchenco 1997). Many definitions of ecosystem management exist and most incorporate sustainability of ecosystem structures and processes as the central goal or value of ecosystem management. In addition to sustainability, other elements vital to the concept include:



NERR water quality monitoring station

- Establishing measurable goals that specify future processes and outcomes necessary for sustainability;
- Incorporating sound ecological principles and the role of linking processes;
- Recognizing that biological diversity and structural complexity are critical to most ecosystem processes and strengthen the system against disturbance;
- Recognizing the dynamic character of ecosystems in which change and evolution are inherent characteristics;
- Understanding that ecosystem processes operate over a wide range of spatial and temporal parameters;
- Acknowledging the role of humans, not only as the cause of challenges to sustainability, but as integral components who must be involved in defining the future of ecosystems;
- Recognizing that current knowledge and paradigms of ecosystem function are subject to change and that management approaches must be viewed as hypotheses to be tested by research and monitoring programs (Christensen et al. 1996).

To be effective at the ecosystem level, management must occur at the appropriate scale. Defining the boundaries of management jurisdictions, without consideration of the appropriate scale at which ecological processes occur, has been one of the challenges to ecosystem management. Current management practices primarily target the individual land parcel; however, the social, economic, physical, and biological consequences that result from parcel level management occur at a much larger scale. What occurs on one parcel will have effects at the local and ecosystem levels. A change from a forested landscape to a home site, managed pine plantation, or shopping mall, will have differing impacts on the surrounding ecosystem. Land use planning decisions often involve weighing the economic benefit to society against the loss of natural resource function associated with the land use change. This evaluation must occur at the system level rather than at the arbitrary jurisdiction of political units such as a parcel, city, county, or state boundary. Water, habitat, air, and wildlife concerns should be balanced with land use planning and development in order to provide and maintain an ecologically sound and sustainable system. Managers must seek consensus among the various stakeholders within each ecosystem.

Today's resource managers must be aware of the complexity and interdependence of the resources within the ecosystems that they are managing. To be effective, they need tools that integrate information in a timely manner allowing them to move from an ad hoc approach to a more systematic one that identifies and anticipates resource needs.

Changing Information Needs and New Technology

As the scope of resource management has become more diverse, the information needs have become more complex. Information and technology requirements have moved from static, difficult-to-update paper documents, to digital documents, links to the Internet and the World Wide Web, Geographic Information Systems (GIS), and a multitude of informational CDs and software designed to model many aspects of the ecosystem. There are a variety of powerful tools already available, or being developed, to help resource managers evaluate trends, choices, and trade-offs related to the decisions that they must make on a daily basis.

One of the foremost problems is transferring extensive, detailed scientific information and data to users in a timely manner and in a usable format (Kineman and Parks 1996). A regular comment received from resource managers is that extensive information and data exist in the scientific community, but these are either not readily available to the public or are not understandable, except to the specialist. This characterization provides both descriptive text and data, in an accessible and understandable format, that can be easily updated as new issues arise or new information becomes available.

The Role of Ecological Characterizations

While the definition and scope of ecological characterizations may vary, an accepted definition is

[...]a structured approach to the synthesis of current knowledge about ecosystems and human activity for management purposes (Kineman and Parks 1996). The synthesis of information about an ecosystem should include biological resources, physical environment, key processes and important human interactions. Because ecological characterizations have an orientation toward resource and ecosystem management, they may also include descriptions or analyses of anticipated resource users, societal impacts, and management response options.

The first ecological characterizations were initiated in the mid-1970's by the US Fish and Wildlife Service. Four pilot projects that established the characterization framework were located in different geographic regions where coastal resource issues related to potential oil and gas development arose. Funded by Congress and the EPA, these projects were designed to be assessment tools, to provide information for environmental impact statements, to identify data gaps, to evaluate the state of relevant scientific information, and to present ecosystem data in map form (Parks and Kineman 1996). Such early efforts were broad in scope and resulted in paper documents that assembled information and data into an integrated synthesis of knowledge about an ecosystem within a geographic region. The Ecological Characterization of the Sea Island Coastal Region of South Carolina and Georgia was one of these early efforts which also encompassed the ACE Basin region (Sandifer et al. 1980). In the 1980's, the approach to ecological characterizations changed and began focusing more on hydrologic units or watersheds, linkages between habitats, issues of importance to managers and planners, and incorporation of extensive databases. The Edisto River Basin Project developed an ecological characterization of this type. Two publication were produced, Assessing Change in the Edisto River Basin: An Ecological Characterization (Marshall 1993) and Managing Resources for a Sustainable Future: The Edisto River Basin Project Report (Beasly 1996). The Edisto River Basin Project EXIT continues to address questions of sustainability in the Edisto River Basin

Some limitations of earlier ecological characterizations, such as limited flexibility and time consuming or costly means of updating them, have been eliminated by digital technology. A digital format permits incorporating new information into data and text portions, provides enhanced interactivity with the user, and provides a means for relatively inexpensive, convenient distribution through CD-ROM and the World Wide Web. Combining information from a number of disciplines in an interactive format with analytical capabilities enhances the user's ability to access and manipulate data for historical, spatial, and thematic comparisons. Innovative examples of such applications are the SCDNR/NOAA Otter Island Ecological Characterization EXIT on CD-ROM and on the Web, the NOAA/USFWS/Delaware Department of Natural Resources Coastal Ocean Management, Planning and Assessment System (COMPAS) Project, and the NEMO Project EXIT, which provides tools to municipalities for estimating impacts of land use change, such as increased area of impervious surfaces on water quality. These projects use tools, such as Geographic Information Systems (GIS), to examine spatial relationships between various components of ecosystems.

Back to Top

ACE Basin Characterization Workshop

To be useful to a wide range of people, ecological characterizations need to be developed cooperatively by scientists and resource managers, with advice from the community of users, in order to provide a product that addresses pertinent issues. Incorporation of socio-economic and other human dimensions is a necessity so as to establish relationships between anthropogenic influences, ecological conditions, and implications to society in the future. In addition, the format of characterizations should be flexible enough to address new issues that may arise or those that change over time (Kineman and Parks 1996). In an effort to identify issues in the ACE Basin and receive input from stakeholders, approximately 30 resource managers and planners were brought together for a workshop in August 1997. The goal of the workshop was to break the large issues of land use or economic development into more manageable components that could be addressed and implemented at the local level. Some of these issues are the basis for the integrated synthesis modules included in this product.

Back to Top

Disclaimer

While considerable effort has been put forward to provide a comprehensive and accurate information source, the South Carolina Department of Natural Resources, the National Oceanic and Atmospheric Administration's Coastal Services Center, other project partners, individual authors, and project team members make no express or implied warranties with respect to the accuracy of the information presented in this product or its suitability for use. The act of distribution shall not constitute any such warranty.

We strongly recommend that careful attention be paid to the contents of the metadata files associated with the spatial data and that all information be used in a reasonable and proper manner. The South Carolina Department of Natural Resources, the National Oceanic and Atmospheric Administration's Coastal Services Center, other project partners, individual authors, and project team members shall not be held liable for any harm or damage that may result from use of this product.

NEXT SECTION: About this CD-ROM

Authors

E. Wenner, SCDNR Marine Resources Research Institute

G. Riekerk, SCDNR Marine Resources Research Institute

References

Beasley, B. R.; W.D. Marshall; A.H. Miglarese; J.D. Scurry; C. Vanden Houten 1996. Managing resources for a sustainable future: The Edisto River Basin project. SC Department of Natural Resources, Water Resource Division, Columbia, SC 226p.

Christensen, N. L., A. M. Bartuska, J. H. Brown, S. Carpenter, C. D'Antonia, R. Francis, J. F. Franklin, J. A. MacMahon, R. F. Noss, D. J. Parsons, C. H. Peterson, M. G. Turner, and R. G. Woodmansee. 1996. The report of the Ecological Society of America Committee on the scientific basis for ecosystem management. Ecological Applications 6(3):665-691.

Costanza, R. , R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. O'Neill, J. Paruelo, R. G. Raskin, P. Sutton, and M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. Nature 387:253-260.

Doppelt, B., M. Scurlock, C. Frissell, and J. Karr. 1993. Entering the watershed: A new approach to save America's river ecosystem. Island Press, Washington, DC.

Kineman, J.J. and B.O. Parks (eds.). 1996. Ecological characterization: Recommendations of a science review panel. NOAA workshop. March 9-10, 1995. KGRD#32 and NOAA CSC/10-96/001. National Geophysical Data Center, Boulder, CO and Coastal Services Center, Charleston, SC.

Marshall, W. D. 1993. Assessing change in the Edisto River Basin: An ecological characterization. SC Water Resource Committee, Report No. 177.

Meffe, G. K. and C. R. Carroll. 1994. Principles of conservation biology. Sinauer Associates Inc., Sunderland, MA.

Parks, B. O. and J. J. Kineman (eds.). 1996. Implementing a coastal ecological characterization prototype: Proceedings of an analysis and characterization planning workshop. NOAA Workshop. March 15-17, 1995. NOAA CSC/10-96/002. Coastal Services Center, Charleston, SC.

Peterson, C. H. and J. Lubchenco. 1997. Marine ecosystem services. *In*: G. C. Daily (ed.). Nature's services: Societal dependence on natural ecosystems. Island Press, Washington, DC.

Sandifer P. A., J. V. Miglarese, D. R. Calder, J. J. Manzi, and L. A. Barclay. 1980. Ecological characterization of the Sea Island coastal region of South Carolina and Georgia. Vol. III: Biological features of the characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC.

Shabman, L. 1996. Land settlement, public policy, and the environmental future of the southeast coast. *In*: F. J. Vernberg, , W. B. Vernberg, and T. Siewicki. Sustainable development in the Southeastern Coastal Zone. University of South Carolina Press, Columbia, SC.

M
E
N
U

Introduction

Software Requirements and Installation

Navigation and Symbols

Directory Structure

Technical Assistance

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

About This CD-ROM

Introduction

The Ashepoo-Combahee-Edisto (ACE) Basin region of South Carolina contains diverse and relatively unspoiled natural resources and a rich human history and culture. In an effort to identify issues that are important in the ACE Basin and assemble information and data resources needed for decision making, the South Carolina Department of Natural Resources and the National Oceanic and Atmospheric Administration's Coastal Service Center initiated a project to produce an environmental characterization of the ACE Basin. The resulting *Characterization of the Ashepoo-Combahee-Edisto (ACE) Basin, South Carolina* is an interdisciplinary synthesis of information about the ACE Basin, presented in a multimedia, interactive format.

Components include narrative text syntheses of physical setting, biological and socioeconomic resources, and important ecosystem interactions. In addition to descriptions of the ACE Basin environment, this characterization also explores current issues affecting resources in the region, especially land use and water quality. The product is presented in a hyper-text environment, where text is enhanced with pictures, graphs, data tables, a glossary, and links to additional information, including contact information for agencies and organizations important to the ACE Basin. Approximately 100 spatial data "layers" (data with geographical references) are provided for viewing and analysis in a Geographic Information System. Two bibliographic data bases are provided, along with software to conduct searches of the data bases. All of these components provide a summary of the state of our knowledge about the natural and cultural resources of the ACE Basin. (See related section: General Introduction.)

The ACE Basin characterization could not have been completed without input from a number of individuals and agencies. Local governments, planners, and private organizations helped define the issues and guide the organization of the product to enhance its function and utility. (See related section: Acknowledgements.)

Software Installation and Requirements

This section provides information about software that will enable you to fully utilize the information available on this CD-ROM. Information on accessing or installing software is described below.

Web Browser

Most of the information contained on this CD-ROM is accessible through a standard web-browser. Many computer operating systems now include some type of web browsing software. There are two navigational tools provided on this CD-ROM. Both of these tools were designed using the JavaScript language. This language is only supported by **Microsoft Internet Explorer® 4.0** or higher or **Netscape® 4.0** or higher. If you are viewing this product using an older version of Explorer or Netscape, you can navigate through the CD-ROM by using the hyperlinked text headings at the top and bottom of each text page. These will link you to all major sections of this product and will highlight in yellow the major section in which you are currently located. The Menu Box and Site Map described below will not work with older browser versions. Internet Explorer® 4.0 or higher is recommended for best operation.

You can download the most up-to-date version of Internet Explorer by visiting the Microsoft Internet Explorer web site located at http://www.microsoft.com/ie/.

You can download the most up-to-date version of Netscape Communicator by visiting the Netscape web site located at http://www.netscape.com/computing/download/index.html.

Video Player Software

Twelve video segments along the Ashepoo River Basin are included on this CD-ROM as part of a video tour of the ACE Basin. These video clips are QuickTime® Movie files (*.mov). To view these video clips, you must have Apple's QuickTime video software available on your hard drive. To download a free version of Apple's QuickTime software visit this website: http://www.apple.com/quicktime/download/).

Sounds

Audio files (*.wav or *.au) are included on the CD-ROM in the Community Perspectives section and in the Species Gallery. To listen to these audio files, your computer must be equipped with a sound card and have software installed that allows playing of audio files.

ProCite® Bibliographic Software

Two ProCite® bibliographic databases, the ACE Basin Characterization Bibliography and the Sea Islands Characterization Bibliography, are available on this CD-ROM. If you do not have a full version of Procite and wish to view and querry these databases, you will need to install a licensed, read-only version of ProCite® 4 to your hard drive from this CD-ROM. This software will allow you to query the database by author, date, title, or any of the other fields. The version of ProCite 4 available on this product is only compatible with Windows 95/98 and NT operating systems. Instructions for installing this software are located in the bibliography section of this product. ProCite® is licensed from ISI ResearchSoft. (See related section: Bibliography.)

Spatial Data Software

ArcExplorer®

ArcExplorer is a lightweight GIS data explorer developed by Environmental Systems Research Institute, Inc. (ESRI®). ArcExplorer is built using MapObjects®, ESRI's collection of GIS and mapping components for application developers. To use ArcExplorer, you must have Microsoft® Windows® 95/98 or Microsoft Windows NT 4.0 or later installed on your system. To learn more about ArcExplorer, visit the ESRI home page at: http://www.esri.com.

This free GIS software is included on this CD-ROM. To learn how to install this software and to learn about the ArcExplorer Project Files included on the CD-ROM, use your browser to navigate to the GIS Viewing Tools section within GIS Data.

ArcView® GIS

For those users with ArcView GIS software (version 3.1 or higher) installed on their computers, there are several customized ArcView 3.1 project files included on the CD-ROM. To learn about the ArcView Project Files and how to access them, use your browser to navigate to the GIS Viewing Tools section within GIS Data.

Back to Top

Navigation and Symbols

This product offers several ways to navigate within and among the information sections, in addition to standard links within text sections (see "Symbols" below).

Sidebar Menu
The menu in the blue sidebar at the beginning of each Web page provides direct links to the headings *within* that page. Chapters are divided into substantive sections that are made accessible with the use of linked titles provided within the Introduction of that chapter. In a few instances, these sections are further divided into sub-sections that may also be accessed via the linked titles contained within the main text of the section.

Next Section
At the end of each chapter there is a link for navigation to the next chapter or section in a logical, linear sequence through the product.

Header and Footer Menus
The header and footer menus at the "top" and "bottom" of each Web page provide links to all the major chapters of the characterization product, as well as to the Site Map and Search Tool. Major chapter titles will be highlighted in yellow to show your present location.

The Menu Box
If you have a JavaScript enabled browser, then you may navigate through the product via the Menu Box. Located in the far left side of this page is a movable box with the word "MENU" written vertically. This box will expand as you move your mouse over the word "MENU" and collapse as you move your mouse away from the box (Note: in Netscape 6+ click on the word MENU to retract the menu box). The menu within the box contains links to the major sections of this product. "The Box" will scroll with you as you move down the page and will appear on every HTML page. The Return to Top button will allow you to return to the top of the page; the Help button will always return you to this page; the Search button and the Site Map button will link you to the navigational tools described below. If your browser does not support JavaScript, additional navigation tools can be found at the top and bottom of each page (see header and footer menus). These text menus contain the same information as is found in the movable box menu and will link you to the same locations.

Site Map
The site map opens a second browser window that performs two functions. At the top of the site map are the words "Click to display location." When you click on these words, your present location within the product will be shown in the adjacent window and cascading menu boxes will appear below, showing the path to that location. Below the location window are the words "Click to begin navigation" that will activate expandable menus that allow you to browse the contents of each major heading and link to specific sections of text. The Site Map may be accessed from the header and footer menus or from the Menu Box (JavaScript enabled browsers only).

Search Tool

The search tool allows users to search the product for specific words or phrases and may be accessed from the header and footer menus or from the scrolling menu box (JavaScript enabled browsers only). When the user types in a word or phrase, the search will return the names of html pages that contain that specific word or phrase. Click on the page (chapter) title to navigate to that Web page. Recent versions of html browsers may highlite each occurrance of the selected word or phrase within the page (this tool works best in Internet Explorer 5). You may also use your browser's Edit menu and click the "find" option to locate the desired word or phrase within that page. Note that the operators (and, or, exact match) affect the search results. An "exact match" search of mutiple words (e.g. least tern) may return an incomplete list of pages in which that phrase appears. To avoid the search returning word fragments (e.g. tern in pattern) place a space before the word in the search box and use the "exact match" operator. Mac users: the search tool is temperamental on the Mac platform - it works in Netscape 4.6 and 4.7, but not in earlier versions or in Netscape 6; it works slowly in Internet Explorer 5 and not in earlier versions of Internet Explorer.

Symbols

Within this characterization product hypertext links are provided to a variety of destinations such as photos, data tables, glossary terms, other sections of the characterization, and Web pages external to the characterization. In order to allow the user to know where a link will lead, this product attempts to "identify" the type of destination to which it leads. The following is a guide to this methodology.

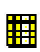
Text Most text links will appear blue. A symbol or icon will accompany such links unless the link leads to contact information (name of an agency or organization) or to another place in the characterization product (name of a section). Links to other parts of the product are usually prefaced by "See related section:"

Text A word in normal black font that is linked, as indicated by an underline, will lead to a defined term in the glossary.

Text Text that is colored green signifies a link which is triggered by moving the mouse over the linked (green) word. In most cases, the "mouseover" will cause a change in pictures or graphics related to the text.

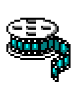
 This icon indicates that an image will be displayed.

 This icon indicates that a chart or figure will be displayed.

 This icon indicates that a table will be displayed.

 This icon indicates that a map will be displayed.

 This icon indicates that a sound can be played for those users with a sound card installed on their computer.

 This icon indicates that a video can be played for those users with a video player installed on their computer.

This icon indicates that you will exit this product and be linked to an outside URL on the World Wide Web.

Maps, tables and figures will open in a second browser window. If you wish to print the contents of the second window, "right click" within the window to access a menu and choose "print" or hold down the "Ctrl" key on the keyboard and press the "P" key (Ctrl-P). If you do not close this window, the next time you click on a map, table or figure icon, the image will open up in the same (second) browser window, which may be located behind the main window.

Back to Top

Directory Structure

HTML	All HTML documents, spatial data, bibliographic databases, and associated files
ARCEXPLR	ArcExplorer Project Files for viewing spatial data
Data	Arc View Project Files and associated Tables
readme.txt	An ASCII (text) file describing the CD-ROM and how to view it
intro.htm	The beginning page for the HTML portion of the CD-ROM

Back to Top

More Information or Technical Assistance

Dr. Elizabeth Wenner
ACE Basin National Estuarine Research Reserve
South Carolina Department of Natural Resources
P.O. Box 12559
Charleston, SC 29422
843.762.5050
wennere@mrd.dnr.state.sc.us

NOAA Coastal Services Center
2234 South Hobson Avenue
Charleston, South Carolina 29405-2413
843.740.1200
843.740.1224 (FAX)
e-mail: clearinghouse@csc.noaa.gov

Click to display location

Click to begin navigation

Acknowledgements

Funding for the ACE Basin Characterization was provided by The National Oceanic and Atmospheric Administration, Department of Commerce, to the South Carolina Department of Natural Resources (SCDNR) via a contract with Technology Planning and Management Corporation (TPMC). The South Carolina Department of Natural Resources (SCDNR) and its Divisions of Marine Resources (MRD); Land, Water, and Conservation; and Wildlife and Freshwater Fisheries implemented the project in partnership with the National Oceanic and Atmospheric Administration's (NOAA) Coastal Services Center (CSC) in Charleston, South Carolina and the National Geophysical Data Center in Boulder, Colorado.

These organizations were responsible for project administration, management, and implementation. Those individuals most responsible for the creation of this characterization product are:

South Carolina Department of Natural Resources

- Myra Brouwer
- Brad Digre
- George Riekerk
- Jim Scurry
- Jeff Trudnak
- Saundra Upchurch
- Robert Van Dolah
- Phil Weinbach
- Elizabeth Wenner
- Lynn Zimmerman

National Oceanic and Atmospheric Administration, Coastal Services Center

- Eugene Olmi
- Mary Anne Poole
- Alicia Sievert
- Pace Wilber

Completion of this characterization was truly a cooperative effort among many organizations and individuals, and the contributions of all who were involved are gratefully acknowledged. This product would not have been completed without their cooperation and expertise. We have attempted to give credit to all contributors below.

Authors

Note: Author(s) of each chapter are listed at the end of that chapter.

- C. Abate, College of Charleston
- D. Allen, SCDNR Wildlife and Freshwater Fisheries Division
- B. Badr, SCDNR Land Water and Conservation Division
- M. Brouwer, SCDNR Marine Resources Division
- M. Brown, Southeast Regional Climate Center
- G. Carbone, University of South Carolina
- W. Clendenin, SCDNR Geological Survey
- D. Clonis, Corporation for Enterprise Development
- N. Cofer-Shabica, NOAA Coastal Services Center
- A. Kirkley, Kirkley and Associates
- D. Knott, SCDNR Marine Resources Division
- B. Martin, SCDNR Marine Resources Division
- T. Mathews, SCDNR Marine Resources Division
- L. McGilvray, NOAA Office of Ocean and Coastal and Resource Management
- M. McKenzie, SCDNR Marine Resources Division
- W. McMillan, SCDNR Marine Resources Division
- C. Nietch, University of South Carolina
- C. Niewendorp, SCDNR Geological Survey
- G. Olmi, NOAA Coastal Services Center
- D. Park, SCDNR Land Water and Conservation Division
- M. Poole, NOAA Coastal Services Center
- W. Rhodes, SCDNR Wildlife and Freshwater Fisheries Division
- G. Riekerk, SCDNR Marine Resources Division
- D. Sanger, SCDNR Marine Resources Division
- R. Scharf, SCDNR Land Water and Conservation Division
- B. Scholtens, College of Charleston
- J. Scurry, SCDNR Land Water and Conservation Division
- A. Sievert, NOAA Coastal Services Center
- E. Starr, SCDNR Land Water and Conservation Division
- P. Sundareshwar, University of South Carolina
- M. Thompson, SCDNR Marine Resources Division
- S. Upchurch, SCDNR Marine Resources Division
- R. Van Dolah, SCDNR Marine Resources Division
- B. Ward, NOAA Coastal Services Center
- E. Wenner, SCDNR Marine Resources Division
- C. Wenner, SCDNR Marine Resources Division
- P. Wilber, NOAA Coastal Services Center
- R. Willoughby, SCDNR Geological Survey
- D. Yow, Southeast Regional Climate Center
- L. Zimmerman, SCDNR Marine Resources Division

Product Development

- R. Bailey, NOAA Coastal Services Center
- K. Cohen, NOAA Coastal Services Center
- J. Cowen, NOAA Coastal Services Center
- G. Olmi, NOAA Coastal Services Center
- M. Poole, NOAA Coastal Services Center
- F. Ruopoli, NOAA Coastal Services Center
- A. Sievert, NOAA Coastal Services Center
- J. Trudnak, SCDNR Marine Resources Division

- S. Lutz, NOAA Coastal Services Center
- J. Ulmer, NOAA Coastal Services Center
- P. Weinbach, SCDNR Marine Resources Division
- P. Wilber, NOAA Coastal Services Center

Project Management and Administration

- M. Brouwer, SCDNR Marine Resources Division
- J. Campbell, Technology, Planning and Management Corporation
- N. Christopher, Technology, Planning and Management Corporation
- B. Digre, SCDNR Marine Resources Division
- A. Hale-Miglarese, NOAA Coastal Services Center
- A.F. Holland, SCDNR Marine Resources Division
- J. Kinneman, NOAA National Geophysical Data Center
- J. Miglarese, SCDNR Marine Resources Division
- G. Olmi, NOAA Coastal Services Center
- B. Parks, NOAA National Geophysical Data Center
- M. Poole, NOAA Coastal Services Center
- G. Riekerk, SCDNR Marine Resources Division
- J. Rosen, Technology, Planning and Management Corporation
- P. Sandifer, SCDNR
- R. Scharf, SCDNR Land Water and Conservation Division
- J. Scurry, SCDNR Land Water and Conservation Division
- J. Trudnak, SCDNR Marine Resources Division
- R. Van Dolah, SCDNR Marine Resources Division
- E. Wenner, SCDNR Marine Resources Division
- P. Wilber, NOAA Coastal Services Center
- L. Zimmerman, SCDNR Marine Resources Division

Reviewers

- D. Allen, SCDNR Wildlife and Freshwater Fisheries
- C. Amer, SC Institute of Archaeology and Anthropology
- W. Anderson, SCDNR Marine Resources Division
- R. Bacon, SC SeaGrant
- B. Baker, SCDNR Wildlife and Freshwater Fisheries
- C. Barans, SCDNR Marine Resources Research Institute
- D. Baumann, SCDNR Wildlife and Freshwater Fisheries
- S. Bennett, SCDNR Wildlife and Freshwater Fisheries
- B. Bouton, Independent Contractor
- K. Boyle, SCDNR Wildlife and Freshwater Fisheries
- D. Browning, USFWS ACE Basin National Wildlife Refuge
- M. Bunch, SCDNR Wildlife and Freshwater Fisheries
- V. Burrell, SCDNR Marine Resources Research Institute
- B. Carmichael, SCDNR Wildlife and Freshwater Fisheries
- T. Chandler, University of South Carolina
- M. Clark, North Carolina Museum of Natural History
- W. Clendenin, SCDNR - Geological Survey
- N. Cofer-Shabica, NOAA Coastal Services Center
- M. Collins, SCDNR Marine Resources Research Institute
- W. Conner, Clemson University
- M. Corley, SCDNR Land, Water, and Conservation Division

- B. Dabson, Corporation for Enterprise Development
- K. Derting, SC Institute of Archaeology and Anthropology
- M. Dodd, SCDNR Wildlife and Freshwater Fisheries
- L. Duncan, US Fish and Wildlife Service
- G. Esch, NOAA Coastal Services Center
- J. Fauth, College of Charleston
- M. Fletcher, University of South Carolina
- D. Florian, NOAA Coastal Services Center
- M. Fulton, NOAA - NOS - Charleston
- J. Gamboa, Independent Contractor
- J. W. Gibbons, Savannah River Ecology Lab
- W. Greene, SC Dept of Archives and History
- J. Grobowski, Westvaco
- C. Hackney, University of North Carolina - Wilmington
- D. Harrigal, SCDNR Donnelly Wildlife Management Area
- J. Harrison, College of Charleston
- D. Hernandez, SCDHEC Office of Coastal and Resource Management
- B. Hockensmith, SCDNR Land, Water, and Conservation Division
- C. Huffines, The Huffines Company
- L. Hughes, Independent Contractor
- W. Hughes, US Geological Survey
- J. Hyland, NOAA
- C. Judge, SCDNR Wildlife and Freshwater Fisheries
- M. Katuna, College of Charleston
- P. Keener-Chavis, College of Charleston
- S. Keith, SCDNR Office of Fisheries Management
- J. Kelly, The Citadel
- G. Kleppel, University of South Carolina
- D. Knott, SCDNR Marine Resources Research Institute
- P. Laurie, SCDNR Marine Resources Research Institute
- A. Lewitus, University of South Carolina
- W. Marshall, SCDNR Land, Water, and Conservation Division
- B. Martin, SCDNR Marine Resources Division
- B. McCord, SCDNR Marine Resources Research Institute
- J. McGovern, SCDNR Marine Resources Research Institute
- M. McKenzie, SCDNR Office of Fisheries Management
- J. Morris, University of South Carolina
- T. Murphy, SCDNR Wildlife and Freshwater Fisheries
- S. Murphy, SCDNR Wildlife and Freshwater Fisheries
- G. Olmi, NOAA Coastal Service Center
- M. Paramore, SC Dept of Archives and History
- D. Park, SCDNR Land, Water, and Conservation Division
- B. Parks, NOAA National Geophysical Data Center
- A. Pittman, SCDNR Wildlife and Freshwater Fisheries
- B. Pittman, SCDNR Wildlife and Freshwater Fisheries
- R. Porcher, The Citadel
- M. Prevost, The Nature Conservancy
- R. Rauscher, Stratus Consulting
- W. Rhodes, SCDNR Wildlife and Freshwater Fisheries
- A. Ringwood, SCDNR Marine Resources Research Institute
- W. Roumillat, SCDNR Marine Resources Research Institute
- A. Saunders, The Charleston Museum
- D. Shipes, SCDNR Wildlife and Freshwater Fisheries
- S. Skelton, SC Dept of Archives and History

- S. Snyder, SC Department of Health and Environmental Control
- T. Strange, SCDNR Wildlife and Freshwater Fisheries
- T. Swayngham, SCDNR Wildlife and Freshwater Fisheries
- C. Tank, Low Country Council of Government
- M. Thompson, SCDNR Marine Resources Research Institute
- T. Turbeville, Savannah River Ecology Lab
- R. Van Dolah, SCDNR Marine Resources Research Institute
- N. Vinson, SC Coastal Conservation League
- W. Waltz, SCDNR Office of Fisheries Management
- P. Wendt, SCDNR Office of Fisheries Management
- J. Wescott, Lowcountry and Resort Island Tourism Commission
- D. Whitaker, SCDNR Marine Resources Research Institute
- P. Wilber, NOAA Coastal Service Center
- R. Willoughby, SCDNR Geological Survey

Contributors of Data and Information

- S. Adair, Ducks Unlimited
- C. Amer, SC Institute of Archaeology and Anthropology
- C. Aulbach-Smith, Botanical Service of South Carolina
- O. Baker, SCDNR Wildlife and Freshwater Fisheries
- C. Barans, SCDNR Marine Resources Division
- D. Barthel, SCDNR Land, Water, and Conservation Division
- D. Baumann, SCDNR Wildlife and Freshwater Fisheries
- D. Bearden, NOAA NOS Charleston
- S. Bennet, SCDNR Wildlife and Freshwater Fisheries
- S. Bennett, SCDNR Wildlife and Freshwater Fisheries
- J. Boylan, SCDNR Marine Resources Research Institute
- K. Boyle, SCDNR Wildlife and Freshwater Fisheries
- C. Browdy, SCDNR Waddell Mariculture Center
- S. Brown, SC Raptor Center
- M. Brown, Southeast Regional Climate Center
- M. Bunch, SCDNR Wildlife and Freshwater Fisheries
- M. Cameron, SCDNR Land, Water, and Conservation Division
- J. Cely, SCDNR Wildlife and Freshwater Fisheries
- D. Chestnut, SC Dept. of Health and Environmental Control
- K. Chung, NOAA NOS Charleston
- M. Clark, North Carolina Museum of Natural History
- W. Clendenin, SCDNR Geological Survey
- M. Collins, SCDNR Marine Resources Research Institute
- W. Connor, Clemson University
- M. Corley, SCDNR Land, Water, and Conservation Division
- L. Delancey, SCDNR Office of Fisheries Management
- K. Derting, SC Institute of Archaeology and Anthropology
- R. DeVoe, SC Sea Grant Consortium
- M. Dodd, SCDNR Wildlife and Freshwater Fisheries
- J. Duke, SC Department of Natural Resources
- W. Dukes, SCDNR Wildlife and Freshwater Fisheries
- L. Duncan, US Fish and Wildlife Service
- M. Edmonds, SC Dept of Archives and History
- W. Eiser, SCDHEC Office of Coastal and Resource Management
- D. Elwart SC Parks, Recreation, and Tourism
- D. Fairy, SCDNR Land, Water, and Conservation Division

- G. Ford SC Parks, Recreation, and Tourism
- M. Fulton, NOAA NOS Charleston
- W. Gibbons, Savannah River Ecology Laboratory
- H. Gillam, SC Institute of Archaeology and Anthropology
- T. Ginn, Colleton County - Soil and Water Conservation District
- J. Glover, SC Department of Health and Environmental Control
- H. Golde, Corporation for Enterprise Development
- D. Gordon, US Fish and Wildlife Service
- W. Greene, SC Dept of Archives and History
- T. Hahn, Westvaco Corporation
- J. Hamilton, Ducks Unlimited
- D. Harrigal, SCDNR Donnelly Wildlife Management Area
- L. Harris, SC Institute of Archaeology and Anthropology
- C. Hope, SCDNR Marine Resources Research Institute
- S. Hopkins, SCDNR Waddell Mariculture Center
- M. Hourigan, SCDNR Marine Resources Division
- L. Hughes, Marine Resources Division
- B. Hughes, US Geological Survey
- C. Judge, SCDNR Wildlife and Freshwater Fisheries
- W. Keith SCDNR, Marine Resources Division
- D. Knott, SCDNR Marine Resources Research Institute
- R. Lacy, SCDNR Land, Water, and Conservation Division
- H. Lane, Bank of South Carolina
- P. Laurie, SCDNR Marine Resources Division
- J. Leader, SC Institute of Archaeology and Anthropology
- D. Lee, SC Department of Natural Resources
- A. Lewitus, University of South Carolina
- M. Lowery, US Geological Survey
- S. Lutz, NOAA Coastal Services Center
- W. Mahan, SCDNR Wildlife and Freshwater Fisheries
- T. Marcinko, SCDNR Marine Resources Research Institute
- J. McCord, SCDNR Marine Resources Division
- M. McKenzie, SCDNR Marine Resources Division
- J. Moran, SCDNR Office of Fisheries Management
- J. Morris, SCDNR Land, Water, and Conservation Division
- J. Morris, University of South Carolina
- S. Murphy, SCDNR Marine Resources Division
- T. Murphy, SCDNR Wildlife and Freshwater Fisheries
- L. Nance, Natural Resource Conservation Service
- C. Niewendorp, SCDNR Geological Survey
- J. Palmer, Clemson University
- M. Paramore, SC Dept of Archives and History
- K. Pardiek, US Geological Survey
- B. Parks, NOAA National Geophysical Data Center
- B. Peterjohn, US Geological Survey
- A. Pittman, SCDNR Wildlife and Freshwater Fisheries
- M. Poole, NOAA Coastal Services Center
- W. Post, The Charleston Museum
- M. Prevost, SC Nature Conservancy
- B. Richardson, US Fish and Wildlife Service
- W. Roumillat, SCDNR Marine Resources Research Institute
- C. Ruth, SCDNR Wildlife and Freshwater Fisheries
- J. Schmid, SC Parks, Recreation, and Tourism
- J. Schryver, Charleston County Park and Recreation Commission

- J. Scurry, SCDNR Land, Water, and Conservation Division
- D. Shipes, SCDNR Wildlife and Freshwater Fisheries
- J. Shipman, New Mexico Tech University
- A. Sievert, NOAA Coastal Services Center
- S. Skelton, SC Dept of Archives and History
- J. Stewart, Westvaco Corporation
- A. Stokes, SCDNR Waddell Mariculture Center
- T. Strange, SCDNR-WFF-McClellanville
- G. Sullivan, SCDNR - Land, Water, and Conservation Division
- C. Tank, Lowcountry Council of Government
- M. Taylor, SCDNR Heritage Trust Program
- M. Thompson, SCDNR Marine Resources Research Institute
- C. Tomason, SCDNR Wildlife and Freshwater Fisheries
- T. Turbeville, Savannah River Ecology Laboratory
- S. Upchurch, SCDNR - Marine Resources Division
- P. Verity, Skidaway Institute of Oceanography
- W. Waltz, SCDNR Office of Fisheries Management
- S. Warner, SCDNR - Land, Water, and Conservation Division
- P. Weinbach, SCDNR - Marine Resources Division
- E. Wenner, SCDNR - Marine Resources Division
- J. Westerhold, SCDNR Wildlife and Freshwater Fisheries
- D. Whitaker, SCDNR Office of Fisheries Management
- P. Wilber, NOAA Coastal Services Center
- R. Willoughby, SCDNR Geological Survey
- M. Zierden, The Charleston Museum
- L. Zimmerman, SCDNR Marine Resources Division

Additional Contributors

- R. Banks, US Fish and Wildlife Service
- R. Berry, South Carolina Department of Health and Environmental Control (SCDHEC)
- C. Bickley, Lowcountry Council of Governments
- P. Brownell, NOAA National Marine Fisheries Service Habitat
- D. Browning, USFWS ACE Basin National Wildlife Refuge
- M. Creighton, Colleton County Museum
- S. Davis, SCDNR Office of Fisheries Management
- E. Duncan, SCDNR Office of Fisheries Management
- R. Dunlap, SCDNR Office of Fisheries Management
- M. Eng, NOAA Coastal Services Center (Facilitator)
- D. Florian, NOAA Coastal Services Center
- R. Franklin, Clemson Extension Service
- C. Griffith, Colleton County
- J. Hamilton, Ducks Unlimited, Wetlands America Trust
- D. Hernandez, SCDHEC Office of Coastal and Resource Management
- T. Hewitt, South Carolina Department of Health and Environmental Control (SCDHEC)
- B. Hodgins, Union Camp Corporation
- R. Jess, ACE Basin National Wildlife Refuge (NWR)
- C. Johnston, Ducks Unlimited, Wetlands America Trust
- T. Kinard, Colleton County Council
- A. Kirkley, SC Parks Recreation and Tourism
- J. Koches, The Nature Conservancy (TNC)
- C. Logan, SCDNR Land, Water, and Conservation Division

- R. E. Marvin, Robert E. Marvin & Assoc.
- W. McAdams, SC Sea Grant Consortium
- L. McGilvray, NOAA Office of Ocean and Coastal and Resource Management
- M. McKenzie, South Carolina Department of Natural Resources (SCDNR)
- D. Merrill, SC Sea Grant Consortium
- G. Mixon, SCDNR Land, Water, and Conservation Division
- S. Moore, SCDHEC Office of Coastal and Resource Management
- D. Morgan, Beaufort County
- M. Prevost, The Nature Conservancy (TNC)
- B. Price, Colleton Co. Historical Society
- B.J. Richardson, US Fish and Wildlife Service
- C. Rigby, SCDHEC Office of Coastal Resource Management
- R. Scharf, South Carolina Department of Natural Resources (SCDNR)
- J. Stuart, Westvaco Corp.
- L. Sutter, NOAA Coastal Services Center
- C. Tank, Low Country Council of Governments
- J. Wescott, Lowcountry and Resort Island Tourism Commission
- K. Williams, Ducks Unlimited, Wetlands America Trust

Photographs and Sounds

Photographs

- D. Anderson, US National Office of Marine Biotoxins and Harmful Algal Blooms
- American Bear Association
- Aquatic Systems, Inc.
- Assateague Naturalist web site
- D. Baccus
- Bat Conservation International
- Bird Identification Infocenter
- Birmingham Zoo
- D. Cahlander
- D. Carr
- Clemson University Department of Entomology, Cooperative Extension Service
- D. Cowell
- Cyber Zoomobile
- Florida Department of Environmental Protection
- G. Gothard
- P. Hargraves, University of Rhode Island
- G. Histler
- Human Dolphin Institute
- D. Kamykowski, Aquatic Botany Lab, North Carolina State University
- Harmful Algal Page
- S. Holt
- ISU Extension
- M. Klug, Michigan State University
- W. I. Langstaff, Jr.
- J. Lenhard, Department of Entomology, Louisiana State University
- J. Loefer, South Carolina Department of Natural Resources
- G. McGrane, The Bird Identification Infocenter
- K. Morgan
- S. Morgan, US Fish and Wildlife Service
- N. Murdock, US Fish and Wildlife Service

- T. Murphy, South Carolina Department of Natural Resources
- National Park Service
- NY Sportfishing and Aquatic Resources Education Program (SAREP)
- G. Olmi, NOAA Coastal Services Center
- B. Paty
- The Raptor Center, University of Minnesota
- J. Rathert,"Nature's Painted Bird", photography by Jim Rathert, Missouri Conservationist. Copyright June 1997 by the Conservation Commission of the State of Missouri. Reproduced with permission.
- G. Riekerk, South Carolina Department of Natural Resources
- D.A. Rintoul
- B. Samuelson
- J. R. Sauer, The Bird Identification Infocenter
- B. Schuster
- T. Shaffer, US Fish and Wildlife Service
- P. Slichter
- C. Smith, South Carolina Department of Natural Resources
- South Carolina Institute of Archaeology and Anthropology
- South Carolina Wildlife Magazine
- J. Spendelow
- T. Spofford
- E. Starr, South Carolina Department of Natural Resources
- J. Stasz, The Bird Identification Infocenter
- Texas Parks and Wildlife
- R. Terry, Dept. of Agronomy and Horticulture, Brigham Young University
- The Turkey Vulture Society
- University of Puget Sound
- R. VanVleck
- Virginia Cooperative Extension
- J. Warr
- P. Weinbach, South Carolina Department of Natural Resources
- C. Wenner, South Carolina Department of Natural Resources
- M. Williams, University of Illinois Veterinary Medicine Library

Sounds

- Cornell Laboratory of Ornithology, Copyright 1998
- G. McGrane, The Bird Identification Infocenter
- J. R. Sauer, The Bird Identification Infocenter
- J. Stasz, The Bird Identification Infocenter
- Thayer Birding Software, Copyright 1998
- C. Wenner, South Carolina Department of Natural Resources

NEXT SECTION: Video Tour

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

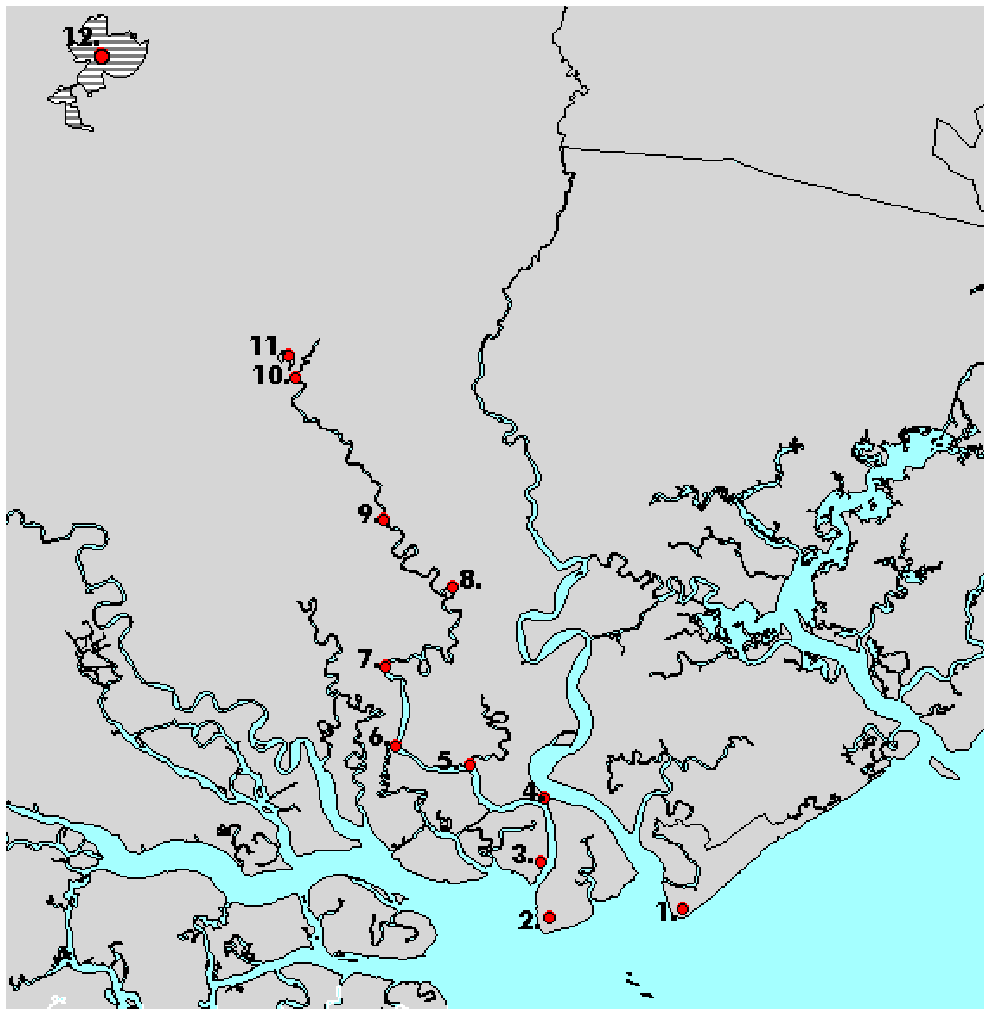
MENU

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

ACE Basin Video Tour

Below is a map of the Ashepoo River Basin. The numbers on the map correspond to the legend on the left. By clicking on the names in the legend, you will link to a more detailed map of that area. From there you can link to a video of that area. **(Note: You must have the appropriate software on your hard drive to view the videos. To download a free version of Apple's QuickTime software visit this website: http://www.apple.com/quicktime/download/).**

1. Edisto Beach
2. Otter Island
3. Saltmarsh
4. Fenwick Cut
5. Bennett's Point
6. Rice Fields
7. Pine and Mixed Hardwoods
8. Airy Hall Plantation
9. Upper Ashepoo Rice Field
10. Highway 17 and Horseshoe Creek
11. Upper Ashepoo Blackwater
12. Walterboro



HISTORY

Introduction | History of the ACE Basin | Archaeology |
Interactive Map

ENVIRONMENTAL CONDITIONS

Introduction | Geology | Geomorphology | Soils | Biogeochemistry | Climatology | Surface Water | Ground Water | Hydrochemistry and Pollution | Water Quality

BIOLOGICAL RESOURCES

SPECIES GALLERY

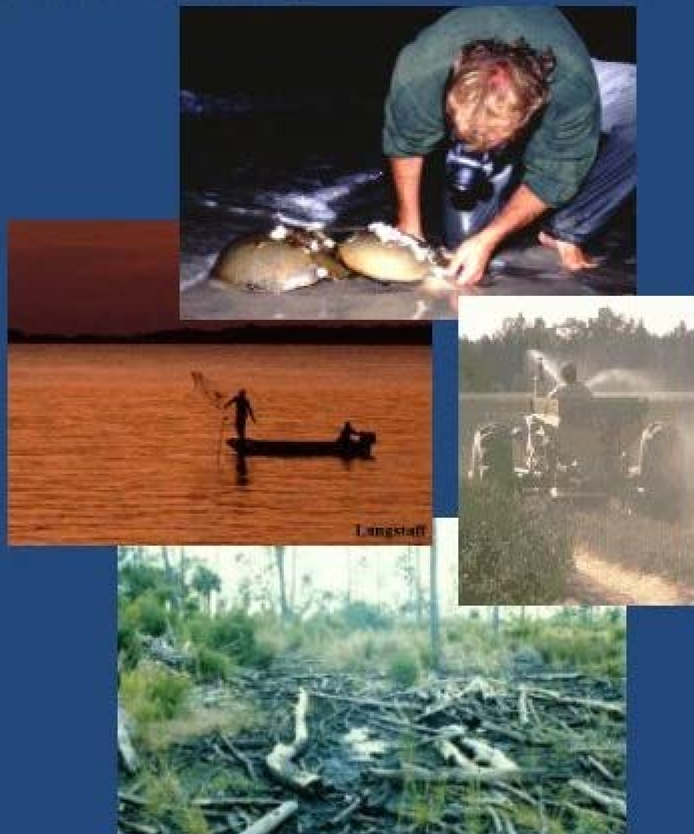
Introduction
Birds
Fish
Invertebrates
Mammals
Plants
Reptiles

Introduction | Birds | Fish | Invertebrates | Mammals |
Plants | Reptiles

SOCIOECONOMIC ASSESSMENT

Assessment of the ACE Basin Study Area

RESOURCE USE



RESOURCE MANAGEMENT

Introduction | Regulations | ACE Contacts

SYNTHESIS MODULES

Introduction | **Water Quality Module** |
Land Use Module

COMMUNITY PERSPECTIVES

Introduction | Water Quality Issues | Land Use Issues | Tourism Issues | Biographical Sketches

MENU

Environmental Conditions

Landcover Imagery

Hydrology and Hypsography

Biological Resources

Demographics

Recreation and Tourism

Resource Management

Administrative and Project Boundaries

Infrastructure

Shoreline and Islands

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Image Atlas

The following tables describe the GIS data available on this CD-ROM. Map ( ) and photo ( ) links provide a static image with all or a portion of the data's spatial extent displayed. **Metadata** links provide the metadata record for that data layer. A few files are divided by watershed (a=Ashepoo, c=Combahee, e=Edisto) to facilitate their use on slower computers.

History

Description	File Name	File Format	Link
Archaeological Inventory by HUC (polygon)	archaeol	Shapefile	Metadata

Environmental Conditions

Description	File Name	File Format	Link
Deep Cores: The metadata explain how this shapefile The metadata explain how this shapefile can be linked to a DBF table that shows metal concentrations at the two core stations (point)	deepcore	Shapefile	Metadata
National Wetlands Inventory 1989 (polygon)	nwi89_a nwi89_c nwi89_e	Shapefile	Metadata
National Wetlands Inventory 1989 revised to correct errors found in early releases of the 1989 data (polygon)	nwi89r_a nwi89r_c nwi89r_e	Shapefile	Metadata
National Wetlands Inventory 1994 (polygon)	nwi94_a nwi94_c nwi94_e	Shapefile	Metadata
Soil Surveys: The metadata explain how this shapefile can be linked to several DBF tables that describe soil type, layering, and source in detail (polygon)	solis_a solis_c solis_e	Shapefile	Metadata

Land Cover Imagery

Description	File Name	File Format	Link
1995 Landsat TM satellite image from NOAA Coastal Change Analysis Program	ace95tms.img	Imagine	Metadata
Landcover derived from 1990 Landsat TM image by the NOAA Coastal Change Analysis Program	acemosai0.tif	TIF	Metadata
Landcover derived from 1995 Landsat TM image by the NOAA Coastal Change Analysis Program	acemosai1.tif	TIF	Metadata
Landcover change derived from 1990 and 1995 Landsat TM images	acematrix.tif	TIF	Metadata

Hydrology and Hypsography

Description	File Name	File Format	Link
ACE River Basins (polygon)	spltbasn	Shapefile	
Flow Points for 14-digit HUC's (point)	flow_pts	Shapefile	Metadata
Freshwater/Saltwater Boundary for each river (point)	frshsalt	Shapefile	Metadata
8 Digit HUC's (polygon)	huc_8	Shapefile	Metadata
11 Digit HUC's (polygon)	huc_11	Shapefile	Metadata
14 Digit HUC's (polygon)	huc_14	Shapefile	Metadata
14 Digit HUC's, revised (polygon)	huc_14r	Shapefile	Metadata
Hydrology by River Basin (line)	hydroa_a hydroa_c hydroa_e	Shapefile	Metadata
Hydrology by River Basin (polygon)	hydrop_a hydrop_c hydrop_e	Shapefile	Metadata
Hypsography by River Basin (line)	hypsog_a hypsog_c hypsog_e	Shapefile	Metadata

Biological Resources

Description	File Name	File Format	Link
Breeding Bird Census Route: The metadata explain how this shapefile can be linked to two DBF tables that provide survey results by year (line)	bredbird	Shapefile	Metadata
Colonial Waterbird Nests: The metadata explain how this shapefile can be linked to a DBF table that provides survey results by year (point)	cwbnests	Shapefile	Metadata
Eagle Nests: The metadata explain how this shapefile can be linked to a DBF table that provides survey results by HUC and year (polygon)	eagles	Shapefile	Metadata
Epifauna: Presence/absence of species from trawl samples (point)	epifauna	Shapefile	Metadata
Furbearing Animal Survey Routes: The metadata explain how this shapefile can be linked to a DBF file that shows survey results by year	fursurvy	Shapefile	Metadata
Freshwater Benthos: Results of benthic sampling in rivers and steams (point)	fwbnthos	Shapefile	Metadata
Infauna: Results of benthic sampling in estuarine areas (point)	infauna	Shapefile	Metadata
Plant Communities: The metadata explain how this shapefile can be linked to a DBF table that provides detailed taxonomic descriptions (polygon)	plantcom	Shapefile	Metadata
Quail Surveys: The metadata explain how this shapefile can be linked to a DBF table that shows survey results by year (line)	quail	Shapefile	Metadata
Trammel Net Surveys: The metadata explain how this shapefile can be linked to two DBF tables that show survey results by year (point)	trammel	Shapefile	Metadata
Trawl Surveys: The metadata explain how this shapefile can be linked to two DBF tables that show survey results by year (point)	trawls	Shapefile	Metadata
Christmas Bird Census Area: The metadata explain how this shapefile can be linked to a DBF table that shows survey results by year (polygon)	xmasbird	Shapefile	Metadata

Demographics

Description	File Name	File Format	Link
Census Block Groups (polygon)	aceblks	Shapefile	Metadata

Census Tracts (polygon)	acectbna	Shapefile	Metadata
Census Results by County (polygon)	acecty90	Shapefile	Metadata

Recreation and Tourism

Description	File Name	File Format	Link
Public Beaches (point)	beaches	Shapefile	Metadata
Bed and Breakfast Inns (point)	bedbreak	Shapefile	Metadata
Birding Sites (point)	birdsite	Shapefile	Metadata
Boatramps (point)	boatramp	Shapefile	Metadata
Campgrounds (point)	campgrnd	Shapefile	Metadata
Museums, Arts Centers and Festivals (point)	cultural	Shapefile	Metadata
Golf Courses (point)	golfcors	Shapefile	Metadata
Hotels (point)	hotels	Shapefile	Metadata
Marinas (point)	marina	Shapefile	Metadata
Outfitters (point)	outfiter	Shapefile	Metadata
Hiking and Biking Trails (point)	trails	Shapefile	Metadata

Resource Management

Description	File Name	File Format	Link
USACE Permits for filling wetlands coastal construction (point)	coeprmit	Shapefile	Metadata
EMAP Sediment Texture Stations (point)	emapseds	Shapefile	Metadata
Endangered Species by HUC (polygon)	endangrd	Shapefile	Metadata
Beach Erosion and Accretion Measures (point)	erosion	Shapefile	

			Metadata
Horseshoe Crab Nesting Beaches (polygon)	hrshocrb	Shapefile	Metadata
NPDES Permits pollution discharges (point)	npdespmt	Shapefile	Metadata
Protected Lands (polygon)	protlnds	Shapefile	Metadata
Seaturtle Nesting Beaches (line)	seaturtl	Shapefile	Metadata
Shellfishing Permits (polygon)	sfpermit	Shapefile	Metadata
Shellfishing Waters (polygon)	sfwaters	Shapefile	Metadata
Shellfish Habitat (polygon)	sf_hab	Shapefile	Metadata
EPA STORET Water Quality Stations: The metadata explain how this shapefile can be linked to DBF tables that show raw monitoring results (points)	storet	Shapefile	Metadata
Trawling Boundary: shows where trawling is permitted within the ACE Basin (line)	trawlbnd	Shapefile	Metadata

Administrative and Project Boundaries

Description	File Name	File Format	Link
Project Boundary (polygon)	acebound	Shapefile	Metadata
County Lines (polygon)	cnty100k	Shapefile	Metadata
ACE Basin NERR Boundary (polygon)	nerrbndy	Shapefile	Metadata
ACE Basin Task Force Boundary (polygon)	taskbndy	Shapefile	Metadata

Infrastructure

Description	File Name	File Format	Link
Airports (point)	airports	Shapefile	Metadata
Cities (polygon)	cities	Shapefile	Metadata

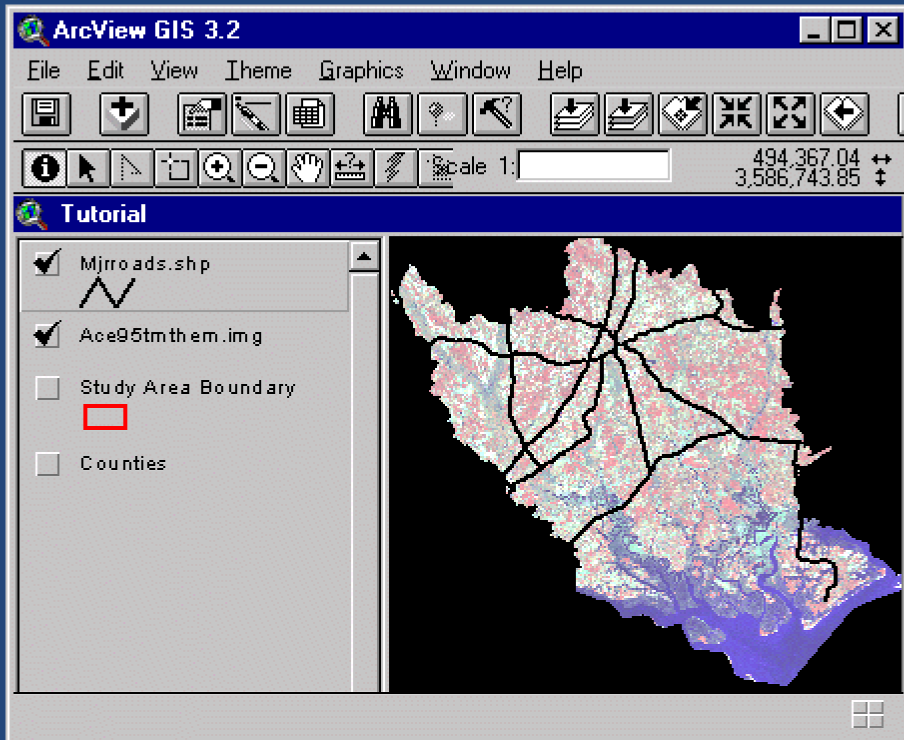
Major Roads (line)	mjrroads	Shapefile	Metadata
Transmission Lines (line)	pipeline	Shapefile	Metadata
Railroads (line)	railroad	Shapefile	Metadata
Roads by River Basin (line)	roads_a roads_c roads_e	Shapefile	Metadata
Weather Station (point)	weather	Shapefile	Metadata

Shoreline and Islands

Description	File Name	File Format	Link
Islands (polygon)	islands	Shapefile	Metadata
Shoreline (polygon)	scshore	Shapefile	Metadata

General Introduction | History| Environmental Conditions | Biological Resources | Species Gallery| Socioeconomic Assessment | Resource Use | Resource Management| Synthesis Modules | Community Perspectives | Image Atlas| GIS Data | Bibliography | Glossary| About This CD-ROM | ACE Contacts | Site Map| Search

GIS DATA



What is GIS? | GIS in the ACE Basin |
GIS Viewing Tools | GIS Tutorial

M
E
N
U

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Bibliography

Two ProCite® bibliographic databases, the ACE Basin Characterization Bibliography and the Sea Islands Characterization Bibliography (see descriptions below), are available on this CD-ROM. If you do not have a full version of Procite and wish to view and querry these databases, you will need to install a licensed, read-only version of ProCite® 4 to your hard drive from this CD-ROM. This software will allow you to query the database by author, date, title, or any of the other fields. The version of ProCite 4 available on this product is only compatible with Windows 95/98 and NT operating systems. ProCite is licensed from ISI ResearchSoft.

To install the read-only version of ProCite 4 software, go to the CD-ROM drive in your file manager and find the Setup.exe file located in the biblio folder, which is in the html folder. Double click on Setup.exe and follow the instructions. The entire install process should only take a couple of minutes. Once the ProCite software has been installed, you should be able to link to the bibliographic databases described below. If you encounter problems accessing the bibliographic database(s) from the CD-ROM, we suggest copying the database(s) from the CD-ROM to your hard drive and then opening these using the File menu within Procite. The files that need to be copied are aceref.pdt and aceref.pdx for the ACE Basin Characterization Bibliography and seaisl.pdt and seaisl.pdx for the Sea Island Bibliography.

The first bibliographic database contains approximately 1400 references that were assembled during the research and writing of this characterization.	ACE Basin Characterization Bibliography
The second bibliography contains approximately 6,000 references assembled in the late 70's during the writing of the "Ecological Characterization of the Sea Island Coastal Region of South Carolina and Georgia." Although some of the references are dated, it is one of the most comprehensive bibliographies assembled that covers the coast of South Carolina and Georgia.	Sea Island Characterization Bibliography

MENU

Glossary

This glossary is provided as a reference for technical terms found within the ACE Basin Characterization. It should be noted that many words have multiple usage and all definitions (usages) may not be provided here. Following each term in the list below is a number that refers to the reference (source material) for the definition. The references are listed following the definitions. In many cases, the definitions have been modified from those found in the source material. Use the "back button" to return to the narrative text from the glossary.

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | Glossary Sources

- TERM - Source Number - DEFINITION

TOP

- A -

- *abdomen* - 46 - In Arthropoda, main division of body behind thorax; in crayfish and lobsters, often miscalled the tail. Mammalian abdomen lies behind diaphragm and contains liver, stomach, and intestines.
- *abiotic* - 8 - Describing the nonliving components of an ecosystem.
- *acacia* - 2 - A genus of leguminous trees of the tropics and subtropics, especially Australia, that may form the dominant vegetation in arid areas. Dyes, perfumes, timber and many other commercial products are derived from acacias, and some (e.g., Acacia albida) might be exploited more as a species of great value to people living in arid regions.
- *actinarians* - 14 - An order of Zoantharia, commonly called sea anemones, which are solitary, without a skeleton, and have complete and incomplete septa in multiples of six.
- *acute toxicity* - 20 - The ability of a substance to cause severe biological harm or death soon after a single exposure or dose. Also, any poisonous effect resulting from a single short-term exposure to a toxic substance.
- *aeolian* - 8 - Referring to mineral particles moved and sorted by wind, usually fine sands and coarse silt; also eolian.

- *aerobic* - 6 - Organisms, activities, and conditions that exist only in the presence of free oxygen. Aerobic organisms require oxygen for their life processes.
- *algae* - 42 - Simple plants, many microscopic, containing chlorophyll; forming the base of the food chain in aquatic environments; some species may create a nuisance when environmental conditions are suitable for prolific growth..
- *aliphatic* - 10 - Referring to an organic compound with properties similar to those of the alkanes, alkenes, and alkynes and their derivatives. Most aliphatic compounds have an open chain structure, but some have rings. The term is used in distinction to aromatic compounds.
- *allochthonus* - 48 - Refers to rocks or materials formed elsewhere than in their present position, such as particulate matter originating outside and carried into a new body of water.
- *ammonium ion* - 2 - The ion NH4+, formed by the relationship between NH3 and H+. .
- *amnion* - 39 - A thin membrane forming a closed sac surrounding the embryos of reptiles, birds, and mammals. It contains a serous fluid, the amniotic fluid, in which the embryo is immersed, and is usually formed by folds (the amniotic folds) arising from the ectoderm and outer layer of the mesoderm of the extraembryonic part of the blastoderm. The folds unite over the back of the embryo, called the amniotic cavity. Only that layer of the folds is called the false amnion and forms part of the chorion. In parturition the amnion is ruptured and the amniotic fluid escapes.
- *amniotic eggs* - 40 - The type of eggs produced by birds, reptiles and prototherian (egg laying) mammals in which the embryo develops inside an amnion. The shell of the egg is either calcium-based or leathery.
- *amphibians* - 1 - (Amphibia). Class of vertebrates including newts, salamander, frogs and toads. The adults are aquatic or live in damp situations, and have moist, smooth skins, often used as well as lungs for respiratory purposes. Apart from a few viviparous species, most have to return to the water to breed, because the eggs have no shell to prevent desiccation. The larvae have gills. The earliest (Carboniferous) Amphibia resembled osteolepid fishes, from which they differed in having pentadactyl limbs instead of fins, and middle ear apparatus.
- *amphipods* - 1 - (Amphipoda). Order of Crustacea including the freshwater shrimps and sandhoppers. Most are marine and have laterally compressed bodies.
- *anadromous* - 4 - A form of life cycle among fishes in which maturity is attained in the ocean, and the adults ascend streams and rivers to spawn in freshwater. Salmon and shad are examples.
- *anaerobic* - 8 - Occurring in the absence of oxygen as applied to chemical and biochemical processes; opposite of aerobic.
- *anal fin* - 46 - In fish, a mid-ventral fin behind the anus.
- *androgens* - 40 - A class of male hormones (which includes testosterone and androsterone) responsible for the development of male secondary characteristics.

- *anoxia* - 2 - A severe deficiency of oxygen in tissues, blood or a body of water, causing harm to living organisms.
- *anoxic* - 40 - Lacking or not involving or requiring oxygen.
- *anthesis* - 38 - The time or action of a flower opening; full bloom.
- *anthropogenic* - 2 - Produced as a result of human activities.
- *anthropomorphic* - - Of or pertaining to anthropomorphism. See anthropomorphism.
- *anthropomorphism* - 2 - The projection on to non-humans, especially mammals, of motives, emotions or thoughts that a human might experience in circumstances apparently similar to those affecting the individual animal being observed. It is a common attitude for a person to hold when confronting a non-human, but it has no scientific validity.
- *aquaculture* - 2 - The breeding and rearing of freshwater or marine organisms in a controlled manner; frequently in captivity.
- *aquifer* - 2 - A geologic formation through which water can percolate, sometimes very slowly, for long distances. Springs and wells are charged from aquifers and the contamination of an aquifer may lead to the contamination of wells and springs over a wide area. .
- *archaeology* - 7 - The study of human cultures through the recovery and analysis of their material relics.
- *archaic* - 7 - Related or belonging to an earlier (and usually more primitive) time. In new world archaeology, a prehistoric cultural stage that follows the Lithic.
- *argillaceous* - 6 - Applied to rocks and substances composed of clay minerals or having a notable proportion of clay in their composition.
- *argillic* - 6 - Pertaining to clay or clay minerals.
- *aromatic hydrocarbons* - 35 - A major group of unsaturated cyclic hydrocarbons containing one or more rings, typified by benzene, which has a 6-carbon ring containing three double bonds. The vast number of compounds of this important group, derived chiefly from petroleum and coal tar, are rather highly reactive and chemically versatile. The name is due to the strong and not unpleasant odor characteristic of most substances of this nature. Certain 5-membered cyclic compounds such as the furan group (heterocyclic) are analogous to aromatic compounds.
- *Arthropoda* - 2 - The largest phylum of animals, containing more than 700,000 species, and the only major invertebrate phylum with members adapted for life in truly dry land. Arthropods are characterized by the possession of a jointed exoskeleton containing chitin, paired jointed limbs, a well-developed head and a haemocoelic (blood-containing) body cavity.
- *arthropods* - 2 - Animals belonging to the phylum Arthropoda (see Arthropoda).
- *assimilation* - 2 - The incorporation of food substances into the cells, tissues or organs

of a living organism.

- *assimilation rates* - 2 - The rate at which food substances are incorporated into the cells, tissues and organs of a living organism.
- *autolysis* - 40 - The process of self-destruction of a cell, cell organelle, or tissue, occurring by the action of enzymes.
- *autolytic* - - See autolysis.
- *autotrophs* - 9 - An organism that is able to synthesize all needed organic molecules from simple inorganic substances (e.g., H_2O, CO_2, NH_3) and some energy source (e.g., sunlight); in contrast to heterotroph. Plants, algae, and some bacteria are autotrophs.
- *avifauna* - 41 - Members of the vertebrate class Aves or birds; usually referring to birds within a specific community.

TOP

- B -

- *bacterivore* - 42 - An organism that feeds on bacteria.
- *bacterivorous* - 42 - Relating to feeding upon bacteria.
- *barbels* - 46 - Thin, sensory appendages found near mouths of some fishes, e.g., catfishes. Barbels are sensitive to touch giving the fish tactile awareness.
- *barrier islands* - 6 - Elongate coastal islands, generally parallel to the coastline and fronting the ocean, barrier islands are formed of rows of parallel ridges of sand created by repeated deposition and erosion. Generally have beaches, dunes, vegetated terrains and swampy areas. Barrier islands tend to change shape and migrate in response to sea level rise and fall and erosion/deposition processes.
- *bathymetric* - 4 - Of or pertaining to the science of measuring ocean depths in order to determine the sea floor topography.
- *beach facies* - 3 - The section of the beach normally exposed to the action of the wave uprush. The foreshore of a beach.
- *benthic* - 4 - That portion of an aquatic environment inhabited by organisms which live permanently in or on the bottom sediments.
- *berm* - 46 - Generally flat part of beach leveled by previous erosion and sometimes bounded at lower side by ridge; occur above high water mark; formed by deposition of material by wave action.
- *bioaccumulated* - - See bioaccumulation.
- *bioaccumulation* - 42 - A build up of specific organic or inorganic compounds within tissues of given organisms; usually applied to certain heavy metals, pesticides, or

metabolites.

- *bioavailable* - 18 - Available for uptake by living organisms.
- *Biochemical oxygen demand* - 2 - The amount of oxygen taken up by aerobic microbes that decompose organic matter in a unit volume of water over a given time. It is used as a measure of the degree of organic pollution of water. The more organic matter the water contains, the more oxygen is used by microorganisms.
- *biodiversity* - 8 - Totality of the richness of biological variation, ranging form within-species genetic variation, through subspecies and species, to communities, and the pattern and dynamics of these within the landscape.
- *biogeochemical* - 40 - (Biogeochemical cycle). The circulation (cycling) of chemical elements such as nitrogen, carbon, etc. in specific pathways from the abiotic (non-living) portions of the environment into living components and then back again into abiotic forms.
- *biogeochemistry* - 6 - Study of the effects of life processes on the distribution and fixation of chemical elements in the biosphere, e.g. nitrogen or sulfur cycling.
- *biological bench-marking* - 2 - The use of plant or animal species to measure pollution based on assessments (bench marks) of population level and fitness, against which changes can be evaluated. Also, The natural process by which a water body purifies itself of organic pollution, largely by the action of microorganisms.
- *biological indicator* - 42 - A species or organism that is used to grade environmental quality or change.
- *biological oxygen demand* - 7 - The amount of oxygen, measured in parts per million, that is removed from aquatic environments rich in organic material by the metabolic requirements of aerobic microorganisms. Used as a standardized test to measure nutrient pollution.
- *biomass* - 40 - The total mass (weight or volume) of all the organisms of a given type and/or in a given area; for example, the biomass of fishes in a pond.
- *biomedicine* - 38 - The study of medicine in relationship to all biological systems. The branch of medicine that deals with human response to environmental stress.
- *biomolecules* - 40 - Any molecule that is involved in the maintenance and metabolic processes living organisms.
- *biosphere* - 2 - That part of the Earth and its atmosphere in which organisms live.
- *biospheric* - - Of or pertaining to the biosphere. See biosphere.
- *biostabilizer* - 42 - A machine used to convert solid waste into compost by grinding and aeration.
- *biota* - 2 - The flora and fauna of an area.
- *biotoxins* - 15 - A toxin (poison) which originates from a living thing (a plant, animal, fungi, bacteria, etc.).

- *bioturbation* - 27 - The stirring of sediment by animal life.
- *bivalve* - 4 - One of a class (Pelecypoda or Lamellibranch) of molluscs generally sessile or burrowing into soft sediment, rock, wood, or other materials. Individuals possess a hinged shell and a hatchet-shaped foot, which in some is used in digging. Many molluscs are notable fouling organisms; several are marine borers. The clams, oysters, and mussels are bivalves.
- *blackwater* - 42 - Swamp, stream and river water that is dark in color because of tannins (complex organic molecules) that have leached from organic matter such as leaves and bark.
- *bottomland* - 15 - Lowlands along streams and rivers, usually on alluvial floodplains, that are periodically flooded.
- *boundary layer (effect)* - 2 - The layer of fluid that is influenced by its proximity to a rigid boundary. Frequently, but not always, refers to the slower motion of flowing water proximal to a solid surface (e.g. the bottom) compared to the mainstream flow..
- *brackish* - 4 - Water in which salinity values range from approximately 0.50 to 17.00 parts per thousand.
- *bryozoans* - 4 - One of a phylum (Bryozoa or Polyzoa) of minute, mostly colonial, aquatic animals with body walls often hardened by calcium carbonate and growing attached to aquatic plants, rocks, and other firm surfaces. Colonies may be encrusting, creeping, or erect branching. Encrusting colonies may be white, yellowish, or brick red and consist of many tiny, beautifully formed shells. Members of the phylum are widespread and notable fouling organisms.
- *butylbenzyl phthalate* - 35 - Clear, oily liquid; slight odor. Combustible. Plasticizer for polyvinyl and cellulosic resins, organic intermediate.
- *bycatch* - 43 - Bycatch is defined as marine life caught during fishing operations that is not targeted. While most bycatch is thrown back into the ocean, it is almost always either dead, or too weak to survive. Biomass of bycatch may exceed that of targeted organisms in some fisheries.

TOP

- C -

- *carapace* - 4 - A chitinous or bony shield covering the whole or part of the back of certain animals, such as many crustaceans and turtles.
- *carbamate pesticides* - 28 - A class of new-age pesticides that attack the nervous system of organisms.
- *carbonates* - 6 - Mineral compounds created by weathering of minerals by carbon dioxide and having a characteristic anionic structure. Sediments formed of carbonate minerals (e.g. limestone).

- *carnivore* - 1 - A flesh-eating animal or plant (e.g. sundew). A secondary consumer in a food chain.
- *catadromous* - 4 - A form of life cycle among fishes in which maturity is attained in fresh waters, and the adults migrate into the ocean to spawn. The common eel is an example.
- *catadromy* - - See catadromous.
- *cation exchange capacity* - 42 - The total of exchangeable cations that a soil can absorb; expressed in milliequivalents per gram to 100 grams of soil (or other exchanges, such as clay).
- *caudal fin* - 46 - The posterior fin of a fish, associated with the caudal bones of the tail.
- *caviar* - 26 - Processed salted roe of large fish (such as sturgeon).
- *cheliped* - 46 - Large, grasping claw in many crustaceans.
- *chemical oxygen demand* - 1 - The amount of oxygen taken up by the organic matter in a sample of water, expressed as parts per million of oxygen taken up from a solution of boiling potassium dichromate in two hours. The test is used to assess the strength of sewage and trade wastes.
- *chemoautotrophs* - - See chemosynthetic.
- *chemolithotrophic* - 40 - Describing an organism that is able to obtain its energy from the oxidation of inorganic compounds, including those of iron, nitrogen and sulphur.
- *chemoorganotrophs* - 15 - An organism which oxidizes chemical bonds for energy but requires organic carbon compounds to grow. A type of heterotroph.
- *chemosynthetic* - 1 - Applied to organisms that produce organic material from inorganic compounds using simple inorganic reactions as a source of energy. The process is chemosynthesis. For example, Thiobacillus obtains energy by oxidizing hydrogen sulphide to sulpher; other bacteria utilize energy from the oxidation of ferrous salts to their ferric form..
- *chlorinated organics* - 15 - Any organic chemical which includes chlorine atoms. A class of water pollutants. Chlorinated organic compounds, along with other halogenated organics, are believed to cause health risks such as cancer, endocrine system disruption, birth defects, compromised immune systems, and reduced fertility. Examples of chlorinated organics include trichloroethylene, ethylene dichloride, vinyl chloride, PCBs chlorobenzene, and many chlorinated solvents and biocides.
- *chlorophenoxy* - 20 - A class of herbicides that may be found in domestic water supplies and cause adverse health effects.
- *chlorophyll* - 1 - A green pigment, present in algae and higher plants, that absorbs light energy and thus plays a vital role in photosynthesis. Except in Cyanophyta (blue-green algae), chlorophyll is confined to chloroplasts. There are several types of chlorophyll, but all contain magnesium and iron. Some plants (e.g., brown algae, red algae, copper beach trees) contain additional pigments that mask the green of their chlorophyll.

- *chlorphenolic acids* - - See chlorophenoxy.
- *chordate* - 1 - A phylum (Chordata) of animals characterized by the possession, at least in the early stages of development, of a notochord (a longitudinal supporting rod or vacuolated cells, enclosed in a firm sheath, lying just below the central nervous system), pharyngeal ('gill') pouches and a hollow, dorsal, nerve chord. The phylum includes the vertebrates (vertebrata) and the more primitive Protochordata (extinct forms lacking shells and vertebrae).
- *chronic toxicity* - 20 - The capacity of a substance to cause long-term poisonous health effects in humans, animals, fish, and other organisms.
- *cilia* - 46 - Hair-like appendages that can move together in a waving motion; used for locomotion in various one-celled animals and to produce a current in a fluid in higher animals or their larvae.
- *ciliates* - 7 - Any protozoan belonging to the class Ciliata and characterized by the presence of cilia throughout its life cycle. Known range, Upper Jurassic to the present.
- *circumpolar* - 41 - Located around one of the polar regions of earth.
- *clearcutting* - 42 - A method of forest cutting that removes the entire timber stand on the area cut.
- *clotting factor* - 40 - A group of substances present in blood plasma that, under certain circumstances, undergo a series of chemical reactions leading to the conversion of blood from a liquid to a solid state.
- *clupeid* - 43 - A member of the fish family Clupeidae which includes herrings, alewives, menhaden and sardines in the United States. Clupeids are generally deep-bodied, silvery fishes that have relatively large, easily-shed scales and often associate in large schools. They have rough scales, or scutes, along the ventral edge of the body, a single dorsal fin midway along the body, and a deeply forked caudal fin. In addition, clupeids have no lateral line and lack spines on all their fins.
- *cnidarians* - 2 - A phylum of aquatic, mostly marine animals, that are usually radially symmetrical. They have simple, two-layered bodies with only one opening to the gut (the coelenteron) and characteristically they bear stinging cells (nematoblasts) on tentacles. Colonial forms are common. This group includes sea-anemones, corals, and jellyfish. .
- *coliform bacteria* - 40 - A group of Gram-negative rod-shaped bacteria that are found in the vertebrate gastrointestinal tract; their presence in water is an indication of fecal pollution. Well known coliform bacteria include Escherichia coli and Salmonella.
- *colloidal* - - See colloids.
- *colloids* - 40 - Substances which exist as a system of two or more phases, with one (the dispersed phase) distributed in the other (the continuous phase). At least one of the phases has very small dimensions. Colloids include sols, emulsions, gels, foams and aerosols.
- *comminuter (or)* - 42 - A device that breaks solids into smaller pieces. For sewage treatment, to make solid wastes easier to treat.

- *comminution* - 40 - The act of breaking solids into smaller pieces; grinding; pulverization.
- *compound eye* - 38 - The eye of most insects and crustaceans, composed of many light sensitive units, the ommatidia, each with its own refractive system which forms a portion of the image.
- *concretions* - 2 - A solid mass of matter formed by the cohesion or coalescence of its constituent particles.
- *conservation* - 12 - The continuing protection and management of natural renewable resources- e.g. soil, water, wildlife, forest- in accordance with principles that assure their optimum economic and social enjoyment.
- *convection* - 38 - Heat transfer by the movement of a heated gas or liquid between regions of unequal density.
- *convective cooling* - - Cooling of a substance by the process of convection (see convection).
- *copepods* - 40 - Members of the crustacean subclass Copepoda. These are a group of small (0.5-2.0 mm), freshwater and marine crustacea that lack a carapace and compound eye. Some are free swimming and may form a major part of the plankton (e.g., Calanus on which herrings feed). Some are parasitic. Many have enlarged first antennae, used for swimming. Cyclops, with a single median eye, is common in ponds.
- *coppice selection* - 12 - Silvicultural systems in which the crops originate mainly from stools but sometimes in small part from suckers or seed, and the rotation is generally comparatively short.
- *Cretaceous* - 6 - In the geologic time scale, the final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 65 million years ago.
- *critical area* - 42 - An area that, because of its size, location, condition, or value, must be treated with special consideration because of inherent site factors and difficulty of management.
- *crustacean* - 46 - One of group (Crustacea) of mostly aquatic (freshwater and marine) arthropods which breathe by means of gills; segmented body commonly covered by hard shell or crust. Group includes barnacles, copepods, crabs, shrimps, and lobsters.
- *cryoturbation* - 2 - The disturbance of material by frost action, frost heaving and differential mass movements.

TOP

- D -

- *DBH* - 13 - Diameter Breast Height. The stem diameter of a tree measured at breast height (1.3 m above ground level).

- *decapod* - 40 - A member of the crustacean order Decapoda, characterized by the presence of five pairs of walking legs, the first of which may be modified as a grasping pincer. Includes crabs, shrimps, and lobsters.
- *deltaic* - 39 - Pertaining to or characterized by a delta; e.g. "deltaic sedimentation". Also, constituting a delta; e.g. a "deltaic coast".
- *demersal* - 43 - Describes animals that live near (but not in) water bottoms. Examples are flounder and croaker.
- *demographic* - 2 - The study of the age and sex structure, geographical distribution, rate of change of size, etc. of populations.
- *dendritic* - 9 - Of or pertaining to nerve fiber, typically branched, that conducts impulses toward the cell body of a neuron. In reference to drainage pattern, an arrangement of surface drainage in which streams branch randomly at almost any angle, resembling in plan the branching habit of trees.
- *denitrification* - 2 - The breakdown of nitrates by soil bacteria (e.g., Bacterium denitrifications), resulting in the release of free nitrogen. This process takes place under anaerobic conditions, such as are found in water-logged soil, and it reduces soil fertility.
- *dentine* - 46 - Hard, bone-like material that is major component of teeth. Mainly composed of type of calcium phosphate, dentine contains tiny tubules leading to soft pulp cavity deep inside tooth where there are nerves and blood vessels.
- *dentition* - 40 - The type, number, and arrangement of teeth in a species.
- *depocenter* - 7 - An area or site of maximum deposition; the thickest part of any specified stratigraphic unit in a depositional basin.
- *depolymerization* - - See depolymerize.
- *depolymerize* - 39 - To separate a polymer into simpler substances of the same percentage composition.
- *deposition* - 7 - The laying, placing, or throwing down of any material; specifically, the constructive process of accumulation into beds, veins, or irregular masses of any kind of loose rock material by any natural agent, such as the mechanical settling of sediment from suspension in water, the chemical precipitation of mineral matter by evaporation from solution, or the accumulation of organic material on the death of plants and animals.
- *depredate* - 38 - To prey upon, plunder or lay waste by force.
- *depredation* - 38 - The act of preying upon or destroying.
- *desorbes* - - See desorption.
- *desorption* - 40 - The removal of adsorbed atoms, molecules, or ions from a surface.

- *detritivores* - 9 - Organisms that live on dead and discarded organic matter; including large scavengers, smaller animals such as earthworms and some insects, and decomposers (fungi and bacteria).

- *detritus* - 45 - Small particles of organic matter resulting from the decay of dead animals and plants.

- *diabase* - 6 - A fine-grained, intrusive, crystalline rock consisting essentially of labradorite and pyroxene, and characterized by ophitic texture.

- *diabase dikes* - - See diabase. See dikes.

- *diel* - 38 - Referring to a 24-hour period that usually involves the day and an adjoining night; used most frequently in ecology.

- *dikes* - 6 - 1. A tabular body of igneous rock that cuts across the structure of adjacent rocks. 2. A wall or mound built around a low-lying area to prevent flooding.

- *Dimorphic* - 46 - Occurring in two forms as differently shaped shells of males and females or minerals identical in composition but having different crystal forms (calcite, aragonite). Sexual dimorphism describes a species in which male and female take two distinct, different forms.

- *dinoflagellates* - 15 - The members of this class of fire algae (Division Pyrrophyta) are a major component of marine algae. Dinoflagellates, many of which have a very strange appearance, usually move via two flagella that beat in grooves along their bodies. These organisms, which are often red in color, can produce strong toxins; they are responsible for the deadly red tides that can kill many fish and other marine organisms. One dinoflagellate, Gessnerium catenellum, often causes red tides on the Pacific coast and Gulf of Mexico. Filter-feeding molluscs such as clams and oysters sometimes become toxic to humans and other animals due to their eating dinoflagellates. Many species of dinoflagellates are bioluminescent; they produce a faint light when they are disturbed, thus sometimes causing nighttime waves breaking against the shore to be faintly luminous.

- *dioxin* - 2 - (2,3,7,-tetraclorodibenzo-p-dioxin) A by product formed during the preparation of the herbicide 2,4,5-T, and sometimes produced by the incineration of chlorinated organic compounds. It may also occur naturally and is distributed widely in the environment, except locally in extreme low concentrations. Substantial amounts were released by the industrial incident at Seveso in 1976. Exposure to high concentrations causes chloracne. Although dioxin is suspected of causing more lasting damage, including chromosome malformation, there is no conclusive evidence for this.

- *dissolved organic carbon* - 15 - Organic material in an aquatic medium having a least dimension smaller than 0.45 micron (passes through a 0.45 micron filter).

- *dorsal fin* - 46 - Pertaining to fish, the fin on the back or upper surface.

- *down warping* - 7 - Subsidence of a regional area of the Earth's crust, as in an orogenic belt or a cratonic basin.

- *draping* - 7 - The general structural concordance of warped strata, lying above a limestone reef or other hard core, to the upper surface of that reef or core, due to initial dip, to differential compaction, or to both.

- *drift fences* - 12 - Any fence designed to prevent drift, constituting a barrier rather than an enclosure, is termed a drift fence.
- *duff* - 42 - The more or less firm organic layer on top of mineral soil, consisting of fallen vegetative matter in the process of decomposition, including everything from pure humus below the litter on the surface; a general, nonspecific term.
- *duff depth* - - The depth of the duff layer (see duff).

TOP

- E -

- *ebb* - 38 - To decline or recede. Also see ebb tide.
- *ebb tide* - 46 - That stage of the tide when water is outgoing, receding, or falling; the period between high water and a succeeding low water.
- *echinoderms* - 2 - A phylum (Echinodermata) of marine invertebrate animals, most of which exhibit five-rayed symmetry as adults. The skin bears calcareous plates. The coelom is intricate and large, with extensions into the many tube feet which protrude from the body surface. The pelagic larvae have affinities with those of the Hemichordata. Includes sea stars, brittle stars, sand dollars and sea cucumbers.
- *ecological characterization* - 32 - A study which compiles existing available information utilizing a holistic approach that identifies functional relationships among natural processes and components of ecosystems. This study is designed primarily to integrate environmental and socioeconomic information useful for planning , impact assessment, and analysis, and to identify research needs.
- *ecotonal* - - See ecotone.
- *ecotone* - 7 - A transition zone that exists between two ecologic communities. Members of both communities may compete within this zone, yielding an apparent enrichment known as the edge effect.
- *edge habitat* - 42 - The transitional zone where one cover type ends and another begins.
- *effluent* - 2 - Generally, any fluid emitted by a source. More specifically, a waste fluid (usually liquid) produced by an agricultural or industrial process.
- *egress* - 38 - The act of going out from a place of actual or seeming confinement; emergence.
- *electron acceptors* - - Substance that accepts or receives electrons in an oxidation-reduction reaction, becoming reduced in the process.
- *elongate* - 26 - Stretched out, slender. To make or become longer.

- *embankment* - 7 - 1. A narrow depositional feature, such as a spit, barrier, or bar, built out from the shore of a sea or lake by the action of waves and currents that deposit excess material at its deep end; it may be emerged or submerge. 2. A dike, seawall or other linear structure of earth built to retain water or tailings, or to carry a roadway or railroad.

- *endangered species* - 42 - Any species that is in danger or extinction through all or significant portion of its range; a species of native fish, wildlife, or plants threatened with extinction because its habitat is threatened with destruction, drastic modification, or severe curtailment, or because of over-exploitation, disease, predation, or other factors affecting its survival.

- *endemic* - 40 - 1. Describing a plant or animal species that is restricted to one or a few localities in its distribution. 2. Describing a disease or a pest that is always present in an area.

- *endogenous* - 7 - Originating or produced from within. Said of a geologic process, or of its resultant feature or rock, that originates within the Earth, e.g. volcanism, volcanoes, extrusive rocks. The term is also applied to chemical precipitates, e.g. evaporites, and to ore deposits that originate within the rocks that contain them. In biology, describing a substance, stimulus, organ, etc. that originates from within an organism.

- *endotoxin* - 40 - A poisonous substance produced by a living organism (usually a bacteria) which resides inside the cell and is released only on disintegration of the cell.

- *energetics* - 4 - The branch of study dealing with the systematic description of the energy conversion and transfer processes which take place within a physical system

- *Entisols* - 2 - Young soils, characterized by dominance of mineral soil materials and absence of distinct horizons.

- *environmental sustainability* - 20 - Maintenance of ecosystem components and functions for future generations.

- *Eocene* - 7 - An epoch of the early Tertiary period, after the Paleocene and before the Oligocene; also, the corresponding worldwide series of rocks. It is sometimes considered to be a period, when the Tertiary is designated as an era.

- *eolian* - 8 - Referring to mineral particles moved and sorted by wind, usually fine sands and coarse silt; also aeolian.

- *epifauna* - 15 - Animals living on the surface of the substrate.

- *epiphyte* - 2 - A plant that grows on the outside of another plant, using it for support only and not as a source of nutrients. An example is lichen on trees.

- *epiphytic* - - Of or pertaining to an epiphyte. See epiphyte.

- *epizootiology* - 39 - Veterinary science treating of epizootic diseases.

- *equilibrium state* - 44 - In ecology, the condition in which a population or community is maintained with only minor fluctuations in composition over an extended period of time; sometimes called dynamic equilibrium. In chemistry, refers to the state of a reversible chemical reaction in which the forward and reverse reactions are taking place at the same rate.

- *ER-L* - 37 - Effects Range - Low. ER-L values are sediment quality guidelines for potentially toxic substances based upon empirical analyses of matching chemical and biological data. The ER-L values represented chemical concentrations below which adverse effects on sediment-dwelling fauna were rarely observed, and, therefore, estimated the low end of the effects range.

- *ER-M* - 37 - Effects Range - Median. ER-M values are sediment quality guidelines (SQG's) for potentially toxic substances based upon empirical analyses of matching chemical and biological data. The ER-M values represented the chemical concentrations toward the middle of the effects range and above which adverse effects on sediment-dwelling fauna would be likely to occur.

- *estuarine* - - Pertaining to an estuary (see estuary).

- *estuary* - 46 - A partially enclosed area where freshwater from a river or stream comes into contact with salty oceanic water; characterized by water whose salt content is between that of fresh and marine environments, tidal effects are evident, and by a population of animals and plants which is distinct from either the freshwater or oceanic environments.

- *Euclidian zoning* - - See zoning, euclidian.

- *euhaline* - 2 - Applied to full-strength seawater or to water of nearly equivalent salinity (i.e. to water containing about 35 parts salt per thousand parts of water (ppt)). Coastal waters have a salinity of about 30 ppt.

- *eukaryotic* - 9 - A cell having a membrane-bound nucleus, membrane-bound organelles, and chromosomes in which DNA is combined with special proteins; an organism composed of such cells.

- *euryhaline* - 7 - Said of marine organisms that tolerate a wide range of salinities.

- *eustatic sea level* - 7 - Pertaining to worldwide changes of sea level that affect all the oceans due to absolute changes in the quantity of seawater. Eustatic changes may have various causes, but the changes dominant in the last few million years were caused by additions of water to, or removal of water from, the continental icecaps.

- *eutrophic* - 2 - Applied to waters that are rich in plant nutrients and therefore highly productive; the large number of planktonic organisms (see plankton) sometimes rendering them cloudy. Eutrophic water bodies are frequently characterized by a deficiency of oxygen because of the decay of plant material.

- *eutrophication* - 6 - The process whereby a body of water becomes highly productive of aquatic plants, such as algae, due to the input of large quantities of nutrients. Eutrophication may happen naturally, but it often results from pollution. See eutrophic.

- *evapotranspiration* - 2 - The combined evaporation of water from the soil surface and transpiration from plants.

TOP

- F -

- *facies* - 2 - The sum total characteristics of a rock (e.g., its texture, mineral or organic composition, form and structure) from which its environment of deposition and subsequent history can be deduced.
- *facultative anaerobes* - 40 - Organisms, such as bacteria, fungi and some internal parasites, that are able to alter their metabolism to grow in either the presence or absence of oxygen..
- *facultative anaerobic bacteria* - - See facultative anaerobes.
- *faults* - 2 - In geology, a fracture in the Earth along which there has been displacement of the sides relative to one another parallel to the fault plane. Faults are classified by the relative motions of the faulted blocks as: (a) dipnslip faults (e.g., normal faults, reverse faults, and thrusts) in which the movement is parallel to the dip of the fault plane; (b) strike-slip faults (e.g., wrench, tear and transform faults) in which movement is parallel to the strike of the fault plane; and (c) oblique slip faults in which movement is at an appreciable angle to both dip and strike. .
- *fauna* - 2 - The animals of a particular region or period of time.
- *fecal coliform* - 42 - A group of bacteria normally present in large numbers in the intestinal tracts of humans and other warm-blooded animals. Frequently used as an indicator of sewage pollution.
- *Federal Register* - - The Federal Register is the official newspaper of the United States government. Issued daily by the U.S. Government Printing Office (excepting weekends and official holidays), it is the vehicle through which all federal agencies publish their regulations and legal notices. The size of the Federal Register varies from 200 to 600 pages (or more), depending on the number and length of announcements. The Federal Register is comprised of two major publications, the daily Federal Register and the annually revised Code of Federal Regulations (CFR). The daily Federal Register and CFR work together to provide an up-to-date version of any federal agency regulation. The Federal Register is published every Federal working day and includes rules and regulations that businesses must follow.
- *FEMA* - 22 - Federal Emergency Management Agency- federal agency that implements the National Flood Insurance Program and provides disaster assistance to coastal states and local governments. Key authorizing legislation includes National Flood Insurance Act, Flood Disaster Protections Act and the Stafford Disaster Relief and Emergency Assistance Act. FEMA's stated mission is to reduce loss of life and property and protect our nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery..
- *filter feeder* - 46 - An animal that obtains food by straining organisms from water passed through some portion of its body; e.g. corals, mussels, sponges, and baleen whales.
- *filter strips* - 42 - A strip or area of vegetation for removing sediment, organic material,

organisms, nutrients, and chemicals from runoff or wastewater.

- *filter-feeding* - - See filter feeder.
- *finfish* - 46 - True fish as opposed to shellfish.
- *flagellates* - 7 - Organisms, especially protozoans or algae, that bear flagella.
- *flatfish* - 46 - Member of fish order Heterosomata. It swims or lies on one side of its body; sides are greatly flattened and compressed. As young flatfish mature, lower eye "migrates" to upper side so that both eyes are on one side of head. Mainly marine animals, flatfish include such commercially valuable food fish as flounder, sole and halibut.
- *flexure* - 7 - A bend or turn; an act of bending. In Geology, a hinge.
- *flood tide* - 46 - Incoming or rising tide.
- *floodplain* - 2 - A relatively level part of a river valley, adjacent to the river channel, formed from sediments deposited by the river during periods of flooding or as river meanders cut into the leading edge of the channel, deposit silt at the trailing edge, and so advance across level ground.
- *floodway* - 42 - A channel, either natural, excavated, or bounded by dikes and levees, used to carry excessive flood flows to reduce flooding. Sometimes considered to be the transitional area between the active channel and the floodplain.
- *fluvial* - 8 - Related to stream or river flow and its associated erosional/depositional processes.
- *flux* - 42 - The rate of movement of liquid, particles, or energy over a given surface area; the act of flowing.
- *fluxes* - - See flux.
- *food webs* - 45 - The interlocking pattern interconnecting the sequences of food chains. In a food web a particular organism may feed at more than one trophic level.
- *foot* - 46 - In ordinary usage, terminal portion of walking appendage that contacts substrata. In molluscs, ventral surface of body, variously modified in different groups for creeping or digging or to serve as prehensile arms. Also, a unit of measurement in the United States system equal to 12 inches (30 cm).
- *forb* - 2 - A herbaceous plant, not including grasses and those resembling grasses (e.g., sedges).
- *forbs* - 2 - All herbaceous plants, except for grasses and those resembling grasses (e.g., sedges).
- *fungivorous* - 36 - Feeding on mushrooms or fungi.

TOP

- G -

- *gastropod molluscs* - 4 - One of a class (Gastropoda) of molluscs in which the animals possess a distinct head, generally with eyes and tentacles, and a broad flat foot and usually are enclosed in a spiral shell.

- *genus* - 40 - A category used in the binomial classification system of organisms that consists of a number of similar or closely related species. Similar genera are grouped into families.

- *geographic information system (GIS)* - 20 - A system of computer hardware and software designed for storing, manipulating, analyzing, and displaying data in a geographic context.

- *geomorphic* - 6 - Pertaining to the form of the earth or its surface features. Pertaining to geomorphology (see geomorphology).

- *geomorphology* - 8 - The study of landforms and their origin.

- *geotextiles* - 31 - Any woven material used with rock or soil in a manmade product or structure.

- *gig* - 38 - A fish spear with two or more barbed prongs (fishgig).

- *gigging* - 38 - The act of using a gig (see gig) to capture fish.

- *gill net* - 46 - Net which is set upright in water to capture fish. Gills of fish become entangled in its meshes.

- *gill raker* - 46 - One of small, bony structures on inside edge of fish's gill arches which support gills; they prevent solid particles from injuring gills and stop food from escaping with the water which flows in through fish's mouth, over gills and out again through opening in animal's skin.

- *GIS* - - An acronym for Geographic Information System (see geographic information system).

- *glacioeustatic* - 4 - Pertaining to the worldwide changes in sea level produced by the successive withdrawal and return of water in the oceans accompanying the formation and melting of ice sheets

- *gobblers* - 38 - Male turkeys.

- *granivore* - 2 - An animal that eats mainly grain.

- *granivorous* - - Pertaining to a granivore (see granivore).

- *greenbelt* - 38 - An extensive area of largely undeveloped or sparsely occupied land surrounding a community; often associated with a community program to contain development, preserve the character of the countryside and community and provide open space.

- *greenhouse effect* - 2 - Worldwide changes in climate and sea levels caused by a warming of the atmosphere due to the release of gases, principally carbon dioxide, which are transparent to short-wave radiation, but absorb radiation at longer wavelengths. Thus the gases form a 'blanket' trapping outgoing heat, much as the glass or plastic does in a greenhouse. The burning of fossil fuels and clearance forests, releasing carbon dioxide held in forest soils, has increased the atmospheric concentration of carbon dioxide..

- *greenspace* - - See greenbelt.
- *greenways* - - See greenbelt.
- *ground water* - 44 - Water within the earth that supplies wells and springs. Specifically, water in the zone of saturation where all openings in soils and rocks are filled, the upper surface of which forms the water table.
- *Grylloblattaria* - 14 - (Grylloblatta) An order of insects secondarily without wings, with incomplete metamorphosis, small or absent eyes, and fairly long, filiform antennae.

TOP

- H -

- *halocline* - 4 - Layer of water in which salinity change is maximal.
- *halophilic* - 4 - Said of an organism that prefers a saline environment.
- *halophytes* - 40 - Plants that naturally grow in salty water or soil with a high salt content.
- *halophytic* - - Of or pertaining to halophytes. See halophytes.
- *heavy metals* - 44 - Metals having a specific gravity (i.e., weight in comparison to weight of an equal volume of water) of 5.0 or over, and generally toxic in relatively low concentrations to plant and animal life. Such metals can persist in animal tissue and are capable of increasing in concentration as they pass upward through the food chain. Major sources of heavy metal contamination are pesticides, limestone, and phosphate fertilizers, manures and sewage sludges, and mine wastes. Examples include lead, mercury, cadmium, and arsenic.
- *hemicellulose* - 40 - A large polysaccharide which helps give structure to plant cells. Along with pectin, it forms a matrix in which cellulose fibrils from the plant cell walls are embedded..
- *herbaceous* - 2 - (herbaceous plant). A non-woody vascular plant having no parts that persist above the ground.
- *hermaphroditic* - 46 - Possessing both male and female reproductive organs.
- *herpetofaunal* - - Referring to reptiles and amphibians.
- *herpetology* - 38 - The scientific description of reptiles and amphibians.

- *heterocercal tail* - 46 - Unsymmetrical tail, upper lobe of which is often longer than lower. Backbone may extend into upper lobe or merely curve upward before reaching it as in mudfish.

- *heterotroph* - 9 - An organism that must feed on organic materials formed by other organisms in order to obtain energy; in contrast to autotroph. Animals, fungi, and many unicellular organisms are heterotrophs.

- *heterotrophic* - - See heterotroph.

- *heterotrophic bacteria* - 42 - Bacteria that are dependent on organic material for food (see heterotroph).

- *heterotrophic protists* - - See heterotrophic. See protists.

- *high water mark* - 4 - An established reference mark on a structure or natural object which indicates the maximum observed stage of tide.

- *highstand* - 7 - The interval of time during one or more cycles of relative change of sea level when sea level is above the shelf edge in a given local area.

- *histopathology* - 15 - The science concerned with the study of microscopic changes in diseased tissues.

- *Histosols* - 2 - Taxonomic soil classification. Organic soils developed largely by the accumulation of organic matter in a waterlogged site. Most Histosols are saturated or nearly saturated most of the year and include bog soils, half-bog and peat soils.

- *Holocene* - 7 - An epoch of the Quaternary period, from the end of the Pleistocene, approximately 10,000 years ago, to the present time; also, the corresponding rocks and deposits. When the Quartenary is designated as an era, the Holocene is considered to be a period.

- *horizon* - 2 - An approximately horizontal layer within a solid or sediment that is clearly distinct and distinguishable from the layers above and below it.

- *humate* - 7 - A salt or ester of humic acid.

- *humic* - 7 - Pertaining to or derived from humus (see humus).

- *humus* - 2 - The more or less decomposed organic matter in the soil. Besides being the source of most of the mineral salts needed by plants, humus improves the texture of the soil and holds water, so reducing the loss of nutrients by leaching. Mild humus (mull) is produced in soil containing abundant earthworms where decay is rapid.

- *hybrid* - 2 - An organism produced by crossing parents of different taxa (e.g., different species, subspecies or varieties) and thus different genotypes. Hybrids are often sterile.

- *hydrocarbons* - 2 - Strictly, chemical compounds composed only of hydrogen and carbon; more loosely, many organic (i.e.,. carbon-based) compounds that contain other elements (e.g., fossil fuels are sometimes described as hydrocarbon fuels).

- *hydrochemistry* - 39 - The chemistry of water, especially that of natural waters.
- *hydrography* - 4 - That science that deals with the measurement and description of the physical features of the oceans, seas, lakes, rivers, and adjoining coastal areas, with particular reference to their use for navigational purposes.
- *hydrologic unit* - 28 - A geographic area representing part or all of a surface drainage basin or distinct hydrologic feature.
- *hydrological* - 42 - Pertaining to the science dealing with the properties, distribution, and circulation of water, specifically the study of water on the surface of the land, in the soil and underlying rocks, and in the atmosphere , particularly with respect to evaporation and precipitation.
- *hydrological units* - - See hydrologic unit.
- *hydrolysis* - 6 - A decomposition reaction involving water; a reaction in which water reacts with a substance (frequently silicate minerals) to break it into components.
- *hydroperiod* - 39 - The period during which the water table occupies a definite vertical zone or layer next to the surface.
- *hydrophytic* - 40 - Of or pertaining to a plant that typically lives in water or very wet soils.
- *hydrosphere* - 7 - The waters of the Earth, as distinguished from the rocks (lithosphere), living things (biosphere), and the air (atmosphere). Includes the waters of the ocean; rivers, lakes, and other bodies of surface water in liquid form on the continents; snow, ice, and glaciers; and liquid water, ice, and water vapor in both the unsaturated and saturated zones below the land surface. Included by some, but excluded by others, is water in the atmosphere, which includes water vapor, clouds, and all forms of precipitation while still in the atmosphere.
- *hyphae (tubes)* - 2 - In Fungi, one of the mass of filaments that make up a mycelium. Hyphae are tubular and branched and may have crosswalks.
- *hypoxia* - 40 - A deficiency of oxygen in body tissues, which can result from living in an oxygen-deficient environment.
- *hypoxic* - - See hypoxia.
- *hypsography* - 2 - The science of measuring or describing elevation above or below a datum (usually sea level).

TOP

- I -

- *ichthyoplankton* - 5 - The small fish (mostly larval forms) that float or drift in water.
- *impoundment* - 6 - The process of forming a lake, or pond by a dam, dike or other barrier; also, the body of water so formed.

- *impoundments* - - See impoundment.
- *Inceptisols* - 2 - In soil classification, young soils with horizons weakly developed, occurring in variable climates, including brown earths and tundra soils.
- *indicator species* - 2 - Species whose presence indicates certain environmental conditions.
- *indicator taxa* - - See indicator species.
- *indigenous* - 2 - Native or original to an area.
- *indigo* - 38 - A blue dye obtained from the decomposition of any of several plants.
- *infauna* - 34 - Animals living within a soft sediment and being large enough to displace sediment grains.
- *infaunal* - - See infauna.
- *inferior mouth* - 29 - The type of mouth that opens on the ventral surface (like sturgeon).
- *influent* - 42 - Flowing in (e.g., influent water). Water that flows into other bodies of water (a stream into a lake) or into the ground through sinkholes or other openings.
- *infrastructure* - 42 - The services and facilities that are an integral part of the life of an urban community; includes transport facilities and communications, power, shopping facilities, housing, schools, and recreational facilities.
- *ingress* - 39 - Act of entering; entrance; as, the ingress of air into the lungs or fish into an estuary.
- *inlet* - 4 - A short, narrow waterway connecting a bay or lagoon with the sea. When it is a natural inlet maintained by tidal currents, the name tidal inlet or tidal outlet is applied.
- *inoculation* - 39 - The introduction of a pathogen or antigen into a living organism to stimulate the production of antibodies.
- *inorganic* - 7 - Pertaining to or relating to a compound that contains no carbon.
- *interfluves* - 7 - The area between rivers; esp. the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction
- *intertidal* - 4 - The benthic zone between high and low water marks. According to some authorities the benthic zone between the shore and water depths of approximately 100 fathoms (200 meters).
- *intertidal zone* - 4 - Also called the littoral zone. Generally considered to be the zone between mean high water and mean low water levels.
- *invasive species* - 15 - A species which when introduced to a new area spreads rapidly disrupting and replacing native species.

- *invertebrate* - 42 - Referring to an animal without an internal skeletal backbone composed of vertebra, for example, insects molluscs, crayfish.
- *invertebrates* - 42 - See invertebrate.
- *ion* - 38 - An atom, group of atoms or molecule that has acquired a net electric charge by gaining or losing electrons from a neutral configuration.
- *ionic form* - - See ion.
- *isohalines* - 27 - In physical oceanography, a contour of constant salinity..
- *isomorphous* - 36 - Having the property of crystallizing in the same or closely related geometric forms; said especially of two compounds or groups of compounds of different elements, but analogous composition.

TOP

- J -

- *Jurassic* - 7 - The second period of the Mesozoic era (after the Triassic and before the Cretaceous), thought to have covered the span of time between 190 and 135 million years ago; also, the corresponding system of rocks. It is named after the Jura Mountains between France and Switzerland, in which rocks of this age were first studied.

TOP

- K -

- *Kjeldahl nitrogen* - - See Kjeldahl's method.
- *Kjeldahl's method* - 10 - A method for measuring the percentage of nitrogen in an organic compound. The compound is boiled with concentrated sulphuric acid and copper(II) sulphate catalyst to convert any nitrogen to ammonium sulphate. Alkali is added and the mixture heated to distil off ammonia. This is passed into a standard acid solution, and the amount of ammonia can then be found by estimating the amount of unreacted acid by titration. The amount of nitrogen in the original specimen can then be calculated. The method was developed by a Danish chemist Johan Kjeldahl (1849-1900).

TOP

- L -

- *labile* - 6 - Constantly undergoing or likely to undergo chemical change; unstable; said of rocks, minerals and plant and animal matter that is easily decomposed.

- *lability* - - See labile.
- *lacustrine* - 6 - Of or pertaining to a lake or a region of lakes, or of plants and animals growing in or inhabiting lakes.
- *larvae* - 4 - Plural form of larva. Embryos which become self-sustaining and independent before assuming the characteristic features of parents.
- *lateral line* - 4 - A system of sense organs possessed by fishes, usually arranged in a single series along the side of the body, and functioning in part to detect low frequency vibrations such as those produced by local disturbances in the water.
- *laws of thermodynamics* - 2 - Laws describing relationships between heat and mechanical forms of energy.
- *laymen* - 38 - Someone who does not belong to a particular profession or specialty.
- *life histories* - - See life history.
- *life history* - 40 - The complete sequence of events undergone by organisms of a particular species from the fusion of gametes in one generation to the same stage in the following generation.
- *ligand* - 38 - A group, ion, or molecule coordinated to the central atom in a coordination complex.
- *lignin* - 38 - An amorphous substance or mixture that together with cellulose forms the woody cell walls of plants and the cementing material between them and thus gives them added mechanical strength. Any of various usually brown substances derived from the breakdown of wood.
- *lignocellulose* - 14 - Essential constituent of woody tissue, lignin and cellulose combined.
- *lignocellulosic* - - See lignocellulose.
- *limnetic* - 7 - Relating to the pelagic or open part of a body of fresh water (having salinity less than 0.5 parts per thousand).
- *liposolubility* - 38 - Liposoluble. Refers to a substance that is soluble in fats or oils.
- *lithogenous* - 14 - Rock-forming, or rock-building, as certain corals.
- *lithosphere* - 7 - The solid portion of the Earth, as compared with the atmosphere and the hydrosphere..
- *lowcountry* - 36 - A region whose level is lower than that of the surrounding country. Local term for the South Carolina coastal area south of Georgetown.

TOP

- M -

- *macrobenthic* - - See macrobenthos.
- *macrobenthos* - 34 - Organisms (animals or plants) living in or on aquatic substrates and whose shortest dimension is greater than 0.5 mm (usually large enough to be seen with the unaided eye).
- *macrofauna* - 34 - Animals whose shortest dimension is greater than 0.5 mm (usually large enough to be seen with the unaided eye).
- *macrophyte* - 34 - An individual alga or aquatic plant large enough to be seen with the unaided eye.
- *mafic* - 6 - Term used to describe an igneous rock composed chiefly of dark-colored iron and magnesium minerals; also, said of those minerals..
- *mafic-ultramafic intrusions* - - See mafic.
- *mantle* - 6 - In biology, portion of body wall in molluscs that lines shell and contains shell-secreting glands. In geology, the zone of the earth below the crust and above the core.
- *mantle cavity* - 46 - Space containing respiratory organs between mantle and body of a mollusc or brachiopod.
- *mariculture* - 46 - Controlled cultivation of marine plants or animals (similar to aquaculture, but for marine species only).
- *marl* - 2 - A calcareous mudstone formed under aquatic conditions.
- *megalopae* - - Plural of megalops (see megalops).
- *megalops* - 46 - In crustaceans, larval stage just before adult stage of marine crabs. Transitional stage between larval and juvenile forms.
- *meiofauna* - 34 - Animals whose shortest dimension is less than 0.5 mm but greater than or equal to 0.1 mm.; the size class of transition from micro- to macrofauna.
- *mesofauna* - 40 - Small soil-dwelling animals such as worms and insects.
- *mesohaline* - 28 - Term to characterize waters with salinity of 5 to 18 0/00 (parts per thousand), due to ocean-derived salts.
- *mesotidal* - 7 - Said of a coast with a tidal range of 2 to 4 meters.
- *Mesozoic* - 7 - An era of geologic time, from the end of the Paleozoic to the beginning of the Cenozoic, or from about 225 to about 65 million years ago.
- *metabolism* - 2 - The sum of all chemical reactions occurring within a cell or organism.
- *micro* - 47 - A prefix denoting very small or minute in size. In the metric system, a prefix meaning 1/1,000,000. A microgram is 1/1,000,000 of a gram.
- *microalgae* - - Microscopic algae (see algae).

- *microbiota* - 38 - The microscopic flora and fauna of a region.
- *microsiemens* - 30 - One millionth of a siemens (practical unit of conductance equal to the reciprocal of the ohm and formerly called a mho). The microsiemens is the practical unit of measurement for conductivity, and is used to approximate the total dissolved solids content of water..
- *microzooplankton* - - Microscopic zooplankton (see zooplankton).
- *middens* - 42 - In archeology, an accumulation of waste materials that mark the site of a dwelling, usually kitchen midden.
- *Miocene* - 7 - An epoch of the upper Tertiary period, after the Oligocene and before the Pliocene; also, the corresponding worldwide series of rocks. It is considered to be a period when the Tertiary is designated an era.
- *mitigation* - 38 - Reduction of the adverse effects of an action.
- *Mollisols* - 2 - Grassland soils characterized by a thick, organic-rich surface layer, covering a wide variety of profiles with strong structural development, including the brown chestnut, chernozem, prairie (brunizem), red prairie, rendzina and brown forest soils.
- *mollusks* - 2 - Also spelled molluscs. Members of the phylum Mollusca, a large phylum of soft-bodied, unsegmented, mainly aquatic animals, most of which have calcareous shells. Locomotion of an individual is usually by means of a large muscular 'foot'.
- *molt* - 38 - To cast or shed periodically the outer body covering, including hair, feathers, horns, outer skin or shell in a process of growth or renewal. Permits an increase in size in invertebrates such as crabs.
- *monoculture* - 46 - The cultivation of a crop of the same type in successive years to the exclusion of all other crops.
- *monosulfides* - 38 - A compound of sulfur analogous to an oxide in which the sulfur molecule contains a single atom of sulfur.
- *monotypic* - 15 - Including a single representative; containing only one taxon of the next lower rank (e.g., applied to a family containing only one genus or a genus with only one species).
- *mucilage* - 38 - A gelatinous substance that contains protein and polysaccharides secreted by certain plants or plant organs.

TOP

- N -

- *NPDES* - 20 - National Pollutant Discharge Elimination System. A provision of the Clean Water Act which prohibits discharge of pollutants into waters of the United

States unless a special permit is issued by EPA, a state, or, where delegated, a tribal government on an Indian reservation..

- *natural areas* - 7 - An area of land or water that has retained its wilderness character, although not necessarily completely natural and undisturbed, or that has rare or vanishing flora, fauna, archaeological , scenic, historical, or similar features of scientific or educational value; e.g. a "research natural area" where natural processes are allowed to predominate and which is preserved for the primary purposes of research and education.

- *neap tide* - 4 - Tide of decreased range which occurs about every two weeks when the moon is in quadrature (not new or full).

- *nematodes* - 2 - Members of the phylum Nematoda, the roundworms. A very large group (usually regarded as a phylum) of unsegmented worms without a coelom and usually pointed at both ends. Some are free-living in soil or water and play an important role in recycling of organic matter. Many are parasites, (e.g., potato root eelworm, sugarbeet eelworm, pinworms of vertebrates).

- *nemerteans* - 2 - Members of the phylum Nemertea (Nemertinea, Nemertini), the probiscis worms and ribbon worms. A small phylum of flattened, unsegmented mainly marine animals with a large, reversible probiscis, used for catching prey.

- *neotropical* - 45 - The area embracing South America, Central America, the West Indies, and the coasts of Mexico; Mexico being for the most part a transition tract between the Neotropical and the Nearctic.

- *nephelometric* - 15 - Measure of the concentration or size of suspended particles (cloudiness) based on the scattering of light transmitted or reflected by the medium.

- *neritic* - 2 - Applied to the parts of the sea lying over the continental shelf, usually less than 200 meters deep.

- *nitrate* - 2 - A salt ($NO3-$), or ester of nitric acid ($HNO3$). Nitrates are the chief source of the nitrogen used by plants in their synthesis of proteins (see nitrification). They are highly soluble in water and so prone to leaching from land supporting vegetation. Where nitrogen is supplied as a soluble fertilizer the rate of leaching may increase, leading to nitrate pollution.

- *nitrifiaction* - 2 - The conversion by aerobic soil bacteria (nitrifying bacteria) of organic nitrogen compounds into nitrates ($NO3-$), which can be absorbed by green plants. Dead organic matter is broken into substances such as ammonia, which reacts with calcium carbonate. Ammonium carbonate is oxidized to nitrite ($NO2-$) by nitrite bacteria (Nitrosomonas), then into nitrate.

- *nitrite* - 2 - A salt ($NO2-$) or ester of nitric acid ($HNO3$).

- *nitrogen fixation* - 2 - Any reaction as a result of which gaseous nitrogen forms a soluble compound that is available as a plant nutrient either directly or after it has engaged in further reactions. In soils, certain nitrogen-fixing bacteria and Cyanophyta utilize gaseous nitrogen and release it for the use of other organisms as metabolic waste products or as a decay product following their death. Some nitrogen-fixing bacteria are free-living in the soil; others live symbiotically in the root nodules of legume plants. .

- *non-point source pollution* - 42 - Pollution arising from an ill-defined and diffuse source, such as runoff from cultivated fields, grazing land, or urban areas.

- *nonpoint source runoff* - - See non-point source pollution.

- *non-point sources* - 42 - Sources of pollution that cannot be defined as discrete points, such as areas of crop production, timber, surface mining, disposal of refuse, and construction.

- *non-polar* - 38 - Describing a molecule in which two or more atoms with incomplete outer shells combined to share an electron, thus achieving greater stability. Molecules having no separation of centers of positive and negative electrical charge that would make the molecule assume certain orientations more than other in an electric field.

- *nontidal* - 4 - Areas of waterbodies not exhibiting changes in height or current as a result of tidal influence. Also, any current that is caused by other than tide-producing forces. This includes all permanently established oceanic currents as well as all temporary ocean currents generated by winds.

- *nursery habitat* - 16 - The complex environmental area for maturation of young organisms that may migrate out of the habitat of maturity; nutrition and protection from predators are afforded by plants and their by-products.

- *nutrient loadings* - 42 - The amount of nutrients (e.g., nitrogen and phosphorous) entering into a defined geographic area, such as a watershed.

TOP

- O -

- *obligate aerobes* - 40 - Organisms that must use free oxygen for respiration.

- *obligate anaerobes* - 41 - A microorganism which can not use free oxygen for respiration and finds the presence of oxygen harmful.

- *Odonata* - 2 - An order of large, often highly colored insects (division: Exopterygota) whose members have two similar pairs of membranous wings. The adults are strong fliers, preying on insects which they seize while on the wing. The nymphs are aquatic and predatory with a lower lip (labium) modified as an extensible, prehensile mask used to catch prey. Includes dragonflies and damselflies..

- *offlap* - 7 - The progressive offshore regression of the updip edges of sedimentary units within a conformable sequence of rocks, in which each successively younger unit leaves exposed a portion of the older unit on which it lies. Also, the successive contraction in the lateral extent of strata (as seen in an upward sequence) due to their being deposited in a shrinking sea or on the margin of a rising landmass.

- *Oligocene* - 7 - An epoch of the early Tertiary period, after the Eocene and before the Miocene; also, the corresponding worldwide series of rocks. It is considered to be a period when the Tertiary is designated as an era.

- *oligochaetes* - 2 - Members of a class (Oligochaeta) of mostly terrestrial and freshwater worms (Annelida) whose members (e.g., earthworm) have few bristles (chaetae), no muscular, lateral projections (parapodia) along the body and no specialized head appendages. Oligochaetes are hermaphrodites, and the eggs develop inside a cocoon. Earthworms are very important in the maintenance of soil fertility because their tunnels aerate and drain the soil, and some species continually bring to the surface fresh soil containing humus. .

- *oligohaline* - 2 - Applied to slightly brackish waters whose salinity is 0.5 - 5 parts per thousand.

- *omnivore* - 2 - An animal which eats both plant and animal food items (e.g., raccoon, man).

- *onlap* - 7 - An overlap characterized by the regular and progressive pinching out, toward the margins or shores of a depositional basin, of the sedimentary units within a conformable sequence of rocks, in which the boundary of each unit is transgressed by the next overlying unit and each unit in turn terminates farther from the point of reference. Also, the successive extension in the lateral extent of strata (as seen in an upward sequence) due to their being deposited in an advancing sea or on the margin of a subsiding landmass.

- *opithosoma* - 40 - The posterior section of the body of arachnids and other arthropods of the subphylum Chelicerata, which consists of those body segments that do not bear legs.

- *optimal sustained yield* - 42 - The yield that a renewable resource can produce continuously at a given intensity of management; implies a balance at the earliest practical time between increment (growth) and harvesting.

- *organic material* - 7 - Pertaining or relating to material containing carbon, especially as an essential component. Material derived from plants and animals.

- *organochlorine* - 47 - Organochlorines are chlorinated hydrocarbon molecules and include the best known of all the synthetic poisons: endrin, heptaclor, aldrin, toxaphene, dieldrin, lindane, DDT, chlordane, and methoxychlor. There is no clear understanding of just how organochlorines work. Apparently, the central nervous system is affected, for typical symptoms of acute poisoning are tremors and convulsions. Chronic levels have various effects. In aquatic organisms, which are especially sensitive to this class of compounds, the uptake of oxygen through the gills is disrupted and death is associated with suffocation, rather than with a nervous disorder.

- *organochlorine pesticides* - - See organochlorine.

- *organo-metallic* - 10 - A compound in which a metal atom or ion is bound to an organic group.

- *organophosphates* - 42 - A group of pesticide chemicals that contain phosphorus, such as malathion and parathion, that are formulated as insecticides; they are short lived and normally do not reach environmentally toxic concentrations; some of these chemicals are initially, extremely toxic and can be environmentally dangerous.

- *organophosphorous pesticides* - - See organophosphates.

- *orogenic* - - Of or pertaining to orogeny (see orogeny).
- *orogeny* - 6 - The process of mountain building. In present usage, the process by which structures in fold-belt mountains areas were formed, including thrusting, folding, and faulting in the outer and higher layers and metamorphism and plutonism in the inner and deeper layers. May also refer to the period in which orogeny occurs.
- *orthophosphate* - 10 - Naturally occurring phosphates of the form M3PO4; these are salts or esters of orthophosphoric acid.
- *osmoregulate* - 2 - See osmoregulation.
- *osmoregulation* - 40 - Regulation of the osmotic pressure within a body via control of water content and the concentration of salts.
- *ostracods* - 2 - Members of the subclass Ostracoda, a small subclass of Crustacea whose members have a bivalve carapace enclosing the body and reduced trunk limbs. They live in fresh and salt water and may be pelagic or bottom-dwellers.
- *overwinter* - 38 - To pass or last through the winter.
- *ovigerous* - 38 - Bearing eggs or modified for the purpose of bearing eggs.
- *ovoviviparous* - 46 - Reproductive pattern in which eggs develop within mother's body without further nutritive aid from mother.
- *oxidation* - 9 - Gain of oxygen, loss of hydrogen, or loss of an electron by an atom, ion, or molecule. Oxidation and reduction take place simultaneously, with the electron lost by one reactant being transferred to another reactant.
- *ozone* - 2 - A form of oxygen (O3) in which the molecule consists of three atoms rather than two. It is very reactive chemically and is an irritant to eyes and respiratory tissues. It occurs naturally at about 0.01 ppm of air; 0.1 ppm is considered toxic. As a pollutant, it is harmful to plants and is involved in the formation of photochemical smog. It is formed by the recombination of oxygen following its ionization (e.g., by electrical discharges or ultraviolet radiation).

TOP

- P -

- *Paleocene* - 7 - An epoch of the early Tertiary period, after the Gulfian epoch of the Cretaceous period and before the Eocene; also the corresponding worldwide series of rocks.
- *paleoenvironmental* - 7 - Referring to an environment in the geologic past.
- *paleogeographic* - - See paleogeography.
- *paleogeography* - 6 - The study of the physical geography of all or a part of the earth's surface at some time in the geologic past.

- *Paleoindian* - 38 - One of a hypothetical mixed Asian group that migrated to North America.
- *palustrine* - 7 - Pertaining to material growing or deposited in a marsh or marsh-like environment or to the environment itself.
- *Pangea* - 7 - A super continent that existed from about 300 to about 200 million years ago and included most of the continental crust of the Earth, from which the present continents were derived by fragmentation and continental displacement. During an intermediate stage of the fragmentation, between the existence of Pangea and that of the present continents, Pangea is believed to have split into two large fragments, Laurasia on the north and Gondwana on the south. .
- *parasitoids* - 2 - An animal whose mode of life is intermediate between parasitism and predation because the parasitoid ultimately kills its host. An example is ichneumons (e.g., Aculeata) which lay eggs inside the larvae or eggs of other insects.
- *particulate feeders* - 34 - Aquatic organisms (usually sedentary) that feed by capturing particles from the water column; also called suspension feeders.
- *particulate matter* - 38 - Existing in the form of minute particles that may be transported in the air or water.
- *pathogen* - 42 - An organism capable of producing disease.
- *PCBs* - 2 - Polychlorinated biphenyls. A group of closely related chlorinated hydrocarbons whose principal use has been as liquid insulators in high-voltage transformers. Their use is being reduced due to the evidence of their persistence and toxicity in the environment.
- *pectoral fin* - 40 - Anterior paired fins of fish that are attached to the pectoral (shoulder) girdle, usually of the upper thoracic region.
- *pelagic* - 34 - Refers to organisms living in the water column seaward of the shelf-slope break. Also see pelagic zone.
- *pelagic zone* - 4 - Living in the water column. Also, a primary division of the sea which includes the whole mass of water. The division is made up of the neritic province which includes the water shallower than 100 fathoms (200 meters), and the oceanic province which includes that water deeper than 100 fathoms.
- *pelvic fin* - 40 - Posterior paired fins, attached to the pelvic (hip) girdle and located in the abdominal position.
- *penaeid shrimp* - 24 - Primitive shrimps, members of the family Penaeidae; constitute the backbone of the shrimp fishing industry in North and South America and in many parts of Asia. Penaeid shrimps are the basis of the shrimping industry in South Carolina.
- *periopod* - - A walking leg of crabs, shrimps and lobsters.
- *periphyton* - 7 - Micro-organisms that coat rocks, plants, and other surfaces on the water bottom.

- *pharyngeal teeth* - 46 - Specialized dentition on various gill arch elements in fishes; in some species these teeth are used in sound production.
- *phenols* - 42 - A group of organic compounds that in very low concentrations produce a taste and odor problem in water and at higher levels are toxic to aquatic life; they are by products of petroleum refining, tanning, and other manufacturing processes.
- *photoautotrophs* - 14 - Organisms using light as an energy source and carbon dioxide as the main source of carbon; includes green plants and some bacteria.
- *photolysis* - 40 - A chemical reaction produced by exposure to light or ultraviolet radiation. Chemical decomposition or dissociation by the action of radiant energy (light). The photolysis of water is a key reaction in photosynthesis.
- *photoperiod* - 7 - The relative number of alternating daylight and dark hours in a 24-hour period. The photoperiod has a significant effect on the development of certain organisms, especially flowering plants.
- *photoreceptor* - 40 - A sensory cell or group of cells that reacts to the presence of light, usually resulting in a chemical transformation.
- *photosynthesis* - 9 - The conversions of light energy to chemical energy; the synthesis of organic compounds from carbon dioxide and water in the presence of chlorophyll, using light energy.
- *photosynthesize* - - See photosynthesis.
- *photosynthetic* - - See photosynthesis.
- *physiochemical* - 38 - Of or relating to physiological chemistry, the chemistry of living things.
- *physiographic* - - See physiography.
- *physiography* - 38 - Description of nature or natural phenomena or features; usually applied to the description and origin of land forms. May be used synonymously with physical geography and geomorphology.
- *phytobenthos* - 4 - The bottom of a sea or lake that supports plant life, anywhere from the high-water mark down to the deepest level; the organisms living there. .
- *phytoflagellates* - 11 - Unicellular photosynthesizing organisms in the plankton that posses a flagella (whip-like structure used for locomotion).
- *phytoplankton* - 34 - The photosynthesizing organisms (plant forms) residing in the plankton; includes dinoflagellates and diatoms.
- *piedmont* - 6 - Located or formed at the base of a mountain range; an example would be a piedmont terrace. In the southeast U.S., refers to the area between the blue ridge mountains and the coastal plain.
- *piedmont basement* - 6 - The crust of the earth (undifferentiated rocks) underlying sedimentary rocks in the piedmont region (see piedmont).

- *pigment* - 40 - A compound that gives color to a tissue. Pigments perform a variety of functions and include hemoglobin in mammals and chlorophyll in plants.
- *pigmentation* - 38 - The natural coloring of plants and animals
- *pioneer species* - 14 - The organisms which first establish themselves on bare ground at the start of a primary succession, including plants, microorganisms, and small animals.
- *piscivorous* - 38 - Feeding on fishes.
- *pitfall traps* - 38 - A pit with the opening masked, into which animals may fall and be captured.
- *planktivore* - 34 - An organism that feeds on planktonic organisms.
- *planktivorous* - 34 - Feeding on planktonic organisms.
- *plankton* - 4 - The passively drifting or weakly swimming organisms in marine and fresh waters. Members of this group range in size from microscopic plants to jellyfishes measuring up to 6 feet across the bell, and include the eggs and larval stages of the nekton and benthos.
- *planktonic* - - Of or pertaining to plankton (see plankton).
- *plastron* - 46 - Lower shell of a turtle.
- *Pleistocene* - 7 - An epoch of the Quaternary period, after the Pliocene of the Tertiary and before the Holocene; also, the corresponding worldwide series of rocks. It began two to three million years ago and lasted until the start of the Holocene some 10,000 years ago. When the Quaternary is designated as an era, the Pleistocene is considered to be a period.
- *pleopod* - 46 - One of paired abdominal appendages among some crustaceans; pleopods may be used in swimming, fanning water, respiration or reproduction (some decapod females carry eggs on pleopods).
- *Pliocene* - 7 - An epoch of the Tertiary period, after the Miocene and before the Pleistocene; also, the corresponding worldwide series of rocks. It is considered to be a period when the Tertiary is designated as an era.
- *point sources* - 42 - In reference to pollution, a stationary, identifiable pollution source, such as a smoke stack or discharge pipe. In contrast to non-point sources of pollution, such as farm fields.
- *polar* - 9 - Having parts or areas with opposed or contrasting properties, such as positive and negative charges, head and tail.
- *polyaromatic hydrocarbons* - - See polycyclic aromatic hydrocarbons.
- *polychaete* - 2 - A member of the group of bristle worms. An order (Polychaeta) of mainly marine annelid worms whose members have numerous bristles (chaetae) borne on flat outgrowths (parapodia) of the body segments. Their heads bear sense organs

and tentacles. Males and females are separate, and fertilization is external. Some (e.g., ragworms) are free-swimming; others (e.g., tubeworms, lugworms) live in tubes or burrows.

- *polychaetes* - - See polychaete.
- *polycyclic aromatic hydrocarbons* - 2 - A major group of cyclic hydrocarbons known as PAHs. The vast number of compounds of this important group, derived chiefly from petroleum and coal tar, are rather highly reactive and chemically versatile. The name is due to the strong and not unpleasant odor characteristic of most substances of this nature. Includes benz-a-pyrene, debenzopyrene and dibenzoacridine, that are carcinogenic to humans. Also see aromatic hydrocarbons.
- *polygamy* - 2 - The condition of bearing both unisex and hermaphrodite flowers on the same or different plants. The condition of having more than one mate at one time.
- *polyhaline* - 2 - Applied to brackish waters whose salinity approaches that of seawater (i.e., 18 to 30 parts per thousand salt).
- *pore waters* - 7 - Subsurface water in the voids of a rock.
- *postemergence herbicides* - 42 - Chemicals applied to kill undesired plants (herbicides) after the desired crop has emerged through the soil surface.
- *postlarva* - 46 - In Crustacea, a developmental stage between larval and juvenile stages. Form is usually more like juvenile and adult form than preceding larval forms.
- *postlarvae* - - Plural of postlarva (see postlarva).
- *postlarval* - - Of or pertaining to a postlarva (see postlarva).
- *preemergence herbicides* - 42 - Chemicals applied to kill undesired plants (herbicides) before the desired crop has emerged through the soil surface.
- *primary producers* - 34 - Organisms capable of using the energy derived from light or a chemical substance in order to manufacture energy-rich organic compounds.
- *primary production* - 42 - The rate at which organic matter is stored by photosynthetic and chemosynthetic activity of producer organisms (autotrophs), usually measured in grams per day.
- *primary productivity* - 40 - The total amount of organic matter synthesized by the primary producers of an ecosystem.
- *progradation* - 41 - Seaward buildup of a beach, delta, or fan by near-shore deposition of sediments transported by a river, by accumulation of material thrown up by waves, or by material moved by longshore drifting.
- *prokaryote* - 9 - A cell lacking a membrane-bound nucleus and membrane-bound organelles; a bacterium or a cyanobacterium.
- *prosoma* - 40 - The anterior section of the body of arachnids and other arthropods of the subphylum Chelicerata (includes horseshoe crabs), which consists of the fused head and thorax (cephalothorax) and bears the chelicerae and other appendages.

- *protists* - 40 - Members of the (former) kingdom Protista. In older classifications, all organisms of simple biological organization were classified in this kingdom and included algae, bacteria, fungi, and protozoa. It was later restricted, and in modern classification it has been replaced by the Protoctista. See Protoctista.

- *Protoctista* - 40 - A kingdom consisting of unicellular or simple multicellular organisms that possess nuclei and cannot be classified as animals, plants or fungi. Includes protozoa, algae, dinoflagellates, and slime molds.

- *Protozoa* - 40 - A group of unicellular or acellular, usually microscopic, organisms now classified in various phyla of the kingdom Protoctista. They were formally regarded either as a phylum of simple animals or as members of the kingdom Protista. They are very widely distributed in most marine, freshwater, and terrestrial habitats.

- *pseudofeces* - 14 - Excess particles of food discharged by bivalve molluscs. Also spelled pseudofaeces.

- *pseudohermaphrodism* - 38 - The condition of having the gonads of one sex and the external genitalia and other sex organs so variably developed that the sex of the individual is uncertain. Also spelled pseudohermaphroditism.

- *pyrene* - 38 - A pale yellow crystalline hydrocarbon (C16H10) that consists structurally of a cluster of four compactly fused benzene rings. It is obtained from coal-tar distillation, from petroleum cracking, and is made synthetically.

- *pyrite* - 7 - A common , pale-bronze or brass-yellow, isometric mineral: FeS2. Pyrite has a brilliant metallic luster and an absence of cleavage, and has been mistaken for gold (which is softer and heavier). Pyrite is the most widespread and abundant of the sulfide minerals and occurs in all kinds of rocks, such as in nodules in sedimentary rocks and coal seams or as a common vein material associated with many different minerals. Pyrite is an important ore of sulfur, less so of iron, and is burned in making sulfur dioxide and sulfuric acid; it is sometimes mined for the associated gold and coppe.

TOP

- Q -

- *Quarternary* - 2 - Geological time since the end of the Pliocene (i.e., the Pleistocene and the Holocene) and ranked either as an era, following the Cenozoic era, or a period of the Cenozoic era, following the Tertiary period. Quaternary also refers to rocks formed during this time.

TOP

- R -

- *radionuclides* - 10 - A nuclide that is radioactive. A nuclide is a nuclear species with a given number of protons and neutrons.

- *raptors* - 42 - Birds of prey, such as hawks and eagles.
- *recruit* - 43 - In ecology, an individual fish or other animal that has moved into a certain class, such as the spawning class, fishing-size class, or in a specific geographic region. General usage, to seek out someone for work or service; one who has been recruited.
- *recruitment* - 45 - The number of young annually added to the population. The number of individuals added to a certain class of the population, such as recruitment to the spawning stock or recruitment to the fishery. General usage, the act of recruiting.
- *redox* - 10 - Of or relating to oxidation-reduction reactions where there is a transfer of electrons; one atom gives up electrons (oxidation) and the other receives electrons (reduction). See redox layer.
- *redox potential* - 10 - The inherent tendency of a compound to act as an electron donor or an electron acceptor. Normally expressed as reduction potentials, they are obtained by electrochemical measurements. Also called standard electrode potential.
- *redox layer* - 27 - Also called the redox potential discontinuity. A zone of rapid transition between areas of aerobic and anaerobic decomposition in oceanic sediments. Its depth within the sediment depends on the quantity of organic matter available for decomposition and the rate at which oxygen can diffuse down from the overlying water. For example, in organic muds, relatively impermeable to oxygen-carrying water, the upper aerobic layer may only be a couple of millimeters deep, while in permeable sands with a low rate of organic input aerobic conditions can extend for tens of centimeters.
- *redox state* - - See redox.
- *refractory* - 38 - Said of a substance that is resistant to decay or corrosion. Said of any substance that is notably resistant to heat. Said of an ore from which it is difficult or expensive to recover its valuable constituents.
- *refractory compounds* - - See refractory.
- *regeneration* - 44 - Renewal, regrowth or restoration. In forestry, the renewal of a tree crop, whether by natural or artificial means.
- *regressive* - 2 - Applied to a body of water or to sediments associated with a lowering of sea level.
- *relict* - 6 - Said of a community, mineral, or landform or fragment of these that has survived some important change, remaining after other parts have disappeared, often to become in appearance an integral part of the existing community, rock, or topography.
- *relict marsh* - - See relict.
- *remineralization* - 31 - The process by which inorganic nutrients are released to seawater during the consumption of organic matter by the processes involved in respiration.

- *reptiles* - 2 - A class of essentially terrestrial vertebrates, whose modern representatives are poikilothermic (cold blooded) and scaly-skinned, with embryos protected by an amnion and an allantos. Most lay large eggs with leathery shells. Includes snakes, lizards, and turtles.

- *residence times* - 7 - The average amount of time a particular substance spends within a designated earth system. The residence time is inversely proportional to the rate of movement within the system and directly proportional to the size of the system.

- *resource allocation* - 39 - The action of apportioning the supply of a resource to specific uses or to particular persons or organizations.

- *resource conservation* - 2 - Preservation or protection of resources from decay or destruction, usually in reference to natural resources such as trees and rivers.

- *riparian* - 38 - Of or related to or living or located on the land bordering a water body, especially a stream, river or lake.

- *riverine* - 46 - Pertaining to a river. A natural stream, larger than a brook, creek, or rivulet, flowing into a lake, sea, or other stream.

- *roe* - 38 - The eggs of a fish, especially when still enclosed in the ovarian membrane. May also be applied to invertebrate eggs. Often eaten by humans, such as shad roe or sturgeon roe (caviar).

- *rookery* - 42 - The breeding place of a group of birds or seals.

- *rostrum* - 46 - In Crustacea, forward prolongation of carapace beyond the head.

- *rotenone* - 38 - A crystalline pentacyclic compound that is toxic to many animals. Used as an insecticide and for capturing fish. Of low toxicity to mammals.

- *rotifers* - 2 - Members of a phylum (Rotifera) of minute animals that move and feed by means of a crown of cilia. They have no true coelom. Most live in fresh water, a few occur in the sea. The great majority are free-swimming, a few are sedentary, colonial or parasitic..

TOP

- S -

- *scarp* - 6 - A line of cliffs produced by faulting or erosion. The term is an abbreviation of escarpment, and the two terms have essentially the same meaning. A more or less continuous line of cliffs or steep slopes facing in one general direction which are caused by erosion or faulting.

- *scute* - 46 - External horny plate found on some fish and many reptiles.

- *sea-floor spreading* - 31 - A theory that the oceanic crust is increasing in area by upwelling of magma along the mid-ocean ridges or world rift system, and by a moving-away of the new material at rates of one to ten centimeters per year. This movement provides the source of dynamic thrust in the hypothesis of plate tectonics.

- *sediment* - 6 - Solid material that has settled down from a state of suspension in liquid or other fluid medium. More generally, solid, fragmented material transported and deposited by wind, water or ice, chemically precipitated from solution or excreted by organisms, and that forms in layers in loose, unconsolidated form..

- *seine* - 46 - Type of net used to catch fish by encirclement, usually by active closure of 2 ends but also including closure or pursing of the bottom (purse seine). Also as a verb, to use a net of this sort.

- *seismic reflector* - - See seismic-reflection profiles.

- *seismic-reflection profiles* - 41 - A subsurface profile that is generated by seismic data and indicates a distinctive type of sediment geometry produced by sea-level changes; used to correlate stratigraphic sequences.

- *semi-diurnal* - 6 - Occurring approximately every half day. Descriptive of a tide that has a cycle of approximately one-half a tidal day, i.e., with two high and two low waters per tidal day.

- *sequential hermaphrodite* - 46 - During the course of its life, when an animal or plant possesses both male and female reproductive organs, but only one set is functional at a time. An unusual condition in higher vertebrates, it is common in many worms and some molluscs and echinoderms.

- *setback* - 39 - A withdrawal of the face of a building to a line some distance to the rear of the building line, or to the rear of the wall below. The steplike profile of tall buildings is now required by many buildings codes to reduce the obstruction the upper stories offer to sunlight reaching the streets and the lower stories of adjacent buildings.

- *sheetflow* - 42 - Water, usually storm runoff, flowing in a thin layer over the ground surface; also called overland flow.

- *shards* - 6 - Fragments or broken pieces of pottery. Also spelled sherds.

- *shoal* - 6 - Noun - A relatively shallow region in a body of water; a submerged ridge, bank or bar made of deposited sediments and rising to near the waters surface. Verb - to make shallow or to come to a shallow part of a water body.

- *shoaling* - - See shoal.

- *shrink-swell clays* - - See shrink-swell potential.

- *shrink-swell potential* - 42 - The susceptibility of soil to volume change due to loss or gain in moisture content.

- *silicates* - 38 - Any of numerous insoluable often complex metal salts that contain silicon and oxygen; silicates constitute the largest chemical group of minerals and with quartz make up the greater part of the earth's crust.

- *silicoflagellates* - 7 - Any chrysomonad protozoan belonging to the family Silicoflagellidae and characterized by a skeleton composed of siliceous rings and spines. Range Cretaceous to present.

- *siltation* - 42 - The process of depositing silt.
- *silviculture* - 38 - The phase of forestry that deals with the establishment, reproduction and care of forest trees.
- *simple eye* - 38 - An eye with a single lens, in contrast to compound eyes of insects. .
- *sinkholes* - 42 - Depressions in the earth's surface caused by dissolving of underlying limestone, salt, or gypsum; drainage is through underground channels; may be enlarged by collapse of a cover roof.
- *siphon* - 46 - Specialized tube of mantle of certain bivalve, gastropod and cephalopod molluscs, or test of tunicates for entrance of water.
- *slump* - 6 - The downward slipping of a mass of rock or unconsolidated material, moving as a unit; the sliding down of a mass of sediment shortly after its deposition on an underwater slope. The mass of material produced by a slump.
- *slump areas* - - See slump.
- *slumping* - - See slump.
- *snags* - 13 - A dead tree or portion thereof, from which most of the branches have fallen.
- *socio-ecological characterization* - 33 - A structured approach to the synthesis of current knowledge about ecosystems and human activity for management purposes. In general, ecological characterizations synthesize interdisciplinary knowledge about ecosystems including their biological resources, physical environment, key processes and important human interactions. Ecological characterizations may also include descriptions or analyses of anticipated resource uses, proposed development scenarios, an management response options. May also be called environmental characterization.
- *sondes* - 2 - Any of various devices for testing and measuring physical conditions, including measurements of atmosphere, ground water and surface water.
- *spat* - 4 - The spawn or young of bivalve molluscs, especially used for young that have recently attached to a hard substrate.
- *spawn* - 42 - In aquatic animals, to produce or deposit eggs or sperm. Also, collective term for the eggs and sperm so produced or deposited.
- *species richness* - 34 - The number of species in an area or biological collection.
- *specific gravities* - 42 - The relative weight of a given volume of any kind of matter (volume occupied by solid phase, pore space excluded) compared with an equal volume of distilled water at a specified temperature; average specific gravity for soil is about 2.65.
- *spermatophore* - 46 - Packet of sperm within complicated case secreted by male, as in crustaceans, copepods and cephalopods.
- *spodosols* - 2 - Soils with a diagnostic iron oxide and/or organic-enriched B horizon underlying an ashy grey, leached layer in the A horizon, associated with a cool and

cool-humid climate, a forest or heath vegetation cover.

- *spreading centers* - - See sea-floor spreading.
- *spring tide* - 4 - Tide of increased range; occurs about every two weeks when the moon is new or full.
- *stable isotopes* - 7 - A nuclide that does not undergo radioactive decay (also see radionuclide).
- *standing crop* - 8 - The amount of biomass that occurs on a given site at a particular rime without reference to rate of accumulation.
- *standing stocks* - - See standing crop.
- *standstill* - 7 - Stability of an area of land, as a continent or island, with reference to the Earth's interior or mean sea level, as might be reflected, for example, by a relatively unvarying base level of erosion between periods of crustal movement. Also called stillstand.
- *stenohaline* - 7 - Said of a marine organism that tolerates only a narrow range of salinity.
- *storage capacity* - 42 - The capacity to store water available for use by plants, usually expressed in linear depths of water per unit depth of soil; the difference between the percentage of soil water at field capacity and the percentage at wilting point. Also, the volume of water normally available for release from a reservoir below the stage of the maximum controllable level.
- *strand-line* - 7 - The ephemeral line or level at which a body of standing water (e.g., the sea) meets the land; the shoreline, especially a former shoreline now elevated above the present water level.
- *stratification* - 6 - The arrangement of sedimentary rocks in strata; bedding. Also, the layering of waters of different densities, usually because of heating of the surface layer.
- *stratigraphy* - 7 - The arrangement of strata, especially as to geographic position and chronologic order of sequence. The science of rock strata.
- *stream gradient* - 6 - The angle between the water surface or the channel floor of a stream and the horizontal, measured in the direction of flow; the general slope, or rate of vertical drop per unit of length, of a flowing stream.
- *strike-slip* - 7 - In a fault, the component of the movement or slip that is parallel to the strike of the fault.
- *structural feature* - 7 - A feature produced by deformation or displacement of the rocks, such as a fold or fault. For such features, the more colloquial term structure (used as a specific noun) is now generally accepted.
- *stumpage* - 12 - Standing timber as viewed by a potential harvester.
- *subadult* - 29 - A developmental life stage when the individual exhibits most but not all

traits of an adult; usually is similar in appearance to an adult, but is not yet sexually mature.

- *sub-basin* - 28 - A portion of a subregion or basin drained by a single stream or group of minor streams; the smallest unit into which the land surface is subdivided for hydrologic study purposes.
- *substrate* - 7 - The substance, base, or nutrient on which, or the medium in which, an organism lives and grows, or the surface to which a fixed organism is attached; e.g., soil, rocks, water, and leaf tissues, or perhaps a gel for the accumulation and preservation of prebiologic organic matter.
- *subtidal* - 25 - A marine or estuarine environment that lies below extreme low water of the spring tides; any substratum that is continuously submerged within a tidally-influenced water body.
- *sub-watershed* - 28 - Drainage area composed of two or more sub-basins. (Also see sub-basins).
- *succession* - 40 - The sequence of communities that develops in an area from the initial stages of colonization until a stable mature climax community is achieved. Many factors, including climate and changes brought about by the colonizing organisms, influence the nature of a succession..
- *sulphides* - 6 - Mineral compounds characterized by the linkage of sulfur with a metal. Also spelled sulfides.
- *supercontinent* - - See Pangea.
- *surfactants* - 10 - A substance that lowers surface tension and has properties of wetting, foaming, detergency, dispersion, and emulsification (e.g., a soap or other detergent).
- *surficial* - 7 - Pertaining to, or occurring on, a surface, especially the surface of the Earth.
- *suspended particulates* - 28 - A sample drawn from natural water or from a wastewater stream consists of a mixture of both dissolved and suspended matter. Those solid materials that are retained on a filter prescribed by the specific technique being followed are referred to as particulate matter. The suspended particulate matter can be subdivided into two fractions: volatile and fixed. The volatile particulates are those that are lost when the filter is heated to about 550C (1,022F), and the fixed particulates are those that are not lost upon being so heated. The volatile substances are generally considered to be of biological origin, and the fixed solids are considered to be minerals.
- *suspended solids* - 28 - Solids which are not in true solution and which can be removed by filtration. Such suspended solids usually contribute directly to turbidity. Also see suspended particulates.
- *sustainable* - 23 - A state or process that can be maintained indefinitely. The principles of sustainability integrate three closely interlined elements - the environment, the economy and the social system - into a system that can be maintained in a healthy state indefinitely.

- *swales* - 6 - Swale (singular). A long, narrow, generally shallow natural depression between two beach ridges. A slight depression, sometimes swampy, in the midst of generally level land.
- *swim bladder* - 4 - A membranous sac of atmospheric gases lying in the body cavity between the vertebral column and the alimentary tract of certain fishes. It serves a hydrostatic function in most fishes that possess it (to regulate buoyancy); in some it participates in sound production. Also called an air bladder.
- *symbiosis* - 9 - An intimate and protracted association between two or more organisms of different species. Includes mutualism, in which the association is beneficial to both; commensalism, in which one benefits and the other is neither harmed nor benefited; and parasitism, in which one benefits and the other is harmed.
- *symbiotic* - - Of or pertaining to symbiosis. See symbiosis

TOP

- T -

- *tactile* - 38 - Of, pertaining to, or issuing from the sense of touch. Used for feeling (i.e. a tactile organ).
- *taxonomy* - 42 - The science of classification; laws and principles governing the classifying of objects, particularly living and extinct organisms.
- *tectonics* - 6 - A branch of geology dealing with the broad architecture of the outer part of the earth, that is, the major structural or deformational features and their relations, origin, and historical evolution.
- *tectonism* - 7 - A general term for all movement of the crust produced by tectonic processes, including the formation of ocean basins, continents, plateaus, and mountain ranges. Similar to diastrophism..
- *telson* - 38 - The terminal segment of the body of some arthropods and segmented worms; in some crustaceans (shrimps, lobsters) it forms the middle lobe of the tail.
- *tertiary treatment* - 44 - Wastewater treatment processes, beyond primary and secondary wastewater treatment, which remove or reduce the amount of nitrate and phosphate nutrients still present in their effluents. Tertiary treatment may consist of extensions or modifications of secondary treatment processes, additional forms of chemical treatment, electrochemical processing, carbon filtration, and other more complex procedures.
- *Tertiary* - 2 - That part of geological time from the end of the Cretaceous (65 mya) to the beginning of the Pleistocene (2 mya), comprising the Paleocene, Eocene, Miocene, Oligocene and Pliocene. Tertiary also refers to rocks formed during this time. In some usage's Tertiary is synonymous with Cenozoic, whereas in other usages, Tertiary and Quaternary together make up the Cenozoic.
- *tetrapods* - 40 - Members of the superclass Tetrapoda, the jawed chordates comprising

all vertebrates with four limbs (2 pairs). Includes amphibians, reptiles, birds, and mammals.

- *thermocline* - 4 - A vertical, negative gradient of temperature that is characteristic of the layer of ocean water under the mixed layer; also, the layer in which this gradient occurs. A thermocline may be either seasonal or permanent.

- *threatened species* - 44 - Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range and which has been designated in the Federal Registry by the Secretary of Interior as a threatened species.

- *tidewater region* - 46 - Region where water is affected by tides or sometimes that part of it which covers tideland. Term is sometimes used broadly to designate the seaboard.

- *topographic* - - Of or pertaining to topography. See topography.

- *topography* - 6 - The general configuration of a land surface, including its relief and the position of natural and man-made features.

- *topology* - 7 - Study of the properties of geometric configurations. In digital cartography, it is concerned with the characteristics of data that describe the spatial relationships, such as dimensionality, adjacency, and connectivity, of map elements to each other. The detailed study of minor landforms, requiring fairly large scales of mapping. The topographic study of a particular place, specifically, the history of a region as indicated by its topography.

- *trace metals* - 18 - Trace elements regulated because of their potential for human, plant, or animal toxicity, including cadmium (Cd), copper (Cu), chromium (Cr), mercury (Hg), nickel (Ni), lead (Pb) and Zinc (Zn).

- *trammel nets* - 38 - A rectangular net made of a middle layer that is slack and of fine mesh and two outer layers that are stretched and of coarse mesh so arranged that fish attempting to pass in either direction carry some of the fine net through the coarse net and are thus pocketed.

- *transgression* - 6 - In geology, the spread of sea over land areas; also, any change that brings offshore, deep-water environments to areas formerly occupied by nearshore, shallow-water conditions, or that shifts the boundary between marine and non-marine deposition outward from the center of a marine basin. The resulting sequence of strata would be a transgressive sequence. Also, a discrepancy in the boundary lines of continuous strata.

- *transgressive* - - See transgression.

- *trawl* - 46 - Noun - Bag or funnel-shaped net to catch bottom-dwelling animals (e.g. fish, crustaceans) by dragging it along the bottom. Large research net designed on bottom trawl principles to catch large zooplankton and fish by towing in intermediate depths. Verb - the act of pulling a trawl net.

- *treeline* - 38 - Timberline. The height or limit beyond which trees do not grow in mountainous or artic regions.

- *Triassic* - 7 - The first period of the Mesozoic era (after the Permian of the Paleozoic era, before the Jurassic), thought to have covered the span of time between 250 and 190 million years ago; also, the corresponding system of rocks. The Triassic is so named because of its threefold division in the rocks of Germany.

- *triazine herbicides* - 42 - Herbicides that inhibit photosynthesis, leading to yellowing of leaves, followed by death of leaf tissue; uptake can occur through leaves but there is little movement inside the plant; when applied to soils, they are taken up by the roots and move in the xylem to plant leaves.
- *tributaries* - 42 - Secondary or branch of a stream or other channel that contributes flow to the primary or main channel.
- *trochophore* - 46 - Free-swimming, pelagic larval stage in certain aquatic invertebrates (some annelids and molluscs), distinguished by ciliated, pear-shaped body.
- *trophic* - - See trophic levels.
- *trophic levels* - 40 - The position that an organism occupies in a food chain. For example, green plants are primary producers; herbivores are primary consumers and secondary producers; a carnivore that eats only herbivores is a secondary consumer and tertiary producer. Many animals feed at several different trophic levels.
- *turbellarians* - 2 - Members of a class (Turbellaria) of mainly free-living flatworms (phylum Platyhelminthes) that move by means of cilia which cover the body. Some (e.g., Planaria) live in fresh water, others are marine, and a few are terrestrial..
- *turbid* - 7 - Stirred up or disturbed, such as by sediment; not clear or translucent, being opaque with suspended matter, such as of a sediment-laden stream flowing into a lake; cloudy or muddy in physical appearance.
- *turbidity* - - The quality or state of being turbid. See turbid.

TOP

- U -

- *unconformities* - 7 - A substantial break or gap in the geologic record where a rock unit is overlain by another that is not next in stratigraphic succession, such as an interruption in the continuity of a depositional sequence of sedimentary rocks or a break between eroded igneous and younger sedimentary strata. It results from a change that caused deposition to cease for a considerable span of time, and it normally implies uplift and erosion with loss of the previously formed record. Also, the structural relationship between two groups of rocks that are not in normal succession.
- *understory* - 38 - A foliage layer lying beneath and shaded by the main canopy of a forest. The plants that form the foliage understory. Also, a layer of low vegetation underlying a layer of taller vegetation.
- *uropod* - 38 - Flattened, life-like, paired appendage of the last abdominal segment of various crustaceans (as the lobster) that with the telson forms the fantail. Used for swimming by some crustaceans.

[TOP]

- V -

- *veliger* - 4 - The planktonic, larval second stage of many gastropods.
- *velum* - 40 - In zoology, circular, muscular, locomotory membrane of hydromedusans; ciliated, swimming organ of a trochophore larva; or any of various ring-shaped structures in animals, such as the segments of earthworms or other annelids.
- *vertebrates* - 40 - Any of a large group of animals comprising all those members of the phylum Chordata that have backbones. Vertebrates include the fishes, amphibians, reptiles, birds and mammals.
- *vertical stratification* - - See stratification.
- *viviparous* - 38 - Giving birth to living offspring that develop inside the body of the mother rather than hatching from an egg. Synonymous with viviparity.

[TOP]

- W -

- *water column* - 28 - A hypothetical column of water from the surface to the bottom of a stream, lake, or ocean within which the physical and/or chemical properties can be measured.
- *water quality indicators* - 28 - Constituents or characteristics of water that can be measured to determine its suitability for use.
- *watershed* - 28 - All lands enclosed by a continuous hydrologic drainage divide and lying upslope from a specified point on a stream. Also referred to as a water basin or drainage basin. Also, a ridge of relatively high land dividing two areas that are drained by different river systems.
- *wattles* - 38 - Fleshy, often vividly colored flaps of skin hanging from the head or neck of certain lizards and birds (e.g., turkey). Also, sticks and twigs, branches, reeds, etc. woven into a construction material, as for walls or fences.
- *weir* - 38 - A damn built to direct or back up the flow of water. A fence or barrier, as of branches or a net, placed in a stream to catch or retain fish.
- *WQ indicators* - - See water quality indicators

[TOP]

- XYZ -

xenobiota - 20 - Any substance foreign to living systems. Xenobiotics include drugs, pesticides, and carcinogens. Also, any biota displaced from its normal habitat.

- *xenobiotics* - - See xenobiota.
- *xeriscape* - 19 - Shortened form of xeric landscape. Landscaping designed for water and energy efficiency and lower maintenance. The seven xeriscape principles are: good planning and design; practical lawn areas; efficient irrigation; soil improvement; use of mulches; low water demand plants; good maintenance.
- *xeriscaping* - - See xeriscape.
- *year class* - 29 - Fish in a stock born in the same year. For example, the 1987 year class of cod includes all cod born in 1987, which would be age 1 in 1988. Occasionally, a stock produces a very small or very large year class which can be pivotal in determining stock abundance in later years.
- *zoning, Euclidian* - 44 - Zoning of the type adopted by the city of Euclid, Ohio, and made famous in 1926 by the United States Supreme Court decision in village of Euclid vs. Ambler Realty company, upholding the nation's first comprehensive zoning ordinance. The Euclid zoning ordinance restricted the location of trades, industries, apartment houses, two-family houses, single-family houses, the lot area to be built upon, the size and height of buildings, etc. The court found these restrictions neither "unreasonable" nor "arbitrary." Since that time the term has come to describe the most common form of zoning in the United States, in which "use districts" are designated (I.e., light manufacturing, commercial, single-family residential) and only the permitted use or a "higher" one is allowed. Thus in an area zoned for heavy industry, all other uses would theoretically be permitted (though there are some exceptions to this under the principle of exclusive zoning), whereas in an area of single-family residences, no other uses are likely to be permitted.
- *zoomorphic* - 38 - Having, or represented as having, the form of an animal.
- *zooplankton* - 40 - The animal component of the plankton (see plankton). All major animal phyla are represented in zooplankton as adults, larvae, or eggs; some are just visible to the unaided eye but most can not be seen without magnification. Near the surface of the sea there may be many thousands of such animals per cubic meter of water.

TOP

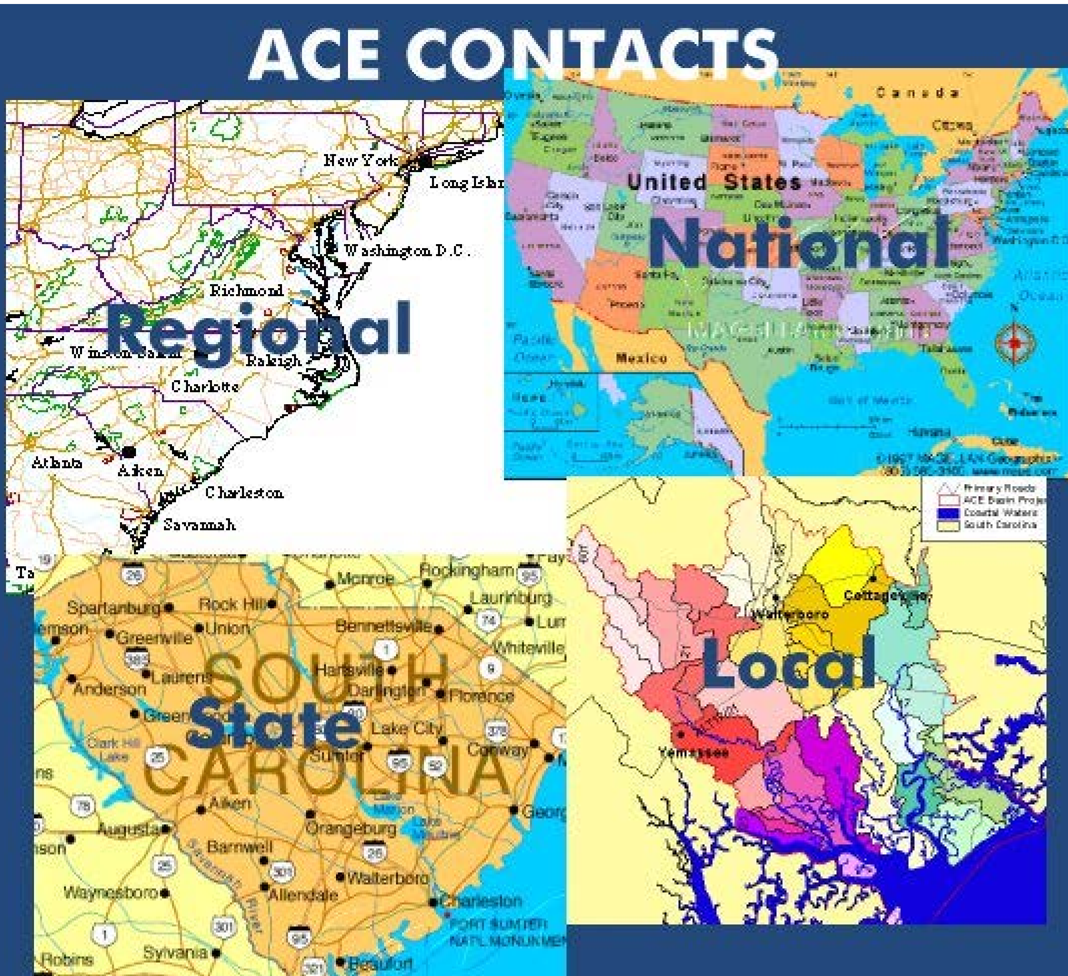
GLOSSARY SOURCES

- 1 - Allaby, M. 1983. Dictionary of the Environment. New York University Press, New York, NY and London, UK.
- 2 - Allaby, M. 1988. MacMillan Dictionary of the Environment: Third Edition. MacMillan Press Ltd, London and Basingstoke, UK.
- 3 - Allen, R. H. 1972. A Glossary of Coastal Engineering Terms. U.S. Army, Corps of Engineers Coastal Engineering Research Center, Fort Belvoir, VA.
- 4 - Baker, B. B., Jr., W. R. Deebel, and R. D. Geisenderfer. 1966. Glossary of Oceanographic Terms: Second Edition. U.S. Naval Oceanographic Office, Washington, DC.
- 5 - Barnhart, R. K. 1986. The American Heritage Dictionary of Science. Houghton

Mifflin Company, Boston, MA.
- 6 - Bates, R. L. and J. A. Jackson. 1984. Dictionary of Geological Terms: Third Edition. American Geological Institute, Alexandria, VA.
- 7 - Bates, R. L. and J. A. Jackson. 1987. Glossary of Geology: Third Edition. American Geological Institute, Alexandria, VA.
- 8 - Cauboue, M., W.L. Strong, L. Archambault, and R.A. Sims. 1996. Terminology of Ecological Land Classification in Canada. Micromedia Ltd., Ottawa, ON.
- 9 - Curtis, H. 1983. Biology: Fourth Edition. Worth Publishers Inc., New York, NY.
- 10 - Daintith, J. 1996. A Dictionary of Chemistry: Third Edition. Oxford University Press, Oxford, UK.
- 11 - Day, J. W., C. A. S. Hall, W. M. Kemp, and A. Yanez-Arancibia. 1989. Estuarine Ecology. John Wiley and Sons, New York, NY.
- 12 - Ford-Robertson, F.C. and R. K. Winters. 1983. Terminology of Forest Science Technology Practice and Products. Society of American Foresters, Bethesda, MD.
- 13 - Haddon, B.D. 1989. Forestry Inventory Terms in Canada: Third Edition. Canadian Government Publishing Centre, Ottawa, ON.
- 14 - Holmes, S. 1979. Henderson's Dictionary of Biological Terms: Ninth Edition. Van Nostran Reinhold Company, New York, NY.
- 15 - http://biotech.icmb.utexas.edu/search/dict-search.html - Indiana Institute for Molecular and Cellular Biology. 1998. Life Science Dictionary. (accessed 1998).
- 16 - http://hammock.ifas.ufl.edu/txt/fairs/16218 - University of Florida, Institute of Food and Agricultural Sciences. undated. EDIS. (accessed 1998).
- 17 - http://life.bio.sunysb.edu/marinebio/glossary.html - State University of New York at Stony Brook. 1999. Glossary of Marine Biology. (accessed 1998)
- 18 - http://soilslab.cfr.washington.edu/S-7/soilglossary.html - Robert B. Harrison. University of Washington, Seattle, WA. (accessed 1999.
- 19 - http://www.edwardsaquifer.net/glossary.html - Eckhardt, G. A. 1995. Glossary of Water Resource Terms . (accessed 1998.
- 20 - http://www.epa.gov/OCEPAterms/ - United States Environmental Protection Agency. 1998. Terms of the Environment. (accessed 1998)
- 21 - http://www.federalregisterdigest.com/wfr.html - Educational Digest Service, Inc. 1999. Federal Register Digest Service. (accessed 1999.
- 22 - http://www.fema.gov/ - Federal Emergency Management Agency. 2000. Main Home Page. (accessed 2000)
- 23 - http://www.for.gov.bc.ca/pab/publctns/glossary/GLOSSARY.HTM - Ministry of Forests, Province of British Columbia, Canada. 2000. Glossary of Forestry Terms. (accessed 1999, 2000.
- 24 - http://www.lam.mus.ca.us/search - Natural History Museum of Los Angeles County. 1997. (accessed 1998)
- 25 - http://www.midcoast.com/~wpl/mvlt/nri/glossary.html - Medomak Valley Land Trust. undated. A to Z Glossary. (accessed 1998)
- 26 - http://www.m-w.com - Merriam-Webster, Inc. 2000. Merriam-Webster Online. (accessed 1998, 1999, 2000.
- 27 - http://oceanworld.tamu.edu/ - TOPEX/Poseidon Education Project. 2000. Ocean World. (accessed 1998, 1999, 2000.
- 28 - http://www.state.nv.us/cnr/ndwp/dict-1/waterwds.htm - Nevada Division of Water Planning. 1997. Water Words Dictionary. (accessed 1998)
- 29 - http://www.streamnet.org/ff/Glossary/ - Streamnet. 1998. Glossary of Terms. (accessed 1998)
- 30 - http://www.wqa.org - Water Quality Association. Main Home Page. (accessed 1998)
- 31 - Jackson, J. A. 1997. Glossary of Geology. American Geological Institute, Alexandria, VA.
- 32 - Johnston, J. B. 1977. Coastal Ecological Characterization: An Overview. p. 1-3.

In: Contributed Papers on Coastal Ecological Characterization Studies. Fourth Biennial International Estuarine Research Federation Conference. October 1977. Fish and Wildlife Service, Office of Biological Services. FWS/OBS-77/37.

- 33 - Kineman, J. J. and B. O. Parks (eds.). 1996. Ecological Characterization. In: Recommendations of a Science Review Panel. March 9-10, 1995, Charleston, SC. National Geophysical Data Center, Boulder, CO and NOAA Coastal Services Center, Charleston, SC. KGRD #32 and NOAA CSC/10-96/001.
- 34 - Levinton, J. S. 1982. Marine Ecology. Prentice-Hall Inc., Englewood Cliffs, NJ.
- 35 - Lewis, R. J., Sr. 1997. Hawley's Condensed Chemical Dictionary: Thirteenth Edition. John Wiley and Sons Inc., New York, NY.
- 36 - Little, W., H. W. Fowler, J. Coulson, and C.T. Onions. 1967. The Shorter Oxford English Dictionary on Historical Principles. Oxford University Press, Ely House, London, UK.
- 37 - Long, E. R. and L. G. Morgan. 1990. The Potential for Biological Effects of Sediment-sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. Seattle, WA.
- 38 - Merriam-Webster, Inc. 1993. Webster's Third New International Dictionary. Merriam-Webster Inc., Springfield, MA.
- 39 - Neilson, W. A., T. A. Knott, and P. W. Carhart (eds.). 1947. Webster's New International Dictionary of the English Language: Second Edition. G. and C. Merriam Company, Springfield, MA.
- 40 - Oxford University Press. 1996. A Dictionary of Biology. Oxford University Press, New York, NY.
- 41 - Parker, S. P. 1997. Dictionary of Earth Science. McGraw-Hill, New York, NY.
- 42 - Pritchard, H. W., D. E. Hutchinson, F. W. Schaller, R. L. Schultz, W. Briggs, G. Hertel, and J. Sanders. 1982. Resource Conservation Glossary: Third Edition. Soil Conservation Society of America, Ankeny, Iowa.
- 43 - Roberts, K. J., J. W. Horst, J. E. Roussel, and J. A. Shephard. 1991. Defining Fisheries: A User's Glossary. Louisiana Sea Grant College Program, Louisiana State University, Baton Rouge, LA.
- 44 - Schwarz, C. F., E. C. Thor, and G. H. Elsner. 1976. Wildland Planning Glossary. Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
- 45 - Tarpley, W. A. 1962. An Ecological Glossary With an Emphasis on Insect Ecology. Virginia Polytechnic Institute, Department of Entomology, Blacksburg, VA.
- 46 - Tver, D. F. 1979. Ocean and Marine Dictionary. Cornell Maritime Press Inc., Centreville, MD.
- 47 - Tver, D. F. 1981. Dictionary of Dangerous Pollutants, Ecology, and Environment. Industrial Press Inc., New York, NY.
- 48 - Veatch, J. O. and C. R. Humphrys. 1964. Lake Terminology. Department of Resource Development, Agricultural Experiment Station, East Lansing, MI.



[Introduction](#) | [Local](#) | [State](#) | [Regional](#) | [National](#)

ACE Basin CD Search Page

Please enter the word(s) for which you would like to search.

Search

find all words (AND)

Please be patient after entering a search.

Notes:

1) To avoid the search returning word fragments (e.g. tern in pattern) place a space before the word in the search box and use the "exact match" operator;

2) An "exact search" of multiple words (e.g. least tern) may return an incomplete list of pages in which that phrase occurs;

3) Mac users: Caution. Before using the search tool, please read the Navigation - Search Tool section in About This CD-ROM.

Executive Summary

History

History

Humans have lived and utilized natural resources in the ACE Basin for thousands of years. The first human presence in the Basin occurred approximately 6,000 years ago with the Paleoindians. Like their Asian counterparts, Paleoindians are believed to have lived in mobile hunter-gatherer groups and hunted large animals such as mammoths and mastodons. New ways of hunting and gathering marked the end of the Paleoindian period and the beginning of the Archaic period and the modern-day Indians. Until the arrival of Europeans in the sixteenth century, Paleoindian culture evolved into a more sedentary society that relied on hunting in smaller territories and agriculture. Semipermanent villages of several families were built near the hunting grounds. Villagers tilled and planted crops such as corn, beans, and squash during the spring and harvested in the fall. During the summer months, the entire village moved to the homesteads near the coast, where they subsisted on seafood and wild plants, particularly roots.

The early European settlers adopted the traditions of the Native Americans. The success of rice culture and cattle ranching in South Carolina contributed to the expansion of white settlements into Colleton County. By 1712, the colonists were shipping approximately 12,727 barrels of rice to England and over 3,000 pounds of salted meat to the English West Indies (Otto 1989). Planters and ranchers began to disperse along the coastal plain in search of land. The early economy of Colleton County grew as a result of the growing wealth of its planters, who began to develop the infrastructure of the county (Bryan 1993).

Aerial view of Bear Island WMA Impoundments

Human activities have shaped the history, and the cultural and natural resources of the Basin. Early Carolinians cleared thousands of acres of old-growth hardwood forests and planted a variety of crops including corn, tobacco, and root crops. Tens of thousands of acres of bottomland hardwoods along the navigable rivers and creeks of the ACE Basin study area were converted to rice fields (McCrady 1897). Lumber companies of the late 1800s to early 1900s logged most of the virgin pine forests and swamplands in Colleton County. The modernization of farming practices after World War II resulted in extreme increases in profit and crop production (Gliessman 1998). Improvements in farming techniques, and the construction of the Intracoastal Waterway, roads, and railways were instrumental in promoting the development of the farming industry during the early twentieth century. Today, the extensive pine plantations and rice field systems established during this period are still evident.

Many of the large plantations that once supplied the mills with timber were converted to hunting preserves. The abandoned rice fields and logged forests attracted a rich abundance of game animals, including migratory waterfowl and deer to the area. The interest in hunting led to the evolution of sophisticated wildlife management techniques that help to preserve the natural quality of the ACE Basin study area that we enjoy today.

Colleton County Courthouse

Most of the more well-known archaeological sites in the ACE Basin date from the recent historic period, particularly the 18th and 19th centuries when the area flourished as a prosperous agricultural region. Some of the more popular historic attractions around the ACE Basin study area include the Colleton County Courthouse, Hunting Island Lighthouse, and Edisto Beach State Park. It is important to recognize that although hundreds of sites have been formally recognized, hundreds to thousands of sites may never be discovered without careful site planning, inventories, and management during land clearing. The use of appropriate planning, identification, and preservation of these cultural resources will sustain them for tourism and future generations. (See related sections: History of the ACE Basin and Archaeology.)

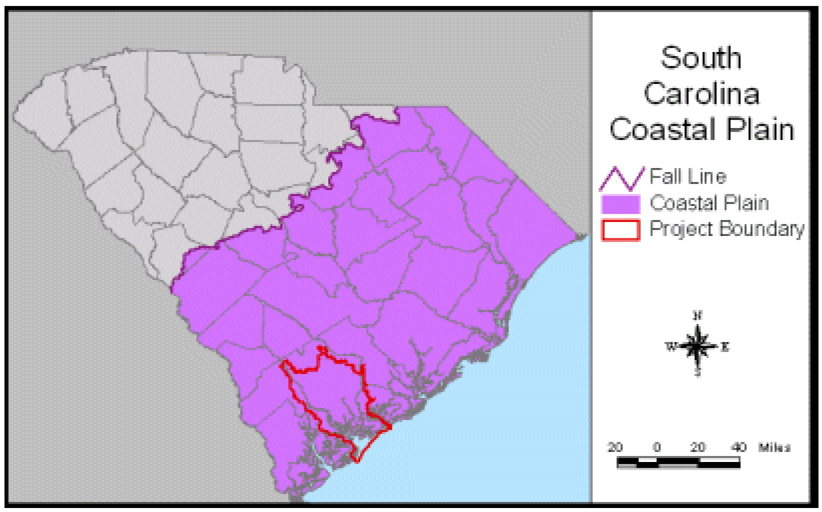
Back to Executive Summary Introduction
Next Section: Environmental Conditions

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Executive Summary
Environmental Conditions

An understanding of the environmental conditions of the ACE Basin is important for its management. The environmental parameters addressed in this characterization are geology, geomorphology, soil characteristics, biogeochemistry, climatology, hydrology, hydrochemistry and pollution, and water quality.

Geology



The geologic history of the ACE Basin includes influences by a series of stratigraphic, tectonic, climatic, and oceanic events. Overall, the Piedmont basement of the coastal plain in which the ACE Basin resides has not been well studied; however, it is known that the Garner-Edisto Fault that extends from the Savannah River to at least the mouth of St. Helena Sound is seismically active (Colquhoun et al. 1983). This fault is believed to represent a suture between the Piedmont rocks of North America to the north and rocks with African affinity to the south (Chowns and Williams 1983).

The opening of the Atlantic Ocean caused igneous activity that increased over the future continental margin of South Carolina. The coastal plain of South Carolina was submerged from the late Jurassic period to the middle Eocene epoch (approximately 150-45 mya), until sea level began to fluctuate. Alternating rise and fall in sea level formed the characteristic substrate of the ACE Basin. As sea level increased, marine sediments were deposited and as sea level fell, marine, barrier, backbarrier (marsh), and fluvial sediments were deposited over the eroded remnants of the previous transgressive sequence (Colquhoun 1969; Colquhoun and Muthig 1991; Soller and Mills 1991). During protracted periods of standstill, deltaic deposition allowed the formation of secondary barrier islands (Colquhoun 1974). Subtle topographic highs and morphologic changes in rivers indicate that a northeast-trending zone of tectonic uplift exists northwest of Charleston (Marple and Talwani 1993). Regional studies indicate that this zone of uplift is approximately 200 kilometer long and 15 kilometers wide. The zone of uplift appears to have deflected the Edisto River (Doar pers. comm.). The South Fork Edisto River flows southeast out of Saluda County and past its confluence with the North Fork Edisto River, the Edisto River continues to flow in nearly a straight line southeast until it reaches the northwest margin of the zone of uplift. At this locality, the Edisto River is deflected abruptly to the south into the ACE Basin. If the zone of uplift were not present, the Edisto

River would connect with the Ashley River and flow into Charleston Harbor (Soller and Mills, 1991). (See related section: Geology.)

Back to Top

Geomorphology

Geomorphology integrates the study of the interactions between physical components of the atmosphere, the earth (lithosphere), and water (hydrosphere) with the biological communities of plants and animals, and especially humans that modify landforms. The periodic landward and seaward movement of the shore across the coastal plain can be seen in the landforms of the ACE Basin such as relict dune ridges and marsh plains.

The lower coastal plain of South Carolina, including the ACE Basin, has been subjected to repeated cycles of sea-level rise and fall which has resulted in a complex three-dimensional mosaic of Pleistocene-age fluvial and marine sediments. The coastal portion of the ACE Basin is characterized by sea islands, marsh islands, and barrier islands that are interlaced by estuaries, extensive salt marshes, intertidal areas, and oyster reefs. Three major rivers (Ashepoo, Combahee, and Edisto) provide freshwater and influence the character of inland portions of the study area. Additionally, there are approximately 20 Carolina bays in Colleton County that are larger than 0.8 hectares (Bennett and Nelson 1991). One bay in Colleton County exceeds 3,000 meters in length.

Aerial photograph of a Carolina Bay. Note the northwest to southeast orientation.

The primary source of sediments to the Basin is the deposition of terrestrial sediments carried there by rivers, and from the deposition of reworked marine sediments during submerged periods (McIntyre et al. 1991; Soller and Mills 1991). The major rivers in the ACE Basin, the Ashepoo, Combahee, and Edisto, each have extensive drainage areas. The Edisto River, with its headwaters beginning below the fall line in South Carolina has the largest watershed of the three rivers. The Edisto River is the primary source of materials eroded from upland areas and supplied to the ACE Basin. The smaller Ashepoo and Combahee rivers originate from swamps on the coastal plain and also contribute large amounts of freshwater, and dissolved and suspended materials to St. Helena Sound. During wet weather episodes, the rivers of the ACE Basin, and especially the Edisto River, may expand out into their flood plains carrying thousands of tons of sediment. Fine mud and organic materials settle onto the soil and provide a fresh source of nutrients and minerals to the plant communities, making the flood plains very productive areas.

The ACE Basin has extensive areas of salt marsh formed during periods when sedimentation rates are great enough to keep pace with sea-level rise. The primary salt marsh vegetation type is Spartina spp. with a multispecies community developing at higher elevations not frequently inundated by seawater. Oyster reefs are also found in the

Basin's plankton-rich tidal streams and provide habitat (structure) for animals within the intertidal zone, replacing the function which submerged aquatic vegetation (SAV) and coral reefs serve in other regions.

More recent anthropogenic processes shaping the ACE Basin coastal landscape include timber harvesting; agriculture; land use conversion, primarily for development; modifications to beachfronts; and dredging or filling of channels and wetlands. Implementing land use practices that recognize the geomorphic constraints within the ACE Basin will help to reduce anthropogenic impacts to its environment. (See related section: Geomorphology.)

Back to Top

Soil Characteristics

Approximately 100 different soils are found in the ACE Basin. Five factors important in the formation of soils include the parent material, organisms, climate, relief or landscape position, and time (Jenny 1941). Oceans and rivers deposited most of the parent materials of soils in the ACE Basin. Additionally, parent materials formed from the calcareous remains of marine organisms produce sediments with near neutral to alkaline pH. In the ACE Basin, dwarf palmetto (Sabal minor) is a well-known indicator of calcareous sediments since this species requires neutral to alkaline soil pH. In the ACE Basin, wetland soils have a high organic content because anaerobic soil bacteria decompose matter less efficiently than aerobic bacteria.

The climate in the ACE Basin is conducive to relatively rapid rates of soil formation. Local relief is the environmental factor that has the greatest effect on soils of the ACE Basin study area. Changes in elevation of only a few feet produce major changes in soil properties. Soils formed in the ACE Basin are relatively young and the main types of soil landscapes are dune ridge and trough, flood plain/salt marsh, high sandy ridges, and low relief uplands. Understanding soil characteristics of the ACE Basin is important for determining the land use capabilities of each soil type. Each county that comprises the ACE Basin study area has its own soil survey that is available to all interested parties. (See related section: Soil Formation.)

Back to Top

Biogeochemistry

Biogeochemistry refers to the underlying chemical processes that dictate the cycling of major elements (i.e., carbon, hydrogen, nitrogen, oxygen, phosphorous, sulfur) in an ecosystem. In general, very little biogeochemical research has been performed in the ACE Basin; however, other estuarine systems in South Carolina have been studied and inferences can

Aerial view of the South Edisto River

be made about how these systems may vary after accounting for the unique attributes of the ACE Basin. Some of the unique characteristics of estuaries in the ACE Basin include the black water of the Edisto River, landscape characteristics such as the lack of urbanization in the basin, and its extensive network of wetlands.

The Edisto is one of the longest free-flowing black water rivers in the United States, and is laden with dissolved organic matter, the bulk of which (humic acids) is resistant to metabolic breakdown by bacteria. The high concentration of humic substances in the black water act to bind phosphorus until it comes into contact with saltwater, when a precipitation/flocculation event occurs releasing orthophosphate into the estuary system. In the higher salinity regions of the estuary where phosphorus has desorbed and becomes bioavailable, primary production is limited by nitrogen. Nitrogen loading in the high salinity estuary will be more important to carbon biogeochemistry than in the low salinity estuary. Nutrients in marsh pore water along the Edisto River tend to be higher than the concentrations observed in the Cooper River and Winyah Bay/ North Inlet. The nutrients carried in the black water discharge that dominates the ACE Basin study area may impart estuarine-wide eutrophication in a relatively pristine and nutrient-sensitive estuary.

Overall, the ACE Basin appears to be a healthy ecosystem because of low levels of nitrate/nitrogen in its estuaries and the balanced nitrogen to phosphorus ratio. However, relatively high ammonium and phosphorus concentrations do exist in the water column. This information suggests future management of the ACE Basin ecosystem should be directed at maintaining balanced nutrient ratios. (See related section: Biogeochemistry.)

Back to Top

Climatology

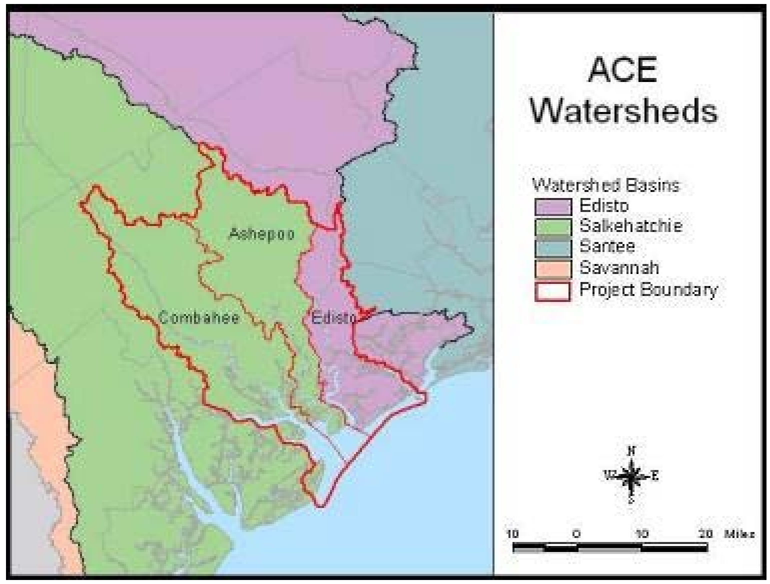
Weather patterns found in the ACE Basin are influenced by its latitude, the southern Appalachian Mountains, and the Gulf Stream. Three weather stations, Edisto Island (1956-present), Walterboro (1948-present), and Yemassee (1896-present), provide data to describe the subtropical climate of the Basin. A

weather station also exists at the ACE Basin National Estuarine Research Reserve (NERR) field station at Bennett's Point, but data have only been collected there since 1995. In general, hot, humid summers, mild winters, and ample precipitation throughout the year characterize the ACE Basin climate. The relatively local scale of the moderating effect that the Gulf Stream imparts is evident in differences in mean temperature between Edisto Island and Yemassee, only 48 km (30 mi) inland. Average maximum and minimum temperatures for the ACE Basin in July and August are 32°C (90°F) and 21°C (70°F), respectively. In January, the average mean temperature is 10°C (50°F) with large interannual fluctuations occurring. The ACE Basin receives 100-130 cm (40-50 in) of precipitation per year with maximum precipitation occurring during summer months because of thunderstorms. Between September and February, winds commonly come from the north, northeast, or west. By March the predominant directions are west, southwest, and south, a tendency that persists through August. Average speeds are greatest from December through May. The ACE Basin can also experience severe weather from thunderstorms and hurricanes. (See related section: Climatology.)

Back to Top

Surface Water

The ACE Basin Characterization study area is located in the lower coastal plain of South Carolina; however, the headwaters of many of its rivers and streams originate in the middle or upper coastal plain. All of the surface water flowing into the ACE Basin eventually empties into the Atlantic Ocean via St. Helena Sound (SCWRC 1972). The South Carolina Department of Natural Resources recognizes two



river sub-basins in the ACE Basin: the Edisto River sub-basin and the Combahee-Coosawatchie River sub-basin.

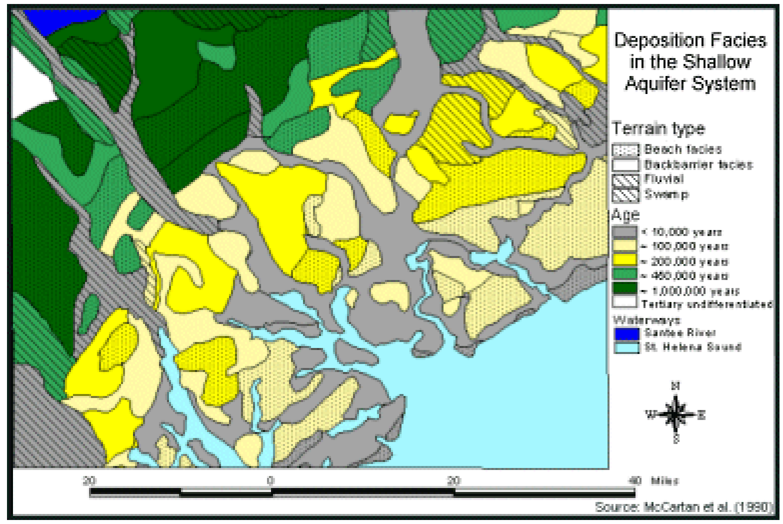
The Edisto River sub-basin is entirely within South Carolina and drains the following four tributaries : South Fork Edisto River, North Fork Edisto River, Edisto River, and Four Hole Swamp. The Edisto River is tidally influenced within 21.7 km (35 mi) of the coast and the saltwater interface extends approximately 12.4 km (20 mi) inland during high tide. Stream flow in the Edisto River is substantial (74 m^3/sec, or 2,614 ft^3/sec, at Givhan's Ferry) and fairly constant (SCWRC 1983). Surface water in the Edisto River sub-basin supplies approximately 93% of the total water demand for public supply and agricultural irrigation. In particular, the City of Charleston withdraws large amounts (65 million gallons/day) of Edisto River water upstream of Givhans. Total water use in the Edisto River sub-basin is projected to increase 52% by the year 2020, with agriculture and thermoelectric power plants being the leading gross water users (SCWRC 1983).

The major freshwater rivers draining the Combahee-Coosawhatchie River sub-basin are the Salkehatchie, Coosawhatchie, and Ashepoo rivers. The Little Salkehatchie and Salkehatchie rivers are the major tributaries to the tidally influenced Combahee River. The Combahee and Ashepoo Rivers drain into the ACE Basin; however, the Coosawhatchie River drains outside of the Basin into Port Royal Sound. The freshwater-saltwater interface for the Combahee and the Ashepoo rivers are located about 24.8 km (40 mi) inland and 18.6 km (30 mi) inland, respectively. The largest surface water withdrawal in this sub-basin is related to agricultural practices with most water use coming from ground water sources. (See related section: Surface water.)

Back to Top

Ground Water

Ground water in the ACE Basin is found in six aquifer systems and three principal confining beds in the lower coastal plain (Aucott et al. 1987). The principal aquifer systems are Cape Fear, Middendorf, Black Creek,



Tertiary Sand, Floridan, and Shallow. Each system has unique and diagnostic combinations of lithography, hydraulics, and water chemistry that determine their potential use by humans. The only aquifers in use today are the Tertiary Sand, Floridan, and Shallow. The Tertiary sand and Floridan aquifer systems are the principal sources of domestic, commercial, and public water supplies, and well yields as great as 1,900 L/min (500 gpm) are reported for most of the basin. The shallow aquifer system is the least consistent with respect to well yield. However, wells drilled in areas underlain by beach facies provide enough water for domestic supply and produce up to 190 L/min (50 gpm) locally. Treatment is likely to be required for hardness in water from the Tertiary sand and Floridan aquifer systems and for dissolved iron in water from the Floridan and Shallow systems. Fluoride, sodium, bicarbonate, and chloride increase coastward in all but the Shallow system. The Shallow aquifer produces water with low-dissolved solid concentrations except where it contacts saltwater marshes and streams. Saltwater intrusion occurs in the Floridan aquifer system at Edisto Beach owing to water-level declines. Chloride concentrations in the Floridan aquifer at Edisto Beach can be expected to increase with time owing to pumping-induced upcoming and saltwater intrusion. The Edisto Beach and Walterboro public water supply systems are the largest users in the ACE Basin study area. (See related section: Ground Water.)

Back to Top

Hydrochemistry and Pollution

Chemical contamination in the ACE Basin may originate from atmospheric, terrestrial, and aquatic sources and include point and nonpoint source pollution. Once introduced into the system, the fate of pollutants is modulated by a number of physical factors such as organics, pH, salinity, and humic acids. Several studies have been conducted in the ACE Basin to examine the level of chemical contaminants in the sediment, which is the primary environmental sink for pollutants. The overall level of sediment contamination in the ACE Basin study area was found to be low with very little potential for adverse biological effects. Scott et al. (1998) found only arsenic in high enough concentrations to exceed the ER-L level, which is the concentration at which 50% of the studies found there to be significant negative effects on organisms. Ten of 34 study sites had sediment arsenic concentrations exceeding the ER-L level but not the ER-M level, or the point where 10% of the studies noted significant negative effects on organisms. These high levels are due to naturally occurring arsenic concentrations in the basement rock within the region. Scott et al. (1998) found concentrations of PAHs, PCBs and organochlorine pesticides to be below ER-L levels at 34 study sites within the ACE Basin. Another study of sediment contamination within the ACE Basin found one site on the South Edisto River near Bear

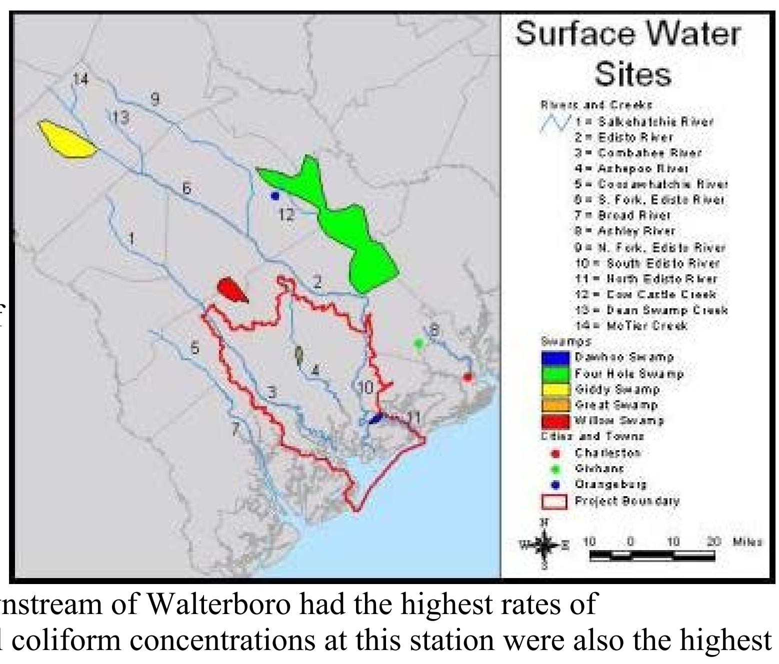
Island Wildlife Management Area to have exceeded the ER-L level for five tested contaminants: arsenic, chromium, nickel, P,P'-DDD, and total DDT. The source of the contaminants at this site is unknown. While sediment contamination in the ACE Basin is generally at acceptable levels, it is important that land use planning in the region limit new sources of pollutants. (See related section: Hydrochemistry and Pollution.)

Back to Top

Water Quality

Water quality of a system may be affected by natural events such as tides and hurricanes, as well as anthropogenic factors such as point and nonpoint source inputs. The Clean Water Act requires the U.S. Environmental Protection Agency (USEPA) to establish criteria guidelines for use by states (i.e. S.C. Department of Health and Environmental Control in South Carolina) in preserving designated uses of lakes, streams, and rivers within their states. The South Carolina Department of Health and Environmental Control (SCDHEC) has established water quality standards required to meet beneficial uses (e.g., drinking water, recreational use, support of aquatic life). SCDHEC has been taking periodic measurements at numerous stations in the ACE Basin for over 14 years. Water quality variables measured in the ACE Basin are pH, conductivity, salinity, temperature, dissolved oxygen (DO), turbidity, fecal coliform bacteria, nitrogen, phosphorus, and biological and chemical oxygen demand.

There are a total of 13 National Pollutant Discharge Elimination System (NPDES) permit holders within the study area. By comparison, Charleston County has 47 NPDES permit holders and Beaufort County has 20 permit holders. The major point source dischargers of concern in the study area include the City of Walterboro wastewater treatment facility on the Ashepoo River (35 mi, or 56 km, inland); the Yemassee wastewater treatment facility on the Combahee River (28 mi, or 48.3 km, inland); the South Carolina Electric &Gas Canadys power station on the Edisto River (36 mi, or 57.6 km, inland); and the CCX Fiberglass Products plant in Walterboro on the Ashepoo River (28 mi, or 48.3 km, inland). Major nonpoint sources in the ACE Basin include agriculture, forestry, construction, urban development, and mining facilities.



Eleven primary and secondary SCDHEC monitoring stations (located on the Combahee, Ashepoo, S. Edisto, N. Edisto, and Coosaw Rivers) were evaluated and found to be in compliance with dissolved oxygen standards over 90% of the time, except for two stations on the Ashepoo River and two of the three stations on the Combahee River. The rate of noncompliance at the 53 sites in regard to fecal coliform ranged from 0% to 97%. The Ashepoo River downstream of Walterboro had the highest rates of noncompliance. Average fecal coliform concentrations at this station were also the highest within the study area. The Big Bay and Fishing Creek estuaries located adjacent to the town of Edisto Beach also exhibited high rates of fecal coliform noncompliance. Significant increasing trends in fecal concentrations were found at Coosaw River stations near Beaufort, and Back Bay and Fishing Creek stations near Edisto Beach. All areas exhibiting high rates of noncompliance were associated with urban development.

Concentrations of nitrates /nitrites and phosphorus have generally been stable or have decreased from 1985 to 1995. Only one (S. Edisto River at Jacksonboro) of the eleven stations evaluated for nitrate-nitrite concentrations displayed excursion rates exceeding 10% of recommended values; the concentrations at the other stations averaged less than 0.2 mg/l. Concentrations of phosphorus commonly exceeded levels recommended to prevent eutrophication at nine of the eleven monitoring stations. Rich natural deposits of phosphorus throughout the ACE Basin study area contribute to the high concentrations of phosphorus. Decreasing trends in nitrate-nitrite and phosphorus concentrations were noted at most stations. The decreasing trends in nutrients may be related to decreased agricultural activity and point-source pollution control measures, but best management practices for agriculture and forest industries may also help control nutrient runoff if accepted on a broad scale.

The South Carolina Department of Natural Resources (SCDNR) has been collecting continuous (i.e. every half-hour) water quality data at two sites in the National Estuarine Research Reserve (NERR) portion of the ACE Basin since 1995. The SCDNR sampling has found that estuarine water quality naturally varies on many spatial scales (e.g., by region, by creek) and temporal scales (e.g., tidal, diurnal, lunar, seasonal, annual). In general, water quality within the ACE Basin NERR met or exceeded standards. Oxygen levels, however, were depressed below levels known to cause biological effects for brief periods.

Current water quality issues within the ACE Basin project area are primarily related to urbanization as evidenced by excursions around developed areas within the study area. With increasing urbanization, water quality in the ACE Basin may decline unless sound management principles are applied. (See related section: Water Quality.)

Back to Executive Summary Introduction
Next Section: Biological Resources

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Introduction
Ecosystem Processes
Phytoplankton
Plants
Decomposers
Zooplankton
Benthic Invertebrates
Insects
Decapod Crustaceans
Fish
Herpetofauna
Birds
Mammals
Threatened and Endangered Species
Species Gallery

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Executive Summary
Biological Resources

Introduction

The ACE Basin contains six distinct ecosystem habitat types that range from subtidal areas and vast wetlands to uplands. These habitats are characterized by more than 1500 different plant and animal species that interact with the physical environment to create the ACE Basin ecosystem. Major groups of organisms that occur in the ACE Basin and are described in the Biological Resources section include phytoplankton, plants, decomposers, zooplankton, benthic invertebrates, insects, decapod crustaceans, fish, reptiles and amphibians, birds, and mammals. In addition to groups of organisms, this section describes some of the basic ecological principles that underlie the ACE Basin ecosystem. Many of these concepts are applicable to the habitats, communities, and ecosystems that are described in the Biological Resources section and other sections of this product. (See related chapter: Biological Resources .)

Ecosystem Processes

An ecosystem is defined as "a set of organisms (community) living in an area, their physical environment, and the interactions between them" (Daily, 1997). Although it has not always been clearly recognized, humans are completely dependent on the ecosystems in which they live. Humans have been dependent on the ACE Basin ecosystem for over 6,000 years. The many processes that integrate energy and nutrients flowing through the ACE Basin ecosystem provide its human inhabitants a variety of services. Besides providing food and shelter, the ecosystem provides waste treatment (by way of carbon dioxide consumption, oxygen production, and breakdown of sewage), a water filtration system (by the soil), recreational opportunities, and a basis for economic development. Some of these services, such as food production, are readily apparent and have a market value. In the ACE Basin, commercial fishing is an important means of food production. Likewise, both agriculture and forestry products are produced in the ACE Basin and have a market value. Less apparent services include biological and chemical processes, such as the transfer of energy through the food chain, that operate in order to produce the fish or agricultural products (Peterson and Lubchenco 1997; Odum 1997). These services are generally taken for granted; yet they may be severely impacted by land use and pollution. Remove any one of these "services" and the character and function of the other components can be compromised.

Coastal areas, such as the ACE Basin, located between the open ocean and upland areas, have a high diversity of habitats and microhabitats, supporting diverse and abundant communities of plants and animals. As habitats are modified, ecological processes in these habitats also change and some of these changes may be significant.

One of the greatest threats to habitat diversity in the ACE Basin is the conversion of existing habitats to structurally and biologically simpler habitats such as agricultural fields, pine plantations, and urban or residential areas. In addition to the direct loss of habitat, the resulting fragmentation of the remaining forested and wetland areas results in decreased species diversity. As a consequence of fragmentation in the ACE Basin, ecotones where the vegetative communities previously graded slowly from wetland to upland forest have been changed to sharper boundaries between wetland areas and what are now agricultural fields or suburban developments.

Other threats to the ACE Basin ecosystem occur as a result of human disturbance of the natural transfer of energy and trophic structure, which can alter the carrying capacity of the ecosystem. In addition, the current global economy is consuming more energy than is renewable over the long term, and humans are heavily dependent on nonrenewable fossil fuels and nuclear energy. Energy use at the local level of the ACE Basin is no exception. Millions of dollars in fuel, fertilizer, and pesticides are used to increase the production of agricultural products well beyond natural levels. When fossil fuels become expensive and scarce, it will be difficult to maintain the current production levels on ACE Basin farms. In order to limit the impact humans have on the ACE Basin ecosystem, appropriate management decisions must be made at the federal, state, and local government levels as well as by individual property owners and residents of the ACE Basin. (See related section: Ecosystem Processes.)

Back to Top

Phytoplankton

Phytoplankton communities are the base of the aquatic food chain. They are free-floating microscopic plants that are mostly unicellular and produce chemical energy from light, a process called primary production. In general, the primary productivity of these organisms is very high. For example, phytoplankton can be 15 to 175 times more productive than a rice field. The importance of phytoplankton, particularly diatoms and cyanobacteria, to primary production has been observed in southeastern estuaries and freshwater systems (Grant 1974; Molley et al. 1976; Camburn et al. 1978; Davis and Van Dolah 1992; NOAA 1996; Lewitus et al. 1998). Phytoplankton communities in the ACE Basin have not been characterized.

Common marine phytoplankton

Phytoplankton production is affected by several biological and physical factors. For example, at a grazing rate of 20%, zooplankton can decrease phytoplankton populations by approximately 75% (Dawes 1998). With adequate nutrients, phytoplankton growth and productivity increases with increasing light. Increased sediment loads can result in declines in phytoplankton populations. If these controlling factors are altered, the effects on phytoplankton populations can be detrimental. For example, excess nutrients promote rapid growth of phytoplankton populations and sometimes a shift in the composition of phytoplankton species. Subtle shifts in phytoplankton populations may have significant impacts on organisms that feed on them. (See related section: Phytoplankton.)

Back to Top

Plants

Spartina salt marsh

Thirty plant community types were identified and classified by The Nature Conservancy during botanical surveys of 28 natural areas in the ACE Basin (TNC 1993). The dominant vegetation types in the highest strata of the habitat define the plant communities. Three of the 30 plant communities (maritime dry grassland, maritime shrub thicket, and barrier island forest) are on the barrier and barrier-like islands. Estuarine wetlands contain four plant communities (salt marsh, salt flat, salt scrub thicket, brackish marsh), and 16 community types are in palustrine wetlands that are divided into two major categories: tidal and inland. There are 12 communities (depression meadow, bay forest, non-riverine swamp forest, pond pine woodland, pocosin, Carolina bay, maritime wet grassland, shrub swamp, depression pond complex, inland freshwater marsh, swamp tupelo pond, stream head pocosin) in inland wetlands that are defined as habitats having no hydrologic connection to major water bodies. Four communities (tidal marsh, bald cypress-tupelo swamp, bottomland hardwood, and spruce pine-mixed hardwood community) occur in tidal wetlands. The upland areas on the marsh islands and the mainland areas contain seven plant community types (loblolly pine-mixed hardwood forest, longleaf pine flatwoods, oak-hickory forest, South Atlantic inland maritime forest, Southern mixed hardwood forest, subxeric pine-scrub oak sandhill, and temperate shell midden woodland (TNC 1993).

The physical environment of the habitat affects the types and distribution of plants occurring in each community type. Van der Valk (1974) demonstrated that the zonation of maritime plant species is strongly influenced by the differential tolerance of the plants to sand burial and sand movement. On ACE Basin barrier islands where sand movement and salt spray deposition is high, clonal species such as sea oats dominate. As the intensity of sand movement and salt spray decreases, the numbers of inland species (e.g., camphorweed, fleabane, beach pea, and evening primrose) increase (TNC 1993). In the most stable areas, TNC (1993) noted that woody species, including live oak, cabbage palmetto, and wax myrtle characterize the plant communities.

Salinity and tidal regime are the two most important environmental factors influencing plant compositions and distribution in the estuarine communities (Tiner 1977; TNC 1993). At the fresher end of the estuarine wetland zone (salinity about 0.5 ppt), a mixture of freshwater and brackish plant species (e.g., needlerush [*Juncus roemerianus*]) is common in the low and high marsh zones (Tiner 1977; TNC 1993). Near the salt marsh upstream boundary, the species composition of the ACE Basin brackish marsh resembles the high marsh zone of the salt marsh (Tiner 1977). As the salinity rises above 10 ppt, smooth cordgrass becomes an important component of the salt marsh. The distribution of plant species within a marsh also changes in response to a salinity gradient that exists from the mean low tide mark to the marsh-upland border (Adams 1963; Stalter 1968). Near the brackish-freshwater marsh border, the flood water salinity level is about 0.5 ppt, and the range of freshwater plant species extends to the mean low tide mark (Tiner 1977). Where the salinity fluctuates between 5 and 10 ppt, freshwater species are restricted to the marsh-upland border brackish species such as giant cordgrass dominate the low marsh, and smooth cordgrass forms a monoculture stand in the low marsh (flooded daily by the tides).

A typical Carolina Bay wetland community

The major factor affecting the plant community distributions in the palustrine ecosystem is hydrology, especially the timing, duration, and depth of flooding (Wharton et al. 1982; Sharitz and Gresham 1998). Bald cypress, water tupelo, and swamp blackgum are generally found in wetlands where the substrate is inundated or saturated throughout the growing season (Wharton et al. 1982). The remaining tidal plant species on the floodplains require some period of drawdown during the growing season. Here, oaks (*Quercus* spp.) and a variety of other hardwoods as well as a few pine species thrive. As the duration of yearly flooded events decrease, the numbers of shrub and herbaceous (nonwoody) species in these communities increase. The species composition of inland wetlands also corresponds to the flooding regime. Pocosin and Carolina bay plant communities are the only fire-maintained wetlands in the ACE Basin, and the frequency and intensity of these fires control the distribution of plant species in these wetlands (Wharton 1978).

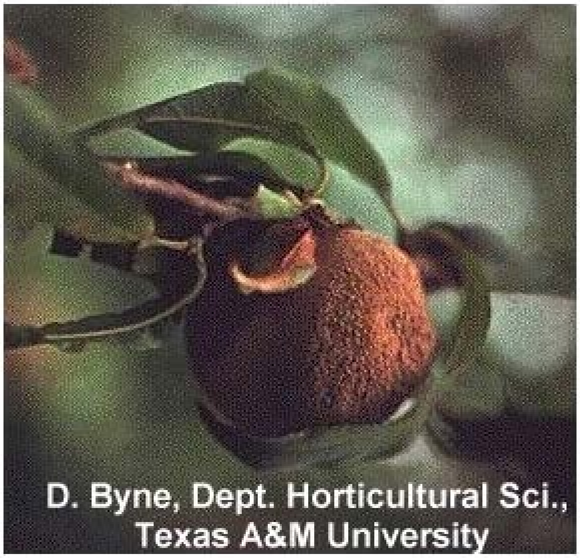
Soil moisture level and organic matter content, and the frequency of fires affect the distribution of plant species in the upland communities of the ACE Basin (Quarterman and Keever 1962; Monk 1968; Veno 1976; TNC 1993). The low, loamy soils of the ACE Basin favor the establishment of mesophytic hardwoods such as swamp laurel oak, and sweetgum; whereas, a mixture of pines and scrub oaks characterizes the well-drained, coarse sands on the sloping terrain of the ACE Basin's mainland areas. The sandy soils of the coastal islands within the ACE Basin NERR support the South Atlantic inland maritime forest community, and the soils that contain large deposits of shells are vegetated by the temperate shell midden woodland plant association. These two communities are considered variants of the barrier island forest community because they are also subjected to salt spray. Areas that burn regularly (i.e., once each year) are dominated by pyric (fire tolerant or loving) species such as longleaf pine (*Pinus palustris*).

Land use practices also affect the types and distribution of plant species in the ACE Basin study area. During the Antebellum Era, bald cypress-dominated swamps along the navigable portions of these rivers were cleared and planted in rice. Agriculture, livestock grazing, and turpentine production accounted for the loss of longleaf pine-dominated forest prior to 1900. From the 1890s to 1920s, an era of intensive logging in Colleton County, most of the remaining old-growth longleaf pines and bald cypress were felled. The fire exclusion policies of the mid-1900s resulted in further decline in the longleaf pine populations. From 1959 to 1972, approximately 687 ha (1,698 ac) of brackish marshes in the estuarine ecosystem along the Ashepoo, Combahee, and South Edisto Rivers were impounded to increase waterfowl habitat, primarily for hunting (Morgan 1974). Many landowners also repaired the rice field dikes and developed water management techniques to enhance the value of the fields as waterfowl habitat. The techniques employed by waterfowl managers to eradicate plants of low nutritive value are significantly changing the species composition of these impounded brackish marsh communities (Morgan 1974; Prevost 1988 1991). Thus, the populations of estuarine species such as black needlerush and big cordgrass and of several freshwater species (e.g., alligatorweed and bladderworts) have been reduced. Development on Edisto Island, an ACE Basin barrier island, has dramatically affected the plant zonation in the maritime ecosystem.

Quantitative information about the community structure and soil conditions of ACE Basin's ecosystems is needed before any conclusions can be drawn about the effects that natural and artificial perturbations have on the functioning of the plant communities. To understand these processes more fully, future studies must consider the effects of the interactions of hydrology, soil regimes, community type (and stand history), and species life history on the distribution of plant species and the production of biomass. As these processes are better elucidated, we will improve our ability to assess the wetlands and will be able to manage these plant communities in a sustainable manner for future generations. (See related section: Plants.)

Back to Top

Decomposers



Brown rot fungi

Decomposers are essential components of nutrient cycles in terrestrial and aquatic systems. This guild of organisms resides in or on the soil surface where it processes organic matter (i.e. plants). Bacteria and fungi are the primary decomposers because they provide the necessary enzymes needed to breakdown organic matter to inorganic forms (i.e. nitrogen [N] and phosphorus [P]). However, they rely on the activity of the secondary decomposers. The soil fauna not only modify soil parameters such as porosity, aggregation, and bulk density, but also create an ideal environment for microbial activity. Partially digested organic matter in the fecal aggregates of soil fauna provides a good habitat for enhanced microbial activity.

The structure and function of decomposer communities in these environments have the potential to alter the dynamics of nutrient cycling through various feedback mechanisms between faunal and biogeochemical processes. For example, Perison et al. (1997), while studying the relative impacts of harvest methods in the blackwater bottomland forests of the Edisto River estuary, found that the decomposition rates were higher in the harvested area. They attributed this to accelerated microbial activities as a result of higher soil temperatures. Higher ammonium and organic carbon concentrations in groundwater samples were attributed to increased decomposition rates. Similarly, deforestation in such river dominated ecosystems can lead to increased concentrations of ammonium and nitrate in drainage waters that are associated with eutrophication in streams and rivers. The interrelatedness of various nutrient cycles and decomposers means that changes within ecosystems (with respect to any one nutrient) will impact other components of the ecosystem. The tight coupling between structure and function of decomposer communities and their environment encourages the use of decomposers as indicators of ecosystem changes in response to anthropogenic perturbations. We expect that the ongoing nutrient cycling studies at several sites in the South Edisto River (e.g., Big Bay vs. St. Pierre Creek) will provide some insights. (See related section: Decomposers.)

Back to Top

Zooplankton

Zooplankton, small animals (mainly invertebrates) resident in the water column but with limited mobility, are important for their trophic position in aquatic environments. Microplankters, such as heterotrophic protists, are the primary link between phytoplankton and bacterial biomass and higher trophic levels. Mesoplankters, particularly copepods and cladocerans, are essential as food for early fish larvae and macroplankters, which in turn are fed upon by late larval and postlarval fish and other organisms.

Amphipod ***(Gammarus palustris)***

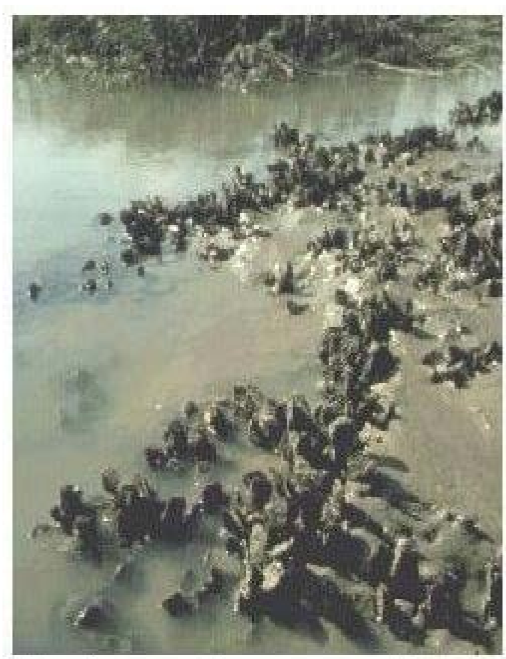
Knott (1980) described the abundance of mesozooplankton in the North Edisto River at Bluff Point, near the boundary of the ACE Basin Characterization Area, where copepods were the dominant group. Although the abundance of meroplanktonic zooplankton (spending only a portion of their lives as plankters) was uniformly low at this site, organisms such as decapod crustaceans appeared to be dominant components of the macroplankton community. Recent studies by researchers working in the North Inlet estuary of South Carolina provided some insight into the composition and dynamics of a macroplanktonic community that is likely to closely resemble that in the ACE Basin. The most abundant organisms in a 6-month series of daily samples were fish larvae, larval and postlarval decapod crustaceans (including noncommercial species), juvenile bivalves, and holoplanktonic organisms (permanent zooplanktonic residents of the water column) (Houser and Allen 1996). The existing data on freshwater zooplankton communities suggest that free-living non-photosynthetic protists, rotifers and microcrustaceans are the dominant components (Sandifer et al. 1980).

For many larval fish and crustacean species that depend on wetlands and shallow water bodies as spawning or nursery grounds, an abundant zooplanktonic population is necessary. In estuaries, macroplankters such as mysid shrimp and gammarid amphipods are an important food source for large animals (e.g., Atlantic croaker, Atlantic menhaden, seatrout, drum, blue crab, and white shrimp) (Ragotzkie 1959; Van Engel and Joseph 1968; UGMI 1971). In freshwater floodplain wetlands, larger animals preferentially select cladocerans.

Very little data exist on the dynamics of zooplankton populations in the southeast, including the ACE Basin study area. However, like other organisms, the assemblages of zooplankton in marine, estuarine, and freshwater habitats are subjected to the vagaries of their habitat. For example, in coastal marine and estuarine habitats, zooplankters are influenced by strong tidal forces, wind stress, bottom friction, and buoyancy fluxes. An abundance of both food items and predators, as well as other environmental cues such as light, salinity, and temperature, influences the activity and production of estuarine and freshwater zooplankters. (See related section: Zooplankton section.)

Back to Top

Benthic Invertebrates



Eastern oyster community
(Crassostrea virginica)

Benthic invertebrates are the small animals, such as clams, worms, and crustaceans that live on or in the bottom substrate of a water body. These organisms are an important food source for many fish and crustaceans, including many recreationally and commercially important species. In addition, benthic organisms can be important organisms for monitoring the adverse effects from anthropogenic impacts. Numerous studies have described benthic invertebrate communities in coastal South Carolina, a few of which have occurred in the ACE Basin study area.

Benthos can be classified into two categories based on their size: meiofauna (63 to 500 m m) and macrofauna (>500 m m). Studies of meiofaunal communities and their distribution patterns in both the estuarine and freshwater portions of the ACE Basin drainage system are lacking. Research on meiofaunal organisms from other coastal areas of South Carolina indicate that they have an important role in the estuarine food web complex since meiofauna consume bacteria, other microfauna and flora, and detritus; and they are, in turn, consumed by many larger macrofaunal invertebrates and juvenile finfish (Bell and Coull, 1978; Smith and Coull, 1987; Coull, 1990).

Studies of the benthic macrofauna in the ACE Basin have been more extensive than for the meiofauna, although sampling has largely been limited to subtidal estuarine and nontidal freshwater habitats. A diverse array of epifaunal species was found at most of the estuarine stations sampled in the ACE Basin. Species present at more than 70% of the stations sampled by Calder and Boothe (1977a) and Van Dolah et al. (1979) included several species of arthropods, cnidarians, and bryozoans.

Infaunal species which frequently occurred in collections in the ACE Basin included the polychaetes and amphipods (Calder and Boothe 1977b; Calder et al. 1977; Van Dolah et al. 1984 1991; and Hyland et al. 1996, 1998). A few species were found at only one or a few sites, but were very abundant (>1000 individuals/m^2). Other taxa that were commonly found at many of the sites in the ACE Basin, often at high abundances, and were not identified to the genus or species level included oligochaetes, nemerteans, and actinarians. Although benthic invertebrates from tidal creeks, sand beaches and marsh flats have not been sampled in the ACE Basin, species collected from these habitats in other parts of South Carolina should be representative of those found in the ACE Basin system.

The dominant taxa observed at riverine sites in the ACE Basin include insects, an isopod, crayfish, and oligochaetes. In general, insect taxa form a much greater component of the invertebrate taxa found in freshwater habitats compared to estuarine.

In general, there are many factors that play an important role in regulating the distribution and abundance of the meiofaunal and macrofaunal communities in the ACE Basin. Since these biota represent an important food source for many other larger taxa, predation effects are often a major regulating factor. Competition, both among individuals within a species as well as among species, can also play a major role in limiting faunal abundances and distribution. These factors, when combined with the effects of various physico-chemical factors such as salinity, temperature, dissolved oxygen, sediment grain size, depth of the redox (reducing) layer within the sediments, and distribution along the intertidal-subtidal depth gradient in estuarine environments, result in very complex spatial and temporal patterns of these assemblages. Both sediment characteristics and salinity conditions appear to be the primary environmental factors influencing the distribution of the infaunal species, as well as some of the epifaunal taxa that were collected from the ACE Basin. (See related section: Benthic Invertebrates.)

Back to Top

Insects

Because of their diversity and abundance, insects play major roles in the functioning of terrestrial and freshwater ecosystems. For example, insects influence the nutrient and energy flow of ecosystems in many ways, but perhaps most importantly as decomposers. No source of decaying organic material goes unused by insects, and their action is often necessary before other groups of decomposers can take advantage of the material. In both terrestrial and freshwater aquatic ecosystems, insect decomposers are crucial to the breakdown of plant material (both leaf litter and woody material), dead animals, and waste material. The decomposition of carrion is also slowed when insects are excluded from the process (Payne, 1965).

Despite the many important ways that insects influence ecosystem structure and function, we know relatively little about the insect faunas of most southeastern U.S. habitats, including those in the ACE Basin study area. Based on known and likely distributions, the ACE Basin study area should have 30 orders of insects (out of the 31 recognized in Borror et al. 1989), only lacking the Grylloblattaria, which are known only from beyond the treeline in the mountains and the arctic (Scholtens pers. comm.). Scholtens (pers. comm.) estimated that 8,000 to 10,000 insect species live in the Basin. This estimate should be considered preliminary because so few groups have been surveyed, and for those that have, there are either relatively few collections, or survey work was done outside the ACE Basin study area.

Probably the best studied taxa of insects in the ACE Basin study area and elsewhere are the butterflies and skippers (Papilionoidea and Hesperioidea). They occur in all major habitats in the ACE Basin study area, and approximately 125 butterfly and skipper species are either residents or migrants. Of the 125 butterfly and skipper species in the ACE Basin study area, 41 are classified as habitat specialists. Of these, 27 are restricted to some sort of wooded habitat and 12 to open habitats, and 2 have mixed preferences. Overall, 24 species prefer wet or moist habitats and 17 prefer dry habitats. These numbers indicate that the loss of some specialized habitats, particularly wetlands, could result in the disproportionate loss of species from two families of butterflies and skippers. For at least these insect groups, the numbers emphasize the importance of swamps, freshwater marshes, and saltwater marshes for maintaining species diversity.

For most groups of insects in most habitats, however, a great deal remains to be learned about how they influence the structure and functioning of that ecosystem. Of all habitats characteristic of the ACE Basin study area, the most is known about the community of insects found in salt marshes (Davis 1978; Davis and Gray 1966; Foster and Treherne 1976; Marples 1966; Teal 1962). Davis and Gray (1966) showed that the most abundant insects in the salt marsh are the Diptera (true flies) and Homoptera (hoppers), each with only a few common species represented. The next most abundant orders of insects are Coleoptera (beetles), Orthoptera (grasshoppers, katydids, and crickets), Lepidoptera (butterflies and moths), Hemiptera (true bugs), Hymenoptera (bees, wasps, and ants), and Odonata (dragonflies and damselflies), respectively, as well as smaller numbers of other orders. Vernberg and Sansbury (1972) found similar results in Port Royal Sound, South Carolina, and these same dominants are likely abundant throughout salt marshes in the ACE Basin study area. However, salt marsh habitat has a relatively low diversity of insects despite their high abundance.

Since no group of insects in any ACE Basin habitat has received significant attention, it is difficult to make knowledgeable decisions about how best to maintain insect diversity in the region. However, there is consensus in the field of insect conservation that the most important factor in maintaining diversity is maintaining appropriate habitat (Gaston et al. 1993; Pullin 1995). In this regard the ACE Basin study area is fortunate because large areas of habitat are already set aside as protected lands. Additional conserved areas could be advantageous in maintaining insect diversity, but decisions about which habitats are most important will have to await more complete information on occurrence and distribution of insects in the region. (See related section: Insects.)

Back to Top

Decapod Crustaceans

Fiddler crab *(Uca pugnax)*

Decapod crustaceans are known to play a critical role in metabolizing and controlling the flow of energy in estuarine ecosystems. Decapods are preyed upon by a variety of predators and are also important predators themselves, consuming phytoplankton, benthic algae, and macrobenthos (Coull and Bell 1983). Depending on its intensity, predation is a factor in controlling population density, as well as structuring species assemblages within a habitat. Decapod particulate feeders consume detritus derived from smooth cordgrass and feces, thereby making detritus available to several different trophic levels and processing particles in such a way that substrate is enhanced for accelerated growth by diatoms and bacteria (Field 1983). Decapod crustaceans in the ACE Basin study area occupy subtidal and intertidal estuarine habitats where they are provided a refuge from predation and a source of food. These habitats are exploited by year-round residents, such as grass shrimp, or seasonally abundant species such as blue crab and the penaeid shrimps (Kneib 1984; Weinstein 1979).

Although decapod species are conspicuous inhabitants of the ACE Basin study area and many are economically important, few comprehensive studies of the decapod community have been done in that region. Information is available on the decapod community from shallow marsh, oyster reefs, impoundments and tidal freshwater areas for other coastal areas of South Carolina. Most of the information on decapod species assemblages has come from trawl surveys of the rivers in and near the ACE Basin study area. The trawl surveys (1973-1975) collected a total of 38 species from eight stations in the North Edisto River, and 30 species from four stations in the South Edisto (Wenner et al. 1991). A more recent survey (1993-1999) in the ACE Basin collected a total of 43,319 individuals representing 28 species during the first five years. A greater number of species (26) was collected in the South Edisto, while 23 species were collected from the Ashepoo River and 17 from the Combahee River. This difference probably reflects influence of the strong salinity gradient in the South Edisto, which encourages invasion by stenohaline marine species from the coastal zone. The white shrimp, the brown shrimp, and blue crab were the most abundant species in all three rivers. Because these species utilize the estuaries for only a portion of their life cycle, distinct seasonal changes in abundance of these dominant species occurred in the study area.

Given the baseline information collected on decapod crustaceans from the ACE Basin study area, it appears that this system is similar to others that have been studied throughout the state. This system supports a diverse assemblage of decapods, and provides seasonal habitats for transient species and permanent year-round habitats for resident species. Given differences in life history, sizes, and behaviors of decapod crustaceans, further efforts to understand their community structure in the ACE Basin study area should focus on shallow marsh and freshwater areas where there is a paucity of information. (See related section: Decapod Crustaceans.)

Back to Top

Fish Communities

The ACE Basin contains a diverse assemblage of fish species in its freshwater, estuarine, and coastal environments. Salinity, vegetation, and bottom substrate are some of the physical characteristics that affect fish species composition and distribution. Many of the fish species that characterize the ACE Basin move in response to environmental cues, and because their reaction to cues may change with growth and development, few species mature in the area where they were spawned. Thus, occurrence within a habitat or salinity regime may change with life history stage or season, making a static description of the fish community in the ACE Basin difficult to obtain.

Redbreast sunfish *(Lepomis auritus)*

Freshwater fishes occupy the uppermost portions of rivers in the ACE Basin study area, occurring in nontidal freshwater areas. In low salinity (brackish) areas of the estuary, freshwater and estuarine fishes co-occur, thereby creating a dynamic and diverse community. In recent years, research emphasis has been placed on characterizing the status of the fisheries resources and the structure and composition of the fish community in the Edisto River (Thomason et al. 1993), which is one of the most significant "blackwater streams" of the southeastern coastal plain (Marcy and O'Brien-White 1995). Since 1967, 87 species from 25 families have been identified from the freshwater portion of the Edisto River Basin. Although diversity is high, production is low in the Edisto River, especially in the area below Orangeburg (Tomason et al. 1993; Marcy and O'Brien-White 1995). High diversity in combination with low production suggests that there may be impacts on the macroinvertebrate food base in the system. Most species in the freshwater fish community utilize the shallow, palustrine emergent wetlands as foraging areas. Plankton, crustaceans, aquatic insects and small fishes are preferred prey. The introduction of the non-endemic flathead catfish to the Edisto River has had a profound effect on the resident freshwater fish community. Abundances of the native bullhead catfish are dramatically reduced in areas where flathead are abundant. Populations of the sportfish, redbreasted sunfish, have also been depleted by the presence of flathead catfish in the Edisto River. As the abundance of flathead catfish increases, certain native species appear to decline in abundance. This can lead to a significant alteration of the fish community in the Edisto River and possibly other areas of the ACE Basin study area.

Estuarine portions of the ACE Basin study area and adjacent rivers are typically important nursery areas for numerous fish species. These areas have been sampled extensively over the past 30 years. Most studies of the community ecology and life history of fishes from subtidal estuarine habitats have been based on sampling with otter trawl. A long-term trawl survey of the three rivers begun in 1993 collected a total of 54,714 individuals and 80 species of fish during the first five years. The greatest number of species was recorded from the Ashepoo (68) and Edisto (67) rivers, while the Combahee (49) yielded the fewest species. Within each river, the greatest number of species was recorded from stations nearest the mouth. The numerically dominant finfish species for all three rivers were star drum, Atlantic croaker , and bay anchovy. These species showed temporal regularity in their abundance in the three major rivers within the characterization study area. Although some competition for food undoubtedly occurs, preferences for different salinity regimes, substrates and bathymetric zones are adaptive means to reduce competition from co-occurring species.

Sampling fish with rotenone

Tidal creeks are a major feature of estuaries in the ACE Basin study area. Variable in size and water depth, they provide primary nursery habitat for larvae and juveniles of many fish species. Shallow water creek habitats in the ACE Basin study area have been sampled by trammel nets and rotenone. Both methods provide an effective way to sample shallow habitats and to capture fast-moving as well as demersal species. The spotted seatrout, striped mullet, spot, hardhead catfish, red drum, and southern flounder were the most abundant species collected in tidal creeks and together constituted over 80% of the total number of individuals. The fish community from other intertidal habitats of salt marsh, impoundments, and oyster reefs has not been specifically studied in the ACE Basin. Research on fishes from these habitats in other areas of the state indicates that they provide nursery grounds for larvae and juveniles of many fish species before they move into deeper subtidal habitats in the estuary. The shallow-water marsh and oyster reef habitats also serve as a refuge from predation by providing spatially complex habitat which predators have difficulty penetrating (Boesch and Turner 1984; Knott et al. 1996).

Fishes that occur in the coastal zone consist of year-round residents and migrant species that are in transit to or from spawning grounds or are using the coastal zone as spawning grounds (Wenner and Sedberry 1989; Beatty and Boylan 1997). An ongoing trawl survey of fishes in the nearshore coastal zone indicates numerical dominance by a number of species that occur within the estuaries of the ACE Basin during part of their life cycle. Since 1989, collections have been largely dominated by spot and Atlantic croaker, two of the common estuarine transient species found in trawl surveys of the ACE Basin study area. Other species of numerical importance have been the Atlantic bumper, the striped anchovy, the star drum, scup, and pinfish. The fish community from the coastal zone appears to be dominated by sciaenid fishes, many of which utilize estuaries for some part of their life cycle.

The extensive aquatic habitats of the ACE Basin study area that are used for spawning, nursery, and foraging areas support and maintain many fish populations (Beasley et al. 1996). Limiting development in the ACE Basin study area contributes to the health of fish populations by limiting impacts on water quality, hydrology, and vegetation. Because of dependence by fishes on the tidal wetlands in the ACE Basin as a source of food and protection from predators, it is essential that these areas remain intact. Destruction or disturbance of habitat will impact the community dynamics, resulting in decreased utilization by species and, in some cases, avoidance of the area. Habitats at risk from land-based impacts include oyster reefs, mudflats, and emergent tidal marshes. Degradation of water quality or hydrologic modifications can also affect habitat quality. Anthropogenic activities in the ACE Basin that can affect fish populations and the benthic invertebrates upon which they feed include clearcutting hardwood timber, heavy crop irrigation, and industrial/residential development. Cutting of bottomland hardwoods eliminates leaves and woody debris that are an important primary food source. Loss of canopy cover allows solar radiation to raise water temperature to high levels, especially in summer. Erosion and siltation resulting from logging operations can also have detrimental effects on water quality.

As the linkage between anthropogenic impacts and declining fish abundance, health, and quality becomes clearer, the implications of increased population growth in areas surrounding the ACE Basin study area raise concerns. Because the southeast coastal zone is one of the nation's fastest growing regions, it is especially critical that the monitoring of fishes that are dependent on rivers and estuaries for their survival continues. It is also important that effects at the population and community level be linked to physical and hydrologic alteration, as well as water quality modifications. (See related section: Fish section.)

Back to Top

Herpetofauna

Reptiles and amphibians (i.e., herpetofauna) occur in every habitat in the ACE Basin. Herpetofaunal communities are extensive and active throughout the year along the South Carolina coast because of its warm, humid climate. The composition of herpetofauna communities is primarily controlled by water regimes, salinity of the water, and structure of the vegetative community (Sandifer et al. 1980). Species such as the American alligator, the cottonmouth, and the southern toad are examples of species that inhabit a wide range of areas and are important members of the herpetofaunal community in many of the ACE Basin habitats. Other species, such as salamanders or certain treefrogs, may have a very restricted range of habitats because they cannot withstand exposure to saltwater, are very sensitive to dry conditions, or require ephemeral wetland habitats.

Research on herpetofauna of the ACE Basin is scarce. Because

Eastern cottonmouth
(Agkistrodon piscivorus)

population abundance for reptiles and amphibians is difficult to estimate, such data do not exist for the ACE Basin; however, surveys from similar habitats in other areas can provide useful information to estimate the species potentially inhabiting the Basin. Approximately 110 species of herpetofauna have been documented or are expected to occur in the ACE Basin. Of these, there are 36 species of snakes, 18 species of turtles, 12 species of lizards including one introduced species, 20 species of frogs, 4 species of toads, 19 species of salamanders, newts and other amphibians, and 1 alligator species.

Because vegetative communities and herpetofauna are dependent on water conditions, many herpetofaunal communities are associated with particular plant communities and hydrologic conditions. Reptiles occurring in the coastal marine habitat, those areas just seaward of the ACE Basin, include the green, Kemps Ridley, loggerhead, hawksbill, and the occasional leatherback. Most of these are considered transients in South Carolina waters. The loggerhead is the only species that is regularly seen in the estuarine portions of the ACE Basin and also nests on the beaches of the barrier islands.

When compared to adjacent mainland areas, ACE Basin barrier islands (Edisto Beach, Otter Island, Deveaux bank, and Hunting Island) may have a lower abundance and diversity of species (Gibbons and Coker 1978). Only those reptiles and amphibians that can withstand the dry conditions in the dune and shrub habitats such as the six-lined race runner can be regularly found. Other species such as the island glass lizard (state species of concern), eastern glass lizard, eastern coachwhip, and eastern diamondback rattlesnake are seen occasionally (Gibbons and Harrison 1981). The diversity of reptile species that inhabit the maritime forest habitat is higher than dry dune and shrub environments because of the presence of moist habitats, intermittent or permanent water sources, and cover in the form of leaf litter, vegetation, and rotting logs that provide a variety of microhabitats for herpetofauna to utilize (Gibbons and Coker 1978; Sandifer et al. 1980). Species common to these barrier island forests are green treefrogs, Carolina anole, ground skinks, broadhead skinks, rat snakes, and eastern diamondback rattlesnakes. Other less frequently found species include squirrel treefrogs, southern leopard frogs, rough green snakes, southeastern crowned snakes, and cottonmouth snakes.

Because of the difficult conditions found in open water estuarine and salt marsh habitats, there are few species that utilize these habitats. The Carolina diamondback terrapin is the only species that is a resident. They are found in the tidal creeks of the salt marsh where they live and feed. The loggerhead is principally a marine species, but is also frequently seen in the rivers, generally feeding on crustaceans, jellyfish, and fishes. They are seasonal transients, moving south during the winter to find warmer waters. Alligators are known to feed in estuarine waters and may spend time in waters that are between 10 and 20 parts per thousand, but rarely stay in these areas for long periods. Similar to open water estuarine areas, estuarine impoundments are generally saline and have a limited number of herpetofauna. Diamondback terrapins, alligators, and occasionally cottonmouths are found. It is in oligohaline habitats, where the salinity is below 5 parts per thousand (ppt), that the diversity of species begins to increase (Sandifer et al. 1980).

American alligator
(Alligator mississippiensis)

In the tidal freshwater habitats, the number of species of reptiles increases from the numbers in estuarine areas, and many of the species found in the riverine system are also in tidal marshes and impoundments. Species found in freshwaters of the ACE Basin include a number of snakes such as the cottonmouth, redbelly water snake, banded water snake, and brown water snake as well as others. The American alligator and a number turtles including the Florida cooter, snapping turtle, river cooter, spiny softshell, and yellowbelly slider are found in riverine systems. These habitats are prime areas for the American alligator. The variety of habitats in forested wetlands may support more than 30 herpetofauna species. The anurans (frogs and toads) are the most abundant group in these habitats. Turtles are also an abundant group, with approximately seven species potentially occurring in tidal forested habitats.

Nontidal forested wetlands may go through periods of low water levels, restricting the number of species that are dependent on permanent water sources. Thus, while the herpetofauna of these regions are similar to tidal forested wetlands, some species are not found as regularly. A few species are found in nontidal wetlands that are not found frequently in tidal wetlands. These include the carpenter frog, little grass frog, the many-lined salamander, the three-lined salamander, and the oak toad. Some lizards and snakes that are more frequent in nontidal versus tidal forested wetlands because of the drier conditions are the eastern and slender glass lizards, black swamp snake, timber rattlesnake, and the southeastern crowned snake.

The diversity of habitats in upland hardwood and pine flatwood communities can result in a wide variety of herpetofauna. The species that occur in upland habitats in the ACE Basin are dependent on the history of rain in the previous months. Bullfrogs may by common during wet periods while lizards and pine woods treefrogs may be more common during dry periods. Snakes, with their armored scales, tend to dominate in the mostly dry habitat of the upland pine flatwood community. The dominant species include the corn snake, eastern diamondback rattlesnake, black racer, eastern garter snake, and pine snake. The pine woods treefrog is found in these habitats. The upland hardwood forest habitat tends not to be as dry as pine flatwoods and supports additional species of salamanders including the spotted salamander, marbled salamander, and the mole salamander as well as others. The copperhead and cottonmouth snakes are present in this habitat.

Reptiles and amphibians play an important role in the ACE Basin as predators that serve to control the populations of various prey species such as other reptiles and birds, and small mammals such as squirrels, rats, and mice. They are also important as prey species for birds, mammals, and other reptiles and amphibians and can make up most of the vertebrate biomass in some habitats (Burton and Likens 1975). Because of their habitat requirements, especially the amphibians, changes in the diversity of the reptile community may indicate changes in the habitats on which they are dependent and therefore may serve as indicators of environmental change or degradation (Pechmann et al. 1991; Blaustein et al. 1994; Fontenot et al. 1996). (See related section: Herpetofauna.)

Back to Top

Birds

Lesser scaup *(Aimophila aestivalis)*

The ACE Basin study area has an extremely rich bird life. Over half of the species of birds that occur in North America inhabit the 320,000 ha (790,000 ac) of the ACE Basin study area. There are about 8,600 species of birds in the world divided into 28 orders. Of these, approximately 280 species of birds in 17 orders occur in the ACE Basin study area. Many of these birds migrate in tremendous numbers to South Carolina from northern breeding grounds to spend their winters or to rest before continuing their migration to more southern areas. The ACE Basin is well known for its important bird breeding habitats, in particular bald eagles, least terns, and wood storks, three species listed as threatened or endangered by state or federal authorities.

An estimated 30 species of birds utilize the coastal marine subtidal habitat as feeding grounds. Eight of these species are common year-round residents and seven are common in winter. The majority of birds in this habitat are piscivorous and catch fish by aerially diving (e.g., terns, gannets); surface diving (e.g., loons, double-crested cormorants); or surface skimming (skimmers, gull-billed terns). Two species (e.g., Wilson's petrel and northern phalarope) feed on nearshore zooplankton while diving ducks consume benthic organisms (Sandifer et al. 1980). The estimated 44 species of birds that utilize the coastal marine beaches can be divided into three broad categories: (1) marine species such as the royal terns and black skimmers that feed on fish and use the beaches only for resting or breeding; (2) macrobenthic predator species (e.g., sanderlings, American oystercatchers, plovers, and sandpipers) that hunt in the sand for annelids, crustaceans, and mollusks; and (3) beach scavengers such as gulls, crows, boat-tailed grackles, and vultures that feed mostly on dead animal matter that litters the beaches (Sandifer et al. 1980).

Several species of colonial waterbirds (e.g., brown pelicans, laughing gull, sandwich terns, and black skimmers) that feed in the coastal marine habitats nest on bird keys. Bird keys and banks are small isolated islands that usually occur in tidal inlets and broad bays. They are very dynamic habitats because they are susceptible to overwash by storm action and spring tides, and they tend to migrate in response to inlet morphology (Sandifer et al. 1980). Forty-two percent of all colonial waterbird nests counted during 1969 were on Deveaux Bank, the only bird key in the ACE Basin.

The maritime communities (dune, maritime shrub thickets, maritime forests) in the ACE Basin are harsh environments with many stressful physical attributes (e.g., blowing sand, high summer temperature, limited freshwater, and sparse vegetation). In the dune community, the avifauna community is primarily comprised of granivores (grain eaters) and insectivores (insect eaters). Sea oats seeds make up the bulk of the diet for eleven species of granivorous birds such as doves, blackbirds, sparrows, and cardinals. Insectivores (e.g., nighthawk, swallows, chimney swift, and warblers) are the next largest group of bird in the dune habitat. These birds eat a variety of insects including flying ants, mosquitoes, beetles, and gnats. The lack of an understory and the low herbaceous plant density in the maritime shrub thicket community provide little food for granivorous and herbivorous species. Most species in this habitat consume insects (e.g., kingbird, yellow-throat, and sparrow hawk). The maritime forests provide more diverse habitats than the coastal marine and other maritime communities; therefore, they contain a more diverse avian community. Of the 280 birds found in the ACE Basin study area, almost one-third (87) can be found in the maritime forests. Many of the birds in the maritime forests are passerine birds including flycatchers, swallows, crows, nuthatches, wrens, kinglets, thrushes, vireos, warblers, sparrows, blackbirds, grackles, and finches. The painted bunting, a common summer resident, is probably the most visually spectacular bird found in this habitat. Insects make up all or part of the diet of most passerine birds, although grains and fruits also are important. Warblers, swallows, vireos, and flycatchers feed almost exclusively on insects, while sparrows, buntings, and finches feed mainly on vegetarian matter such as fruits, seeds, and grains (Sprunt and Chamberland 1970).

The estuarine subtidal habitat is an open water system used mainly by birds for resting and feeding. All of the birds found in this habitat are waterbirds which feed on fish, benthos, carrion, or insects. Terns, cormorants, and brown pelicans inhabit open water areas to feed on fish. Three species of gulls (laughing, herring, and ring-billed) are important in the consumption of dead animal matter. The osprey is the only bird of prey to utilize this habitat where it feeds on its primary prey, fish. The estuarine intertidal areas provide feeding, nesting, and resting habitats for approximately 87 species of birds. Wading birds such as herons and egrets use intertidal creek habitat for feeding on their primary prey, which includes mummichogs, mullet, menhaden, and penaeid shrimp. Other birds such as rails, swallows, wrens, and blackbirds use the salt marsh habitat as feeding and nesting grounds. The clapper rail is a strict inhabitant of ACE Basin salt marshes. This species feeds, roosts, nests, and raises its young on the *Spartina* marsh (Sandifer et al. 1980). Eight species of herons and egrets utilize the estuarine intertidal flats as feeding grounds with the great egret, snowy egret, and tricolored (Louisiana) heron being the most abundant. Many of the shorebirds such as the American oystercatcher feed extensively in the estuarine habitat types but breed in others such as beaches and bird keys.

The palustrine forested wetlands has the highest avian diversity of any environment in the ACE Basin study area; these wetlands provide an estimated 132 species of birds a wide variety of habitat types. The occurrence of wet and dry tree species and both grassland as well as closed canopy sites contribute to a high diversity of birds (Sandifer et al. 1980). Of the 132 bird species, 34 are year-round residents and 23 are winter residents. Ten species of birds, seven of which are warblers, are closely associated with forested wetlands. The seven species (blue-winged warbler, golden-winged warbler, Tennessee warbler, Swainson’s warbler, black-throated warbler, gray-cheeked thrush, Louisiana waterthrush, and worm-eating warbler) feed on the large number of insects that occur in this habitat; however, these birds are rare or uncommon in the ACE Basin study area. Palustrine forests are also important nesting grounds for wading birds such as herons, ibises, and egrets. Nesting populations of wood storks have steadily increased since 1981 and in 1997, 653 wood stork nests were identified in the ACE Basin study area.

Ninety-two of the 280 avian species in the ACE Basin study area are estimated to occur within non-forested wetlands. These wetlands provide nesting grounds for a variety of birds including gallinules, wrens, swallows, red-winged blackbirds, and king rails. Wading birds such as herons, egrets, and ibises use freshwater wetlands as feeding grounds. Waterfowl are abundant in this habitat because the freshwater vegetation is often preferred over salt marsh vegetation for food. They eat the seeds of water lilies, pondweed, water milfoil, and widgeon grass along with mollusks, crustaceans, and insects. The osprey is the only bird of prey to utilize this habitat where it feeds primarily on fish.

The riverine system as discussed here is limited to the open water areas of rivers and does not include adjacent wetland areas. The avifauna of the riverine systems of the ACE Basin study area is made up of species that occur in other habitats and use the rivers for feeding or resting (Sandifer et al. 1980). Species found here forage in the rivers for aquatic plants or animals. About eleven species of ducks use the river to forage for aquatic vegetation such as pondweeds, wigeon grass, wild rice, eelgrass, and marsh grass. Grebes and wading birds hunt for fish either by diving (grebes) or by fishing from shore (wading birds). Shorebirds such as sandpipers and plovers also fish from shore in the rivers for crustaceans, mollusks, fish, and aquatic insects while gulls and terns forage on the rivers for similar prey. The osprey is the only bird of prey to utilize this habitat extensively. The osprey not only hunts in the riverine waters for fish but it also commonly nests on dead snags, channel markers, and power line poles in rivers.

Impoundments are estuarine or freshwater wetlands which have been diked to create managed bodies of water. Most impoundments in the ACE Basin study area are managed for waterfowl and are characterized by brackish or freshwater vegetation. The waterfowl in impoundments consists of geese (Canada geese); puddle ducks (e.g., mallards, teals, gadwalls, wigeons, and shovelers); and diving ducks (e.g., ring-necked ducks, buffleheads, mergansers, and ruddy ducks). Puddle ducks are the most abundant group of waterfowl. These species preferentially feed on wild rice, spikerush, pondweeds, smartweeds, bulrushes, and wigeon grasses and, therefore, many impoundments are managed for these plant species. Wading birds and shorebirds, as well as birds of prey (e.g., bald eagle and osprey) utilize this habitat type.

Pine-hardwood forests in the ACE Basin study area have more bird species than the other upland communities. These mixed upland forests have extensive subcanopy and understory growth that greatly augments the habitat types available and, therefore, more birds can be found here. The abundance of nuts, seeds, and insects provides ample food for a variety of granivores (grain eaters), insectivores (insect eaters), and herbivores (plant eaters). The avian fauna in pine forests of the ACE Basin study area is less diverse because of the lack of dense understory vegetation. Fifty-two species of birds are estimated to occur in pine forests and almost half are considered common year-round residents. Insect-eaters, generalists, and seed-eaters are represented by warblers, bobwhites, and the brown-headed nuthatch, respectively. Woodpeckers are abundant in this habitat, with the red-bellied being most abundant. Seven birds of prey can be found in pine forests. The screech-owl, which often builds its nest in woodpecker holes, is a dominant owl species in the pine forest habitat (Sandifer et al. 1980). Seventy-four birds are estimated to occur in old-field habitats of the ACE Basin study area. Diversity and densities of birds tend to be low in newly abandoned farmlands because these areas lack a shrub layer. The edge community supports a high diversity and density of avifauna. Many of the 74 birds that are estimated to occur in old-field habitats fulfill part or all of their dietary needs from the seeds, grains, and fruits. Others (e.g., Carolina wren, common yellowthroat, brown thrasher, and eastern meadowlark) consume the insects that are feeding in this habitat.

Birds are rarely restricted to one environment and are often found in a variety of habitats (Potter et al. 1980). Typically, they rely on the resources of several habitats for their survival. For example, a bald eagle pair builds its nest in a wooded area, but to fulfill the daily requirement of their young, the nest is located within one mile of large bodies of water such as impounded marshes. Adult wild turkeys occur in a variety of habitat types, preferring mixed pine/hardwood stands interspersed with open areas. Yet the daily water requirement of the young necessitates that the nest site be located within 0.4 km (0.25 mi) of a water source. Thus, the most serious conservation issue for birds of the ACE Basin study area is loss of habitat diversity.

The loss of bird diversity would impact humans because of the wide range of ecological roles filled by birds. The insectivorous birds consume large quantities of insects each day. For example, the pine warbler forages for insects common to upland forests; the chimney swift feeds over the river, catching beetles, flies, and ants; while the ubiquitous Carolina wren feed on insects found in a variety of plant communities (Bent 1964; Sprunt and Chamberlain 1970). The populations of nuisance animals (e.g., rodents and rabbits) are regulated by the raptor species such as hawks, eagles, and owls. Scavengers such as vultures and gulls play an important role in removal of dead animals from all habitats and the recycling of nutrients. (See related section: Birds.)

Back to Top

Mammals

Gray fox *(Urocyon cinereoargenteus)*

Forty-seven species of mammals, in nine orders, are estimated to occur in the ACE Basin study, representing nine orders: bats, rabbits, rodents, marsupials, insectivores, carnivores, manatees, dolphins, and hooved mammals. A number of mammalian species (e.g., dolphins, whales, and manatees) have adapted to an exclusively aquatic life. Several species of dolphins and whales can be found in waters offshore of the ACE Basin study area. These include the saddleback, Risso, Atlantic spotted, and striped dolphins, as well as the short-finned pilot, killer, goose-beaked, sperm, dwarf sperm, and pygmy whales. These species are almost exclusively oceanic species and are encountered only very rarely in the nearshore coastal regions. Two species of marine mammals are residents in the coastal waters of the ACE Basin study area, the bottlenose dolphin and the West Indian manatee. Most of the species in the ACE Basin are widely distributed, and they utilize a variety of habitats.

The dune and maritime shrub thicket communities on the ACE Basin's barrier islands (e.g., Edisto Beach and Otter Island) are extremely harsh environments, and few mammalian species are adapted to subsist here (Sandifer et al. 1980). In general, only those species which can adapt to survive in any habitat are found in the dune communities. Several of these species, such as the house mouse and raccoon, are generalist feeders that consume a wide variety of plant and animal matter. White-tailed deer, opossums, and raccoons are probably the only large mammals found on sand dunes. These mammals come out onto the dunes to graze (deer) or to hunt (raccoons and opossums). The maritime forests that lie inland of the dune and maritime shrub thicket communities contain a more diverse mammalian assemblage. All five insectivore (insect eater) species such as the short-tailed shrew, least shrew, and eastern moles, of the ACE Basin study area probably occur in maritime forests. Bats are another group of insect eaters that feed in the maritime forest, and the dominant species include Seminole bats, red bats, big-brown bats, and evening bats. Of the larger omnivorous or carnivorous mammals, the raccoon, opossum, and bobcat are probably the most abundant in the maritime forests (Pelton 1975).

Like the dune community, the salt marsh habitats of the ACE Basin study area have a low diversity of mammals, and contain a similar assemblage of mammals (e.g., rats, mice, and shrews). The ubiquitous white-tailed deer and raccoon regularly forage in the salt marsh. River otters are a dominant carnivore in the salt marsh habitat where they feed on a variety of aquatic animals including fish, crustaceans, turtles, and waterfowl (Baker and Carmichael 1996); however, the species also frequents the deep freshwater habitat of the maritime and palustrine ecosystem. Several species of mammals are specifically adapted to estuarine habitat. For example, the marsh rabbit, which is often abundant in the brackish marshes of coastal zones, feeds upon a variety of brackish marsh plants including marsh pennywort and cattails. The marsh rice rat is also adapted to the salt marsh habitat (Webster et al. 1985).

The palustrine ecosystem is the most diverse habitat in the ACE Basin study area. The ecosystem contains freshwater rivers, marshes, meadows, swamps, hardwood forests, mixed forests, and pine forests. Because it is so diverse, the palustrine ecosystem is likely to provide suitable habitat for every mammal found in the ACE Basin study area. Some species, such as the opossum, eastern mole, golden mouse, house mouse, cottontail rabbit, raccoon, long-tailed weasel, and white-tailed deer are ubiquitous and are found in many different palustrine habitats. Other species exhibit specific habitat preferences.

The upland ecosystem in the ACE Basin study area contains fewer unique habitats than palustrine ecosystems and, therefore, a less diverse mammalian community. Upland habitat where cleared fields are interspersed with woodlands provides sites for foraging as well as sufficient cover for protection against predators for a number of small herbivorous mammals such as cottontail rabbits, rats, and mice (Webster et al. 1985). Coyotes and red foxes utilize the agricultural fields to hunt the small mammals which forage there. Both species feed on rabbits, mice, birds, insects, carrion, and even some fruits and berries. Pine forests, a common upland community in the ACE Basin, contain a mammalian community that is similar to that found in palustrine forests. A few species such as the fox squirrel and Seminole bats are probably more abundant in pine forest than in the palustrine forests because of their preference for feeding on or roosting in pine trees.

Similar to bird species, mammals typically utilize several habitat types during their lifetime. Thus, loss of habitat diversity is probably the most significant threat to mammals. For example, the conversion of forested lands to agricultural fields or pine plantations produces monoculture upland habitats that support substantially fewer species (Meffe and Carroll 1994). Consequently, to preserve the mammalian fauna in the ACE Basin study area, managers must continue to protect large tracts of undisturbed land that include an interspersion of many different habitat types such as wetlands, meadows, and forests. (See related section: Mammals.)

Back to Top

Threatened and Endangered Species

Wood stork ***(Mycteria americana)***

Low pollution levels, limited urbanization, and relatively high habitat diversity contribute to the importance of the ACE Basin as a refuge for endangered species. Nine federally endangered species (i.e. peregrine falcon, Canby's dropwort, chaffseed, hawksbill turtle, leatherback turtle, red-cockaded woodpecker, shortnose sturgeon, West Indian manatee, and wood stork) utilize the ACE Basin. Six federally threatened species (i.e. bald eagle, eastern indigo snake, green turtle, American alligator, loggerhead turtle, piping plover) have also been observed in the area. In addition, thirty species are designated as threatened, endangered, or species of concern by the state of South Carolina.

Conservation initiatives that have been implemented over the two last decades protected large tracts of land from significant development. Westvaco and Georgia-Pacific, the largest timber companies working in the ACE Basin have developed management plans that incorporate measures to protect red-cockaded woodpeckers' preferred habitat of old pine trees (Grobowski pers. comm.). The ACE Basin NERR and SCDNR purchased Otter Island to protect one of the last undisturbed barrier islands from development and to conserve a vital habitat for several threatened and endangered species such as the loggerhead turtle. (See related section: Threatened and Endangered Species.)

Back to Top

Species Gallery

The ACE Characterization Species Gallery contains short descriptions of 77 species from six categories of organisms that occur in the ACE Basin. The six categories of organisms are plants, marine invertebrates, fish, reptiles, birds, and mammals. These species were selected for inclusion in the Species Gallery because of their ecological, commercial and/or recreational value in the ACE Basin ecosystem or because they have protected status. Each description contains a picture and a narrative that describes the physical characteristics of the species, their biology and habitat. Sounds are included for some species. (See related section: Species Gallery.)

Back to Executive Summary Introduction
Next Section: Socioeconomic Assessment

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Executive Summary
Socioeconomic Assessment

Introduction

Our interactions with the environment, including extraction of resources and alteration to the physical landscape, often have far-reaching effects. To manage resources of the ACE Basin effectively, there must be both an understanding of the physical and biological environment and knowledge of socioeconomic conditions. Socioeconomic data provide an important perspective of the individuals and businesses that reside in the ACE Basin. These entities are the primary stakeholders in the region's ecological health and economic development, and ultimately determine what strategies will or will not succeed in the area.

The population of the ACE Basin is centered near the three incorporated municipalities of Walterboro, Cottageville, and Edisto Beach. Presently, Walterboro is the only urban area in Colleton County with public water and sewer facilities that can support an increase in the population (Colleton County Land Use Planning Task Force 1997). In 1990, educational attainment was low in the ACE Basin and 24% of residents in the five incorporated areas lived in poverty. Low educational attainment represents a potentially significant economic barrier for the region. The average earnings per job were only $19,497 in 1996 for Colleton County (U.S. Dept. of Commerce 1998), with a racial gap in the earnings (USCB 1990). It is misleading to assume that average figures are representative of the whole region. The urban areas, and especially the pocket resort and high-end residential communities, have higher relative wealth and educational backgrounds than is apparent from the county or subdivision averages.

That nearly 27% of Colleton County residents travel to work outside the county, compared to approximately 7% and 2% in Charleston and Beaufort Counties, respectively (USCB 1990), highlights the need for more opportunities in the Colleton area. It also highlights the potential for Colleton to become a bedroom community to more prosperous areas and the increased threat of the subdivision of natural areas into residential developments. Land use planning in the ACE Basin will be an important tool to guide development in a way that does not compromise the potential benefits of the area's natural resources. If the ACE Basin's proximity to the economic resources of neighboring areas is used to support sustainable economic development of the Basin's natural resources, then the outflowing tide of economic benefits can be turned back toward the Basin.

The primary industry-related activities in the ACE Basin include light manufacturing, the service sector, forestry, and agriculture. Three key strategies were established by the ACE Basin Economic Task Force to encourage economic growth while preserving the natural characteristics of the Basin: (1) create a framework

A farmer surveys his pastures

for responsible growth; (2) enhance awareness, understanding, and appreciation of the Basin; and (3) promote environmentally compatible business development. In particular, natural resource-based industries such as agriculture, forestry, seafood, and local crafts have played a key role in the ACE Basin's heritage, and recommendations were established for exploring new ways to make these industries develop higher value-added products and operate in a more sustainable fashion. New and increased nature-based tourism development is highly desirable and environmentally compatible, thereby allowing the area to capitalize on and protect the region's character and natural assets (ACE Basin Economic Forum 1996). (See related section: Socioeconomic Assessment.)

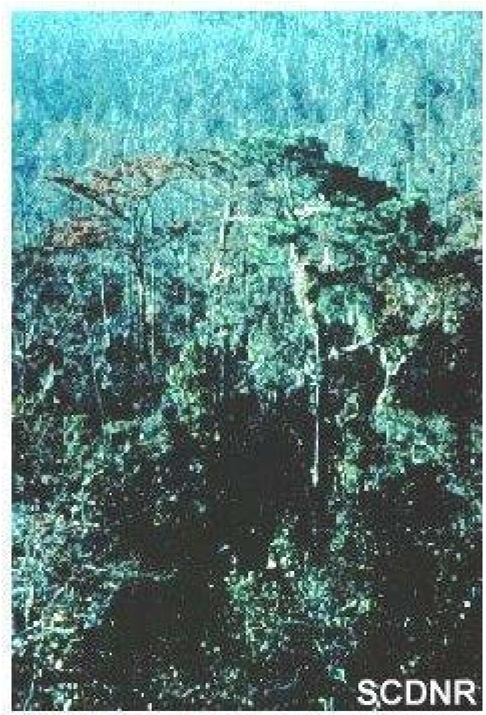
Back to Executive Summary Introduction
Next Section: Resource Use

Executive Summary
Resource Use

Introduction

The ACE Basin Characterization study area is primarily rural with only five incorporated communities. The main land-use types in the ACE Basin are agriculture and silviculture, which together generated $58 million for 1994-95 in Colleton County. In addition to forestry and agriculture, the ACE Basin is utilized for hunting, commercial and recreational fishing, and tourism. Tourism in the ACE Basin is centered on its relatively undeveloped natural environment. One of the factors that makes the ACE Basin a unique area is the large amount of land that has been protected and can never be developed as a result of the efforts of state and federal governments, private landowners, and private organizations. Another aspect which makes the ACE Basin unique is the number of sites which are deemed significant natural areas by the S.C. Heritage Trust Program. (See Resource Use chapter.)

Forestry



Aerial view of upland forest habitat

The forests of the ACE Basin are a vital part of the ecology, economy, and beauty of the region. Forestry is part of the Basin's cultural heritage and is vital to its present economy with 43 million dollars in forestry-related revenue in Colleton County during 1994 (Colleton County Land Use Planning Task Force 1997). Forest survey reports for 1993 indicate that 56 percent of the land cover (1,128,960.4 ha, or 457,069 ac) in Colleton County is classified as timberland (Conner 1993). This acreage is dominated by upland planted pine and forested wetlands with evergreen upland forest, mixed upland forest, and deciduous upland forest being less important. Hardwood dominated forests constitute only 1.4 percent of the total forested area. Westvaco Corporation and Georgia-Pacific are the two largest industrial foresters in the ACE Basin; however, most of the total forested acreage (70%) is owned by nonindustrial private landowners.

Forestry efforts are primarily directed at growing loblolly and shortleaf pines, followed by oak, gum, and cypress trees. In the ACE Basin study area, 457,681.1 ha (185,296 ac) are classified as upland planted pine based on the 1997 National Wetlands Inventory. This constitutes most of the total forested land cover. In addition to directed efforts to grow pines by converting scrub oak and other low-quality hardwood stands, natural reseeding of idle or abandoned agricultural land has also favored establishment of loblolly-shortleaf pine. The overall volume of Colleton's standing timber increased an average of 6-8% (Colleton County Land Use Planning Task Force 1997). Sawtimber also increased, with pine constituting 74% of the total board feet for all species. These trends reflect an improvement in tree stocking as a result of intensive forest management.

Forestry practices have been associated with a number of negative effects over the years. These include impacts to habitat, water quality, biodiversity, and scenic vistas. Effects of forest conversion to pine monocultures include reduction in diversity of forest-dependent animals and canopy/subcanopy vegetation (Meffe and Carroll 1994). Forestry has had a major impact on "natural forests" because of monoculture of loblolly and shortleaf pines as opposed to the native slash pine. A common forest management practice in the southeastern United States and Colleton County is the establishment of loblolly or slash pine plantations. After years of rapid growth, these plantations are harvested to produce fiber, lumber, and wood-based chemicals. The affect of even-aged pine plantations on the quality of wildlife habitat has become an issue in forestry.

Contrary to early forestry practices of clearing and abandoning the land, there is presently a trend toward sustainable forestry through the protection of watersheds and wildlife habitat, conservation of soil, and maintenance of aesthetics while continuing to harvest trees. One approach being used in the southeastern United States involves development of selective harvesting techniques that ultimately produce uneven-aged stands of pine-hardwood as well as understory diversity (Hunter 1990). Several federal forestry assistance programs and landowner assistance programs are available to foresters in the ACE Basin to help them make sound management decisions based on sustainable forestry. An example of an industrial landowner that is practicing sustainable forestry in the ACE Basin is Westvaco Corporation, the single largest private landowner there.

The outlook for forestry in the ACE Basin reflects advances in science and technology, balanced with conservation. These technological advances will continue to help forest landowners meet increasing needs for renewable wood and paper products for local and global markets. An increasing awareness of forest ecology and protection of soil and water in concert with sustainable forest management will help maintain the integrity of forests and contribute to the quality of life in the ACE Basin. (See related section: Forestry.)

Back to Top

Agriculture

Agriculture has been an important part of the historical, cultural, and economic heritage in the ACE Basin. Its importance to the area dates back to the 1600s when rice, indigo, and cotton were the principal crops. Historic rice production was one of the most influential factors in shaping the colonial economy and, through the creation of impoundments, the present physical condition of the ACE Basin. Agricultural lands occur throughout the ACE Basin study area with high concentrations of croplands on Edisto Island, and areas northwest of Walterboro and southeast of Yemassee. The primary crops presently grown in the ACE Basin are soybeans, wheat, corn, and hay. In recent years, commodity prices have declined and farmers in the ACE Basin are attempting to diversify. One means of diversification is truck farming. Currently, the largest truck crop is watermelons, with other vegetables such as cabbage, collards, squash, cantaloupe, and strawberries being cultivated.

In Colleton County, farming directly contributed $15.8

Using tractors to cultivate fields

million in cash to the local economy in 1996, with 75% resulting from crops and the remainder from livestock. Twelve percent of the land in the ACE Basin study area has been developed for agricultural production; however, the amount of land farmed in counties within and surrounding the ACE Basin study area has declined since 1978. The number of farms has declined at an average annual rate of 1.2% during the period from 1982 to 1996. This is greater than the statewide decline of 0.98% over the same time period. Despite this decline, agricultural practices in 1996 accounted for over $15 million in revenue for Colleton County alone. Urbanization is probably a leading cause of the reduction of farmlands in South Carolina. High land prices, which exceed $950 an acre in Colleton County, mean that farmers often profit more from selling the land than from farming the land.

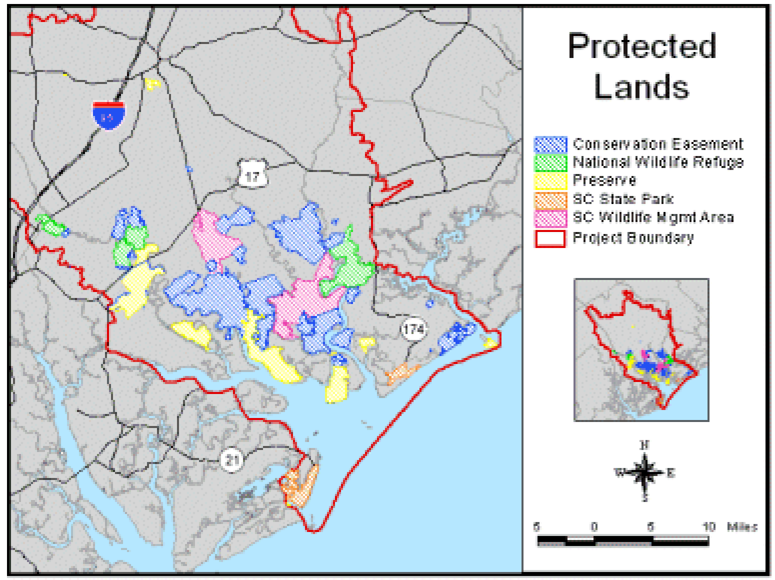
Agriculture can have numerous impacts on the environment. Activities such as land clearing, irrigation, impounding of wetlands, ditching, and soil cultivation have markedly altered the landscape of the ACE Basin. Agricultural effects on water quality have also had a noteworthy impact. Conservation measures have been developed to help the farmer minimize agricultural nonpoint source pollution and other impacts. The most common agricultural conservation measures used in Colleton County are crop rotation, integrated pest management, weed management, runoff management, nutrient management, and pasture management.

In order for agriculture to continue as a viable practice in the ACE Basin, prime agricultural land must be protected as a valuable natural resource, farming practices must be improved and agriculturally-based businesses enhanced (Beasley et al. 1996). The agricultural landscape adds to the quality of life by providing open space to balance that of urban areas in the ACE Basin study area and contributes in the long-term to the economic, social, and ecological fabric of the area. (See related section: Agriculture.)

Back to Top

Protected Lands

The protection of land and resources in the ACE Basin gained national attention in 1986 with the inception of the North American Waterfowl Management Plan (NAWMP). Two years later, the Atlantic Coast Joint Venture (ACJV) portion of the NAWMP made the ACE Basin a "flagship"



project. This led to the formation of the ACE Basin Task Force and the protection of significant habitat areas in the Basin. From its inception, one feature that made the ACE Basin protection initiative unique was its emphasis on protecting the private property rights and developing ways to balance economic growth with conservation efforts. Due to the efforts of the Task Force, approximately 15% of the land in the ACE Basin study area is protected by state and federal ownership, or conservation easements. Approximately 40% of the protected lands are designated as public land, about 60% are private lands that are protected by conservation easements (108,680 ha, or 44,000 ac), and the remainder is protected by organization ownership, management agreements, or other means. Bear Island Wildlife Management Area, Donnelley Wildlife Management Area, the ACE Basin National Estuarine Research Reserve, and the ACE Basin National Wildlife Refuge are large tracts of land managed and protected by state and federal ownership. The ACE Basin Task Force initiative is an outstanding example of how government, conservation groups, and private landowners can unite to protect important natural resources. (See related section: Protected Lands.)

Back to Top

Significant Natural Areas

Significant natural areas are designated by South Carolina's Heritage Trust Program and must contain (1) endangered or threatened animal or plant species; (2) outstanding remnants of an undisturbed plant community or ecosystem; (3) unusual or outstanding scientific, educational, aesthetic, or recreational characteristics; or (4) unique landforms. South Carolina Heritage Trust has designated 246 sites in the ACE Basin study area as significant natural areas (Heritage Trust Database 1997). One hundred and fifty-five of these sites provide habitat for federally endangered or threatened species, state threatened species, and species of concern. Thirty-three significant natural areas are recognized as outstanding examples of coastal plain communities. Fifty-seven of the significant natural areas have outstanding scientific characteristics that include colonial waterbird rookeries and feeding habitats. The natural areas differ in size, natural quality, and uniqueness in regard to species and community type. Consequently, the priority ranking of the natural areas ranges from national to local significance.

Several highly significant natural areas in the ACE Basin study area are protected through purchases or conservation easements. Cowbane Heritage Preserve, the natural area that harbors

Aerial view of Otter Island - southwest

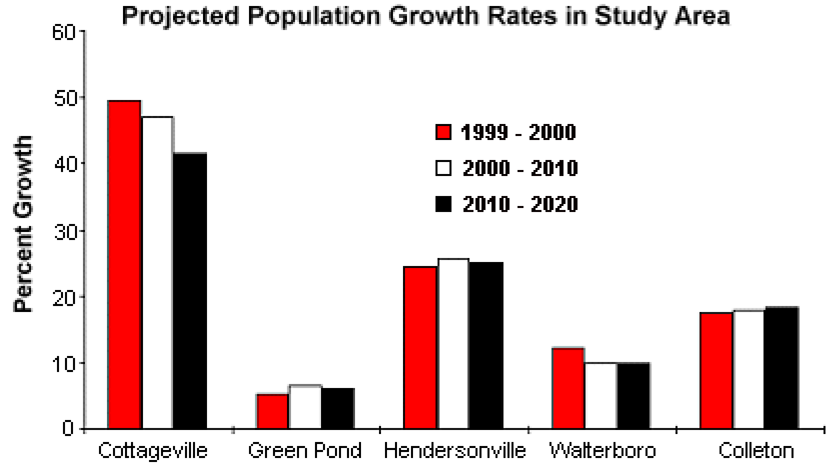
the federally endangered Canby's dropwort(*Oxypolis canbyi*) is owned by the state (Rayner 1984). The Nature Conservancy bought a relatively undisturbed region of Snuggedy Swamp that contains high quality freshwater wetland, including the largest grass-sedge-marsh/loblolly-bay complex in South Carolina. Otter Island located in St. Helena Sound, encompasses a full array of relatively undisturbed representatives of maritime estuarine, and palustrine communities, including dunes, maritime forests, *Spartina* marshes, and fresh to brackish ponds. The island also hosts several nesting colonies of rare birds and populations of rare plants, and it is a nesting site of the loggerhead turtle, a federally endangered species. The state and federal entities and various conservation and private organizations are continuing to purchase lands or acquire conservation easements to protect other areas that have high priority.

Heritage Trust staff continuously updates information about natural areas as new occurrences are found, existing populations change, and the status of species or plant communities are reclassified. The Heritage Trust Program relies on the assistance of professionals that can track and document the occurrences of rare species and communities. The staff will provide technical guidance and appropriate forms and maps to all interested in helping with this process. (See related section: Significant Natural Areas.)

Back to Top

Urban Areas

Diversification in the form of manufacturing and light industry has helped with economic growth and employment in urban areas. Because of this economic growth, urban and residential land cover in the study area has increased by 809 ha (2,000 ac) from 1989 to 1994. By the year 2010, it’s expected the county's 1990 population of



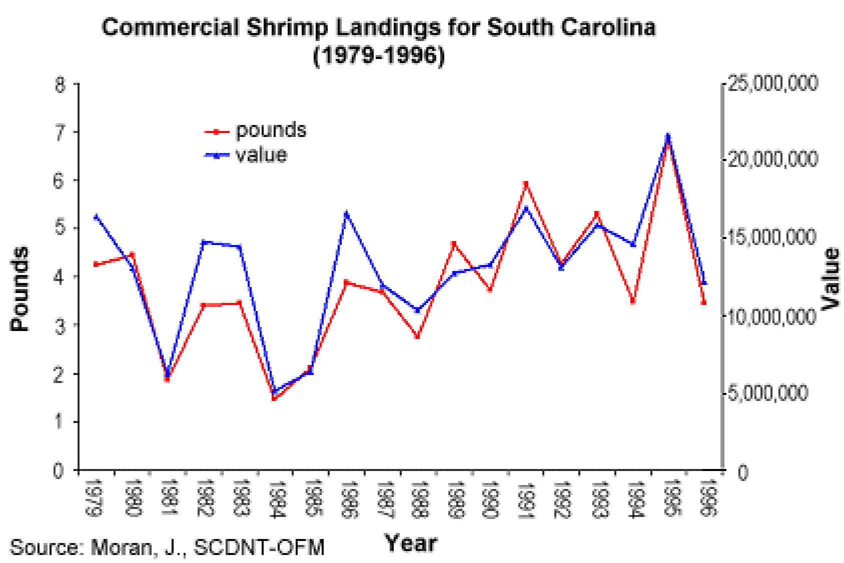
from the Draft Colleton County Land Use Plan, 1997

34,377 people will increase to over 47,500 people. Most of the county's population growth is projected to occur in Walterboro and Cottageville, with more modest growth occurring in and around the towns of Hendersonville and Edisto Beach. Recent growth trends indicate that the highest growth potential will occur in areas east of Walterboro along Highway 17A toward Cottageville and north of Walterboro along Highway 15, where land is available for development.

Because the urban areas of Colleton County are expected to significantly expand over the next decade, the Colleton County Land Use Planning Task Force is developing a land use plan. Potential goals of this plan are to improve the quality of development, minimize the loss of farm and forested lands, discourage urban sprawl, provide better affordable housing, safeguard wetlands, and protect historic and cultural resources. The success of the plan depends on the willingness of residents to accept land use planning and development standards as a means of channeling growth in ways that not only enhance economic assets but also maintain the rural way of life. (See related section: Urban Areas.)

Back to Top

Commercial Fisheries



Source: Moran, J., SCDNT-OFM

Commercial fisheries are important to the economic and social fabric of the ACE Basin. In particular, Bennett's Point and Edisto Beach are the primary centers for shrimp and shellfish harvesting. Fishery products landed in the ACE Basin are consumed locally as well as transported to larger regional markets. In addition to the direct economic impacts of the fisheries, fishing communities also serve as focal points for residents not directly supported by the fisheries.

Blue crabs, shrimp, and oysters/clams are the three main fisheries in the ACE Basin. In addition, there are smaller fisheries for shad, sturgeon, horseshoe crabs, and flathead catfish. Revenue from commercial fisheries during 1996 was estimated to be almost 25 million dollars in South Carolina. The total commercial landings for Colleton County, which largely encompasses the ACE Basin, have an estimated value between $750,000 and $1,500,000 per year. Over 90% of this is from the shrimping industry. To date, there has been no accurate mechanism to evaluate the number of individuals active in the fishery industry of the ACE Basin.

The shrimping industry is the most important commercial fishery in the ACE Basin. Shrimping is of particular economic importance to a number of small coastal communities including Bennett's Point, Edisto Beach, and larger towns such as Beaufort. Not only important to those directly and indirectly involved in the fishery, the presence of the fishing community contributes to the local tourism-based economy. In addition to the commercial shrimp trawl fishery, there are a number of commercial companies raising shrimp in impoundments and ponds in South Carolina, with a few companies in the ACE Basin (Hopkins 1991). Aquaculture landings range from 8 to 19 percent of the total harvest. (See related section: Commercial Fisheries.)

Back to Top

Recreational Fisheries

Recreational fishing in freshwater and saltwater is an activity that attracts people without regard to race, sex, or income level and can often influence the economy of an area (Hammond and Cupka 1977; Smith and Moore 1981). A variety of fishing opportunities exist in the ACE Basin study area, in habitats that range from black water streams and swamps to intertidal marshes, creeks and the ocean surf (Beasley et al. 1996).

Recreational fishing in the ACE Basin

Marine and freshwater recreational fishery resources of the Basin have become very important to the economics and aesthetics of the area. Most of the fishing activity is centered in the Edisto, Ashepoo, and Combahee Rivers, but other small streams in the watershed do provide some opportunities, especially for bank anglers. Most recreational fishing is done from small boats, but bank anglers use areas around landings and bridges. Because of the remoteness of the area, travel upstream in the rivers is often difficult due to obstruction by fallen trees. In general, directed fishing for specific species is done by boating anglers, while undirected fishing is done by bank anglers who catch what they can and keep most everything. Fishing licenses must be obtained to fish from a boat, but bank fishing does not require a license.

Estuarine waters in the ACE Basin study area are considered to be among the best inshore saltwater fishing locations in the state. Inshore anglers may fish in the surf of the front beaches of the barrier islands as well as from bridges, piers, and boats throughout the many rivers and tidal creeks in the ACE Basin study area and St. Helena Sound. Shore-based fishermen catch a variety of species in the marine section of the ACE Basin study area, including spot, Atlantic croaker, bluefish, summer and southern flounders, spotted seatrout, red drum, black drum, pinfish, southern and gulf kingfish, and sheepshead. White and brown shrimp are the species most sought by recreational shrimpers, as well as several different types of small sharks and rays. The blue crab is the only recreationally caught crab. Though not targeted, silver perch are also frequently caught.

High levels of exploitation by fishermen coupled with the loss of productive habitat due to coastal development and pollution have a major impact on estuarine recreational finfish stocks. For some species such as red drum, a gradual reduction in the recreational harvest has been implemented by measures such as size limits and bag limits. Assessments are regularly done to determine if such measures result in reduced mortality of highly sought recreational species throughout the region.

Recreational freshwater fisheries in the ACE Basin study area was valued at almost $2 million annually (Allen and Thomason 1993; Thomason et al. 1993). From the free-flowing streams to the tidally influenced sections of freshwater rivers and creeks, anglers target flathead catfish, largemouth bass, striped bass, redbreast sunfish, and black crappie. In addition, several species of sunfish and catfish are often caught, but not directly targeted.

The majority of freshwater angling is done from small to medium size boats (3.0-4.6 meters or 10-17 feet). Freshwater anglers are required to have a South Carolina fishing license to fish in public waters. The following issues are currently influencing the management of freshwater fisheries in the ACE Basin: (1) logging, (2) urban and industrial development, (3) introduction of foreign fish and plant species, (4) water withdrawal, (5) alteration to wetland habitat, (6) increases in nonpoint source pollution, and (7) instream integrity. The future looks bright for the ACE Basin freshwater fisheries resources. Educational efforts to inform citizens of the importance of natural resource protection are increasing. Because of efforts by government to encourage Best Management Practices (BMPs) and monitor industrial pollution, water quality is not deteriorating drastically. Wetlands are being preserved at an increased rate so that habitats vital for fish production will remain an integral part of the ACE Basin landscape. (See related section: Recreational Fisheries.)

Back to Top

Hunting

The ACE Basin has a long tradition of hunting beginning with Native Americans and continuing to present-day hunters. Hunting has an economic impact in the ACE Basin study area and the entire state. Based on the 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, it was estimated that 300,000 individuals (16 years and older) hunted in South Carolina and made total hunting expenditures of $3.49 million (USFWS, 1996). A total of 201,579 hunting licenses were sold in FY 1991-92 (Shipes, 1993). In the ACE Basin study area, over 200 hunting clubs were operating in 1996.

The primary wildlife hunted in the ACE Basin study area are white-tailed deer; ,wild turkey,; bobwhite quail; mourning dove; eastern gray squirrel; rabbit; terrestrial furbearers such as raccoon, gray fox, and opossum; waterfowl; and American alligator. The white-tailed deer is the most

Turkey hunter

popular species sought by hunters in South Carolina. Trends in deer harvest for Colleton County have remained relatively stable since 1988. Harvest reports obtained from private and public lands in the state represent the minimum number harvested, largely because reporting harvested animals is not required and many killed deer are unreported. The other big game sought by hunters in the ACE Basin is the wild turkey. In the coastal plains of South Carolina hunting for turkey occurs during the spring months. Hunting is restricted to gobblers only, but bag limits are liberal with two birds per day or five per season allowed. No special permits are required to hunt turkey in S.C., and the mandatory turkey tags are issued free to individuals with a license and big-game permit. Turkey harvest in Colleton County has increased steadily since 1989.

One of the most striking changes that has occurred with hunting in the ACE Basin study area and other parts of South Carolina has been the transition from small game, such as squirrels and rabbits, to big game hunting for white-tailed deer and wild turkey. Squirrel hunting was once the most popular hunting activity in South Carolina, but, today, squirrels are among the most underutilized game animals. Rabbit hunting has also declined in popularity. The switch from small game to deer and turkey has increased demand for available hunting land. A score of hunting clubs that are tightly managed have been formed in the ACE Basin and are a popular means of gaining access to private land.

Waterfowl hunting has been a long-standing tradition in coastal South Carolina and the ACE Basin study area. The impoundments of the ACE Basin study area offer ideal wintering habitat for waterfowl. Private lands are not available to most hunters, but Wildlife Management Areas (WMA), such as Bear Island WMA and Donnelley WMA, provide hunting opportunities through the statewide lottery. In Colleton County, the waterfowl harvest has been variable, with the greatest estimated harvest occurring in 1995. The major species of interest to hunters statewide are wood duck, mallard, and green-winged teal. Reports from band returns and surveys indicate that the primary species harvested in Colleton County, over a ten-year period, were green-winged and blue-winged teals, wood ducks, widgeons, and mallards. At Bear Island Wildlife Management Area, primary harvested species in 1996-97 were shoveler, green-winged and blue-winged teal, and widgeon, while at Donnelley Wildlife Management Area, green-winged teal and wood duck constituted greater than 70% of the total harvest.

Management of wildlife is not only a state and federal activity, but is also undertaken by private landowners, hunt clubs, and timber companies. Management of hunting emphasizes maintaining habitat for populations, in particular the creation of edge habitat, and enhancing hunting opportunities for game species. Hunter-based conservation organizations have been instrumental in educating landowners and sportsmen and in promoting sound management practices (Beasley et al. 1996). A major factor in the future of hunting is the public's attitude. As the rural face of the landscape surrounding the ACE Basin changes due to burgeoning population growth, fewer individuals are viewing hunting as an acceptable tradition. The future of hunting in the ACE Basin study area will depend on strict enforcement of laws and regulations along with educational efforts that focus on hunter ethics, safety, and game management. (See related section: Hunting.)

Back to Top

Tourism

Tourism is an important component of the economy in the ACE Basin. Tourism and entertainment in Colleton County (calculated as those working in restaurants, hotels, and recreational services) accounted for 8.6% of the businesses and 11.8% of the jobs in 1995. Tourism-derived income increased by 38% in the last 10 years, much of it in growth from restaurants, cafes, and hotels. Many rural communities and less developed regions, such as the ACE Basin, are typically unable (or unwilling) to support traditional, consumer-driven tourism. As a result, less developed areas must consider specialized niche markets, such as nature- and heritage-based tourism.

The ACE Basin, with nearly 300 species of birds, is a popular spot for birdwatchers

The South Carolina Department of Parks, Recreation, and Tourism (SCPRT) found that visitors to coastal South Carolina spent $747 million in 1996 and that the most popular activities were going to the beach, shopping, playing golf or tennis, and hiking/fishing/hunting. Mainly through efforts by the South Carolina Department of Parks, Recreation, and Tourism (SCPRT), the commercial nature-based tourism industry in South Carolina began to develop rapidly in the late 1980s. In 1995, the South Carolina Nature Based Tourism Association was created to promote sustainable development in the industry, promote voluntary self-regulation, and provide quality assurance through education.

The nature of heritage tourism–the emphasis on authenticity, history, nature, and vanishing lifestyles–and the scale of heritage tourism in South Carolina (2.7 million visitors annually who spend $581 million and support 13,570 jobs) dovetail with the characteristics and unique qualities, as well as economic needs, of South Carolina's ACE Basin. For this region, a place characterized as economically disadvantaged, with a rich historic and cultural past, and an exceptional natural resource base, heritage tourism offers a solid development opportunity for enhanced economic growth and resource protection.

The ACE Basin tourism industry should capitalize on its natural and cultural resources. Residents have enthusiastically supported nature and heritage tourism as an economic development path towards which to channel efforts and funds. They find that tourism can be economically beneficial to the region while also generating fewer detrimental effects on the environment than other economic activities. Some of the tourism assets in the ACE Basin are its two state parks, the National Estuarine Research Reserve, protected lands, festivals, and historic homes and attractions. Unique partnerships between landowners, conservation organizations, and government agencies have been influential in the major progress of conservation of the ACE Basin. The region, however, has yet to make full use of the ACE Basin's unique environmental, historical, and cultural heritage in order to achieve an economic advantage. The tourism task force developed several specific recommendations as part of increasing the tourism profile of the ACE Basin: (See related section: Tourism.)

- Develop a visitor/interpretive center near U.S. Highway 17. Plans for a center were drawn up and then shelved, but 1998 has seen the renewal of interest in the visitors center concept.
- Support the Scenic Parkway Concept Plan and designation effort.
- Develop a consistent ACE Basin graphic identity that would apply to all brochures, maps, and other visitor materials
- Develop primary and secondary environmental and heritage education programs.
- Create a recreational river corridor by developing additional recreation opportunities along the Edisto River that might include additional campsites, a series of inns near some parts of the river, a canoe livery, and additional landings.

Back to Executive Summary Introduction
Next Section: Resource Management

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

M E N U

Introduction

Assessment of Issues and Goals

ACE Basin Task Force Project

Strategies for Resource Protection

Resource Management Issues and Goals

Nature-based Tourism and Public Access

Research and Monitoring

Educational Programs

ACE Contacts

Regulations

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Executive Summary

Resource Management

Introduction

The 182,115 ha (450,000 ac) making up the ACE Basin Task Force Project area support more than 1,500 plant and animal species (not including insects) within six distinct ecosystem habitats. The ecosystems of the ACE Basin are not untouched considering that some level of anthropogenic impact has occurred for the last 6,000 years; however, the ecological integrity of the ACE Basin has been maintained through conscious management and sustainable use of its resources. (See Resource Management chapter.)

Assessment of Management Issues and Goals

Former intertidal swamp modified by human activity for use as rice fields

The identity of the ACE Basin is changing. What began as a concerted effort to protect ecologically significant habitat has, because of its success, evolved into a more comprehensive initiative. While on-going land protection efforts continue, there is now an added interest of deriving economic benefits from the area. Also, through the process of establishing the ACE Basin as an important wildlife and fisheries habitat area, we have attracted the attention of a much broader and more diverse population, nature-based tourists. The purpose of this section is to focus on existing and potential problems and issues in the ACE Basin.

Historically, the ACE Basin has been a working landscape which has been affected by many natural (hurricanes, fires, flooding) and anthropological impacts (rice cultivation, phosphate mining, forestry, farming, and development). Many acres of marsh and hardwood forests were destroyed to create rice fields. In fact, cultural impacts have not only contributed to the maintenance of the Basin's ecological integrity, they have been instrumental in shaping the Basin's character as well. (See related section: Assessment of Management Issues and Goals.)

Back to Top

ACE Basin Task Force Project

Formal protection of the ACE Basin was initiated in 1988 with the development of the ACE Basin Task Force, a unique partnership of state and federal governmental representatives, nonprofit conservation organizations, and private landowners. This group shared a vision of maintaining the natural character of the Basin by promoting wise resource management and continuing traditional uses with improved public access. This vision has provided a framework for land protection in the ACE Basin that has gained national and international recognition. While encouraging traditional land uses such as agriculture, timber production, hunting, and fishing, the overall management goal is to maintain the area's ambiance while restricting industrial and resort development characteristic of much of the state's coastal zone in the past 30 years. To date, well over 316,160 ha (128,000 ac) in the Basin have been protected through conservation easements, management agreements, and fee title purchases. The private landowner initiative has been fundamental to the overwhelming success of the ACE Basin Project.

Conservation, research/monitoring, education, and cooperation have provided the basic architecture for the ACE Basin Project. Conservation is system driven and embraces "sustainable growth" as a key factor. The desire of its rural communities to maintain their quality of life without the pressures to develop for immediate gain has been unusual and to a large degree shaped by historical good fortune. Today, the movement toward incorporating the needs of a community while preserving its natural values is a novel concept. A major challenge in the ACE Basin is to strike a balance between the area's socioeconomic needs while protecting the benefits of natural systems. This requires good science and a commitment to responsible growth.

Because of its remoteness and relatively pristine nature, the ACE Basin provides ideal sites for monitoring changes in the physical and biological components of the region. The fact that the National Estuarine Research Reserve, National Wildlife Refuge, Ducks Unlimited, and The Nature Conservancy are represented here make the Basin even more attractive for gathering scientific information. Interdisciplinary research is providing information for conserving biological diversity, assessing the impacts of pollution on the structure and function of ecosystems, and for developing sustainable production systems for altered habitats. In addition, the ACE Basin provides a framework for comparative studies of similar problems in different coastal regions. Local communities are being introduced to the idea that protecting natural watersheds and sustainable development are to their long-term benefit. Education and outreach activities to strengthen the understanding and appreciation of these concepts are pivotal. (See related section: ACE Basin Task Force Project.)

Back to Top

Management Strategies for Resource Protection

We are now aware that the complexities in coastal management and the integration of science into the decision-making process go hand-in-glove. An holistic approach is required and consideration must be given to how one sector (i.e. forestry) might affect other sectors (e.g. fisheries) and the environment (e.g. habitat). Also, conflict resolution is required between different sectors and for the adoption of flexible management plans that can be fine-tuned and allow for shifts in direction when necessary. Scientists are encouraged to work more closely with managers in roles that are nontraditional.

Enforcement is a critical element in the conservation of natural resources in the ACE Basin.

The perceptions of user groups of the regulatory and enforcement process have had a significant bearing on compliance behavior. A major goal of enforcement is to prevent resource impacts through "preventive enforcement" which is best accomplished by frequent patrols of the area. However, the ACE Basin is much too large of an area and, many times, violations go unnoticed. Enforcement philosophy is shifting to "interpretive enforcement" where voluntary compliance is stressed through educational messages and literature on responsible behavior. Other goals include extended education and outreach activities and the promotion of resource stewardship.

The ACE Basin has traditionally been used for hunting, fishing, agriculture, and forestry. Each of these activities is currently subject to state regulation through required licenses, permits, boundaries, seasons, bag limits, catch limits, and other laws. Establishment of the ACE Basin Project has not changed any of the existing laws and regulations concerning these or any other traditional uses. Therefore, goals and recommendations for this particular issue are generally to maintain the present emphasis on traditional uses and to factor these important socioeconomic activities into the coastal decision-making process.

An important component of the human use environment deals with the kinds of development that take place beyond conservation lands in the ACE Basin. The latest findings on urban and suburban development demonstrate an inefficient use of natural resources. The current land use debate is driven by the SC Local Government Comprehensive Planning Enabling Act of 1994 which provides clear guidance to local governments on the purpose, approach, and procedures for plan preparation, approval and enforcement. Recommendations are made for Colleton County, the heart of the ACE Basin, to create a plan for responsible growth and to address certain critical growth issues facing the County. Reference is made to stewardship development guidelines that help plan a broad policy document focused on sustainable development. (See related section: Management Strategies for Resource Protection section.)

Back to Top

Resource Management Issues and Goals

Wildlife habitat management issues and goals are directly linked to private landowners and include fragmentation of upland habitats, increasing total acreage and size of monoculture forest stands/agriculture fields, urban sprawl, and human use conflicts and interactions with wildlife. Timber management practices can be used to enhance wildlife habitat and are generally successful in the ACE Basin. The size of natural communities is an important consideration in managing for habitat quality. The larger tracts have higher species diversity and contribute to habitat connectivity across the landscape. High quality habitats in the ACE Basin include a mix of wetland and upland communities adjacent to rivers and streams. Riparian habitats in the ACE Basin are intact and provide critical linkages between large landscape units.

An important issue facing managers in the ACE Basin involves landowners that are reluctant to cooperate in management practices for endangered and threatened species because of regulatory measures and economic losses. Financial incentives must be found to motivate these landowners to

Bald eagle on the nest

restore, rather than destroy, habitat critical for the recovery of endangered species. Very few bottomland areas in the Basin are protected. Increased timber harvest and conversion to other uses especially threaten these areas. Local landowners and decision makers are encouraged to consider the needs of sensitive species and manage for biodiversity at the species and community landscape levels.

Cumulative impacts on wetlands are perhaps the most significant issue facing managers not only in the ACE Basin but also on a regional and national scale. These impacts result from many incremental activities and become significant when viewed in aggregate. Managers face deficiencies in making cumulative impact projections and lack historical data. There is also a general lack of statutory guidance, as well as other types of legal barriers when making environmental decisions on cumulative impacts. Managers tend to minimize their authority in consideration of these impacts because of legal interpretations by the courts. It is recommended that managers develop long-term perspectives for monitoring coastal ecosystems and develop systematic approaches for detecting and quantifying cumulative impacts.

The functional resource values of well-managed impoundments are recognized in the context of manipulated wetland ecosystems in the ACE Basin. The re-impoundment of wetlands that once were impounded and managed during the era of rice culture has been a long-standing management issue. Special Area Management Plans (SAMPs) have been considered as a regulatory mechanism to resolve this issue. SAMPs have been successfully used elsewhere in estuary planning and are recognized as effective mechanisms to control development while providing long-term protection to sensitive wetlands. The benefits of SAMPs are well documented and include the prediction of cumulative impacts in a particular watershed. However, there are also a number of concerns over the effects of impoundments on coastal wetlands and their functional relationship to estuaries. Concern is further grounded in the federal and state policies that call for "no net loss" of wetlands. It appears that before any real progress can be made on the issue of re-impoundment of formerly impounded wetlands, the science of functional relationships in salt, brackish, and freshwater marshes must be improved.

Forest management issues in the ACE Basin include careless or inappropriate application of forest management practices by some landowners. The public often misunderstands management practices such as prescribed burning, clear-cutting, intensive pine production, and drainage. Thus, negative perceptions of forest management techniques are present in the local community. The Sustainable Forestry Initiative (SFI) launched by Westvaco in the ACE Basin has set the standard for the local forest products industry. SFI is a system of principles, guidelines, and performance measures that integrate the perpetual growing and harvesting of trees with the protection of wildlife, plants, soil, air and water. In addition, the local forest management community has worked with the ACE Basin Task Force in developing Best Management Practices (BMPs) for forestry, which are recommended for private landowners in the ACE Basin. These guidelines assist landowners in practicing good stewardship on forest lands and protecting the water quality of nearby streams, rivers, lakes, and ponds. Most of the BMPs address the protection of water quality and requirements of Section 404 of the Clean Water Act. All forestry practices must comply with the Endangered Species Act. There is an overriding challenge in the ACE Basin to balance the demands for wood products and ecological benefits derived from forest ecosystems. The private landowner must have an incentive to do this.

Nonpoint source pollution poses the greatest threat to the ACE Basin's water quality. There is insufficient knowledge and public awareness of the impacts of land use practices on water quality. Detailed information on water quality is not readily accessible and reporting on water use is incomplete. Recommendations include the development and implementation of BMPs for all land use activities that potentially impact water quality. Areas within the ACE Basin with the highest nonpoint source potential should be targeted for BMP education and the conservation of riparian zones encouraged. Issues, opportunities, and challenges related to fisheries management in the Basin also center on water quality and habitat protection. The riparian zone is critical to a healthy fish population and private landowners, including those in the agriculture and forestry sectors, need to work cooperatively in reducing impacts to these areas.

Although the ACE Basin is rich in history and historic resources, an intensive archaeological survey has not been conducted. Many unknown sites probably exist in the area but are not officially recorded. This lack of information, coupled with increased development pressures, poses a real threat to valuable cultural resources in the area. (See related section: Resource Management Issues and Goals.)

Back to Top

Nature-Based Tourism and Public Access Management Issues and Goals

Three critical issues must be considered in planning for long-term sustainability in the ACE Basin: 1) increased public demand for access to and use of the Basin's resources; 2) visitor management and resource protection strategies to secure the Basin against overuse and inconsistent use of its resources; and 3) economic development initiatives that can leverage the intrinsic value of the area's natural wealth without compromising the integrity of the environment. Nature-based tourism is a development tool that addresses these issues and serves as a valuable stimulus for sustainable economic development in the ACE Basin. However, for the Basin to take advantage of its unique resource base and leverage its proximity to recognized destinations, it needs a focal point from which to manage and direct visitor experiences. The vision for the ACE Basin involves a network of interpretive, educational, recreational, and research facilities. The critical components are a centrally located education/interpretive center to serve as the primary visitor reception center and provide a broad overview of the Basin; a research field station dedicated to estuarine and marine research; and five satellite interpretive centers and recreation areas strategically located throughout the Basin.

Public access and recreational use of the ACE Basin is a critical issue facing managers. In the ACE Basin study area,

Canoeing in the ACE Basin

public activities are primarily conducted at the two state parks, two wildlife management areas, one national wildlife refuge, and one NERR as well as the approximately 30 public boat ramps. While the public demands access to these resources, delicate and sensitive habitats and resources must be protected. Public access and use may not be compatible in some areas and under certain circumstances. Significant impacts need to be better defined in the context of long-term environmental costs and not just in terms of public recreational benefits. Once there is a sufficient database on numbers of users, their experiences and their impacts on the resources, resource managers should be in a position to make better decisions. Recommendations are made to provide public access to all elements of the Basin and expose visitors to representative aspects of the watershed with opportunities for environmental awareness and compatible recreation while protecting the natural integrity of the area. (See related section: Nature-Based Tourism and Public Access Management Issues and Goals.)

Back to Top

Research and Monitoring

Research and monitoring in the ACE Basin is a major priority. The area provides a benchmark against which to compare other coastal areas where significant human disturbances are occurring. Such comparisons are necessary in developing and understanding the impacts, both obvious and subtle, on coastal resources. Research and monitoring activities in the Basin are guided by national, state, and local plans that identify goals, priorities, and implementation strategies. This approach, when coordinated with a comprehensive program of education, interpretation and outreach, provides for management-oriented research that has utility for solving management issues. The primary research arm for the ACE Basin is the National Estuarine Research Reserve System (NERRS). Goals and priorities are coordinated through NERRS and relate directly to the ACE Basin and coastal resource management. Research opportunities in the ACE Basin are available to any qualified scientist, academician, or student affiliated with any university, college, or school; nonprofit research institution; private profit organization; or state, local, or federal government agency. Graduate research fellowships for the ACE Basin are also available through the NERRS. (See related section: Research and Monitoring.)

Back to Top

Education Programs

Education, training and outreach activities, designed to enhance public awareness of estuaries and coastal resources, are also

Seining program at Edisto Beach, SC

conducted in the ACE Basin. An important aspect of this program is the linkage of education to science and stewardship. The ACE Basin NERR has also taken the lead in providing educational opportunities. The NERR coordinates with federal and state agencies; national education, scientific and environmental organizations; private industry; landowners; and special interest groups. The NERR education program is directly linked to the various satellite interpretive centers in the ACE Basin. (See related section: Educational Programs.)

Back to Top

ACE Basin Contacts

This section provides the reader with contact information about national, regional, state, and local organizations and agencies that have been mentioned in the text. Information about each organization or agency generally includes the mission, activities tying it to the ACE Basin, and a contact person with address and telephone number. (See related section: ACE Basin Contacts.)

Regulations

A number of federal and state regulations that affect the natural resources and natural resource management in the ACE Basin are described in this section. Each regulation is described according to its intent and agency with regulatory power. Although comprehensive, the list may not be all inclusive. (See related section: Regulations.)

Back to Executive Summary Introduction
Next Section: Synthesis Modules

Executive Summary

Synthesis Modules

Water Quality Module

Water resources in the ACE Basin include rivers, streams, estuaries, wetland impoundments, and ground water. People use these waters for different purposes such as swimming, fishing, drinking, agriculture, and industry. The advent of industrialization and rapidly increasing human population has increased the demand for water and necessitated higher water quality standards. The Clean Air Act (CAA) is a federal law passed in 1970 and amended in 1990 and 1997, that forms the basis for the national air pollution control effort. The CAA assigns primary authority to the states to set their own water quality standards, but requires that all states comply with the "fishable and swimmable" goal of the Act through establishment of beneficial uses and water quality criteria. In South Carolina, the South Carolina Department of Health and Environmental Control (SCDHEC) is the primary authority on water quality issues.

Industrial development in the ACE Basin is minimal with National Pollutant Discharge Elimination System (NPDES) permits issued for 13 municipal and industrial facilities. Discharges from these constitute only a portion of the total pollutant input to the ACE Basin ecosystem. Runoff from urban, industrial, and agricultural activities, either in the Basin or from areas upstream, is a significant source of pollution. Although most water quality degradation is due to anthropogenic influences, there are natural events, such as hurricanes and torrential rainfall, which can impact water and sediment quality. Thus, the quality of water resources in the ACE Basin is affected by both natural and anthropogenic events; however, it is often difficult to distinguish between the two because the effects of natural events are often intensified by man’s activities. This module discusses the relationship of water quality issues to the ACE Basin ecosystem, possible mechanisms to mediate the problems, and the importance of each issue nationally and regionally.

Eutrophication is an increase in nutrient concentrations (e.g. nitrogen, phosphorus) above natural levels and the effects caused by this increase (Frithsen 1989; Nixon 1995). Nutrient sources that affect water bodies include wastewater treatment plant discharges and nonpoint source runoff from atmospheric deposition or agricultural fertilization. The adverse effects associated with eutrophication in estuaries

Application of fertilizer is planned to provide needed nutrients but protect water quality

include increases in primary productivity, changes in algal species composition, changes in benthic community structure and function, and declines in oxygen concentrations. Eutrophication is currently the most widespread water quality problem in the nation and accounts for about 60% of the impaired conditions of rivers in the U.S. Moderate concentrations of nitrogen and phosphorus were found in St. Helena Sound in the ACE Basin (NOAA 1996); however, the levels of nitrogen and phosphorus in the ACE Basin are below those of concern for eutrophication. The most effective management practices of eutrophication should be aimed at reducing the levels of nutrients reaching a water body rather than treating the water body once a problem has occurred. Such practices include stormwater control plans, enhanced treatment of effluents, and best management practices for agriculture.

Dredging

Turbidity and sedimentation can influence water quality. Both processes can be greatly accelerated by urban land use, agriculture, timber harvesting, and development. Sedimentation rates are naturally high in estuaries; however, poor soil conservation practices and alterations of natural circulation patterns have increased the rates of filling (Schubel 1977). Increased turbidity and suspended sediments can result in a sag in dissolved oxygen from increased biological oxygen demand, reduced photosynthetic production of oxygen, and resuspension and redistribution of toxic chemicals. An increase in turbidity has been found in the ACE Basin at SCDHEC monitoring stations over the last few years (SCDHEC 1995 1997). Shoaling in the Fenwick Cut has increased by 130% in the last decade, suggesting that this area is an effective trap for suspended sediments (Alexander and Wenner 1995). The concurrence of dredging activities over the period when rapid accumulation rates were seen in the Ashepoo subtidal area suggests that dredging may have a significant impact on concentrations of suspended sediment in the ACE Basin (Alexander and Wenner 1995). There have been no studies conducted in the ACE Basin on boating impacts to shorelines, but sites in the ACE Basin such as Fenwick Island and the shoreline of Mosquito Creek are experiencing rapid erosion. Management of turbidity and sedimentation needs to be accomplished by government agencies at all levels. In addition, outreach programs are needed that inform and educate residents in the ACE Basin study area about the effects of soil erosion and sedimentation, as well as the implementation of best management practices that will prevent this type of pollution. An understanding of the relative impacts of different land uses (e.g. agricultural, residential, or urban) on water quality is critical to the management of turbidity and sedimentation. Ultimately, South Carolina state agencies will need to work with local governments to develop a system of comprehensive planning for locating boat landings and marinas.

Simulation of the effects of potential changes in land use on water quality is provided through preliminary results of a modeling effort implementing the Non-Point Source Pollution Module (NPSM) of the EPA Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) tool. BASINS was developed for improving assessment and integration of point and nonpoint sources in watershed and water quality management. The project is intended to explore the applicability of NPSM to coastal (tidally influenced) watersheds and specifically to establish long-term management policies for the ACE Basin. While this is the first step in preparation of a calibrated simulation, collection of the necessary field data on actual water quality was not part of this study. This model simulates water flow and sediment transport in the nine sub-basins of the Ashepoo River. The uncalibrated results reveal that total sediment concentrations (in mg/l) closely follow storm-related increases in volumetric discharge. Of the three sediment sizes simulated, sand loads appear to dominate the response. Silt and clay represent a very small portion of the total load and are only significant during storm peaks. However, as each storm event is unique in terms of rainfall intensity, duration, and antecedent conditions, the stream response also varies substantially. From this information, predictions of long-term rates of soil erosion, stream turbidity, and storm hydrographs accounting for sub-basin land use distributions are possible. Means for visualizing the model outputs are provided.

Hypoxic water is defined as dissolved oxygen (DO) concentrations below 2 ppm, which is the minimum level required to support most animal life and reproduction. DO levels naturally fall below 2 ppm for short periods of time in estuarine systems (Diaz and Rosenberg 1995; Lerberg 1997); but if hypoxia occurs in a water body for long periods of time, then the aquatic biota can be adversely impacted. In general, except for portions of the Combahee and Ashepoo Rivers, DO levels measured in the ACE Basin by SCDHEC were above the DO standards (4 mg/l). Intensive sampling in the South Edisto River by the ACE Basin NERR revealed that hypoxic conditions (<28% saturation or 2 mg/l) occurred in every season, but were most common in the summer. It appears that these hypoxic conditions are natural occurrences in shallow tidal systems where there is high natural organic input. Land use management appears to be very important in maintaining adequate DO levels. Agencies responsible for water quality monitoring should implement sampling programs that continuously take DO measurements at a wide spatial scale in the ACE Basin, and use the data to develop models that can be used to predict oxygen conditions in tidal creeks (Lerberg 1997). Inadequate data may substantially underestimate the extent of hypoxia in estuarine areas such as the ACE Basin.

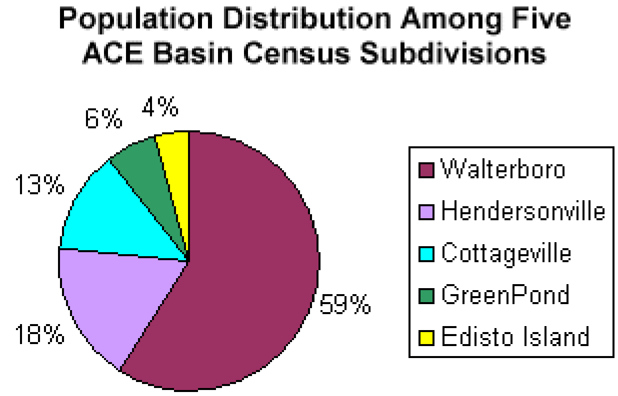
The presence of pathogens (i.e. biopollutants) in the water is the most common risk to human health associated with water quality. The rural nature of the ACE Basin along with its significant areas of protected land may insinuate minimal biopollutant problems associated with human activities. However, the most pressing biopollutant problem faced in the ACE Basin is the frequent closure of shellfish beds due to human and animal pathogens. Localized areas of consistent noncompliance with fecal coliform standards and increasing trends in fecal coliform water concentrations do exist. The urbanized areas of Beaufort, Edisto Beach, and Walterboro produced frequent fecal coliform excursions within their watersheds and displayed increasing trends in concentrations. The Ashepoo River downstream of Walterboro had the greatest frequency of fecal excursions, while the most significant increasing trends were on the Coosaw/Whale Branch Creek near Beaufort and Big Bay and Fishing Creeks near Edisto Beach. Frequent excursion rates lead to closure of shellfish beds as evidenced in the closure of all shellfish beds adjacent to Edisto Beach. Nonindigenous pathogens such as Taura virus and white spot virus are also a potential concern in the ACE Basin because of the expansion of aquaculture businesses. Harmful algal blooms have not been a problem in the ACE Basin; however, management of harmful algal bloom events needs to be closely allied with management of eutrophication in the future. This information indicates the Basin is not immune from potential plant and animal health issues associated with biopollutants.

Toxic pollutants, both organic and inorganic, in the water column can have a detrimental impact on water quality and biological communities. Chemical contaminants in the water column generally adsorb to sediment particles that deposit to bottom sediments. Benthic biota are exposed to pollutants accumulated within these sediments and may transfer potentially toxic contaminants through the food web to organisms in higher trophic levels which can cause both acute and chronic toxicity. In general, sediment contaminant concentrations in the ACE Basin are low with little potential for a biological effect (Hyland et al. 1996, 1998; Scott et al 1998). An examination of sediments from the ACE Basin conducted by Scott et al. (1998) found only trace concentrations of chemical contaminants associated with anthropogenic sources. SCDHEC, however, has issued a fish consumption advisory for parts of the ACE Basin due to mercury levels indicating the Basin is not free of chemical contamination. Potential exists for levels to increase significantly in those areas now undergoing urbanization. Agricultural runoff may be a concern for pesticide pollutants in some areas of the ACE Basin. Reduction of chemical contaminants in point source discharges (e.g. factories, storm sewers) and nonpoint source runoff through land use planning is the best management tool to control chemical pollution from entering aquatic systems.

Salinity may be the most important factor affecting the distribution of estuarine organisms. Estuarine salinities fluctuate naturally because of tides and variability in precipitation within the watershed over time. However, anthropogenic changes in land cover, especially creation of impervious surfaces and channelization, greatly alter the natural patterns of freshwater inflow to estuaries. Increases in the impervious surfaces associated with human development that results in increased volume of runoff, combined with the "flashiness" of discharge events, alters the hydrologic cycle (Arnold and Gibbons 1996). Watershed-based zoning and regulations on the impervious surface coverage can contribute to limiting salinity variability and nonpoint source pollution. In the ACE Basin, seasonal and tidal periodicity was found to strongly influence salinity with local changes in precipitation and evaporation being major contributors to monthly variability. One of the most significant problems associated with salinity in the ACE Basin region is saltwater encroachment into ground water aquifers. Presently saltwater encroachment of the Floridan Aquifer under the ACE Basin is occurring because of high water use by Hilton Head and Savannah. Management of saltwater encroachment involves cooperation of federal and state agencies such as U.S. Geological Survey (USGS) and SCDHEC with municipal public service districts. (See related section: Water Quality Module.)

Back to Top

Land Use Module



The ACE Basin is thought of as a large expanse of minimally developed land, characterized by many people as almost pristine. It has, however, been impacted by historical land use (e.g. creation of impoundments, burning, hunting, agriculture, forestry) so that the landscape of the modern-day ACE Basin is very different from what existed centuries ago. The current land uses and management goals of the ACE Basin study area encourage traditional land uses such as forestry, agriculture, and hunting, but in a sustainable manner. The Basin, however, is located between Charleston and Beaufort, two metropolitan areas that are undergoing rapid population growth. The expansion of urban areas to the north and south combined with the rural character, affordable land prices, recreational opportunities, and natural settings available in the vicinity increases the likelihood of urbanization occurring in the ACE Basin. Seaside, marsh side, and island land occur in abundance in the ACE Basin, and the demand for homes located in these settings is expected to double in the future (Howe et al. 1997). A majority of the land in the ACE Basin study area has no land use plan, and thus, is susceptible to changes that may alter the land use patterns which exist today.

Numerous state and federal agencies have the responsibility for protecting the state's natural resources and thereby influence land use decisions; however, most of the specific land use decisions are made at the community level. These governing agencies must consider the interests of industry, business, private interest groups, and social planning in making land use decisions. The legal framework for land use plannners and regulation in South Carolina is provided by the South Carolina Local Government Comprehensive Planning Enabling Act of 1994 (Municipal Association of South Carolina and South Carolina Association of Counties 1994). The Act outlines seven mandatory elements for a comprehensive land use plan, including population, economic development, natural resources, cultural resources, community facilities, housing, and land use. The Act also requires that local governments establish a Planning Commission to conduct their comprehensive planning.

Over the past two or three years, there has been a noticeable shift in public opinion in coastal South Carolina towards the need for effective land use planning and regulation. There also has been some strong resistance to increasing governmental regulation over the use of private land, both for reasons of ideology and self-interest. This served to slow down the planning process in Colleton County, where development pressures are for the moment less severe. Colleton (draft only), Charleston, and Beaufort Counties as well as the land use plan of the City of Walterboro are summarized in this module. Municipalities are encouraged to adopt wise land use planning and zoning ordinances. To accommodate growth in the ACE Basin, controls must be established so that land use is most compatible with land type. Land use plans should include zoning ordinances to protect assets, rather than the usual conventional regulations that often promote urban sprawl.

The unique landscape of the ACE Basin has been praised nationwide for its importance ecologically and as a model effort in balancing conservation of natural resources with population growth and economic development. Environmental problems in a watershed such as the ACE Basin often result from uncoordinated land use management practices of individual decision makers that, when taken together, cause significant environmental impacts. Natural resources are linked, so that the degradation of one resource affects not only the resource itself but also other resources in and around the impacted area. Land uses and activities that have altered the landscape of the ACE include forestry, agriculture, mining, aquaculture, urbanization, and tourism.

Development in the ACE Basin can be moderated through controlled development, management for habitat and biodiversity, preservation of open space, density neutral development, greenways, buffers, and sustainable development. In particular, sustainable development attempts to integrate ecological and physical processes, human activities, and economic incentives into a management process that conserves the natural resources of an area while sustaining economic goals. Uncontrolled development of land, with no regard for ecological and social impacts, has been recognized as a nonsustainable process. Resource managers, land use planners, developers, and individual land owners have become increasingly aware that development cannot continue down an uncontrolled path without significant negative long-term economic and ecological impacts. Mitigation banking and stewardship development are two alternatives to past development practices that show promise as effective methods to conserve our natural resources. Practices for stewardship development can be implemented during several phases including site selection, site resources, site planning, site development, and site maintenance. The SCDNR has a Stewardship Development Program to promote and honor projects in the state that demonstrate commitment to maintaining and improving natural resources on development sites. Several sites in the ACE Basin have received recognition under the Stewardship Development Program. These are Brays Island Plantation, Spring Island, Newpoint, and Bailey Island Club. (See related section: Planning and Zoning Tools.)

Stakeholders in the ACE Basin must be involved in the planning process despite the diversity of public perception concerning the value of ACE Basin resources. Education and economic status play a major role in forming these views. To complicate matters, it is not always clear where divergent opinions occur, for many participants have multiple and sometimes conflicting interests. Consensus among community members is an important part of the land use planning process, especially when the community must deal with issues of growth and development. Achieving consensus can be difficult. Various factions within a community may have different visions for the future that affect their views of growth and development. (See related section: Stakeholders.)

It is evident that public opinion will influence the path that growth and development follows in the ACE Basin, whether it be in the planning stage, implementation stage, or evaluation stage. It would behoove planners to involve the public early in the planning process. Residents are the ones whose quality of life is affected by the changes that occur from stimulating growth in the community. Residents, visitors, and tourists are all also affected by limits of growth in recreational areas. There can be no question but that the opinions and welfare of each must be considered. The control of growth and development must be a major goal for communities wishing to achieve a level of development that is economically profitable but socially and environmentally acceptable (Martin et al. 1998). What lies ahead will depend largely on whether wise planning and stewardship is continued through educational processes; ecological resources and services are conserved through implementation of development techniques that support sustainable development; and new approaches to land use and management are developed that promote sustained use of our natural resources. (See related section: Land Use Synthesis Module.)

Back to Executive Summary Introduction

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts |

Executive Summary
References

A - E

- ACE Basin Economic Forum. 1996. ACE basin economic forum: Health economy, healthy environment: An action agenda for compatible economic development. Walterboro, SC.
- Adams, D.A. 1963. Factors influencing vascular plant zonation in North Carolina salt marshes. Ecology 44: 445-456.
- Alexander, C. and E. Wenner. 1995. Evaluating the historical record of nonpoint source pollution in the ACE Basin and Sapelo Island National Estuarine Research Reserves. Final Report submitted to South Carolina Sea Grant Consortium. South Carolina Department of Natural Resources, Marine Resources Division, Charleston, SC and Skidaway Institute of Oceanography, Sapelo Island, GA.
- Allen, DE. and C.S. Thomason. 1993. Survey and inventory of fisheries resources in the Combahee River. Study Completion Report. Fisheries Investigations in Lakes and Streams, District VI. South Carolina Wildlife and Marine Resources Department, Freshwater Fisheries Division, Bonneau, SC.
- Arnold, C.L. and J. Gibbons. 1996. Impervious surface coverage: The emergence of a key environmental indicator. Journal of the American Planning Association 62(2): 243-258.
- Aucott, W.R., M.E. Davis, and G.K. Speiran. 1987. Geohydrologic framework of the coastal plain aquifers of South Carolina. Water Resources Investigations, Report 85-4271. U.S. Geological Survey, Columbia, SC.
- Baker, O.E. III and D.B. Carmichael, Jr. 1996. South Carolina's Furbearers. Department of Natural Resources, Division of Wildlife and Freshwater Fisheries, Columbia, SC.
- Beasley, B.R., W.D. Marshall, A.H. Miglarese, J.D. Scurry, and C. Vanden Houten. 1996. Managing resources for a sustainable future. The Edisto River Basin Project Report. South Carolina Department of Natural Resources, Water Resources Division, Columbia, SC.
- Beatty, H.R. and J.M. Boylan. 1997. Results of the Southeast Area Monitoring and Assessment Program - South Atlantic (SEAMAP-SA): Nearshore, day/night trawl sampling in the coastal habitat of the South Atlantic Bight during 1987 and 1988. Special Report No. 65. South Carolina Department of Natural Resources, Marine Resources Division, Charleston, SC.
- Bell, S.S. and B.C. Coull. 1978. Field evidence that shrimp predation regulates meiofauna. Oecologia 35: 141-148.

Bennett, S.H. and J.B. Nelson. 1991. Distribution and status of Carolina Bays in South Carolina. South Carolina Wildlife and Marine Resources Department, Nongame and Heritage Trust Publication No. 1. Columbia, SC.

- Bent, A.C. 1964. Life histories of North American cuckoos, goatsuckers, hummingbirds and their allies. Dover Publishing Inc., New York, NY.
- Blaustein, A.R., D.B. Wake, and W.P. Sousa. 1994. Amphibian declines: Judging stability, persistence, and susceptibility of populations to local and global extinctions. Conservation Biology 8(1): 60-71.
- Boesch, D.F. and R.E. Turner. 1984. Dependence of fishery species on salt marshes: The role of food and refuge. Estuaries 7(4): 460-468.
- Bryan, E.M.F. 1993. Colleton County, South Carolina: A history of the first 160 years, 1670-1830. Florentine Press. R.L. Bryan Company, Columbia, SC.
- Burton, T.M. and G.E. Likens. 1975. Salamander populations and biomass in the Hubbard Brook experimental forest, New Hampshire. Copeia 3: 541-546.
- Calder, D. R. and B. B. Boothe, Jr. 1977a. Some subtidal epifaunal assemblages in South Carolina estuaries. South Carolina Marine Resources Center Data Report No. 4. South Carolina Wildlife and Marine Resources Department, Charleston, SC.
- Calder, D. R. and B. B. Boothe, Jr. 1977b. Data from some subtidal quantitative benthic samples taken in estuaries of South Carolina. South Carolina Marine Resources Center Data Report No. 3. South Carolina Wildlife and Marine Resources Department, Charleston, SC.
- Camburn, K.E., R.L. Lowe, and D.L. Stoneburner. 1978. The haptobenthic diatom flora of Longbranch Creek, South Carolina. Nova Hedwigia 30: 149-279.
- Chowns, T. M. and C. T. Williams. 1983. Pre-Cretaceous rocks beneath the Georgia Coastal Plain: regional implications. *In* G. S. Gohn (ed.). Studies Related to the Charleston, South Carolina Earthquake of 1886: tectonics and seismicity. U. S. Geological Survey Professional Paper 1313. U. S. Government Printing Office, Washington, DC.
- Colleton County Land Use Planning Task Force. 1997. Draft Colleton County land use plan. Colleton County Land Use Planning Task Force, Walterboro, SC.
- Colquhoun, D.J. 1969. Geomorphology of the lower coastal plain of South Carolina. Report MS-15. S.C. Geological Survey, Columbia, SC.
- Colquhoun, D.J. 1974. Cyclic surficial stratigraphic units of the middle and lower coastal plains, central South Carolina. *In*: R.Q. Oaks and J.R. DuBar (eds). Post-Miocene stratigraphy, central and southern Atlantic coastal plain. Utah State University Press, Logan, UT.
- Colquhoun, D.J., I.D. Woolen, D.S. Van Niewenhuise, G.G. Padgett, R.W. Oldham, D.C. Boyland, J.W. Bishop, and P.D. Howell. 1983. Surface and subsurface stratigraphy, structure and aquifers of the South Carolina coastal plain. Report to the South Carolina Department of Health and Environmental Control, Ground Water Protection Division. U.S. Geological Survey, Columbia, SC.
- Colquhoun, D.J. and M.G. Muthig. 1991. Stratigraphy and structure of the Paleocene and Lower Eocene Black Mingo Group, South Carolina. *In*: J.W. Horton and V.A. Zullo (eds).

The geology of the Carolinas. University of Tennessee Press, Knoxville, TN.

- Conner, R.C. 1993. Forest statistics for South Carolina, 1993. Resource Bulletin SE-141. U.S. Department of Agriculture, Southeastern Forest Experiment Station, Asheville, NC.
- Coull, B.C. 1990. Are members of the meiofauna food for higher trophic levels. Transactions of the American Microscopical Society 109(3): 233-246.
- Coull, B.C. and S.S. Bell. 1983. Biotic assemblages: Populations and communities. p 283-319. *In*: F.J. Vernberg and W.B. Vernberg (eds.). The biology of crustacea. Volume 7: Behavior and ecology. Academic Press, New York, NY.
- Daily, G.C. (ed.). 1997. Nature's services: Societal dependence on natural ecosystems. Island Press, Washington, DC.
- Davis, L.V. 1978. Class Insecta. p 186-220. *In*: R.G. Zingmark (ed.). An annotated checklist of the biota of the coastal zone of South Carolina. University of South Carolina Press, Columbia, SC.
- Davis, L.V. and I.E. Gray. 1966. Zonal and seasonal distribution of insects in North Carolina salt marshes. Ecological Monographs 36: 275-295.
- Davis, R.B and R.F. Van Dolah. 1992. Charleston Harbor Estuary. Volume I. *In*: Characterization of the physical, chemical, and biological conditions and trends in three South Carolina estuaries 1970-1985. Volume I: Charleston Haror Estuary. South Carolina Sea Grant Consortium, Charleston, SC.
- Dawes, C.J. 1998. Marine botany. 2nd edition. John Wiley and Sons Inc., New York, NY.
- Diaz, R.J. and R. Rosenberg. 1995. Marine benthic hypoxia: A review of its ecological effects and the behavioral responses of benthic macrofauna. Oceanography and Marine Biology: An Annual Review 33: 245-305.
- Doar, W. 1997. personal communication. South Carolina Department of Natural Resources, Columbia, SC.

F - J

- Field, J.G. 1983. Flow patterns of energy and matter. *In*: O. Kinne (ed.). Marine ecology. Vol. V: Ocean management. Part 2: Ecosystems and organic resources. John Wiley and Sons, New York, NY.
- Fontenot, L., W. Noblet, G. Pittman, S.G. Platt, and J.M. Akins. 1996. A survey of herpetofauna inhabiting polychlorinated biphenyl contaminated and reference watersheds in Pickens County, South Carolina. Journal of the Elisha Mitchell Scientific Society 112(1): 20-30.
- Foster, W.A. and J.E. Treherne. 1976. Insects of marine salt marshes: Problems and adaptations. *In*: L. Cheng (ed.). Marine insects. American Elsevier Publishing Company, New York, NY.
- Frithsen, J.B. 1989. Marine eutrophication: Nutrient loading, nutrient effects and the federal response. University of Rhode Island, Narragansett, RI.

- Gaston, K.J., T.R. New, and M.J. Samways (eds.). 1993. Perspectives on insect conservation. Intercept Ltd., Andover, MA.
- Gibbons, J.W. and J.W. Coker. 1978. Herpetofaunal colonization patterns of Atlantic coast barrier islands. The American Midland Naturalist 99(1): 212-233.
- Gibbons, J.W. and J.R. Harrison. 1981. Reptiles and amphibians of Kiawah and Capers Islands, South Carolina. Brimleyana 5: 145-162.
- Gliessman, S.R. 1998. Agroecology: Ecological processes in sustainable agriculture. Ann Arbor Press, Chelsea, MI.
- Grant, R.R., Jr. 1974. Algae. p 16-30. *In*: Cooper River Survey 1973. Prepared for the E.I. Dupont de Nemours and Company. Academy of Natural Science, Philadelphia, PA.
- Grobowski, J. 1998. personal communication. Westvaco Corporation, Summerville, SC.
- Hammond, D.L. and D. M. Cupka. 1977. An economic and biological evaluation of the South Carolina pier fishery. South Carolina Wildlife and Marine Resources Department, SC Marine Resources Center Technical Report No. 20. Charleston, SC.
- Heritage Trust Database. 1997. List of threatened and endangered species. South Carolina Department of Natural Resources, Freshwater Fisheries and Wildlife Diversity Division, Columbia, SC.
- Hopkins, J.S. 1991. Status and history of marine and freshwater shrimp farming in South Carolina and Florida. *In*: P.A. Sandifer (ed.). Shrimp culture in North America and the Caribbean. World Aquaculture Society, Baton Rouge, LA.
- Houser, D.S. and D.M. Allen. 1996. Zooplankton dynamics in an intertidal salt-marsh basin. Estuaries 19(3): 659-673.
- Howe, J., E. McMahon, and L. Propst. 1997. Balancing nature and commerce in gateway communities. Island Press, Washington, DC.
- Hunter, M.L. 1990. Wildlife, forests, and forestry: Principles of managing forests for biodiversity. Prentice Hall, Englewood Cliffs, NJ.
- Hyland, J.L., L. Balthis, C.T. Hackney, G. McRae, A.H. Ringwood, T.R. Snoots, R.F. Van Dolah, and T.L. Wade. 1998. Environmental quality of estuaries of the Carolinian Province: 1995. Annual statistical summary for the 1995 EMAP-Estuaries Demonstration Project in the Carolinian Province. NOAA Technical Memorandum NOS ORCA 123. NOAA/NOS, Office of Ocean Resources Conservation and Assessment, Silver Spring, MD.
- Hyland, J.L., T.J. Herrlinger, T.R. Snoots, A.H. Ringwood, R.F. Van Dolah, C.T. Hackney, G.A. Nelson, J.S. Rosen, and S.A. Kokkinakis. 1996. Environmental quality of estuaries of the Carolinian Province: 1994. Annual statistical summary for the 1994 EMAP-Estuaries Demonstration Project in the Carolinian Province. NOAA Technical Memorandum NOS ORCA 97. NOAA/NOS, Office of Ocean Resources Conservation and Assessment, Silver Spring, MD.
- Iversen, E.S. 1996. Living marine resources: Their utilization and management. Chapman and Hall, New York, NY.
- Jenny, H. 1941. Factors of soil formation. McGraw-Hill, New York, NY.

- Kineman, J.J. and B.O. Parks (eds.). 1996. Ecological characterization: Recommendations of a Science Review Panel. NOAA Workshop. KGRD#32 and NOAA CSC/10-96/001. March 9-10, 1995. National Geophysical Data Center, Boulder, CO, and Coastal Services Center, Charleston, SC.

K - O

- Kneib, R.T. 1984. Patterns of invertebrate distribution and abundance in the intertidal salt marsh: Causes and questions. Estuaries 7: 392-412.

- Knott, D.M. 1980. The zooplankton of the North Edisto River and two artificial saltwater impoundments. M.S. Thesis. College of Charleston, Charleston, SC.

- Knott, D.M., E.L. Wenner, and P.H. Wendt. 1997. Effects of pipeline construction on the vegetation and macrofauna of two South Carolina, USA salt marshes. Wetlands 17(1): 65-81.

- Lerberg, S.B. 1997. Effects of watershed development on macrobenthic communities in tidal creeks of the Charleston Harbor area. M.S. Thesis. University of Charleston, Charleston, SC.

- Lewitus, A.J., E.T. Koepfler, and J.T. Morris. 1998. Seasonal variation in the regulation of phytoplankton by nitrogen and grazing in a salt-marsh estuary. Limnology and Oceanography 43(4): 636-646.

- Marcy, B.C., Jr. and S.K. O'Brien-White (eds.). 1995. Fishes of the Edisto River Basin, South Carolina. South Carolina Department of Natural Resources, Water Resources Division. Edisto River Basin Project, Report 6. Columbia, SC.

- Marple, R.T. and P. Talwani. 1993. Evidence of possible tectonic upwarping along the South Carolina plain from an examination of river morphology and elevation data. Geology 21: 651-654.

- Marples, T.G. 1966. A radionuclide tracer study of arthropod food chains in a *Spartina* marsh ecosystem. Ecology 47: 270-277.

- Martin, B.S., F.A. McGuire, and L.A. Allen. 1998. Retirees' attitudes toward tourism: Implications for sustainable development. Tourism Analysis 3: 43-51.

- Mathews, T.D., F.W. Stapor Jr., C.R. Richter, J.V. Miglarese, M.D. McKenzie, and L.A. Barclay (eds.). 1980. Ecological characterization of the sea island coastal region of South Carolina and Georgia. Volume I: Physical features of the characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-79/40.

- McCrady, E. 1897. The history of South Carolina under the proprietary government 1670-1719. Macmillan Company, New York, NY.

- McIntyre, M.P., H.P. Eilers, and J.W. Mairs. 1991. Physical Geography. Wiley and Sons, New York, NY.

- Meffe, G.K. and C.R. Carroll. 1994. Principles of conservation biology. Sinauer Associates Inc., Sunderland, MA.

- Molley, M., J. Lennon, N. Drawas, and P. Herbst. 1976. Cross Florida Barge Canal

Restudy Report. Benthic macroinvertebrate and plankton communities of the associated aquatic systems for the proposed Cross Florida Barge Canal. Prepared for Department of Army, Jacksonville District, Corps of Engineers, Jacksonville, FL. Environmental Research and Technology, Inc., Jacksonville, FL.

- Monk, C.D. 1968. Successional and environmental relationships of the forest vegetation of north-central Florida. American Midlands Naturalist 79: 441-457.
- Morgan, P.H. 1974. A study of tidelands and impoundments within a three-river delta system - The South Edisto, Ashepoo, and Combahee Rivers of South Carolina. M.S. Thesis. University of Georgia, Athens, GA.
- Municipal Association of South Carolina and South Carolina Association of Counties. 1994. Comprehensive planning guide for local governments. Columbia, SC.
- Nixon, S.W. 1995. Coastal marine eutrophication: A definition social causes, and future concerns. Ophellia 41: 199-219.
- [NOAA] National Oceanic and Atmospheric Administration. 1996. Estuarine eutrophication survey. Volume 1: South Atlantic Region. Office of Ocean Resources Conservation Assessment, National Ocean Service, Silver Spring, MD.
- Odum, E.P. 1997. Ecology: A bridge between science and society. Sinauer Associates Inc., Sunderland, MA.
- Orlando, S.P., P.H. Wendt, C.J. Klein, M.E. Pattilo, K.C. Dennis, and G.H. Ward. 1994. Salinity characteristics of the South Atlantic Estuaries. NOAA, Office of Ocean Resources Conservation and Assessment, Silver Spring, MD.
- Otto, J.S. 1989. The southern frontiers, 1607-1860: The agricultural evolution of the colonial and antebellum South. Contributions in American History, No. 133. Greenwood Press, Westport, CT.

P - T

- Payne, J.A. 1965. A summer carrion study of the baby pig *Sus scrofa*. Ecology 46: 592-602.
- Pechmann, J.H.K., D.E. Scott, R.D. Semlitsch, J.P. Caldwell, L.J. Vitt, and J.W. Gibbons. 1991. Declining amphibian populations: The problem of separating human impacts from natural fluctuations. Science 253: 892-895.
- Pelton, M.R. 1975. Mammalogy. *In:* W.M. Campbell, J.M. Dean, and W.D. Chamberlain (eds). Environmental inventory of Kiawah Island. Report prepared for Coastal Shores Inc. Environmental Research Center Inc., Columbia, SC.
- Perison, D., J. Phelps, C. Pavel, and R. Kellison. 1997. The effects of timber harvest in a South Carolina blackwater bottomland. Forest Ecology and Management 90(2-3): 171-185.
- Peterson, C.H. and J. Lubchenco. 1997. Marine ecosystems services. *In*: G.C. Daily (ed.). Nature's Services: Societal Dependence on Natural Ecosystems. Island Press, Washington, DC.
- Potter, E.F., J.F. Parnell, and R.T. Teulings. 1980. Birds of the Carolinas. University of

North Carolina Press, Chapel Hill, NC.

- Prevost, M. 1988. Bear Island WMA management plan. South Carolina Wildlife and Marine Resources Department, Columbia, SC.

- Prevost, M. 1991. Wetland management plan for Cheeha [Chehaw]-Combahee Plantation, Colleton County, South Carolina. Draft. Prepared for Cheeha [Chehaw]-Combahee Plantation, Inc. South Carolina Wildlife and Marine Resources Department, Columbia, SC.

- Pullin, A.S. (ed.). 1995. Ecology and conservation of butterflies. Chapman & Hall, London, U.K.

- Quarterman, E. and C. Keever. 1962. Southern mixed hardwood forest: Climax in the southeastern coastal plain, U.S.A. Ecological Monographs 32: 167-185.

- Ragotzkie, R.A. 1959. Plankton productivity in estuarine waters of Georgia. Report Number 6. Publications of the Institute of Marine Science, University of Texas, TX.

- Rayner, D.A. 1984. Inventory of botanical natural areas in Colleton County, South Carolina. *In*: Inventory of Botanical Natural Areas in Colleton, Dorchester, Horry and Jasper Counties, South Carolina. South Carolina Wildlife and Marine Resources Department, Division of Wildlife and Freshwater Fisheries, Nongame, Endangered Species Heritage Trust Section, Columbia, SC.

- Royce, W.F. 1996. Introduction to the practice of fishery science. Academic Press, San Diego, CA.

- Ryther, J.H. and C.B. Officer. 1981. Impact of nutrient enrichment on water uses. *In*: B.J. Neilson and L.E. Cronin (eds.). Estuaries and nutrients. Humana Press, Clifton, NJ.

- Sandifer, P., J.V. Miglarese, D.R. Calder, J.J. Manzi, and L.A. Barclay (eds.). 1980. Ecological characterization of the sea island coastal region of South Carolina and Georgia. Volume III: Biological features of the characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-79/42.

- Scholtens, B. 1999. Personal communication. College of Charleston, Charleston, South Carolina.

- Schubel, J.R. 1977. Sediment and the quality of the estuarine environment: some observations. *In*: I.H. Suffet (ed.). Fate of pollutants in the air and water environments. Part I: Mechanism of interaction between environments and mathematical modeling and the physical fate of pollutants. John Wiley and Sons, New York, NY.

- Scott, G.I., M.H. Fulton, D. Bearden, M. Sanders, A. Dias, L.A. Reed, S. Sivertsen, E.D. Strozier, P.B. Jenkins, J.W. Daugomah and others. 1998. Chemical contaminant levels in estuarine sediment of the Ashepoo-Combahee-Edisto River (ACE) Basin National Estuarine Research Reserve and Sanctuary Site. U.S. Department of Commerce, NOS, Charleston, SC.

- Shabman, L. 1996. Land settlement, public policy, and the environmental future of the southeast coast. *In*: F.J. Vernberg, W.B. Vernberg, and T. Siewicki (eds.). Sustainable development in the southeastern coastal zone. University of South Carolina Press, Columbia, SC.

- Sharitz, R.R. and C.A. Gresham. 1998. Pocosins and Carolina bays. *In*: M.G. Messina and

W.H. Conner (eds.). Southern forested wetlands: Ecology and management. Lewis Publishers, Boca Raton, FL.

- Shipes, D.A. 1993. The utilization of wildlife resources by hunters licensed to hunt in South Carolina during 1991-1992 as determined by a postal survey. South Carolina Wildlife and Marine Resources Department, Columbia, SC.

- Smith, D.L. and B.C. Coull. 1987. Juvenile spot (*Pices*) and grass shrimp predation on meiobenthos in muddy and sandy substrata. Journal of Experimental Marine Biology and Ecology 105: 123-136.

- Smith, J.W. and C.J. Moore. 1981. An inventory of access points and areas available to saltwater recreational fishermen in coastal South Carolina, with recommendations for upgrading and expansion of these facilities. Submitted to SC Coastal Council for Contract #80-105. South Carolina Wildlife and Marine Resources Department, Marine Resources Division, Charleston, SC.

- Soller, D.R. and H.H. Mills. 1991. Surficial geology and geomorphology. p. 290-308. *In*: The geology of the Carolinas. University of Tennessee Press, Knoxville, TN.

- [SCDHEC] South Carolina Department of Health and Environmental and Control. 1995. State of South Carolina monitoring strategy for fiscal year 1996. Technical Report 002-95. South Carolina Department of Health and Environmental Control, Bureau of Water Pollution Control, Columbia, SC.

- [SCWRC] South Carolina Department of Health and Environmental and Control. 1997. Watershed water quality management strategy; Savannah and Salkehatchie river basins. South Carolina Department of Health and Environmental Control, Bureau of Water, Technical Report No. 003-97.

- [SCWRC] South Carolina Water Resources Commission. 1972. ACE framework study: Ashley-Combahee-Edisto River Basin. South Carolina Water Resources Commission, Columbia, SC.

- [SCWRC] South Carolina Water Resources Commission. 1983. South Carolina state water assessment. Report No. 140. South Carolina Water Resources Commission, Columbia, SC.

- Sprunt, A. and E.B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

- Stalter, R. 1968. Ecological study of a South Carolina salt marsh. Ph.D. Dissertation. University of South Carolina, Columbia, SC.

- Teal, J.M. 1962. Energy flow in the salt marsh ecosystem of Georgia. Ecology 21: 245-252.

- Thomason, C.S., D.E. Allen, and J.S. Crane. 1993. A fisheries study of the Edisto River. South Carolina Wildlife and Marine Resources Department, Study Completion Report, Columbia, SC. Wallop-Breaux Projects F-30 and F-32.

- Tiner, R.W., Jr. 1977. An inventory of South Carolina's coastal marshes. South Carolina Wildlife and Marine Resources Department, Marine Resources Center, Technical Report Number 33. Charleston, SC.

- [TNC] The Nature Conservancy. 1993. ACE Basin biological inventory report, 1990-1992. The Nature Conservancy, Charleston, SC.
- Trenhaile, A.S. 1997. Coastal dynamics and landforms. Oxford University Press, New York, NY.
- Turner, R.E. 1977. Intertidal vegetation and commercial yield of penaeid shrimp. Transactions of the American Fisheries Society 106: 411-415.

U - Z

- [UGMI] University of Georgia Marine Institute. 1971. Notes on the natural history and invertebrate fauna of the upper North Newport River. *In*: An ecological survey of the North and South Newport rivers and adjacent water with respect to possible effects of treated Kraft mill effluent. Contract UGA #D2422-122. Final Report to the Georgia Water Quality Control Board. University of Georgia Marine Institute, GA.
- [USCB] U.S. Census Bureau. 1990. 1990 Census summary tape files lookup. http://venus/census.gov.cdrom/lookup. Access date March 1999.
- U.S. Department of Commerce. 1998. The regional economic information system [CD-ROM]. U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economics Measurement Division, Washington, DC.
- [USFWS] U.S. Fish and Wildlife Service. 1996. 1996 National survey of fishing, hunting and wildlife-associated recreation. State Overview. Washington, DC.
- Van der Valk, A.G. 1974. Environmental factors controlling the distribution of forbs on foredunes in Cape Hatteras National Seashore. Canadian Journal of Botany 52:1057-1073.
- Van Dolah, R.F., D. Calder, F. Stapor, R. Dunlap, and C. Richter. 1979. Atlantic Intracoastal Waterway environmental studies at Sewee Bay and North Edisto River. Marine Resources Center Technical Report No. 39. South Carolina Wildlife and Marine Resources Department, Charleston, SC.
- Van Dolah, R.F., D.R. Calder, and D.M. Knott. 1984. Effects of dredging and open-water disposal on benthic macroinvertebrates in a South Carolina estuary. Estuaries 7: 28-37.
- Van Dolah, R.F., P.H. Wendt, and M.V. Levisen. 1991. A study of the effects of shrimp trawling on benthic communities in two South Carolina sounds. Fisheries Research 12: 139-156.
- Van Engel, W.A. and E.B. Joseph. 1968. The characterization of coastal and estuarine fish nursery grounds as natural communities. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC.
- Veno, P.A. 1976. Successional relationships of five Florida plant communities. Ecology 57: 498-508.
- Vernberg. F.J. and C.E. Sansbury. 1972. Studies on salt marsh invertebrates of Port Royal Sound. *In*: South Carolina Water Resources Commission (ed.). Port Royal Sound environmental study. South Carolina Water Resources Commission, Columbia, SC.
- Webster, W.D., J.F. Parnell, and W.C. Biggs Jr. 1985. Mammals of the Carolinas,

Virginia, and Maryland. University of North Carolina Press, Chapel Hill, NC.

- Weinstein, M.P. 1979. Shallow marsh habitats as primary nurseries for fishes and shellfish, Cape Fear River, North Carolina. Fisheries Bulletin 7: 339-357.

- Wenner, C.A. and G.R. Sedberry. 1989. Species composition, distribution, and relative abundance of fishes in the coastal habitat off the southeastern United States. National Oceanic and Atmospheric Administration Technical Report NMFS 79. Prepared by South Carolina Wildlife and Marine Resources Department, Marine Resources Division, Charleston, SC.

- Wenner, E.L. and C.A. Wenner. 1988. Seasonal composition and abundance of decapod and stomatopod crustaceans form coastal habitats, southeastern United States. Fishery Bulletin 87: 155-176.

- Wenner, E.L., W.P. Coon III, P.A. Sandifer, and M.H. Shealy Jr. 1991. A comparison of species composition and abundance of decapod crustaceans and fishes from the North and South Edisto Rivers in South Carolina. Technical Report No. 78. South Carolina Wildlife and Marine Resources Department, Marine Resources Division, Charleston, SC.

- Wharton, C.H. 1978. The natural environment of Georgia. Georgia Department of Natural Resources, Atlanta, GA.

- Wharton, C., W.M. Kitchens, E.C. Pendleton, and T.W. Sipe. 1982. The ecology of bottomland hardwood swamps of the southeast: A community profile. U.S. Fish and Wildlife Service, Biological Services Program, Washington, DC. FWS/OBS-81/37.

Back to Executive Summary Introduction

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

MENU

Clemson University Extension Service

SC Coastal Conservation League

SC Department of Agriculture

SC Forestry Commission

SC Department of Health and Environmental Control

SC Department of Natural Resources

SC Department of Transportation

SC Department of Parks, Recreation, and Tourism

SC Geodetic Survey

SC Institute of Archaeology and Anthropology

SC Nature Based Tourism Association

SC Sea Grant Consortium

SC Waterfowl Association

SC Wildlife Federation

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

State Contacts

Clemson University Extension Service

The Clemson University Extension Service, run by Clemson University, provides technical advice, data, and assistance to individuals and groups along the coast in several major program areas, including agricultural, forestry, and wildlife practices.

Contact
Robert Franklin, Area Forest and Wildlife Agent
PO Box 10866
Walterboro, SC 29488
843-549-2597
http://www.clemson.edu/extension EXIT

South Carolina Coastal Conservation League

The South Carolina Coastal Conservation League is a grass-root, non-profit organization backed by 4,000 members and dedicated to protecting South Carolina's coastal resources. The League serves on the ACE Basin National Estuarine Research Reserve Advisory Committee and is active in conservation efforts in the ACE Basin.

Contact:
Dana Beach, Director
PO Box 1765
Charleston, SC 29402
Phone: 843-723-8035
Fax: 843-723-8308
E-mail: nancyv@scccl.org
http://www.scccl.org EXIT

South Carolina Department of Agriculture

The South Carolina Department of Agriculture was created for the purpose of fostering agriculture in South Carolina and is responsible for the enforcement of more than 30 statutes relating to agriculture. These responsibilities include providing consumer protection in weights and measures to bonded storage for non-perishable agricultural products; marketing programs on livestock, fruits, vegetables, grain and poultry products; and establishing and supervising marketing authorities in communities throughout the State.

Contact:
Annette Reynolds
PO Box 11280
Columbia, SC 29211
803-549-2596

http://www.state.sc.us/scda EXIT

South Carolina Forestry Commission

The South Carolina Forestry Commission was established in 1927. Its mission is to protect, promote, enhance, and nurture the forested lands of South Carolina in a manner consistent with achieving the greatest good for its citizens. The Forestry Commission is responsible for the promulgation and enforcement of laws and regulations related to the protection of forests and their associated values, and the development of Best Management Practice Guidelines for South Carolina's forested land.

Contact:
Dick Boyce
413 Sidneys Rd.
Walterboro, SC 29488
Phone: 843-538-7977
Fax: 843-538-2193

South Carolina Department of Health and Environmental Control (DHEC)

- Bureau of Environmental Services
- Bureau of Land and Waste Management
- Office of Ocean and Coastal Resource Management
- Bureau of Water

The Department confronts the basic problems of disease, pollution, hunger, poverty and ignorance that threaten the health and lives of people and the environment. South Carolina's Department of Health and Environmental Control's mission is to assure community-based efforts through which the health of the state's citizens can be protected and improved. DHEC falls under the executive branch of the state government. It is divided into the Office of Ocean and Coastal Resource Management, Office of Environmental Control, and Health Services. Ocean and Coastal Resource Management is primarily in charge of permitting and critical area resource planning in the coastal counties. Environmental Control has four program areas: Air Quality, Environmental Services, Land and Waste Management, and Water. Environmental Control is responsible for protecting the air, land, and water quality of the entire coast as well as the rest of the state.

Contact:
General Information
Environmental Quality Control
SC Department of Health and Environmental Control
2600 Bull Street

Columbia, SC 29201
803-734-5360
http://www.state.sc.us/dhec/ EXIT

Bureau of Environmental Services
The Bureau of District Services and the Bureau of Environmental Quality Control (EQC) Laboratories recently merged to form the Bureau of Environmental Services. The Bureau of Environmental Services contains twelve (12) District Offices, providing direct support services to the EQC program areas and to the general public. Services include emergency response activities, environmental monitoring for EQC programs (drinking water, wastewater, air quality, and waste management), facility inspections and evaluations, technical assistance, on-site presence at certain commercial hazardous waste facilities, shellfish regulation, special environmental monitoring at the Savannah River Site, and a summer pool inspection program associated with the recreational waters program. EQC has three district offices on the coast.

Contact:
Russell Berry, Director, Lowcountry EQC District Office
1313 Thirteenth Street
Port Royal, SC 29935
Phone: 843-522-9097
Fax: 843-522-8463

Wayne Fanning, Director, Trident EQC District Office
1362 McMillan Ave.
Suite 300
Charleston, SC 29405
843-740-1590

Ron Tata, Director, Waccamaw EQC District Office
1705 Oak Street Plaza
Suite #2
Myrtle Beach, SC
843-448-1902

Bureau of Land and Waste Management
The Bureau of Land and Waste Management administers a variety of environmental permitting programs, planning and preparedness activities, and other activities such as monitoring, enforcement, environmental assessment and remediation, groundwater technical support, and emergency response. All aspects of managing both solid and hazardous waste are the responsibility of the Bureau, including administering grants to city and county governments for solid waste recycling programs, developing environmental education curriculums and training school teachers. In addition, the Bureau's responsibilities include managing radioactive and infectious waste, permitting bulk oil terminals, oil and gas exploration, and mining and land reclamation.

Contact:
General Information
2600 Bull Street
Columbia, SC 29201
803-896-4000

Hydrogeology - G. Kendall Taylor, Director
803-896-4011
Site Assessment and Remediation - J. Keith Lindler, Director
803-896-4052
Waste Assessment and Emergency Response - Ronald W. Kinney, Director
803-896-4092
Compliance Monitoring and Enforcement - J. Ted Buchanan, Director
803-896-4132

Ocean and Coastal Resource Management (OCRM)
The Office of Ocean and Coastal Resource Management is responsible for the enforcement of South Carolina's Coastal Zone Management Act of 1977. The goal of this legislation is to protect South Carolina's coastal resources and promote responsible development. This is accomplished through a permitting and certification program that affects the eight coastal counties, including areas in the ACE Basin.

OCRM annually processes about 3,000 applications. These include applications for the construction of subdivisions, shopping centers, docks, marinas, boat landings, piers, sewage treatment plants, golf courses, bridges and roads, dredging projects, beach nourishment, sea walls, sand fencing, and stormwater management systems. Approximately 85 percent of all projects within the coastal zone require OCRM approval before construction can begin. An enforcement division assures compliance.

Contact:
General Information
1362 McMillan Avenue
Suite 400
Charleston, SC 29405
843-744-5838

Chris Brooks, Director
843-744-5838, ext. 107

Permitting - Richard Chinnis
843-744-5383 ext. 113
Planning - Steve Moore, Director
843-744-5838, ext. 136
Certification - Steve Snyder, Director
843-744-5838, ext. 129

Bureau of Water
The Bureau of Water is the water quality protection office for the entire state, implementing a variety of water quality management programs in the coast and statewide, pursuant to state laws and the Federal Clean Water Act. These include development of water quality standards to protect public health and aquatic ecosystems, issuance of permits for discharge of treated wastewater to surface waters, approval of land application of sludge and agricultural wastes, approval of the design of wastewater treatment systems and issuance of construction permits, approval of stormwater and sediment control plans, issuance of stormwater discharge permits, surface water quality monitoring of water quality, assessment of aquatic conditions, effects of pollution sources, protection of drinking water sources, drinking water facilities permitting and inspection, and groundwater protection.

Contact:

General Information
2600 Bull Street
Columbia, SC 29201
803-734-5300

> *Permitting and Compliance* - Alton Boozer, Bureau Chief
> 803-734-5296
> Joe Richer, Assistant Bureau Chief
> 803-734-5342
>
> *Water Quality Assessment, Monitoring Standards, Enforcement, and Planning* -
> Chester Sansbury, Assistant Bureau Chief
> 803-734-5316

South Carolina Department of Natural Resources (DNR)

- Conservation, Education, and Communication Division
- Wildlife and Freshwater Wisheries Division
- Marine Resources Division
- Law Enforcement Division
- Land and Water Conservation Division
- South Carolina Geological Survey

The South Carolina Department of Natural Resources (SCDNR) is the advocate for, and steward of, the state's natural resources. The Department develops and implements policies and programs for the conservation, management, utilization and protection of the state's natural resources based upon scientifically sound resource management, assessment and monitoring, applied research, technology transfer, comprehensive planning, public education, technical assistance, and constituent involvement.

The agency, as organized on July 1, 1994 under the SC Restructuring Act, is composed of the former Wildlife and Marine Resources Department, Water Resources Commission (non-regulatory programs), Land Resources Commission (non-regulatory programs), State Geological Survey (State Geologist), and SC Migratory Waterfowl Committee. These have been combined into the present structure, which includes the Executive Office and six divisions: Administrative Services; Conservation, Education, and Communications; Wildlife and Freshwater Fisheries; Marine Resources; Law Enforcement; and Land, Water, and Conservation Division.

South Carolina Department of Natural Resources serves on the ACE Basin Task Force, guiding the overall concept and approach to the ACE Basin project area. The Department of Natural Resources has formed its own ACE Basin Committee, which coordinates DNR activities within the ACE Basin and updates the public on its progress. DNR is responsible for the management of properties in the ACE Basin National Estuarine Research Reserve, the Donnelley Wildlife Management Area, and Bear Island Wildlife Management Area. See individual divisions for more information.

Conservation, Education, and Communication Division
The Conservation, Education, and Communications Division of SCDNR seeks to inform and educate the public on issues regarding the conservation, restoration and rational use of the states' natural resources. SCDNR offers diverse education programs for students from kindergarten through high school. The communications section

provides up-to-date news releases regarding SCDNR issues and the state of South Carolina's natural resources. Some of their activities and productions are listed below:

- South Carolina Wildlife Magazine
- Calendar & Product Sales
- Conservation Education Programs
- Publication Design & Production
- Department News Release Program
- SC. Natural Resources newspaper
- Freshwater fishing records
- Hooked On Fishing rodeos for kids
- Wayne Society (bird watching)

Contact:
Deputy Director, Prescott Baines
South Carolina Department of Natural Resources
Conservation Education and Communication Division
(1000 Assembly Street, Dennis Building, 2nd Floor)
P.O. Box 167
Columbia, SC 20202

http://www.dnr.state.sc.us/cec/index.html EXIT

Wildlife and Freshwater Fisheries Division
The Wildlife and Freshwater Fisheries Division is concerned with wildlife and freshwater fisheries management within South Carolina. They protect endangered species and fisheries through management and area programs, while promoting freshwater fishing. Responsibilities include:

- Studying fish & wildlife resources
- Assisting landowners with wildlife management
- Establishing a Wildlife Management Area Program
- Assisting pond owners in management
- Selling fingerlings to farm pond owners
- Managing fish hatcheries, public stocking
- Establishing fish concentration areas
- Investigating fish kills in public waters
- Protecting non-game/endangered species
- Establishing a State Heritage Preserve system
- Issuing scientific collection permits

This division has control over fisheries management, wildlife management, property management, and hunting regulations in the ACE ecosystem. Areas managed by the Wildlife and Freshwater Fisheries Division include Donnelley Wildlife Management Area, Bear Island Wildlife Management Area, and the St. Helena Sound Heritage Preserve.

Contact:
Brock Conrad, Deputy Director
South Carolina Department of Natural Resources
P O Box 167
Columbia, SC 29202
803-734-3889

Dean Harrigal

South Carolina Department of Natural Resources
585 Donnelley Drive
Green Pond, SC 29446
Phone: 843-844-8957
Fax: 843-844-2525

General Information
803-734-3888

http://www.dnr.state.sc.us/wild/index.html EXIT

Marine Resources Division

The Marine Resources Division is in charge of management of the ACE Basin National Estuarine Research Reserve and the management of commercial and recreational fishing of marine species. The Division aims to preserve and protect marine resources by conducting research on fishes and marine habitats. They also involves the public in marine education for sustainable use of marine resources. Responsibilities include:

- Setting seasons for saltwater fishing and shell fishing
- Studying marine resources & does mariculture research
- Promoting recreational fishing and shell fishing
- Managing state shellfish grounds
- Maintaining state's artificial reefs
- Performing environmental reviews
- Promoting seafood marketing
- Maintaining a marine science library
- Conducting marine fish tagging programs
- Conducting marine education programs & public outreach
- Providing information on saltwater commercial fishing
- Providing information on saltwater fishing tournaments

Contact:

John Miglarese, Deputy Director
South Carolina Department of Natural Resources
PO Box 12559
Charleston, SC 29422
843-762-5007

http://www.dnr.state.sc.us/marine/index.html EXIT

Law Enforcement Division

The law enforcement division of SCDNR is in charge of implementing state laws regarding the protection of natural resources, as well as hunting, fishing, and boating laws. Responsibilities include:

- Maintaining 24-hour emergency line
- Enforcing natural resources and boating laws
- Conducting rural search and rescue
- Conducting hunter and boater education programs
- Investigating boating/hunting accidents
- Investigating marine theft and fraud
- Issuing permits for fishing and boating events
- Maintaining statewide radio network
- Assisting other law enforcement agencies

Contact:
Col. Alvin Wright, Deputy Director
South Department of Natural Resources
Law Enforcement Division
(1000 Assembly Street, Dennis Building, 3rd Floor)
P.O. Box 167
Columbia, SC 20202
803-734-4021

http://www.dnr.state.sc.us/law/index.html EXIT

Land, Water, and Conservation Division
In 1997, the department was reorganized, merging the Land Resource and Conservation District Division and the Water Resource Division to form the Land, Water, and Conservation Division. The Division is primarily in charge of land and water planning and resource assessment. Its mission is to manage the State's water and land resources as an inter-linked hydrologic system; to protect these resources as a public trust through the employment of science, technology, and public involvement; and to provide for the maximum reasonable and beneficial use of these resources. Responsibilities include:

- Assisting public through 46 conservation districts
- Providing assistance in watershed conservation
- Registering landscape architects & soil classifiers
- Selling maps, aerial photos & satellite/digital data
- Assisting the public and industry reduce erosion & sedimentation
- Assisting with flood plain management & flood mitigation
- Coordinating the National Aerial Photography Program
- Assisting with soils research through the State Soil Scientist's office
- Administering the SC Stewardship Development Program
- Assisting in land resources planning and water quality
- Conducting studies of surface and ground waters
- Providing river planning and basin resource assessments
- Developing a state natural resources database using GIS
- Assisting in water resources planning
- Maintaining the Southeast Regional Climate Center
- Developing and updating the State Water Plan
- Coordinating the state aquatic pests (plants/animals) program
- Maintaining the State Scenic Rivers program
- Coordinating the state's Adopt-A-Landing Program
- Cosponsoring Beach Sweep-River Sweep (September)
- Cosponsoring SC American Rivers Month (June)

This branch of the Department of Natural Resources assists with spatial data, water quality, land use and water planning, wetland permitting, and coastal property management within the ACE Basin. It provides support for the conservation districts in South Carolina.

Contact:
Alfred H. Vang, Deputy Director
2221 Devine St.
Suite 222
Columbia, SC 29205
803-734-9101

Rich Scharf
South Carolina Department of Natural Resources
Land Water and Conservation Division
2221 Devine Street
Suite 222
Columbia, SC 29205
Phone: 803-734-9135
Fax: 803-734-9200
E-mail: scharfr@land.dnr.state.sc.us

http://www.dnr.state.sc.us/ EXIT

South Carolina Geological Survey
The South Carolina Geological Survey has recently merged with the Land, Water, and Conservation Division, housed under the Department of Natural Resources. SC Geological Survey was established to provide a service-oriented program which collects, studies, interprets, and reports all information pertaining to geology and mineral resources affecting the daily lives of the citizens of South Carolina. The service-oriented program is based on the dissemination of geologic information. This information is used for better land use planning, economic development, emergency preparedness and education.

Contact:
Dr. William Clendinin, Geologist
Land, Water & Conservation Division
5 Geology Rd.
Columbia, SC 29210
803-896-7708
http://www.dnr.state.sc.us/geology/ EXIT

SC Department of Transportation (DOT)

The South Carolina Department of Transportation is an executive branch of the state government. Its mission is to provide South Carolina the best possible inter-modal transportation systems and services for the safe, efficient movement of people and goods, and stewardship of the state's environment and natural beauty.

In the ACE Basin, the Department of Transportation has influence over maintenance of existing roads and bridges, widening roads and bridges, and planning for future growth.

Contact:
Blanche S. Sproul, Environmental Manager
PO Box 191
Columbia, SC 29202-0191
Phone: 803-737-1395
Fax: 803-737-9868
E-mail: sproulbs@dot.state.sc.us

Residence Maintenance
PO Box 169
Walterboro, SC 29488
803-538-8031

http://www.dot.state.sc.us/ EXIT

South Carolina Department of Parks Recreation and Tourism (PRT)

Tourism is ranked as the third largest retail industry in the United States. South Carolina Department of Parks, Recreation and Tourism is committed to providing quality recreational opportunities in South Carolina. PRT is a part of the executive branch of the state government.

The ACE Basin provides a unique atmosphere for tourism and economic growth within South Carolina; however, economic growth must be balanced with conservation efforts. It is the Department of Parks Recreation and Tourism's responsibility to successfully manage this area so that tourism does not destroy the natural ecosystem. Management areas include Edisto Beach State Park, Hunting Island State Park, and the ACE Basin Education Center at the ACE Basin NERR. PRT has direct control over park borders.

Edisto Beach State Park is located on SC 174, 50 miles southeast of Charleston off US 17. The beachfront park was originally developed in the 1930's by the Civilian Conservation Corps. Its 1,255 acres include 1 1/2 miles of beach, a dense live oak forest, and some of the tallest palmetto trees in the state. The park is used for camping, fishing, hiking, swimming, and boating.

Hunting Island State Park is located 16 miles east of Beaufort, SC on US 21. The park is a large secluded barrier island with a historic 1859 lighthouse as its centerpiece. It contains a semi-tropical abundance of plants and wildlife. The park is used for camping, fishing, crabbing, swimming, and contains hiking/biking trails.

Contact:
Carole Mullis, Nature Based Tourism Development Manager
1205 Pendleton Street
Columbia, SC 29201
Phone: 803-734-1449
Fax: 803-734-0670
E-mail: cmullis@prt.state.sc.us

Hunting Island State Park
2555 Sea Island Parkway
Hunting Island, SC 29920
803-838-2011

Edisto Beach State Park
8377 State Cabin Road
Edisto Island, SC 29438
803-869-2756

South Carolina Geodetic Survey

South Carolina Geodetic Survey is under the Budget Control Board. The Geodetic Survey works closely with the National Geodetic Survey (NGS). All surveys are conducted using the national standards promulgated by NGS for the establishment of three dimensional survey control. All survey data are reduced by the SCGS and sent to

NGS for final acceptance and inclusion in the national database maintained by NGS. The Office of Geodetic Survey applies methods of precise positioning and geodetic, photogrammetric, and remote sensing techniques to establish and maintain a consistent coordinate system and to support mapping, charting, navigation, boundary determination, property delineation, infrastructure development, resource evaluation surveys, and scientific applications. SCGS establishes and maintains the horizontal and vertical datums in South Carolina and promulgates these coordinates on the official state coordinate system known as the South Carolina State Plane Coordinate System. All datum point values are available on CD-ROM and can be manipulated using software contained on the CD-ROM known as GRITS. In addition to surveying, SCGS also coordinates county mapping activities. Through a federal grant, SCGS provides funding to the county governments for this effort. SCGS provides assistance to the counties with planning, geodetic control, image quality control and final positional accuracy. At this time, 21 counties are in various stages of completing modern ortho images at scales of 1:1200 and 1:4800 feet. These maps have greater accuracy and detail than can be presently found anywhere else in the state or at the federal level.

Contact:
Lewis LaPine
5 Geology Road
Columbia, SC 29210
803-896-7701
E-mail: llapine@scgs.state.sc.us

http://www.rdc.noaa.gov/~ohb/N/NL0000.html EXIT

South Carolina Institute of Archeology and Anthropology

The South Carolina Institute of Archaeology and Anthropology (SCIAA) was established in 1963 as a University of South Carolina research institute and a state cultural resource management agency. As the latter, it serves as the main state agency concerned with South Carolina's prehistoric and historic archaeology, and its discovery, study, revelation, and official safekeeping at a curatorial facility. As a university research institute, SCIAA initiates and conducts a broad range of field research and collections research throughout the state, and contributes to other facets of the university.

Contact:
Dr. Jonathan M. Leader, Deputy State Archaeologist
1321 Pendleton Street
Columbia, SC 29208
Phone: 803-777-8170
Fax: 803-254-1338

http://www.cla.sc.edu/sciaa/sciaa.html EXIT

South Carolina Nature Based Tourism Association

The South Carolina Nature Based Tourism Association encourages the sustainable development of natural and cultural resources for South Carolina's travel and tourism industry. It has been developed to aid individual and group travelers in planning nature-based trips in South Carolina. The ACE Basin is an attractive area for nature-based tourism, which was identified in the economic forum as a business with economic potential, yet compatible with natural resource conservation.

SCNBTA has joined with Clemson University, SC Sea Grant Consortium, SC Department of Parks Recreation and Tourism, National Coastal Resource and Research Institute, and Coastal Carolina University to create a brochure of all nature-based business sites, agencies, and associations in South Carolina.

Contact:
Charlie Sweat, President
Walterboro, SC 29488
803-549-5591
Jim Koening, Vice President
St. Christopher Camp & Conference Center
2810 Seabrook Island Road
Johns Island, SC 29455
843-768-0429
http://nbta.scenic.net/main.asp EXIT

South Carolina Sea Grant Consortium

The SC Sea Grant Consortium, part of the National Sea Grant College Program's nationwide network of 29 Sea Grant College programs, was founded in 1978. The National Sea Grant College Program is a component of the Office of Ocean and Atmospheric Research (OAR) in the US Department of Commerce's National Oceanic and Atmospheric Administration. The Consortium supports research, education and extension programs to conserve and enhance coastal and marine resources and provide economic opportunities for the citizens of South Carolina. Consortium member institutions include The Citadel, Clemson University, Coastal Carolina University, Medical University of South Carolina, SC Department of Natural Resources, SC State University, University of Charleston, and University of South Carolina. The Consortium conducts research and outreach activities in six program areas: coastal ocean studies, climate and hazards, ecosystem dynamics, sustainable economic development, emerging technologies, and marine education.

The SC Sea Grant Consortium acts as a broker of information and funding by supporting scientific studies and delivering research results generated in the universities to constituents to address priority natural resource and economic development problems and opportunities. The Consortium continues to sponsor ecotourism and community involvement initiatives, and has provided research information and assistance in support of the ACE Basin project. University and research institutions in South Carolina and Georgia are currently involved in the Land Use - Coastal Ecosystem Study (LU-CES), which is funded by the NOAA Coastal Ocean Program and administered by the Consortium, to understand how changes in land use practices, brought about by rapid growth and development in South Carolina and Georgia, will affect coastal and marine resources in the region. The understanding that is developed will be used to create a set of models and GIS-based tools that will permit resource managers, planners and policy makers to consider a variety of growth and development scenarios from which minimal impact alternatives can be selected.

Contact:
M. Richard DeVoe
Executive Director

SC Sea Grant Consortium
287 Meeting Street
Charleston, SC 29401
Phone: 843-727-2078
Fax: 843-727-2080
E-mail: devoemr@musc.edu
http://www.csc.noaa.gov/SCSeaGrant EXIT

South Carolina Sea Grant Extension Program
The SC Sea Grant Extension Program (SGEP), a cooperative program of the SC Sea Grant Consortium and the Clemson University Extension Service, provides technical transfer of research-based information to a variety of businesses, industries, organizations and individuals along the coast. Sea Grant Extension Program Specialists deliver programs in six primary areas: aquaculture, coastal recreation and tourism, commercial fisheries, coastal community and economic development, coastal environmental quality and coastal natural hazards. The Consortium's communications and information services effort provides the mechanisms - hard copy and/or electronic - by which the information is packaged.

Bob Bacon, Program Leader
SC Sea Grant Extension Program
287 Meeting St.
Charleston, SC 29401
843-727-2078
843-727-2080

SC Waterfowl Association

The South Carolina Waterfowl Association (SCWA) seeks to conserve South Carolina's waterfowl and wetland resources. SCWA exists to preserve and pass on North America's waterfowl, other wildlife, and natural resource conservation education to both youth and adults. SCWA defines conservation as "The wise management and use of our natural resources to provide maximum sustainable benefits from these resources to future generations of mankind." SCWA promotes ethical and conservation-based sport hunting and fishing as an integral component of the conservation of these natural resources.

Contact:
Bobby R. Creech, Jr., Secretary/Treasurer
Rt. 1
Box 319
Pinewood, SC 29125
Phone: 803-452-6001
Fax: 803-452-6032
http://www.scwa.org/ EXIT

SC Wildlife Federation

The South Carolina Wildlife Federation (SCWF), a nonprofit citizens' conservation organization, was established by sportsmen in 1931. Originally the SC. Game and Fish Association, it was reorganized as the South Carolina Wildlife Federation in 1946, when it became the state affiliate of the National Wildlife Federation. SCWF strives to educate individuals to understand and act on behalf of wildlife and natural resources; encourage government and the private sector to use natural resources responsibly; and promote responsible outdoor ethics by those who engage in hunting, fishing, and all other natural resource-based recreation. Although affiliated with the National Wildlife Federation, the SCWF receives its support directly through its own membership.

Contact:

2711 Middleburg Drive, Suite 104
Columbia, SC 29204
Phone: 803 256 0670
Fax: 803 256-0690
E-mail: mail@scwf.org
http://www.scwf.org/ EXIT

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

M
E
N
U

Ducks Unlimited

Federal Emergency Management Agency

National Oceanic and Atmospheric Administration

-Coastal Services Center

-National Ocean Service

-National Marine Fisheries Service

-National Weather Service

-Coastal Change Analysis Program

National Trust for Historic Preservation

National Wild Turkey Federation

Quail Unlimited

Quality Deer Management Association

The Nature Conservancy

US Army Corps of Engineers

US Coast Guard

US Department of Agriculture

-Natural Resource Conservation Service

US Environmental Protection Agency

US Fish and Wildlife Service

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

National Contacts

Ducks Unlimited

Ducks Unlimited's Lowcountry Initiative, founded in 1989, is a nationally important wetlands conservation and long-term management effort undertaken in coastal South Carolina. Ducks Unlimited functions in cooperation with the goals of the North American Waterfowl Management Plan. The Initiative contains five major focus areas-Cooper River, Santee River, ACE Basin, Winyah Bay, and Savannah Basin. These focus areas were selected for conservation first and foremost because of their outstanding ecological value. Large privately-owned plantations ranging in size from 2,000 to 52,000 acres (some dating to the 16th Century) are the primary land holdings in the focus areas. This unique situation coupled with expressions of interest from many of the landowners creates an unparalleled opportunity to achieve significant land and water protection.

Through their Lowcountry Initiative, Ducks Unlimited has a unique opportunity to protect wetland and upland habitats using conservation easements on private lands. Ducks Unlimited's conservation easement program accepts easements in perpetuity through its Wetlands America Trust. Such long-term protection will conserve large, undeveloped upland and wetland ecosystems for the benefit of water birds, other wildlife, and the threatened and endangered species that occur in the Lowcountry of South Carolina. Ducks Unlimited serves on the ACE Basin Task Force and the ACE Basin National Estuarine Research Reserve Advisory Committee.

Contact:
Joe Hamilton, Manager
Lowcountry Initiative
1433 River Road
Yemassee, SC 29945
Phone: 843-846-1613
Fax: 843-846-2399

http://www.netside.com/~scdu/duframe.htm EXIT

Federal Emergency Management Agency

The Federal Emergency Management Agency (FEMA) is an independent agency of the federal government. Its mission is to reduce loss of life and property and protect our nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery. FEMA administers the National Flood Insurance Program (NFIP) which makes federally subsidized flood insurance available to owners of flood-prone property in participating communities.

US Geological Survey

Contact:
Mary Hudak, Public Affairs Officer
Federal Emergency Management Agency
3003 Chamblee Tucker Road
Atlanta, GA 30341
Phone: 770-220-5226
Fax: 770-220-5230
http://www.fema.gov/ EXIT

National Oceanic and Atmospheric Administration (NOAA)

NOAA is a branch of the US Department of Commerce. NOAA's mission is to describe and predict changes in the Earth's environment and to conserve and manage wisely the Nation's coastal and marine resources. The agency is composed of five line offices, including National Environmental Satellite, Data and Information Service (NESDIS), National Weather Service (NWS), Office of Oceanic and Atmospheric Research (OAR), National Ocean Service (NOS), and National Marine Fisheries Service (NMFS).

Several NOAA activities are important to the ACE Basin:

Coastal Services Center

The Coastal Services Center is part of the National Oceanic and Atmospheric Administration's (NOAA) National Ocean Service. Its mission is to foster and sustain the environmental and economic well-being of the coast by linking people, information, and technology.

Contact:
Donna McCasskill
NOAA Coastal Services Center
2234 South Hobson Avenue
Charleston, SC 29405-2623
843-740-1272
http://www.csc.noaa.gov/ EXIT

National Ocean Service

The Ocean and Coastal Resource Management Office of NOAA's NOS has designated the ACE Basin a National Estuarine Research Reserve, as part of the National Estuarine Research Reserve System.

NOS and DHEC's Ocean and Coastal Resource Management division have implemented the Coastal Zone Management Act as well as the State Coastal Management Program through the Office of Coastal Resource Management in South Carolina. The South Carolina Coastal Management Program, managed by the Office of Coastal Resource Management of DHEC, has regulatory authority over land use in the coast's critical habitat areas.

http://www.nos.noaa.gov/ EXIT

National Marine Fisheries Service

The National Marine Fisheries Service (NMFS) administers NOAA programs that support the domestic and international conservation and management of living marine resources. NMFS works with the South Atlantic Fishery Management Council and the state to manage recreational and commercial marine fisheries species and habitats. NMFS has endangered species authority for all marine aquatic organisms. NMFS enforces the Magnuson Stevens Fishery Conservation and Management Act of 1976, as well as the Marine Mammal Protection Act of 1972. NMFS also comments on section 404 wetland permit applications in the ACE Basin.

Contact:
Prescott Brownwell, Staff Marine Biologist
219 Fort Johnson Road
Charleston, SC 29412-9110
843-762-8591
http://www.nmfs.gov/ EXIT

National Weather Service

The National Weather Service offices in Charleston, SC and Savannah, GA provide weather forecasts for the ACE Basin area.

http://www.nws.noaa.gov/ EXIT

Coastal Change Analysis Program

The Coastal Change Analysis Program (C-CAP) is managed through the NOAA Coastal Services Center, in Charleston, South Carolina in coordination with the National Marine Fisheries Service Laboratory in Beaufort, North Carolina and with technical support from the Oak Ridge National Laboratory in Oak Ridge, Tennessee. C-CAP is a cooperative interagency and state/federal effort to detect coastal upland/wetland cover and submerged vegetation, as well as monitoring change in the coastal regions of the United States. National Oceanic Data Center (NODC) provides data management support to the program.

Contact:
Dorsey Worthy
2234 South Hobson Avenue
Charleston, SC 29405
843-740-1234
http://www.csc.noaa.gov/ccap/ EXIT

National Trust for Historic Preservation

The mission of the National Trust for Historic Preservation is to foster an appreciation of the diverse character and meaning of our American cultural heritage and to preserve and revitalize the livability of our communities by leading the nation in saving America's historic environments. According to the National Historic Preservation Act, the Historic Preservation Office has review authority in the distribution of section 404 wetland permits.

Contact:
National Trust for Historic Preservation
1785 Massachusetts Ave. NW
Washington, DC 20036
Phone: 202-588-6000
Fax: 202-588-6038

National Wild Turkey Federation

Founded in 1973, the National Wild Turkey Federation is a national non-profit conservation and education organization dedicated to conserving wild turkeys and preserving hunting traditions. Growth and progress define the NWTF as it has expanded from 1,300 members in 1973 to 180,000 today. With that growth has come strides in wild turkey restoration and habitat enhancement as the NWTF has forged dynamic partnerships across the country. Together NWTF's conservation partners and grassroots members have raised and spent more than $90 million on projects benefiting wild turkeys throughout the United States, Mexico and Canada.

Contact:
PO Box 530
Edgefield, SC 29824
Phone: 1-800-THE-NWTF
Fax: 803-637-6643 or 803-637-0034
E-mail: tosa@oburg.net
http://www.nwtf.org/ EXIT

Quail Unlimited

Established in 1981 to battle the problem of dwindling quail and wildlife habitat, Quail Unlimited, Inc.(QU) has become the only national, non-profit conservation organization dedicated to the wise management and conservation of America's wild quail as a valuable and renewable resource. The programs carried out by QU aim to preserve and improve upland game habitat, increase scientific research for the better understanding of habitat needs of quail and other upland game birds and their dynamic relationships with other species, and identify more effective and beneficial habitat management techniques and programs. Funds raised by QU chapters are earmarked for local habitat and educational projects, state wildlife departments, upland game bird management, habitat research and educational programs.

Contact:
Daniel Stillinger
P. O. Box 610
Edgefield, SC 29824
Phone: 803-637-5731
Fax: 803-637-0037
E-mail: Quail1@jetbn.net
http://www.qu.org/ EXIT

Quality Deer Management Association

Founded in 1988, the Quality Deer Management Association (QDMA) is a non-profit wildlife conservation organization dedicated to ensuring a high-quality and sustainable future for white-tailed deer and white-tailed deer hunting. The QDMA mission is to promote ethical hunting, sound deer management, deer research, and positive relationships among landowners, hunters, non-hunters, and biologists through education. The QDMA has developed numerous partnerships with state wildlife agencies, timber companies, hunting groups, and product manufacturers.

Contact:
P.O. Box 227
Watkinsville, GA 30677
1-800-209-DEER
http://www.qdma.com/ EXIT

The Nature Conservancy

The Nature Conservancy was founded in 1951 by ecologists seeking conservation of natural habitats. The organization aims to preserve habitats and species through acquisition of land or interest in land as well as compatible economic development. The Nature Conservancy operates the largest private system of nature sanctuaries in the world-more than 1,500 preserves in the United States alone. Some are modest in size, while others cover thousands of acres. All of them safeguard imperiled species of plants and animals.

The Nature Conservancy (TNC) has designated the ACE Basin "One of the world's last great places." The Nature Conservancy serves on the ACE Basin Task Force and the ACE Basin National Estuarine Research Reserve Advisory Committee. The Nature Conservancy's office in the ACE Basin is located at the US Fish and Wildlife Services ACE Basin Wildlife Refuge. TNC has been instrumental in acquiring properties for the ACE Basin National Estuarine Research Reserve, the ACE Basin National Wildlife Refuge, and in securing conservation easements. TNC has conducted an inventory of plant communities in the ACE Basin and supported the ACE Basin Economic Forum - an approach to balancing economic growth and conserving natural resources.

Contact:
Jennifer M. Koches, Staff Assistant and Kevin McIntyr, Project Director
PO Box 848
Hollywood, SC 29449
843-889-2427
http://www.tnc.org/involved/nsforms/welcome.html EXIT

United States Army Corps of Engineers

The U.S. Army Corps of Engineers provides engineering, management, and technical support to its customers. Within the South Carolina region, USACOE is primarily in charge of navigation, flood control, storm damage reduction, engineering design and construction for other government agencies, and response to disasters and national emergencies such as hurricanes.

The US Army Corps of Engineers dredges navigational channels and maintains the Atlantic Intracoastal Waterways, which cut through the ACE Basin. Through section 404 of the Clean Water Act, the Corps has permitting authority for alterations in wetland areas. The Corps created a manual for defining wetlands, called the *1987 Corps of Engineers Wetlands Delineation Manual.* The Corps enforces regulatory acts 101-The Energy And Water Development Appropriation Act, 404-Wetlands Permitting, and the Marine Sanctuary Act in the ACE Basin.

Contact:
Robert Riggs, Chief of Regulatory Functions
Charleston District Corps of Engineers
PO Box 919

Charleston, SC 29402
843-727- 4330

Robin Coller-Socha, Chief of the Environmental Planning Section
Charleston District Corps of Engineers
PO Box 919
Charleston, SC 29402
843-727-4264
http://www.usace.army.mil/inet/ EXIT

United States Coast Guard

Founded in the 1790s as part of the Department of Treasury, the United States Coast Guard is now part of the Department of Transportation. The Coast Guard's duties include patrolling shores, protecting property, enhancing the flow of commerce, helping the victims of floods and storms, stopping the flow of illegal drugs into the United States, teaching boating safety, and cleaning up oil spills. The United States Coast Guard acts in the ACE Basin area by establishing navigational aids in estuaries and the Atlantic Intracoastal Waterway, enforcing laws which protect coastal zones, oil spill response, and the protection of natural resources.

Contact:
Charleston Coast Guard Base
07-36289 Charleston
196 Tradd St
Charleston, SC 29401-1817
843-724-7600-07 31150
http://www.uscg.mil/hello.html EXIT

United States Department of Agriculture (USDA)

The USDA supports production of agriculture, ensures a safe, affordable, nutritious, and accessible food supply; cares for agricultural, forest, and range lands; supports sound development of rural communities; provides economic opportunities for farm and rural residents; and expands global markets for agricultural and forest products. The USDA is divided into the following six agencies: Farm and Foreign Agriculture Service; Food, Nutrition, and Consumer Service; Food Safety; Market and Regulatory Programs; Natural Resource and Environment; Research Education and Economics; and Rural Development.

Contact:
U.S. Department of Agriculture
14th & Independence Ave. SW
Washington, DC 20250
202-720-2791
http://www.usda.gov/ EXIT

Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS), formerly known as the Soil Conservation Service, is a branch of the USDA working at the local level to help people conserve natural resources on private lands. Nearly three-fourths of the technical assistance provided by the agency goes to helping farmers and ranchers develop conservation systems uniquely suited to their land and individual ways of doing business through soils identification, delineation, and mapping. The agency also provides assistance to rural and urban communities to reduce erosion, conserve and protect water, and solve other resource problems. Every five years, NRCS conducts the National Resources Inventory (NRI) on nonfederal rural lands in the United States.

NRCS relies on many partners to help set conservation goals, work with people on the land, and provide assistance. Its partners include conservation districts, state and federal agencies, Earth Team volunteers, agricultural and environmental groups, and professional societies.

Contact:
Dwayne Magnum, Charleston District Conservationist or Lynette Saverno, Soil Conservationist
2420 Mall Drive
Suite 102
North Charleston, 29405
843-727-4160
http://www.nrcs.usda.gov/ EXIT

United States Environmental Protection Agency

The U.S. Environmental Protection Agency was established in 1970 to solve the nation's urgent environmental problems and to protect public health. Their mission is to protect human health and to safeguard the natural environment - air, water, and land - upon which life depends.

EPA's purpose is to ensure that:

- All Americans are protected from significant risks to human health and the environment where they live, learn, and work.
- National efforts to reduce environmental risk are based on the best available scientific information.
- Federal laws protecting human health and the environment are enforced fairly and effectively.
- Environmental protection is an integral consideration in U.S. policies concerning natural resources, human health, economic growth, energy, transportation, agriculture, industry, and international trade, and these factors are similarly considered in establishing environmental policy.
- All parts of society-communities, individuals, businesses, state and local governments, tribal governments-have access to accurate information sufficient to effectively participate in managing human health and environmental risks.
- Environmental protection contributes to making our communities and ecosystems diverse, sustainable and economically productive.
- The United States plays a leadership role in working with other nations to protect the global environment.

The EPA provides funding to the state's Non-Point Source Pollution Monitoring Program. It also provides wetland support to the state through the South Carolina Department of Health and Environmental Control. The EPA has comment authority, final say, and veto power on section 404-wetland permitting.

Contact:
Hudson Slay

U.S. Environmental Protection Agency, Region 4
61 Forsyth Street, SW
Atlanta, Georgia 30303
404-562-9388
E-mail: slay.hudson@epamail.epa.gov
http://www.epa.gov/epahome/epa.html EXIT

United States Fish and Wildlife Service (USFWS)

The U.S. Fish and Wildlife Service dates back to 1871 when the Fish Commission was established by Congress. The Fish and Wildlife Service is a bureau within the Department of the Interior. Their mission is to work with others to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people. The U.S. Fish and Wildlife Service is primarily concerned with migratory birds; endangered species; freshwater, inter-jurisdictional, and anadromous fish; the wildlife refuge system; wetlands; protecting habitats; conserving coastal areas; and environmental contaminants. USFWS has created the North American Waterfowl Management Plan. It is divided into seven geographic regions, with its headquarters located in Washington, DC.

The US Fish and Wildlife Service manages the ACE Basin National Wildlife Refuge. They serve on the ACE Basin Task Force and the ACE Basin National Estuarine Research Reserve Advisory Committee. USFWS has designated the ACE Basin as a critical habitat in the North American Waterfowl Management Plan. It has endangered species authority for all freshwater and terrestrial endangered species. USFWS also has comment authority on wetlands permitting and helps to enforce section 404 of the Clean Water Act within the ACE Basin.

Contact:
Mr. Roger Banks, Field Supervisor
US Fish and Wildlife Service
217 Ft Johnson Rd.
Charleston, SC 29412
843-727-4707
Donny Browning , National Wildlife Refuge Manager
ACE Basin National Wildlife Refuge
PO Box 848
Hollywood, SC 29449
843-889-3084
http://www.fws.gov/ EXIT

United States Geological Survey

The US Geological Survey was established in 1879. USGS is organized by four subdivisions, including Biological Resources, Geology, National Mapping, and Water Resources. The USGS has identified four principal theme areas to more effectively communicate how USGS earth science information contributes to public policy issues. These areas include hazards, natural resources, environment, and information management. The Geology division of USGS is responsible for mapping hydrographic systems. These data include the ACE Basin.

Contact:
Marge Davenport, District Chief

US Geological Survey
Water Resources Division
720 Gracern Rd., Suite 129
Stephenson Office Center
Columbia, SC 29210
803-750-6100
http://www.usgs.gov/

Local Contacts

ACE Basin National Estuarine Research Reserve (NERR)

The ACE Basin National Estuarine Research Reserve is one of 23 components of the National Estuarine Research Reserve System (NERRS) - a system of protected areas resulting from federal, state, and local partnerships. The program was created with the 1972 passage of the Coastal Zone Management Act. Through linked programs of stewardship, education, and research, the NERRS enhances informed management and scientific understanding of the nation's estuarine and coastal habitats. The ACE Basin National Estuarine Research Reserve includes approximately 10,000 acres in the ACE Basin, and utilizes 140,312 acres for research purposes including the following islands: Otter, Pine, Ash, Beet, Boulders, Big, Warren, and South Williman. The Reserve operates a field office at Bennett's Point, from which research and education activities are coordinated.

Contact:
Mike McKenzie, Reserve Manager
ACE Basin NERR
217 Fort Johnson Road
PO Box 12559
Charleston, SC 29422
843-762-5062

Elizabeth Wenner, Research Coordinator
843-762-5050
http://inlet.geol.sc.edu/ACE/home.html EXIT

ACE Basin National Estuarine Research Reserve Advisory Committee

The ACE Basin NERR Advisory Committee was established to provide for more effective coordination and cooperation among groups and individuals involved and interested in the ACE Basin NERR. The committee advises the Reserve manager on the operation and management of the Reserve. The committee consists of representatives from forestry, educational groups including Colleton County Schools and South Carolina Marine Education Association, recreational fisheries, commercial fisheries, environmental groups including South Carolina Coastal Conservation League, Ducks Unlimited, The Nature Conservancy, US Fish and Wildlife Service, local government, and citizens of the ACE.

Contact:
Mike McKenzie, Reserve Manager
ACE Basin NERR
PO Box 12559

-South Carolina Electric and Gas

-Commission of Public Works

-Coastal Electric Coop.

-City of Walterboro Water Works

Soil and Water Conservation Districts

South Carolina Department of Natural Resources ACE Basin Committee

Walterboro Colleton Chamber of Commerce

Charleston, SC 29412
843-762-5062
http://inlet.geol.sc.edu/ACE/home.html EXIT

ACE Basin National Wildlife Refuge

The wildlife refuge, owned and managed by the US Fish and Wildlife Service (USFWS), is an important part of the overall conservation project for the lower basin of the Ashepoo, Combahee, and Edisto rivers. The refuge includes six parcels in the NWR. These are Bonny Hall Club (established 1990), Grove Plantation (1991), Bonny Hall Plantation (1992), Combahee Fields (1993), Jehosee Island (1993), and Auldbrass Tract (1995). These six parcels, totaling 11,019 acres, are located in Charleston, Colleton, Beaufort, and Hampton counties. The ACE Basin National Wildlife Refuge is used by the public as a recreational and educational facility. Recreational activities include fishing in the tidal creeks and freshwater streams, a limited hunting program for waterfowl and deer, wildlife observation, photography, nature study, and walking.

Contact:
Donny Browning, Refuge Manager
ACE Basin National Wildlife Refuge
PO Box 848
Hollywood, SC 29449
843-889-3084
http://acebasin.fws.gov/ EXIT

ACE Basin Task Force

In 1989, The Nature Conservancy, Ducks Unlimited, South Carolina Department of Natural Resources, U.S. Fish and Wildlife Service and private landowners (including Westvaco) formed the ACE Basin Task Force. The task force guides the philosophy and approach to the ACE Basin project area, and has initiated activities such as the economic forum and land conservation. Their goal is to protect important habitats in the watershed of the ACE Basin. The Task Force has defined five project elements as key to the ACE Basin plan. These elements include (1) National Estuarine Research Reserve and the National Wildlife Refuge, (2) Bear Island and Donnelley Wildlife Management Areas, (3) conservation, (4) private land initiatives, and (5) Nemours Wildlife Foundation and the Lowcountry Open Land Trust which joined the task force in 1997.

Contact:
Charles Lane, Chairperson
205 King Street
Charleston, SC 29401
843-722-2692

Beaufort County

Beaufort County contains approximately 1,057 square miles of land, including the southern tip of the ACE Basin project. Approximately 20% of the ACE Basin Characterization Study Area is contained in Beaufort County, accounting for 406 square miles (655 square kilometers) (county coverage data). The county has a population of 36, 738 (Census, 1995), which is governed by a mayor/council system. The county seat is in the town of Beaufort. The county has developed the Beaufort County Special Area Management Plan and the Beaufort County Land Use Plan which deals with land use issues in the county, including those lands within the ACE Basin.

Contact:
Tom Wilson, Planning Director
PO Box 1228
Beaufort, SC 29901-1228
843-525-7143

Beaufort County Clean Water Task Force

Since its inception in 1995, the Beaufort County Clean Water Task Force has sought to improve the management of Beaufort County waterways, particularly in the Broad Creek and Okatie River areas. The Task Force, a group of Beaufort County citizen volunteers, first identifies specific problems in water quality management, then recommends both long and short-term policy reforms. It found that water quality is heavily linked to land use in the surrounding watershed and therefore has put heavy emphasis on land use planning in neighboring areas. Its main focus is controlling storm water and other pollutants from urbanization. The Task Force is involved with water quality and land planning issues within Beaufort County. The Office of Ocean and Coastal Resource Management (OCRM) will take over the responsibilities of the Task Force to relieve pressure from volunteers, at which time, the focus of the project will broaden to the entire state, though members of the Task Force will still comment on water quality in Beaufort County.

Contact:
Bill Marscher, Chairperson
23 Big Oak Street
Hilton Head, SC 29928
843-837-4388

Beaufort County Open Land Trust, Inc.

Beaufort County Open Land Trust, Inc. is a conservation organization that has authority to preserve natural lands through means such as conservation easements. It currently has easements on 2 plantations just south of the Combahee River, totaling approximately 1,700 acres. It participates with organizations such as Ducks Unlimited, Lowcountry Open Land Trust, and the Nature Conservancy. Currently, the Beaufort County Open Land Trust is working with the state of South Carolina's Wildlife and Freshwater Fisheries Division on the Heritage Trust Program, created by executive order, to conserve land and water areas. The Beaufort County Open Land Trust, Inc. has power to acquire or dispose of conservation restrictions or easements in the same manner as governmental bodies and other conservation organizations.

Contact:
Cindy Baysden, Executive Director
PO Box 75
Beaufort, SC 29901
843-521-2175

Charleston County

Charleston County encompasses approximately 917 square miles, 207 square miles of which (334 square kilometers), is in the ACE Basin Ecological Characterization Study Area, forming the northern edge of the Basin. Approximately 10% of the ACE Basin, including Edisto Island, lies within Charleston County (County coverage data). Charleston County's population is 288,300 (SC State Budget and Control Board, Office of Research and Statistics). The county's government is run on a council/administrator form of government.

Contact:
Kara Browder, Planner
Charleston County Planning Department
3870 Leeds Avenue
Suite 110
North Charleston, SC 29405
Phone: 843-740-3200
Fax: 843-740-3222
E-mail: kbrowder@charlestoncounty.org

Colleton County

Colleton County is situated in the southeastern portion of the State of South Carolina, known as the Lowcountry Region, and touches on the Atlantic Ocean at its southeastern tip. This county encompasses most of the ACE Basin Characterization Study Area, accounting for approximately 64% of 1,266 square miles (2,039 square kilometers) (County Coverage Data). Colleton County's terrain is nearly level to gently sloping and contains numerous rivers, streams and marsh areas. Colleton, containing 1050 square miles of land, is the 5th largest county in the state. Colleton County's seat is the city of Walterboro. The population is approximately 36,738. The county runs on a mayor/council system.

Because so much of the ACE Basin is in Colleton County, the county was largely involved in the ACE Basin Economic Forum - an approach to balancing economic growth and conserving natural resources. The county controls land use planning, schools, and garbage collection within the county limits of the ACE. The county has recently drafted a Colleton County Land Use Plan.

Contact:
Walterboro-Colleton Chamber of Commerce
PO BOX 426 * 109-C Benson Street
Walterboro, SC 29488
Phone: (843) 549-9595
Fax: (843) 549-5775
E-mail: chamber@lowcountry.com
http://walterboro.org/colleton/index.html EXIT

Colleton County Historical Preservation Society

The Colleton County Historical Preservation Society is concerned with the history and culture of Colleton County. Its mission is to promote and preserve the history and historic sites of Colleton, including those sites that lie within the ACE Basin. Sites include plantations, rice fields, churches, and grave sites.

Contact:
Budd Price, President
PO Box 1451
Walterboro, SC 29488
843-549-1930

Colleton County Resource and Development Board

The Resource and Development Board of Colleton County promotes residential and industrial development within the county. The Resource and Development Board has worked together with Colleton County residents, Walterboro-Colleton County Chamber of Commerce, Colleton County Council, Lowcountry Council of Governments, and The Nature Conservancy to create an action agenda for compatible development to foster job creation and business development, while protecting the area's unique natural resources and rural way of life.

Contact:
Gene Butler
PO Box 165
Walterboro, SC 29488
843-549-9597

City of Walterboro

The City of Walterboro, county seat of Colleton County, is located within the Lowcountry region of South Carolina, about 32 miles inland from the Atlantic Ocean. The immediate Walterboro area is on a slight rise, being drained by the Ireland Creek and the Great Swamp River to the west, and the lesser tributaries of the Ashepoo River to the east. Incorporating 4.68 square miles with a population of approximately 7,500, Walterboro is the largest city within Colleton County. The city is governed by a mayor and six council members elected at-large by the registered voters of the City of Walterboro. Council members are elected to staggered four-year terms and are elected under a partisan or party affiliated system. Included in their comprehensive plan is a mission to protect natural resources.

The City of Walterboro is the largest city in the ACE Basin Project area. The city is the major distributor of water for the Colleton County area, however most private homes in rural areas have their own wells. The town has a 3 million-gallon wastewater treatment plant that discharges into a tributary of the basin. The city has planning authority within the city limits.

Contact:
Eric Budds, City Administrator
PO Box 709
Walterboro, SC 29488
843-549-2545

http://walterboro.org/walterboro/index.html EXIT

Edisto Island Open Land Trust

The Edisto Island Open Land Trust is a conservation group that was established in the early 1990s. It works with private landowners to protect the scenic views and vistas of Edisto

Island, part of the ACE Basin in Charleston and Colleton Counties. The Land Trust focuses on the preservation of land by collecting conservation easements. It is the trust's responsibility to make sure that easement requirements are met each year. The Edisto Island Open Land Trust is currently conserving 340 acres, all of which have been donated as fee-simple property.

Contact:
Connie Hiott
PO Box 1
Edisto Island, SC 29438
843-869-9004

Gullah/Geechee Sea Island Coalition

The Gullah/Geechee Sea Island Coalition was founded in 1996 by Marquetta Goodwine. This organization commemorates the direct link to the continent of Africa, which exists in the Sea Islands of South Carolina and Georgia. In these islands, Gullah and Geechee culture began during the enslavement of African people in America. The African people there did not have much contact with people of other races except Native Americans. Thus, they were able to maintain their culture, language, and traditions unlike African people who were living on the mainland.

This organization promotes and participates in the preservation of Gullah and Geechee history, heritage, culture, and language, and works towards Sea Island land re-acquisition and maintenance. It also celebrates Gullah and Geechee cultures through artistic and educational means electronically and via "grassroots scholarship." This coalition is currently petitioning to save St. Helena Island from encroachment. They have also established a Sea Islands Preservation Fund to protect and preserve the history of the Sea Islands.

Contact:
Gullah/Geechee Sea Island Coalition
Post Office Box 1207
St. Helena Island, SC 29920
843-838-1171
Gullah/Geechee Sea Island Coalition-Northeast
Post Office Box 40-0199
Brooklyn, NY 11240-0199
Phone: 888-TRY-ISLE
E-mail: GullGeeCo@aol.com or gullah-geechee@infobro.com

http://users.aol.com/queenmut/GullGeeCo.html EXIT

Lowcountry Council of Governments

The Lowcountry Council of Governments (LCOG) works with Colleton, Hampton, Jasper, and Beaufort Counties on area-wide plans and issues that face local governments collectively. These issues include the environment, economic development and transportation. Advisory plans provide leaders of county and city governments a common direction, so that the actions of each community strengthen the efforts of its neighbors. In developing these plans, the LCOG draws from data supplied by its staff of technical specialists, and citizens who serve without pay on regional advisory committees. Berkeley, Charleston, and Dorchester Counties' COGs work in the same fashion as the LCOG, making area-wide plans more attainable.

Within the ACE Basin project, the council provides research, planning, and technical assistance as requested by any jurisdiction in the region. The work is provided under contract by a full range of staff specialists. LCOG is also in charge of the 208 - Wastewater Quality Program. Any sewage discharge entering the ACE requires Lowcountry Council of Government's approval.

Contact:
Chris Bickley, Director
PO Box 98
Yemassee, SC 29945
843-726-5536
Carol Tank, Planning Director
PO Box 98
Yemassee, SC 29945
843-524-2625

Lowcountry Open Land Trust

The Lowcountry Open Land Trust works with private landowners to preserve the natural and scenic resources of the region through voluntary measures such as conservation easements. The Trust focuses on the preservation of land in the ACE Basin using conservation easements. The Lowcountry Open Land Trust serves on the ACE Basin Task Force.

Contact:
Mary Pope Waring
456 King Street
Charleston, SC 29403
Phone: 843-577-6510
Fax: 843-577-0501
E-mail: LOLT@charleston.net

Lowcountry and Resort Islands Tourism Commission

The Lowcountry and Resort Islands Tourism Commission promotes travel in the Lowcountry area covering Hilton Head, Beaufort County, Jasper County, Colleton County, Edisto Beach, and Hampton County. Within the ACE Basin, the commission promotes tours by river boat, canoe, and kayak, as well as walking tours of cities in the ACE. It also promotes tourism in the Basin through pamphlets displayed in South Carolina's visitors' centers and by mailing publications to individuals interested in the ACE Basin.

Contact:
Jim Wescott
PO Box 615
Yemassee, SC 29945
Phone: 800-528-6870 or 843-717-3090
Fax: 843-717-2888
E-mail: come2sc@hargray.com

Private Landowners

The ACE Basin Task Force strongly supports private landowners; most of the lands within the project area are retained in private ownership. This continues a tradition of resource management cooperation with the private sector that dates back to the early 1700s with the introduction of rice culture. Following the rice plantation era, some of these large properties were purchased by wealthy sportsmen as hunting retreats; most continue in private management as wildlife habitat areas.

The private sector is a major landowner in the ACE Basin. Some landowners have donated or sold properties to the state or non-profit organizations, while others have negotiated conservation easements on their properties. Private landowners serve on the ACE Basin Task Force and the ACE Basin National Estuarine Research Reserve Advisory Committee.

Private landowners also include industry. Westvaco EXIT, a major manufacturer of papers for high quality graphic reproduction, packaging for consumer and industrial uses, and specialty chemicals for commercial and environmental application, is the largest private landowner in the ACE Basin. Westvaco serves on the ACE Basin Task Force and the ACE Basin National Estuarine Research Reserve Advisory Committee. The company uses ecosystem-based multiple use forestry management expertise to manage its 1.5 million acres of timberlands in the United States and Brazil, assuring sustainable forestry for the future.

Contact:
Tom Jewel
Westvaco Cooperation
180 Westvaco Road
Summerville, SC 29484
843-851-4636

Public Utilities

South Carolina Electric and Gas

The SCANA corporation's principal subsidiary, South Carolina Electric & Gas Company (SCE&G) is engaged in the generation, transmission, distribution and sale of electricity and natural gas in South Carolina. SCE&G is a major supplier of electricity and natural gas in the ACE Basin. Public utilities have power line right of way in the ACE. They hold maps of power lines and natural gas lines.

Contact:
Customer Service
1426 Main Street
Columbia, SC 29218
803-748-3000
http://www.scana.com/sce&g/sceg.htm EXIT

Coastal Electric Co-op.

Coastal Electric Co-op, formed in 1940, is an electric distributor to the Lowcountry of South Carolina. It is a non-profit organization that is owned by its customers. The Co-op serves approximately 11,000 customers, 95% of which are in the Colleton County area.

Contact:
Mark Walling, Engineer
2269 Jefferies Highway
Walterboro, SC 29488
843-538-5700

Commissioners of Public Works

Commissioners of Public Works is the major distributor of water for Charleston County. Prior to May of 1998, Public Works withdrew their water from the Edisto River; however, they are currently withdrawing an average of 45-50 million gallons of water per day from Bushy Park. Between 2 and 5% of this is residential, and the remainder is used for industrial and commercial use.

Contact:
Kenny Dorr, Assistant Superintendent
1104 Hanahan Road
Hanahan, SC 29406
843-863-4040

City of Walterboro Water Works

The City of Walterboro is the major distributor of water for the Colleton County area, however most private homes in rural areas have their own wells. The City of Walterboro Water Works withdraws its water from a water tower. They have approximately 5,000 customers, with an even distribution between residential and industrial customers.

Contact:
Curtis Stroble
242 Hampton Street
Walterboro, SC 29488
843-549-2545

Soil and Water Conservation Districts

The Soil and Water Conservation Districts are divisions of the United States Department of Agriculture's Natural Resources Conservation Service (NRCS), the federal agency that works with American citizens to conserve natural resources on private lands. Conservation districts are local units of government responsible for the soil and water conservation work within their boundaries. The districts' role is to increase voluntary conservation practices among farmers, ranchers and other land users.

Their mission is to provide local leadership to the citizens of their respective counties with regard to conservation and use of soil, water, and related resources through a balanced cooperation program that protects, restores, and improves those resources.

Contact:
Beaufort County Office
Anne Walker
PO Box 210
Ridgeland, SC 29936
843-726-7611 x 101

Charleston County Office

Debbie Eckard, District Clerk
2420 Mall Drive, Suite 102
North Charleston, SC 29406-6520
843-727-4160

Colleton County Office
Lane Colson
521 Robinson Blvd., Suite B
Walterboro, SC 29488
843-549-1821 x 101.

Hampton County Office
Paula Rhodes
1005 Elm Street East
Hampton, SC 29924
803-943-2367 x 101

South Carolina Department of Natural Resources ACE Basin Committee

The ACE Basin committee is composed of DNR representatives from the Wildlife and Freshwater Fisheries Division, Marine Resources Division, and Land, Water, and Conservation Division. The committee functions to integrate the comprehensive habitat protection and enhancement concept of the ACE Basin project with appropriate resource management responsibilities of the Department's various divisions. It publishes a newsletter twice annually to inform the public of current events in the ACE Basin, as well as the Department's role as a member of the ACE Basin Task Force.

Contact:
Mike McKenzie, ACE Basin National Estuarine Research Reserve Manager
South Carolina Department of Natural Resources
P.O. Box 12559
Charleston, SC 29422
P 843-762-5062
F 843-762-5412
E-mail mckenziem@mrd.dnr.state.sc.us

Walterboro-Colleton Chamber of Commerce

The Walterboro-Colleton Chamber of Commerce is a non-profit association whose mission is to enhance the economic growth and quality of life in Colleton County. Designated as the primary tourism body in Colleton County, the Chamber provides information to citizens and visitors on all aspects of the county, focusing heavily on ecotourism in the ACE Basin. The Chamber has been a primary player in the ACE Basin Forum; constituents include the Nature Conservancy, Resource and Development Board, Colleton County Council, and Lowcountry Council of Governments. It has also worked with the Department of Natural Resources to produce the ACE Basin Guide, which includes a map of information on the ACE Basin. The Chamber was also responsible for the establishment of the Edisto River Canoe and Kayak Commission, the first in South Carolina.

Contact:
Karen R. Hewitt
Walterboro-Colleton Chamber of Commerce

PO Box 526
Walterboro, SC 29488
Phone: 843-549-9595
Fax: 843-549-5775
E-mail: chamber@lowcountry.com

http://walterboro.org/wccc.html EXIT

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

M
E
N
U

What is a National Estuarine Reserve?

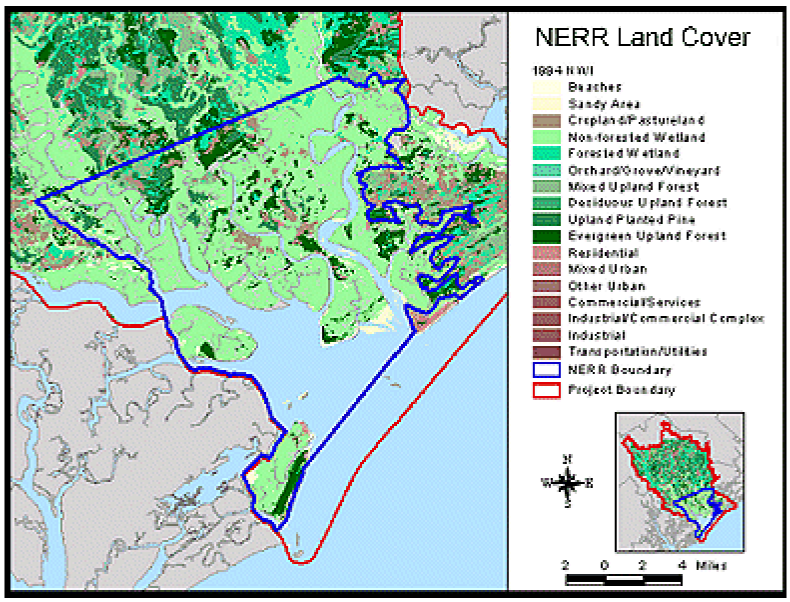
Reserve Program Components

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Protected Lands

ACE Basin National Estuarine Research Reserve

What Is a National Estuarine Research Reserve?



The National Estuarine Research Reserve System (NERRS) is a protected network of federal, state, and local partnerships that provides representative natural areas for long-term research, monitoring, and education. The program was created under the Coastal Zone Management Act of 1972 and is administered by the Sanctuaries and Reserves Division of the National Oceanic and Atmospheric Administration (NOAA) Office of Ocean and Coastal Resource Management (OCRM). The goal of the NERRS program is to create a system of reserves that represent distinct estuarine ecosystems found nationally and, through these reserves, enhance informed management and scientific understanding of the nation's estuarine and coastal habitats. Twenty-three reserves, encompassing nearly 800,000 acres of estuarine waters, wetlands, and uplands, have been protected under the NERRS umbrella. Six additional sites are in the designation process (NERR sites).

The NERRS program emphasizes resource stewardship, monitoring of estuarine conditions, management-oriented research, technical information transfer, and environmental education. Reserves such as the Ashepoo, Combahee, Edisto (ACE) Basin play an important part in preserving our coasts and serve as local links in NOAA's efforts to protect and restore coastal habitats and biodiversity, promote clean coastal waters, and foster sustainable coastal communities compatible with the natural environment.

Back to Top

Reserve Program Components

The ACE Basin National Estuarine Research Reserve (NERR) exhibits tremendous spatial heterogeneity. From northeast to southwest, the area is divided by the South Edisto, Ashepoo, and Combahee Rivers and associated tributaries flowing through extensive wetlands into St. Helena Sound. Habitat diversity, coupled with the absence of industrial pollution and the undeveloped nature of the ACE Basin NERR, contribute to the Reserve's importance to many terrestrial and aquatic species.

The ACE Basin NERR has developed programs that link education, research, and resource management. The Reserve is managed by the South Carolina Department of Natural Resources (SCDNR) in cooperation with the OCRM of the Department of Health and Environmental Control (DHEC), and NOAA. The Marine Resources Division (MRD) of SCDNR has the lead role in implementing and coordinating programs for management, research, monitoring, resource protection, and education in the NERR. Funds for operation of the NERR are provided by NOAA to OCRM/DHEC, which serves as the designated fiscal agent under the federal Coastal Zone Management Act. An advisory committee provides oversight for the various programs in the Reserve.

Research funds are primarily used to support management-related research that will enhance scientific understanding of reserve environments, provide information needed by reserve managers and coastal zone decision makers, and improve public awareness of estuaries and estuarine management issues.

Education plays an important role in the ACE Basin Reserve and NERR system as a whole. Funds are provided to support student curricula, field trips, adult lectures, teacher workshops, volunteer programs, and a wide variety of printed media.

Research and Monitoring Activities

- Management-Oriented Research by the NERR staff
- Management-Oriented Research and Other Activities

Development and maintenance of a research program is a high priority of the ACE Basin Reserve. Because of its relatively low level of disturbance, the ACE Basin has retained many of the attributes associated with estuaries at the turn of the century. This provides a benchmark against which to compare other coastal areas in which significant human disturbances are occurring. The core area of the ACE Basin Reserve is well protected and serves as an undisturbed baseline monitoring area while the large and diverse buffer zone serves as an experimental research and demonstration area.

Prior to designation of the ACE Basin NERR in 1992, most of the research activities in the area were management-oriented projects that were primarily conducted by the SCDNR. The SCDNR performed annual surveys of estuarine fish and invertebrate species with recreational or commercial importance; game and non-game aquatic and terrestrial birds and mammals; threatened/endangered species; and natural plant communities. Data were used to determine the status of these populations, and the results were used to develop policies and management programs to maintain viable populations of the species.

Over 25 research and monitoring projects have been conducted in or adjacent to the ACE Basin NERR, including water quality monitoring and vegetation analysis; studies on mammalian, reptilian, avian, fish, crustacean, and molluscan populations; a survey of sediment contaminants; studies of the impact of marine structures on benthic communities; analysis of cumulative environmental impacts; and studies of toxicology of fishes and oysters. The following agencies have funded projects in the NERR: National Marine Fisheries Service (NMFS), U.S. Geological Survey (USGS), NOAA Sanctuaries and

Reserves Division, NOAA Coastal Services Center, U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers, South Carolina Sea Grant Consortium, South Carolina DHEC and SCDNR, as well as private corporations.

Management-Oriented Research by the NERR Staff

Aerial view of South Williman Island

Research that relates directly to the management of the NERR resources is a high priority. These generally are long-term projects that focus on the status and trends of biotic and abiotic components. One of the first projects initiated by ACE Basin Reserve staff is a long-term survey of the decapod crustaceans and juvenile fish found in the Ashepoo, Combahee, and South Edisto Rivers. In each of the rivers, four sampling stations are situated along a salinity gradient, ranging from polyhaline to oligohaline and limnetic. Bottom tows are made against the tide during daylight flood tide; and basic water quality and atmospheric parameters and tidal stage are recorded at each station. Data collected during the fish and decapod survey over the long term will be utilized to assess temporal and spatial changes in species composition, diversity, and biomass within the Reserve. (See related section: Fish Community).

The ACE Basin Reserve staff has initiated a vegetation characterization study to complete the plant community survey conducted by the Nature Conservancy during 1990 to 1992. During 1995 and 1996, plant communities on South Williman Island were identified, mapped, and characterized. The landscape of South Williman Island is very similar to the marsh islands included in the Nature Conservancy study. The salt marsh communities encompass over 50 percent of these islands, and maritime communities dominate the upland terrain. Freshwater wetlands, especially depression meadows and ponds, are scattered throughout the landscape on most of these areas, characterized primarily by grasses and sedges.

In March 1995, Reserve staff began participating in a NOAA/NERRS national coordinated monitoring program, designed to identify and track short-term and long-term variability in each of 23 Reserves over a range of spatial (local, regional, national) and temporal scales NERRS Centralized Data Management Office EXIT. Results of this program contribute to effective national, regional, and site-specific coastal zone management. This goal will be accomplished through phased monitoring of three major categories: (1) abiotic (physical-chemical) factors, (2) biological communities, and (3) land/water use. The focus of initial monitoring is water quality and meteorological data and the linkage between local weather events and water quality observations.

Aerial view of Edisto Beach

Two sites in the Reserve appear to be best suited for studying contrasting hydrographic conditions and land use patterns. These sites are in the Edisto River drainage basin: one located near the developed Edisto Beach, and the other near undisturbed Bailey Island. Several water quality parameters (water temperature, dissolved oxygen, pH, specific conductivity, and turbidity) are recorded continuously by data loggers. Current data show few indications of major differences in water quality variables among the three sites, but long-term monitoring may reveal some differing trends in water quality as anthropogenic activities increase in the study area.

Management-Oriented Research and Other Activities

SCDNR conducts numerous management-oriented research studies in and around the ACE Basin area. Research conducted in the ACE Basin NERR is closely monitored and cataloged. The following is a list of the management-oriented research that has been conducted in the NERR. Research in other regions of the ACE Basin is not closely monitored and will not be discussed here.

Endangered/Threatened Species

The SCDNR Division of Wildlife and Freshwater Fisheries (WFF) performs annual field surveys in the ACE Basin to determine temporal changes in populations of endangered/threatened species. Aerial and ground surveys are performed to monitor the nesting efforts and densities of loggerhead sea turtles , alligators, bald eagles , wood storks, least terns and colonial wading birds . In 1994, a Dolphin Count Survey was initiated to determine the number of bottlenose dolphins that use the estuaries of South Carolina; two sites are located within the ACE Basin. These surveys are used to evaluate management needs.

Endangered and threatened natural plant communities are also surveyed by the Wildlife Diversity Section. Between 1983 and 1987, the staff surveyed 2,651 Carolina Bays in South Carolina, including 20 in Colleton County. The objectives of the study were to: assess the degree of disturbance in the bays,

A typical Carolina Bay wetland community

characterize the ecological and geomorphic conditions in the bays, and identify the least altered and most significant bays for inclusion into the Heritage Trust protection program. (See Significant Natural Areas).

During the summers of 1990 to 1992, The Nature Conservancy conducted an extensive biological inventory within the ACE Basin watershed. The project focused on the identification and classification of natural plant communities. Aerial photo interpretation and aerial reconnaissance were used to identify specific sites, and 12 of the 25 sites selected are located in the Reserve. The inventory provided detailed, site-specific information on the occurrence and species composition of natural communities, as well as the documentation of rare plant species in the Reserve.

Personnel at the U.S. Forest Service's Southern Research Station in Charleston, South Carolina are conducting studies in the Donnelley Wildlife Management Area (WMA) within the ACE Basin. The objectives are to determine the spatial variation in aboveground production (i.e., stemwood, seed, leaf) of trees across a flooding gradient and to determine the relationship between productivity and nutrient circulation.

Game, Recreational, and Commercial Species
The Wildlife Management Section of WFF conducts annual surveys of game mammals and birds in order to monitor the temporal changes in populations of these species. These data are used to set the hunting seasons and bag limits.

Populations of three fish species (flathead catfish, redbreast sunfish, and striped bass) that inhabit the limnetic and brackish zones of the ACE Basin are monitored by the Freshwater Fisheries Section of WFF. The objectives of these studies are to determine the distribution and abundance of these species and to assess their food preferences as well as their size and age structures. These data are used to develop management plans for enhancing year class strengths of the redbreast sunfish or for controlling populations of the non-native flathead catfish populations. Striped bass are also tagged before release so that biologists can determine migration patterns. Information about the migration patterns of striped bass helps biologists improve stocking methods of the fish and ascertain variability in genetic stocks.

In 1991, SCDNR Marine Resources Research Institute (MRRI) initiated a project to determine life history and population dynamics (temporal and spatial abundance and composition) of selected species of marine recreational fishes in South Carolina. Twelve of the 30 sample sites are located in the Reserve. At those sites, the fishes are counted, measured, weighed, and then released. Selected fishes are tagged for auxiliary migration and growth studies.

The Office of Fisheries Management of the MRD conducts annual field surveys in coastal waters, including the Reserve, to determine the current population levels of recreational and commercially important aquatic species. Adult populations of shrimp and blue crab are also monitored on a yearly basis for the purpose of determining the peak migrations of the organisms from the estuary to offshore. This survey is important in determining the opening and closing dates of the commercial shrimping season.

Tidal creeks are sampled weekly during spring and summer for juvenile shrimp and blue crab. These data are used to determine species composition and distribution, and the growth rates of the species that utilize the tidal creeks. Data are correlated with rainfall, temperature, and salinity in order to determine to what extent these physical factors affect the annual migration rate into the estuaries and the growth rates of juveniles in the estuaries.

Trawling from a small boat

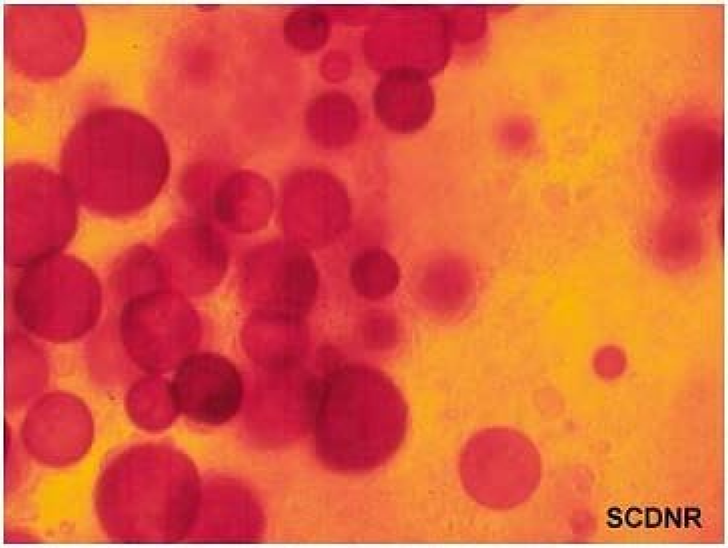
Staff at the MRRI conduct research studies in the ACE Basin that are designed to obtain baseline information on the abundance and distribution of fish, crabs, and shrimp, as well as other biota, in South Carolina estuarine systems. These studies also attempt to identify and evaluate natural and anthropogenic factors that affect the abundance and distribution of important species.

In April 1996, a survey of horseshoe crabs on Otter, Pine, and Harbor Islands was initiated. The primary objectives of the study are to: identify critical spawning habitat, document temporal spawning activities, and estimate magnitude of spawning activities within spawning areas.

Ecosystem Health

In 1991, MRD staff collected oysters from estuarine systems in South Carolina, including the nearby North Edisto River system, to determine the prevalence and infection intensity of an oyster pathogen, *Perkinsus marinus* , in South Carolina.

Between 1991 and 1994, red drum, spotted sea trout, and flounder were collected from various estuarine systems in the state, including St. Helena Sound, and livers and fillets were analyzed for contaminants.



Dermo - an infectious pathogen in oysters

In 1993, the nationwide comprehensive Estuarine Monitoring and Assessment Program (EMAP) was implemented in estuaries from North Carolina to the Indian River lagoon, Florida, including three sites in St. Helena Sound estuary. The program is designed to evaluate the status and trends of ecological resources and identifies associations between pollution stress and ecological conditions. A suite of indicators (water quality parameters, sediment characteristics, sediment contaminants, sediment toxicity test, benthic communities, and nektonic assemblages) was measured at the sites. The data were compared in order to distinguish degraded habitats from those that show no adverse signs of anthropogenic impacts. (For more information see the EMAP data website EXIT).

The Water Quality Section of the South Carolina DHEC monitors surface water and sediment quality in the Ashepoo, Combahee and South Edisto Rivers, about 10 miles upstream from the Reserve. Water samples are collected monthly and analyzed for several basic water quality parameters (i.e., salinity, biological oxygen demand, nutrients, solids). Quarterly or annual analyses of water and sediment samples are performed for metals, pesticides, polyaromatic hydrocarbons (PAH), and volatile and extractable organics. Water quality (salinity, water temperature, fecal coliform levels) at shellfish beds in the Reserve is tested at least six times during the harvest season. (See related section Water Quality).

In September of 1992, the U.S. Army Corps of Engineers collected surface sediment samples from four sites along the Atlantic Intracoastal Waterway through the Reserve. The samples were analyzed for dioxins Polychlorinated dibenzofurans (PCDF) and polychlorinated dibenzodioxins (PCDD), and the data indicated that the concentrations of these dioxins in the sediments were not at toxic levels.

In 1994, a NOAA/NERRS-funded study was conducted to compare the impacts of wood treated by chromated copper arsenate (CCA) on the surrounding benthic communities in the Reserve. The objective of this study was to determine to what degree and over what distances benthic fauna may be adversely affected by contaminants. Drs. Judith and Peddrick Weis of Rutgers University at Newark were the principle investigators in this study.

In 1994, the ACE Basin NERR and NMFS staff initiated a three-year study to assess the distribution of contaminants (trace metals, PAHs, pesticides) in surface sediments within the major rivers of the Reserve. Dr. Geoff Scott at NMFS and Dr. Tom Mathews at MRRI were the primary investigators. (See related section Hydrochemistry and Pollution).

NERR weather monitoring station

In 1995, the ACE Basin NERR and the South Carolina Sea Grant Consortium jointly funded a study to determine the historical input of contaminants to the Reserve. Radiochemical profiles of the sediment cores were taken to determine sedimentation rates and metal concentrations and fluxes over time. Dr. Clark Alexander at Skidaway Institute of Oceanography and Dr. Elizabeth Wenner at MRRI were the principal investigators in this study.

The USGS collects continuous stream flow data from South Edisto and Combahee Rivers, upstream of the Reserve. Water quality, primarily nutrients and particulate levels at the Rivers flow gauging station, are monitored bimonthly. In May 1995, the USGS installed a climate station in the Reserve that is equipped with soil and air thermometers, rain gauge, barometer, pyrheliometer, anemometer, and hygrometer. Continuous measurements are relayed to USGS via satellite, and data are available to the Reserve via the Internet.

Geographic Information System Data and Multimedia Presentations

The Water Resources Division of the SCDNR has developed a geographic information system (GIS) database that includes information about the natural resources in the ACE Basin watershed. The digital cartographic database was developed using an ARC/INFOÒ GIS software and was geo-referenced to the 1983 North American Datum. The database includes a unique digital data layer (1:24,000 scale) for many natural resources in the watershed, including elevation patterns, geologic formations, soil types, land use/cover types, archeological/historical sites and endangered/threatened species locations. This information will improve the staff's public policy and decision making capabilities with regard to natural resource management.

During 1995 and 1996, the NOAA Coastal Services Center and the MRD developed a PC-based desk top mapping and analysis prototype for evaluating and addressing management issues based on interactive access to ecological characterization data linked with other digital information. The prototype revolves around a real-time management scenario on Otter Island and the surrounding area. The characterization draws upon existing ecological and socioeconomic data for the Otter Island area to assess natural resource values, ecologically sensitive areas, human impact on the area, and proposed regulations for long-term protection and management of the island. The prototype CD-ROM product is currently available from the NOAA Coastal Services Center in Charleston, South Carolina and on the Internet .

Facilities to Support Research Efforts

The ACE Basin NERR has recently acquired 2.18 acres with a dock and housing facilities at Bennetts Point to be used for research and housing for visiting scientists. This field station is devoted solely to Reserve activities and supplements existing multiple use facilities at the Marine Resources Center in Charleston, South Carolina, which is part of the SCDNR.

Ft. Johnson Complex

The ACE Basin staff interact regularly with scientific staff of other organizations at the Marine Resources Center. The Marine Resources Center houses various SCDNR divisions, including Marine Resources, Water Resources, and Land Resources. The Center also provides space for the University of Charleston's Grice Marine Biological Laboratory, the Medical University of South Carolina's Marine Biomedical Program, the Charleston Laboratory of the NMFS, the USFWS, and the NOAA/EPA Joint National Coastal Research and Monitoring Program, Carolinian Province office.

Researchers in the Reserve have access to the library at the MRD. The library currently receives 389 serial titles and has a cataloged collection of over 50,000 journal volumes, books and reprints. Reserve staff also have access to the library facilities at the NMFS, USFWS, and the main campus of the University of Charleston.

The computer at the Reserve is linked via modem to the computer server at MRD. The server provides access to the Internet and e-mail. Work stations from IBM and SUN Microsystems Inc., as well image processing software, such as ARC INFOÒ, ArcVewÒ , and ErdasÒ , are connected to the server.

For more information on the ACE Basin NERR, contact Michael McKenzie, Reserve Manager at (843)762-5062.

Research: Support and facilities are provided for qualified scientists to study estuaries and coastal ecosystems.
Education: Education cruises, marsh classroom adventures, workshops, and training sessions are provided to organized groups.
General Public Use: The ACE Basin NERR is accessible by boat and offers primitive camping in specified areas; some restrictions.

Back to Protected Lands

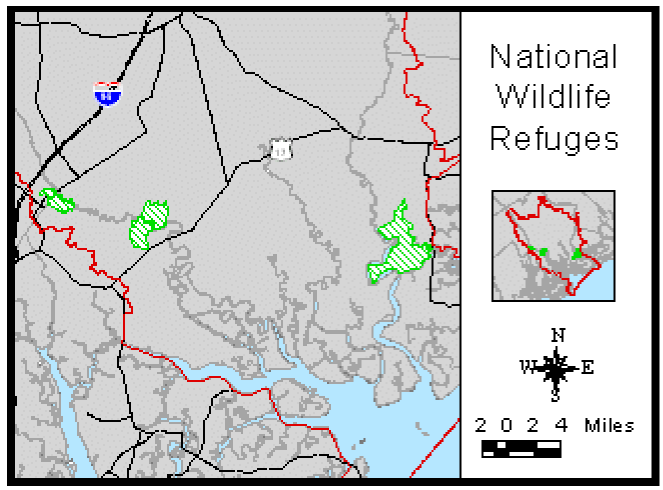
General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

rng.scrollIntoView(); } } }

Protected Lands

ACE Basin National Wildlife Refuge

History



The Ashepoo, Combahee, Edisto (ACE) Basin National Wildlife Refuge (NWR) was established in 1990 as part of an overall habitat protection and enhancement plan implemented by a coalition consisting of the U.S. Fish and Wildlife Service, Ducks Unlimited, the Nature Conservancy, South Carolina Department of Natural Resources, and private landowners in the ACE Basin. The NWR consists of two separate units, one along the Edisto River and another along the Combahee River, which total 11,019 acres. The U.S. Fish and Wildlife Service, which manages the NWR, hopes to eventually acquire up to a total of 18,000 acres in the ACE Basin.

Management of the NWR is focused on providing habitat for a diversity of species such as wintering waterfowl, migratory and resident birds, mammals, reptiles, amphibians, plants, and endangered species. Over 40 percent of the NWR consists of tidal marsh, which is inundated twice daily by tides with a mean amplitude of up to 6 feet. This habitat is protected under both federal and South Carolina law.

Uplands

The refuge has extensive upland forests that are managed for wildlife through selective thinning of trees, creation of edge zones, hardwood and shrub planting, and burning of some forest understories. Old fields are also diked and burned to control growth and enhance habitat variety.

Back to Top

Wetlands

Impoundment trunk being installed

A portion of the refuge consists of impoundments that are managed to encourage growth of vegetation favored as food by various wildlife species. Water levels in these former rice fields are controlled by trunks (i.e., a system of flashboard risers) that maintain water flow between the rivers and the impoundments. By manipulating water level in the impoundments and using prescribed burns to remove undesirable plants, ground litter, and shrubs, growth of forage plants such as widgeon grass, *Ruppia maritima* and saltmarsh bulrush *(Scirpus robustus*) are encouraged. At least 17 species of waterfowl, as well as bald eagles, wood storks, alligators, herons, egrets, ibis, and other wildlife species utilize the refuge's impoundments.

Back to Top

Access

Another major objective of the NWR is to provide opportunities for compatible public educational and recreational opportunities associated with wildlife and their habitats. Access is only allowed in areas in which no adverse impacts to wildlife and sensitive habitats will occur. Recreational opportunities at the NWR include fishing in the tidal creeks and freshwater streams, a limited hunting season, wildlife observation, photography and nature study. All hunting is carefully managed to maintain wildlife populations at a level compatible with the environment. Hunting takes place in accordance with applicable state regulations and special NWR regulations.

Hunting: Archery, primitive weapons hunts for deer; waterfowl hunts in designated areas are allowed on the NWR.

General Public Use: The NWR is open to the general public Monday through Friday 8 AM to 5 PM except during scheduled hunts.NWR is not open on the weekends, except for special events. Schedule of hunts is reported in the ACE Basin National Wildlife Refuge Hunting Regulation Brochure available through the ACE Basin NWR Office in Hollywood, S.C.

For more information about the ACE Basin NWR call (803) 889-3084.

Back to Protected Lands

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

M E N U

Introduction

Private Lands

Public Lands

The Nature Conservancy's Role in Land Protection

Ducks Unlimited's Role in Land Protection

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Protected Lands

Introduction

Protection efforts in the ACE Basin formally began in 1986 with the inception of the North American Waterfowl Management Plan (NAWMP). A cooperative venture between Canada, the U.S., and Mexico, the primary objectives of the NAWMP are the conservation of waterfowl habitat and restoration of waterfowl populations to desirable levels. Because the plan identifies loss and degradation of habitat as the major waterfowl management problem on this continent, it recommends protection and enhancement of migration and wintering habitat through acquisition, protection, and management of wetlands by public and private conservation interests. Approximately 880,000 acres of wetlands and upland habitat were listed for protection from Maine to South Carolina in the Atlantic Coast Joint Venture (ACJV) portion of the NAWMP. The ACJV is a cooperative effort between the Atlantic Coast states and federal agencies including the U.S. Fish and Wildlife Service (USFWS) and the U.S. Department of Agriculture Forest Service (Joint Venture Directory - http:\\www.fws.gov\r9nawwo\jvdir.html). Within the ACE Basin, 90,000 acres were identified for protection through this initiative.

The ACE Basin later became a "flagship" project of the ACJV. Several meetings were held during 1988, and it was decided that the program should combine science, creative action, and effective partnerships to construct a model for saving large, self-sustaining natural systems such as the ACE Basin. A landscape ecological approach was adopted to include a holistic perspective in which the management of resources such as forests, wetlands, agriculture lands, wildlife, and water are not viewed in isolation but rather as parts of a whole.

In 1988, a task force was established to coordinate efforts and provide a plan for accomplishing the overall goal of protection for the ACE Basin. The focus on partnerships culminated in the formation of the ACE Basin Task Force, consisting of the South Carolina Department of Natural Resources (SCDNR), USFWS, Ducks Unlimited, the Nature Conservancy, and local private landowners. These agencies and individuals have cooperated in the protection of ACE Basin lands through a variety of efforts. From its inception, one feature that made the ACE Basin protection initiative unique was its emphasis on protecting private lands and the interests of private landowners. Wise, scientifically-informed resource stewardship protects the ecological integrity of the ACE Basin and encourages continued traditional uses such as forestry, farming, hunting, and fishing. This is the fundamental principle underlying the ACE Basin protection initiative. Private landowners have traditionally prized the qualities of these lands and have managed them to maintain their natural character and ecological values.

Approximately 15 percent of the land within the ACE Basin project area is currently protected. Approximately 40 percent of the protected lands are designated as public land. The principle owners of these public lands are SCDNR (30,000 acres); USFWS (11,000 acres); and South Carolina Parks, Recreation, and Tourism (SCPRT) (6,000 acres). Public lands are acquired by purchase or conservation easement and are maintained for use by the general public. Approximately 30 percent of protected lands are owned by private individuals or organizations. About 60 percent of private lands are protected by conservation easements (44,000 acres), while the remainder is owned by organization ownership, management agreements, or other means (Protected Lands). Conservation easements are legal actions by which landowners voluntarily limit certain uses of and rights in their property; organization ownership is ownership of a property by a private organization (e.g. the Nature Conservancy); and management agreements are non-binding agreements on the management of the property. Some, but not all, significant natural areas that are recognized for outstanding features are acquired through purchase or easement and become legally protected.

The ACE Basin project is an outstanding example of how government, conservation groups, and private landowners can unite to protect important natural resources. Traditional uses, which provide economic benefits, mesh with maintaining the ecological integrity of this area. Private property rights are preserved in a manner that will benefit individual landowners and the public.

For more information on managing lands along the South Atlantic Coast see *Management of South Atlantic Coastal Wetlands for Waterfowl and other Wildlife*.

Back to Top

Private Lands

The ACE Basin Task Force strongly supports private landowners, who control most of the lands within the study area. This continues a tradition of cooperation in resource management with the private sector that dates back to the early 1700s with the introduction of rice culture. Following the rice plantation era, most of these properties were purchased by wealthy sportsmen as hunting retreats and most continue in private management today for agriculture, forestry, and as wildlife habitat areas.

Private landowners who wish to participate in a technical assistance program offered through the ACE Basin Task Force can obtain advice on managing their lands for timber, wildlife, soil, and water conservation and recreational activities dependent upon these natural resource values. In many cases, management plans and agreements are developed on a site-specific basis. Landowner participation is voluntary and signifies a personal commitment to protecting and enhancing wildlife habitat.

Conservation easement is the most important tool in the ACE Basin protection effort. Generally, landowners agree to conservation easements (also known as conservation restrictions) to preserve the natural values of their land and to protect wildlife habitat. To date there have been conservation easements written on 27 tracts totaling over 44,000 acres in the ACE Basin. Some of the larger easements include Ted Turner's Hope Plantation (5,232 acres); Ashepoo Plantation (5,039 acres), owned by the Donnelley family; and Cheeha-Combahee Plantation (12,524 acres), owned by the partners of Cheeha-Combahee, Inc. (See Protected Lands).

Each conservation easement in the ACE Basin is specific to the protection needs of a particular parcel of land. Terms of the easement are specific, detailed, and include documentation such as maps, photographs, and biological inventories. In general, easements limit subdivision of the properties, while allowing for continuation of traditional uses such as hunting, fishing, small-scale agriculture, wildlife management, and forestry. Private landowners generally retain hunting and fishing rights exclusively for themselves. Easements with organizations such as the Nature Conservancy, Ducks Unlimited Foundation, Inc., and Low Country Open Land Trust provide for wide availability of these uses. Commercial development or concentrated residential development is normally prohibited. Mining and mineral exploration are required to be conducted in a manner that conserves the aesthetic value of the property. In most easements, new roads must be constructed of permeable material rather than asphalt.

Westvaco Corporation, a major manufacturer of printing papers, packaging, and specialty chemicals, is the largest single private landowner in the ACE Basin, holding over 17,912 acres. Through a memorandum of mutual cooperation with the ACE Basin Task Force in 1991, Westvaco agreed to support the Task Force objectives as it managed the properties in accordance with the company's multiple-use forestry principles.

Westvaco lands are managed by watersheds with special emphasis on water quality, wildlife habitat, and aesthetics. Protecting landscape features such as concave landforms, streams, intermittent streams, and wetlands is a part of its planning process. Muckenfuss (1994) cites other examples of Westvaco's ecosystem planning and management efforts and its resource stewardship in the ACE Basin.

Nemours Plantation (9,800 acres) is distinguished in the sector of private lands conservation. Eugene Dupont III left this property to a non-profit research foundation named the Nemours Plantation Wildlife Foundation. His vision was to create a model wildlife research center emphasizing the interrelationships of the plantation's diverse habitats, including the salt, brackish, and freshwater marshes.

Back to Top

Public Lands

Certain critical and fragile areas in the ACE Basin have been purchased or donated by private and public agencies for inclusion into public land holdings. Generally, these lands are considered to be of special ecological importance and most are managed to meet the diverse goals of wildlife protection, ecosystem conservation, and public recreational enhancement. Currently, 49,320 acres are held in public trust. Although some of this land was owned by the State of South Carolina prior to the inception of the ACE Basin Task Force, the ACE Basin National Wildlife Refuge (NWR) and the ACE Basin National Estuarine Research Reserve (NERR) recently acquired lands to be included in their respective programs. Large donations by private landowners made these purchases possible by providing needed matching funds for federal grants. For example, Gaylord Donnelley donated Warren and Big Islands to the Nature Conservancy. In turn, the Nature Conservancy transferred title of the islands to the South Carolina Wildlife and Marine Resources Department (SCWMRD), currently the SCDNR. These islands had a fair market value of close to a million dollars, which was used by the SCDNR to match the NOAA grant funds to acquire other lands within the NERR. Other private sector donors have also made significant contributions to lands held in public trust.

All land acquisitions by purchase are made at or below fair market value from willing sellers. In most cases, the state or federal government manages these properties and provides for public access and use. Such publicly managed lands serve to maintain and enhance present habitat diversity while improving recreational and educational opportunities. To date, over 125,000 acres have been acquired and protected through the ACE Basin project initiative (Protected lands).

Large landscape units (more than 5,000 contiguous acres) are managed through Bear Island and Donnelley Wildlife Management Areas (WMA), the ACE Basin NERR, and the ACE Basin National Wildlife Refuge (NWR).

The **Bear Island** and **Donnelley Wildlife Management Areas**, located in southern Colleton County, are managed by the SCDNR Division of Wildlife and Freshwater Fisheries (WFF). Bear Island has been expanded to include over 12,000 acres and Donnelley WMA encompasses over 8,000 acres. Both tracts are managed for wildlife and public recreational opportunities, including hunting, fishing, and wildlife observation. Public access has been expanded and a number of trails and observation platforms are available in these areas.

Bottomland hardwood forest

The **ACE Basin NERR**, designated in 1992, is the third largest NERR in the nation. Located approximately 60 miles southeast of Charleston, it encompasses over 140,000 acres, of which approximately 60,000 are open water; 70,000 acres are covered by salt marsh communities; and the remaining acreage is covered by freshwater wetlands and upland communities such as pine and maritime forests. The core area is comprised of seven marsh and barrier islands (Ashe, Beet, Big, Boulder, Otter, South Williman, and Warren) encompassing over 13,000 acres of wetlands and uplands . The buffer zone is approximately 128,369 acres in size and includes all state-owned bottoms, open waters, and wetlands but excludes uplands and wetlands now held in private ownership. It is characterized by a diverse array of natural and managed communities (Land Cover).

The USFWS is responsible for managing the **ACE Basin NWR** , which was established in 1990, and has identified 11,000 acres along the Combahee and South Edisto Rivers for inclusion into the refuge. The NWR is managed to provide a complex of habitats for a diversity of wildlife. Functional impoundments and bottomland hardwoods are managed for waterfowl, non-game and endangered species, and other wildlife. Public uses such as hunting, fishing, wildlife observation, nature study, and other passive wildlife activities are encouraged on refuge properties.

Back to Top

The Nature Conservancy's Role in Land Protection

The Nature Conservancy was one of the original groups that formed the ACE Basin Task Force in 1988. A primary goal of the Task Force was to maintain the natural character of the area by promoting wise resource management on private lands and protection of strategic tracts by public agencies. The Task Force began work with private landowners and members of local communities and governments to launch protection efforts necessary to preserve the integrity of the region. Primary efforts were begun to establish a NERR within the ACE Basin by the National Oceanic and Atmospheric Administration (NOAA) and the South Carolina Coastal Council (now Office of Ocean and Coastal Resource Management). The reserve's core area was to be comprised of marsh islands around St. Helena Sound. To this end, Sampson Island (2,713 acres) was donated to the Nature Conservancy by Gaylord and Dorothy Donnelley in 1986 and transferred to the SCWMRD (now SCDNR) in 1988 for inclusion in the Bear Island WMA of the NERR's buffer zone. Warren and Big Islands (2,170 acres), also donated to the Nature Conservancy by the Donnelleys, were likewise transferred to SCDNR and included in the NERR in 1988. Islands purchased by the Nature Conservancy for the NERR were Ashe (1,722 acres) and Beet Islands (1,824 acres) in 1989, Otter Island (1,889 acres) in 1993, and South Williman Island (2,764 acres) in 1994. The Rankin Tract (2 acres), purchased by the Nature Conservancy in 1994, and the Smith Tract (2 acres), purchased in 1996, were used to establish the NERR Field Station at Bennett's Point. The latest addition to the NERR buffer zone includes a preserve (403 acres) within a conservation-based development on Bailey Island. This preserve was donated to the Nature Conservancy in 1997 by the Fuller Street Corporation and will remain under the Nature Conservancy ownership.

Preservation efforts outside of the NERR were also begun. The Nature Conservancy conservation easements were placed on Botany Bay Island (484 acres) in 1987, Hope Plantation (5,784 acres) in 1988, Willtown Bluff (979 acres) in 1990, and Auldbrass (138 acres) and Rose Hill Plantations (1,035 acres) in 1995. Bonny Hall (210 acres) was protected privately with deed restrictions in 1993. Ivanhoe and the Great Swamp (474 acres) were donated to the Nature Conservancy in 1989 by Lucius G. Fishburne. In 1996, the Ivanhoe tract was sold to a private buyer and placed under easement with the Lowcountry Open Land Trust.

Purchases were also made of various properties for inclusion in the NWR. Those properties purchased by the Nature Conservancy were Bonny Hall Club (832 acres) in 1990, the Grove (1,955 acres) in 1991, Bonny Hall Plantation (472 acres) in 1992, and Bonny Hall/Newberry (117 acres) in 1993. The Nature Conservancy subsequently resold these properties to the USFWS. Combahee Fields Plantation (1,819 acres) and the Auldbrass Tract (1,324 acres) were purchased by the USFWS for inclusion in the NWR in 1993 and 1995 respectively, but the Nature Conservancy was the organization that actually secured the purchase option (Protected lands).

Aided by substantial loans from the Nature Conservancy, Ducks Unlimited was able to purchase the 9,188-acre Richardson/Mary's Island Plantation in 1990. Portions of this area were subsequently sold to the U.S. Army Corps of Engineers. The Corps property plus that retained by Ducks Unlimited is managed by SCDNR as the Donnelley WMA.

In 1992, the Nature Conservancy designated the ACE Basin as a world class ecosystem level project under the Conservancy's Bioreserve program. This initiative is "science-driven" (i.e., decisions are informed by best available scientific knowledge) and encourages human uses compatible with the care of the environment. A field office was established in the ACE Basin to provide staff for contacting landowners, attending public meetings, working with scientists, drafting management plans, and helping with stewardship activities. Besides the need to respond to the threats on the natural components of the ACE Basin, there arose a need to work with private landowners, local businesses, community groups, and government agencies in order to ensure their compatibility with the natural systems of the Basin.

Presently, the Nature Conservancy is coordinating a community-based plan for sustainable economic development in the ACE Basin and the surrounding area. The ACE Basin Economic Forum was established in 1995 to address the need for compatible economic development. The Steering Committee for the forum is overseen by individuals not only from the Nature Conservancy's ACE Basin Satellite Office and Center for Compatible Economic Development, but also by individuals from the Colleton County Resource and Development Board, the Walterboro-Colleton Chamber of Commerce, the Colleton County Council, and the Lowcountry Council of Governments. Results of this effort will enable local citizens and public officials to gain a better understanding of the area's economic, social, and environmental conditions and of the potential options for compatible development.

After a year of broadly based community involvement and collaboration, an action agenda was created to foster job creation and business development while still protecting the area's unique natural resources and rural way of life. Three guiding principles were established for the Economic Forum:

1. Economic development and environmental conservation are not mutually exclusive; instead, they can be mutually reinforcing.
2. Conservation of natural resources and protection of the environment can lead to economic opportunity for local residents.
3. Economic development need not lead to environmental damage and loss of natural and cultural heritage.

Three separate strategies were also defined. These strategies are:

1. To create a framework for responsible growth. This includes developing a comprehensive land use plan and an integrated development, tourism and resource management plan.
2. To enhance the awareness, understanding, and appreciation of the ACE Basin. This involves developing an interpretive center for the ACE Basin, supporting a scenic parkway plan, developing an ACE Basin logo, supporting a rails-to-trails project, and developing education programs and college courses on coastal resource planning.
3. To promote environmentally compatible business development. This includes building on existing rural tourism efforts and creating management standards for visitor safety and resource impacts for tourism in the ACE; mobilizing business development resources to benefit Colleton County; and providing assistance to local businesses in creating business plans, developing a marketing plan for natural and cultural resource-based tourism in the region, and establishing educational programs for businesses on operating compatibly with the natural resources of the area.

The Steering Committee continues to meet on a regular basis and push forward with the strategies defined in their action agenda. The Nature Conservancy, working together with other members of the ACE Basin Task Force and Economic Forum, remains committed to promoting compatible economic development by building working relationships between conservation partners in the ACE Basin and local communities.

Back to Top

Ducks Unlimited's Role in Land Protection

Ducks Unlimited was among the original groups that formed the ACE Basin Task Force in 1988. A memorandum of agreement among the USFWS, SCWMRD, Ducks Unlimited and the Nature Conservancy provided the guidelines for new and existing conservation programs. Task Force members projected that the ACE Basin would be ideal for the ACJV, the plan by which the NAWMP would be implemented. Through the ACJV, cooperative efforts of various states have resulted in the formation of numerous regional focus areas. Nine geographic areas in South Carolina, including the ACE Basin, have been identified as focus areas by the SCDNR.

The dedication of the 696-acre Springfield Matching Aid to Restore States' Habitat (MARSH) project occurred on October 25, 1987. This was South Carolina's first project funded under Ducks Unlimited's MARSH program. MARSH monies, representing 7.5 percent of the funds contributed to Ducks Unlimited in South Carolina, were provided to the SCWMRD to acquire the site and immediately begin restoration of this valuable waterfowl habitat. This property was brought into the folds of SCWMRD's Bear WMA. The adjoining Cut Marsh was purchased in 1989 through a joint initiative with Ducks Unlimited and other Task Force members along with the National Fish and Wildlife Foundation. This 966-acre tract was also added to the Bear Island WMA for enjoyment by the public.

Ducks Unlimited lobbied for federal funding to support land acquisition for the ACE Basin NWR and was instrumental in securing funding for the ACE Basin NWR's headquarters at the Grove Plantation in Charleston County. Ducks Unlimited served as liaison between local government and private landowners to secure a site for the ACE Basin Interpretive Center. Ducks Unlimited and other Task Force members promoted eco-tourism for Colleton County and the ACE Basin by engaging the SCPRT Commission.

Ducks Unlimited's Lowcountry Initiative was established in 1989 in an effort by Ducks Unlimited and its affiliate, Wetlands America Trust, Inc., to concentrate land protection efforts in South Carolina's 14 coastal counties with an emphasis on the ACE Basin. Ducks Unlimited was instrumental in purchasing several properties in 1990 and 1991 that were threatened with residential and commercial development. Marys Island Plantation was purchased from the Richardson family and two parcels, totaling approximately 1,000 acres were protected with conservation easements, and another parcel was purchased subsequently with mitigation funds from the US Army Corps of Engineers (COE). The COE portion and the remaining acreage owned by Ducks Unlimited are being managed by the SCDNR (formerly SCWMRD) as the Donnelley Wildlife Management Area, named in honor of Gaylord and Dorothy Donnelley. Ducks Unlimited will formally transfer its portion of the Donnelley to the SCDNR in 2,001. Ducks Unlimited initiated the purchase of the 12,534-acre Cheeha-Combahee Plantation and then sold it to conservation minded buyers who protected the property with a perpetual easement.

Since 1991, Ducks Unlimited's Lowcountry Initiative and Wetlands America Trust, Inc., have protected 13 properties with conservation easements totaling over 31,000 acres in the ACE Basin. Furthermore, Ducks Unlimited/Wetlands America Trust serves as the secondary holder of easements to other land trusts on nearly 6,000 acres in the ACE Basin Protected lands.

Ducks Unlimited's Lowcountry Initiative has partnered with the Nature Conservancy and SCDNR to conduct Habitat Management Workshops in the ACE Basin. These workshops are directed primarily toward wetlands management on private properties. A 29-page booklet entitled, *Management of South Atlantic Coastal Wetlands for Waterfowl and other*

Wildlife, was funded by Ducks Unlimited, Inc., and the South Carolina Plantation Society. The authors represented Ducks Unlimited/Lowcountry Initiative, the Nature Conservancy, and SCDNR.

Ducks Unlimited has participated in public awareness of the ACE Basin by providing financial support for publication of informational items such as brochures and maps related to the ACE Basin project. Recently, Ducks Unlimited and other Task Force members produced the *ACE Basin Users' Guide*. This publication contains an array of natural history information about the area as well as a tour map for those enjoying the ACE Basin by automobile.

The manager and regional biologist are often called upon to deliver oral presentations and slide shows to various conservation groups, wildlife enthusiasts, and school classes. As a part of our public enlightenment program, articles are written for local newspapers regarding land conservation efforts of Ducks Unlimited/Lowcountry Initiative. An article entitled "South Carolina's ACE Basin" was written for *River Magazine*, published in Bozeman, Montana and distributed nationally.

Staff of Ducks Unlimited's Lowcountry Initiative also provide technical assistance to landowners/managers for management of important migrating and wintering waterfowl habitat. Management plans are developed for key properties, particularly those with conservation easements.

Mitigation funds were donated to the Ducks Unlimited/Lowcountry Initiative and earmarked for repair of dikes and water control structures on Jehossee Island, a portion of the USFWS's ACE Basin NWR. This project began in October 1998.

The Ducks Unlimited/Lowcountry Initiative staff inspects each of its conservation easement properties on an annual basis to check for compliance with terms of individual easements, seeking prospective properties for conservation easements in an ongoing process. Ducks Unlimited supports the efforts of other land trusts in land protection and is an active member of the coalition of South Carolina Land Trusts. The Ducks Unlimited/Lowcountry Initiative staff also serves on the Task Force of four additional focus areas in South Carolina's coastal region.

Ducks Unlimited's Lowcountry Initiative is leading the effort to have a significant portion of the ACE Basin officially recognized under the Ramsar Convention. This convention became the first treaty in which signatory countries agreed to modify land use planning for the protection of selected wetlands within their boundaries. This designation will give international attention to the area and will facilitate funding for land conservation.

NEXT SECTION: Significant Natural Areas

Author

E. Wenner, SCDNR Marine Resources Research Institute

References

Harrigal, D. 1993. Five-year plan. Donnelley Wildlife Management Area, Colleton County, SC.

Harrigal, D. 1996. Management plan for Bear Island Wildlife Management area. South Carolina Department of Natural Resources.

Prevost, M. 1988. Bear Island WMA Management Plan. South Carolina Wildlife and Marine Resources Department.

M
E
N
U

Ace Basin Characterization Workshop

Tuesday, August 5, 1997

Meeting Notes

Attendees:

Elizabeth Wenner, *South Carolina Department of Natural Resources (SCDNR)*

George Riekerk, *SCDNR*

Jeff Trudnak, *SCDNR*

Laurie McGilvery, *NOAA Office of Ocean and Coastal and Resource Management*

Richard Scharf, *SCDNR*

Rob Dunlap, *SCDNR*

Mike McKenzie, *SCDNR*

Geno Olmi, *National Oceanic and Atmospheric Administration's Coastal Services Center (NOAA CSC)*

Mike Eng, *NOAA CSC*

Cindy Fowler, *NOAA CSC*

Mary Anne Poole *NOAA CSC*

Prescott Brownell, *NOAA National Marine Fisheries Service Habitat*

Ted Hewitt, *South Carolina Department of Health and Environmental Control (SC DHEC)*

Russell Berry, *SC DHEC*

Chris Rigby, *SC DHEC Office of Coastal Resource Management*

Bud Price, *Colleton Co. Historical Society*

John Stuart, *Westvaco Corp.*

Joe Hamilton, *Ducks Unlimited*

Carol Tank, *Lowcountry Council of Governments*

BJ Richardson, *US Fish and Wildlife Service*

Bill Hodgins, *Union Camp Corporation*

Michael Prevost, *The Nature Conservancy (TNC)*

Jennifer Koches, *TNC*

West McAdams, *SC Sea Grant Consortium*

Denver Merrill, *SC Sea Grant Consortium*

Robert Franklin, *Clemson Extension Service*

Robert E. Marvin, *Robert E. Marvin & Assoc.*

Ann Kirkley, *SC Parks, Recreation, and Tourism*

Donny Browning, *ACE Basin National Wildlife Refuge (NWR)*

Robert Jess, *ACE Basin NWR*

Charles Griffith, *Colleton County*

Ted Kinard, *Colleton County Council*

Marth Creighton, *Colleton County Museum*

Dan Morgan, *Beaufort County*

The ACE Basin Characterization workshop was held on Tuesday, August 5, 1997 at the Lowcountry Council of Governments from 1:00 until 5:00 pm. The first half of the workshop consisted of introductions and familiarizing participants with the project. Following introductions, Mike Eng, a trained facilitator from the NOAA Coastal Services Center, reviewed the objectives of the meeting. He reiterated that the objectives of the workshop.

These were to bring together interested stakeholders to:

- provide them with information about the ACE Basin Characterization Project
- identify issues and problems affecting the ACE Basin

- identify data and informational needs that could be included on the ACE Basin Characterization CD-ROM
- determine what data is available and how we can access this data

An overview of the ACE Basin Ecological Characterization project was provided by Dr. Elizabeth Wenner from the South Carolina Department of Natural Resources. She explained that the ACE Basin Characterization project will provide an interdisciplinary synthesis of information about the ACE Basin, in an interactive, multi-media format. The synthesis will include the physical setting, biological and socioeconomic resources, and important ecosystem interactions. In her slide presentation, Dr. Wenner described some of the specific components of the CD-ROM product including management models that address effects of land use and human impacts on key natural resources in the ACE Basin. Dr. Eugene Olmi from the NOAA Coastal Services Center, then demonstrated the prototype Otter Island Characterization CD-ROM to familiarize participants with the type of product they could expect from the ACE Basin Characterization Project.

The second half of the workshop was dedicated to identifying issues and concerns that affect the ACE Basin. To begin this process, each participant was given a questionnaire and asked to list the problems or issues faced by their organization that affect the ACE Basin. The questionnaire also asked participants to list the data or information needed to address those problems and what information was currently available to address those issues. After completing the questionnaire, participants were asked to identify the three most pressing or important issues. Next, participants were asked to pair up with the person beside them. Each pair of individuals was then asked to identify the top three of four issues from both lists that they agreed were the most important. From this list, Mike asked each pair to pick the one, clearest issue and display it at the front of the room. He asked the group to repeat this process until all of the issues were displayed. After all of the issues were fully displayed, Mike asked the participants to group the issues according to a common theme or subject. Once all of the issues had been grouped, Mike asked the participants to decide on headings for each group. Following is a list of the issues and their headings. Some of the issues may have fallen under more than one heading.

Land Use Planning for Sustainable Development

- balancing economic development with natural resource protection
- residential development impacts on traditional land use
- development of land use plans
- identification of stakeholders interests
- education of public for support of land use plan
- potential land development
- identification of stakeholders
- development and growth management needs and projections
- implementation of land use plans (ordinances)

Water Quality Management

- combination of databases for water quality management
- land use link to water quality
- water quality degradation
- identification of stakeholders
- impact of forestry on water quality
- forestry- estuarine water quality
- GIS tools to define wetlands buffering

Habitat Integrity

- forest fragmentation
- habitat degradation
- specific habitat decline
- endangered species management
- public access/ use
- wetland losses (all types)
- value of traditional land use
- ecosystem tolerance to human activity

Local Concerns

- public misconception (taxes, forestry, habitat loss)
- effect on tax base (of conservation efforts)
- value of traditional land use

Access to Information

- database of land protection histories
- comprehensive database for public use

Public Education was identified as an overriding heading that could be applied to all of the issues.

After labeling each group with a specific heading, the participants were asked to consider how each group was related to one another.

Lastly, participants were asked to identify any special feature, function, or capability that they would like to see included on the CD-ROM. Listed below are their suggestions.

- predictive models (including storm water runoff and water quality degradation)
- updates on data
- output capabilities (maps, etc.)
- what if scenarios (land use, e.g. highway)
- provide area data
- more information and data regarding specific development plans
- video for public education
- expandable to include additional data (e.g., soils)
- management information (e.g., for red-cockaded woodpecker, maritime forest, or sensitive habitats)
- identify data gaps and deficiencies
- digital orthophotos
- get more information out there for decision making
- identify accessible, readily available educational materials

GIS Viewing Tools

Introduction

The "GIS data" folder in the root directory of this CD-ROM contains nearly 100 GIS data layers that are part of the ACE Basin Characterization. To view these data fully, you must use GIS software, such as ArcInfo, ArcView or ArcExplorer from Environmental Systems Research International (ESRI) or MapInfo from MapInfo Corporation. To provide a quick overview of these data, the "GIS data" folder contains ArcView and ArcExplorer project files. You must have ArcView to use the ArcView project files, and the contents of these files are described below. **If you do not have GIS software installed on your computer**, you can still use the ArcExplorer project files. This CD-ROM has a copy of ArcExplorer, and a section below describes how to install and use this program. In addition, the Image Atlas provides a cursory overview of the data that does not require GIS software.

ArcView® Project Files (for V. 3.1 Users Only)

For those users with ArcView GIS software installed on their computers, several ArcView V. 3.1 project files have been included on this CD-ROM. These project files incorporate all of the vector, image, and tabular data that are available on this CD-ROM. The file named **gis_tour.apr** contains an overview of the data with related themes grouped into respective views. On slower computers, this file make take a few minutes to load. The following is a list of views available in this project file.

Views in Gis_tour.apr	
View Name	Principal Data Layers
1989 National Wetland Inventory	Wetlands by river basin according to the revised 1989 data from the National Wetland Inventory program.
1994 National Wetland Inventory	Wetlands by river basin according to the revised 1994 data from the National Wetland Inventory program.
Aquatic Fauna	Locations of stations for surveying populations of fish and benthos; shellfish habitat; and sea turtle and horseshoe crab nesting beaches.
Environmental Monitoring	Locations of USACE and NPDES permits, STORET water quality monitoring stations, EMAP sediment monitoring, stations, and erosion/accretion monitoring stations.
Hydrology	Rivers, streams and creeks by river basin (represented as arcs and polygons); 8, 11, and 14-digit HUCs; and the boundaries between fresh

	and salt water
Infrastructure	Major highways, streets by river basin, power transmission lines, railroads, and airports.
Population Census Data	Census data by blocks, block groups, tracts, and county.
Recreation and Tourism	Locations of public beaches, birding areas, hiking and biking trails, boat ramps, marinas, outfitters, museums, campgrounds, hotels, bed and breakfast inns, and golf courses.
Terrestrial Fauna	Locations of stations and transects used for surveying populations of birds and furbearing animals; endangered species by 14-digit HUC.
Tutorial	Study area boundary and counties of the ACE Basin serve as the base map for conducting the GIS Tutorial on this CD-ROM.
Tutorial for Data Summary	Roads, permits, protected lands, and some aquatic fauna and recreation/tourism data to be used in conjunction with the Data Summary Tool portion of the GIS Tutorial on this CD-ROM.

ArcView Project Files with Link Tables

The CD-ROM also provides several ArcView project files that focus on a particular resource or aspect of the Basin. These files include tabular data linked to the spatial data. Tables are located in the tables folder within the gis_data directory.

Fish_tables.apr		
Shapefile	Link Tables	Description
trawls	trwlcoll.dbf trwlsum.dbf	The shapefile shows the locations of trawl samples within the ACE Basin. The table trwlcoll.dbf describes general environmental conditions at the time of sampling; trwlsum.dbf describes the catch from each sample. The attributes "station" and "collection" link these tables to the shapefile.
trammel	tramcoll.dbf transum.dbf	The shapefile shows the locations of trammel net samples within the ACE Basin. The table tramcoll.dbf describes general environmental conditions at the time of sampling; tramsum.dbf describes the catch from each sample. The attribute "station" links these tables to the shapefile.

Bird_tables.apr		
Shapefile	Link Tables	Description
bredbird	bird1lnk.dbf bird2lnk.dbf	The shapefile shows the route traveled for the annual survey of breeding birds in the ACE Basin (there is only one route). The tables describe the findings of each annual survey; birdlnk1.dbf describes general environmental conditions at the time of sampling, birdlnk2.dbf describes the birds found during each survey. The attribute "year" links the two tables; no link is provided to the shapefile because the same route is surveyed each year.
cwbnests	cwb1lnk.dbf	The shapefile shows areas where colonial waterbird nests have been found within the ACE Basin. The table provides the species and number of nests by year found within each area. The attribute "site_num" links the table to the shapefile.

eagles	eaglelnk.dbf	The shapefile shows the 14-digit HUC's within the ACE Basin. The table provides the number of eagle nests by year found within each 14-digit HUC. The attribute "huccode" links the table to the shapefile.
quail	quaillnk.dbf	The shapefile shows the route traveled for the annual survey of quail in the ACE Basin. The table describe the findings of each survey. The attributes "id" and "quail_id" link the table to the shapefile.
xmasbird	xmaslnk.dbf	The shapefile shows the area surveyed each Christmas for birds (there is only one area surveyed in the ACE Basin). The table describes the findings of each annual survey. No link is provided to the shapefile because the same area is surveyed each year.

Other_tables.apr		
Shapefile	Link Tables	Description
deepcore	dcorelnk.dbf	The shapefile shows locations of two deep (approximately 50 cm) sediment cores in the ACE Basin. The table provides the concentrations of metals in those cores by sediment layer. The attribute "station" links the table to the shapefile.
emapseds	emaplnk.dbf	The shapefile shows locations of sediment cores in the ACE Basin that were collected by the EMAP Program, US Environmental Protection Agency. The table provides the concentrations of pesticides, organochlorines, heavy metals, and other pollutants in those samples. The attribute "station" links the table to the shapefile.
fursrvy	furlink.dbf	The shapefile shows the routes traveled for the annual surveys of furbearers in the ACE Basin. The table describe the findings of each survey. The attribute "lin_numb" links the table to the shapefile.
plantcom	plantlnk.dbf	The shapefile shows the areas identified by The Nature Conservancy to contain high-quality plant communities. The table describes the plants and community associations found within each area. The attribute "polygonid" links the table to the shapefile.
islands	islndlnk.dbf	The shapefile shows the principal islands within the ACE Basin. The table describes the landuse on each island. The attribute "island" links the table to the shapefile.

ArcView Project File for the BASINS Model

The ArcView project file named **model.apr**, which also is in the data folder, illustrates output from the BASINS model.

Back to Top

ArcExplorer® Project Files (Windows 95 OR NT 4.0 Users Only)

ArcExplorer is a lightweight GIS data explorer developed by ESRI. As a stand-alone application, ArcExplorer allows users to display and query a wide variety of standard data sources. ArcExplorer also features legends, overview maps, multiple views, saving and retrieving views, and map printing. This free GIS software is on this CD-ROM and ready to be installed. If you've never worked with GIS software, give it a try — it's easier than you think!

To learn more about ArcExplorer, visit the ESRI home page.

The ArcExplorer project files are located in the arcexplr folder of this CD-ROM set. These projects files have been designed for users that do not have ArcView® to view the spatial data provided on this CD-ROM. The below table lists the ArcExplorer project files included in this CD-ROM. These pre-made views combine the various ACE Basin data layers into an easy-to-use format for viewing. These files can be accessed by starting the ArcExplorer software, choosing the **File Open** option, and navigating to the *.aep file in the arcexplr folder. For more instructions, please see on the on-line help files.

ArcExplorer Project Files		
File Name	Description	Location
bio_res.aep	Locations of stations or transects for surveying populations of fish, benthos, birds, and furbearing animals.	arcexplr/bio_res.aep
demog.aep	Census data by blocks, block groups, tracts, and county.	arcexplr/demog.aep
hydro.aep	Rivers, streams and creeks by river basin; 14-digit HUCs; and the boundaries between fresh and salt water.	arcexplr/hydro.aep
rec_tour.aep	Locations of public beaches, birding areas, hiking and biking trails, boat ramps, marinas, outfitters, museums, campgrounds, hotels, bed and breakfast inns, and golf courses.	arcexplr/rec_tour.aep
res_mgmt.aep	Locations of USACE and NPDES permits, STORET water quality monitoring stations, EMAP sediment monitoring, stations, shellfish permit areas, sea turtle and horseshoe crab nesting areas, and protected lands.	arcexplr/res_mgmt.aep

Installing ArcExplorer

- Use either the File Manager® or Windows Explorer® to navigate to the arcexplr directory on the CD-ROM.
- Double-click on the file aeclient.exe.
- Follow the ArcExplorer installation instructions displayed on your monitor.

Note: After ArcExplorer is installed on your computer, a full set of instructions for operating the software is located in the on-line help section of the program. Also, please see the licensing agreement that will be installed on your computer with the software.

System Requirements for ArcExplorer

ArcExplorer is built with 32-bit MapObjects® technology. Therefore, to use ArcExplorer®, you must have Microsoft Windows 95/98 or Microsoft Windows NT 4.0 or later installed on your system. The tables below provide minimum and recommended system requirements for running ArcExplorer.

Minimum Requirements		
System Feature	Windows 95/98	Windows NT 4.0 or later
System RAM	8 MB	12 MB
CPU	486DX 33	486DX 33
Video Adapter	VGA	VGA
Free Disk Space	5 MB	5 MB

Recommended		
System Feature	Windows 95/98	Windows NT 4.0 or later
System RAM	16 MB or better	16 MB or better
CPU	Pentium 60 or better	Pentium 60 or better
Video Adapter	PCI Video Card	PCI Video Card
Free Disk Space	10 MB	10 MB

As with most Windows software, performance will improve with more memory and faster systems.

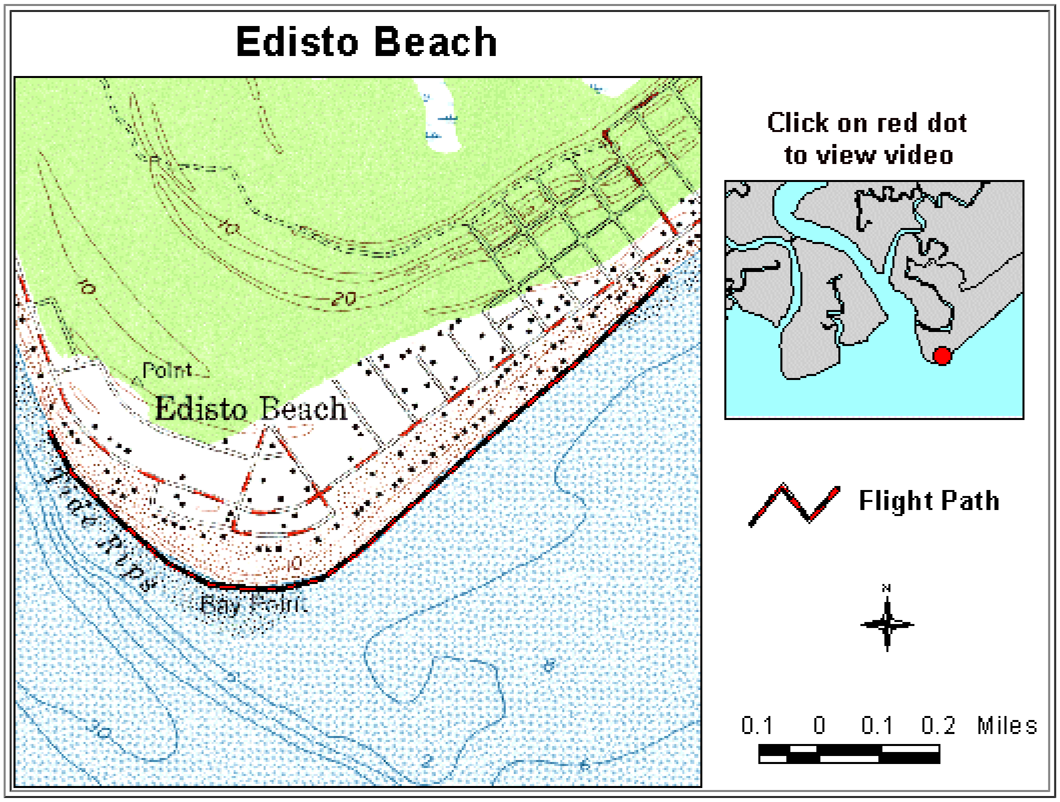
** Note for NT Users: ArcExplorer Version 1.1 requires both Service Pack 3 and administrator privileges.

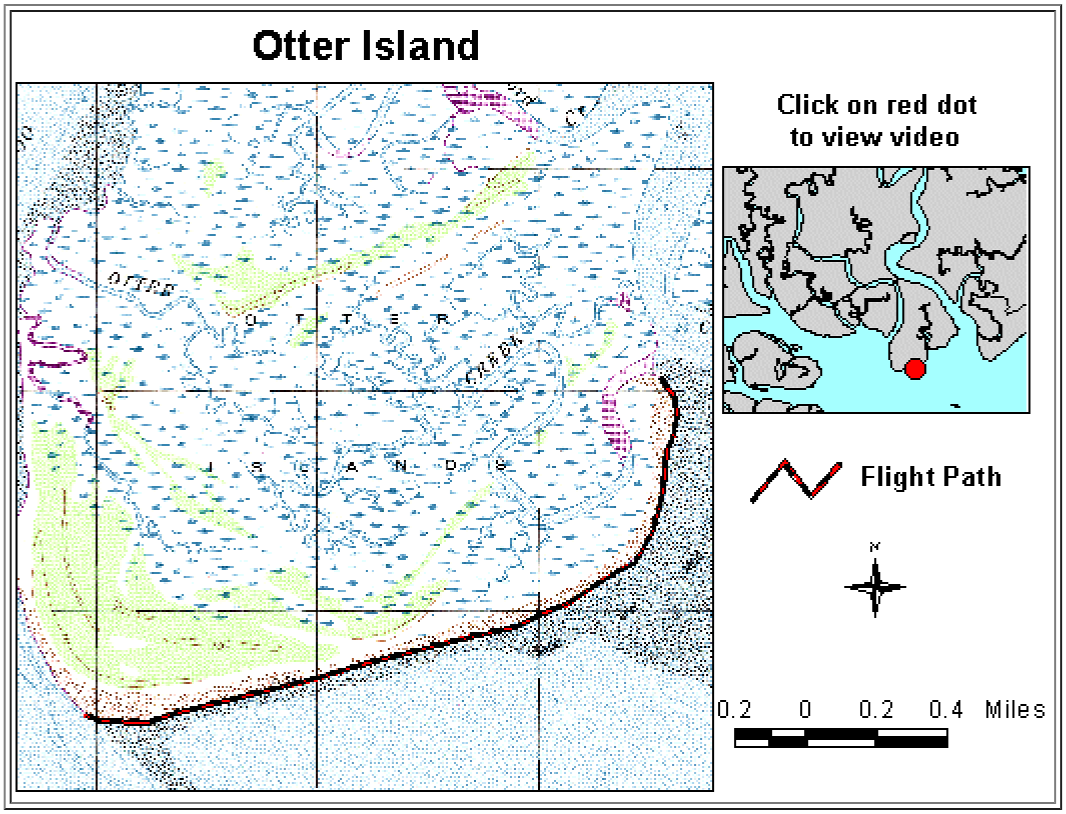
Next Section: GIS Tutorial

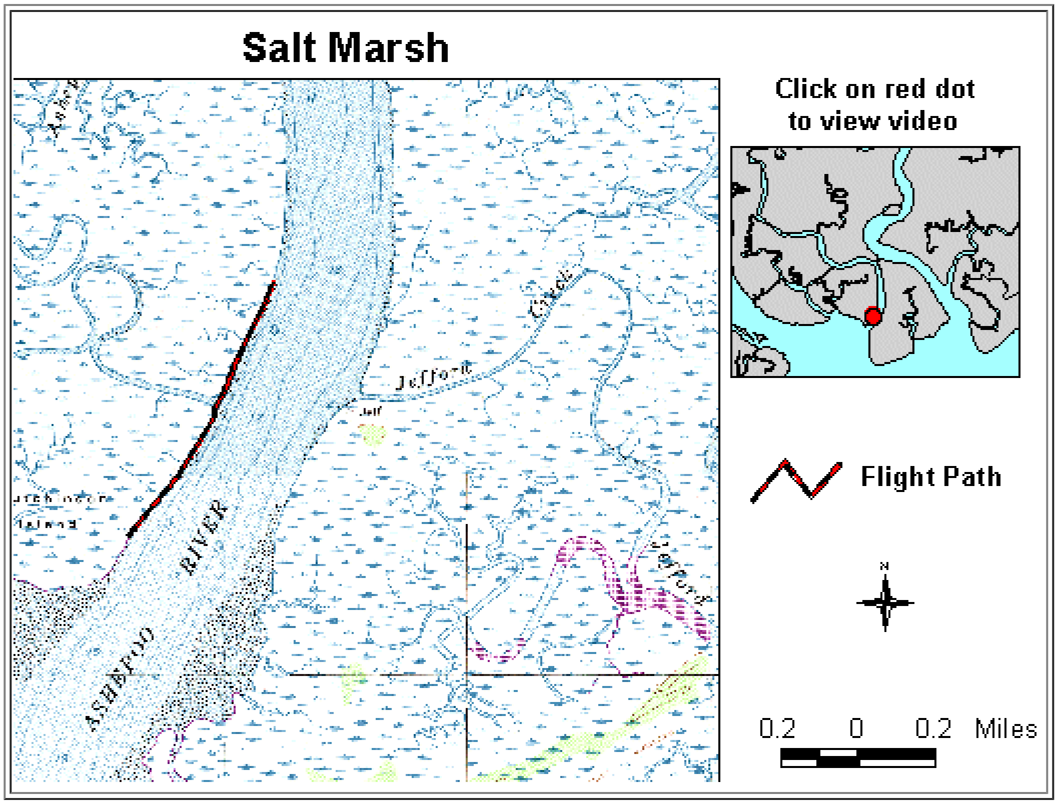
Author

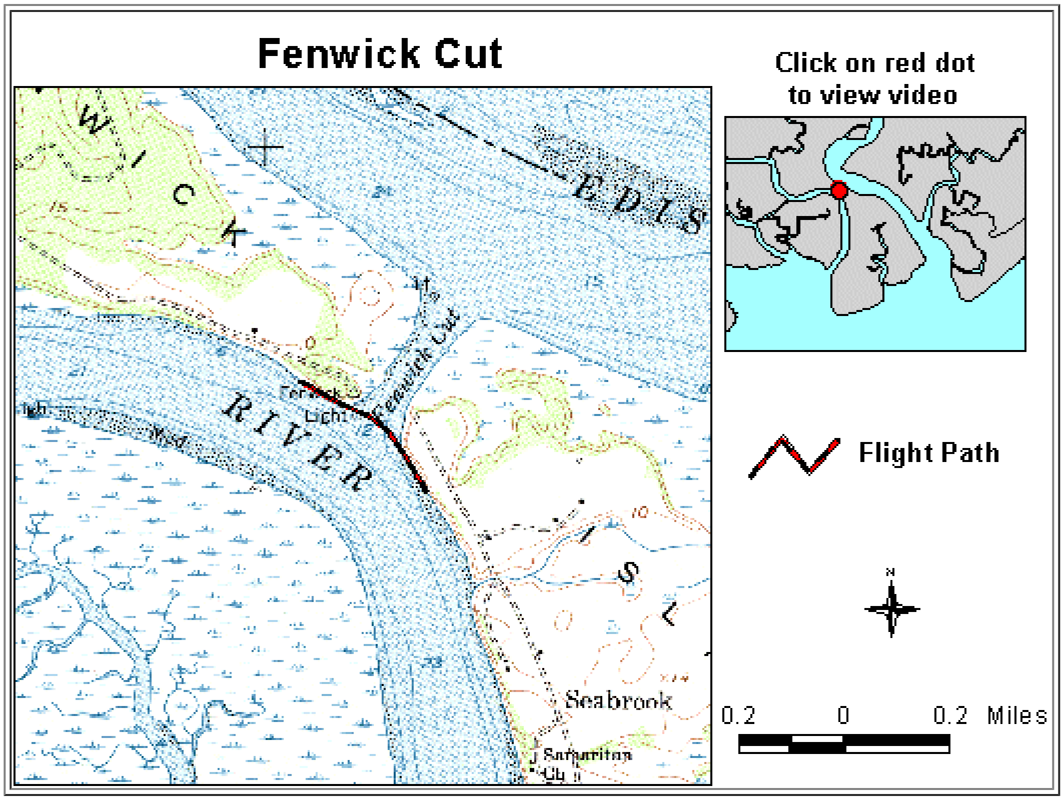
NOAA Coastal Services Center

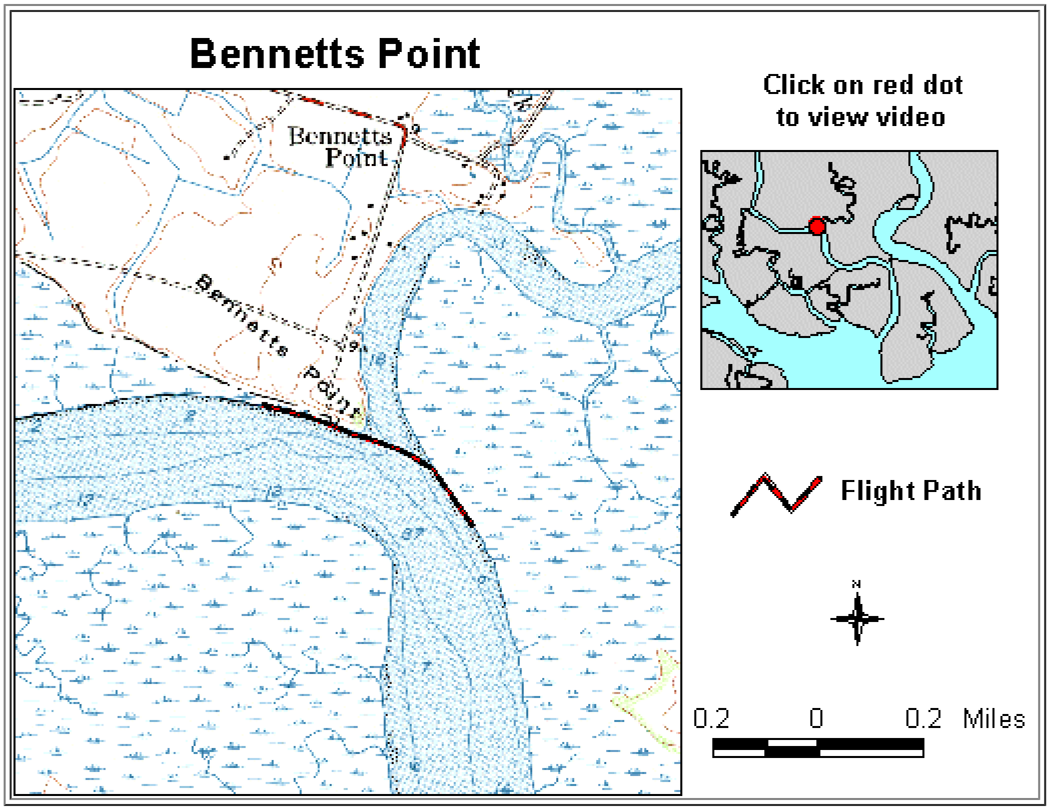
General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

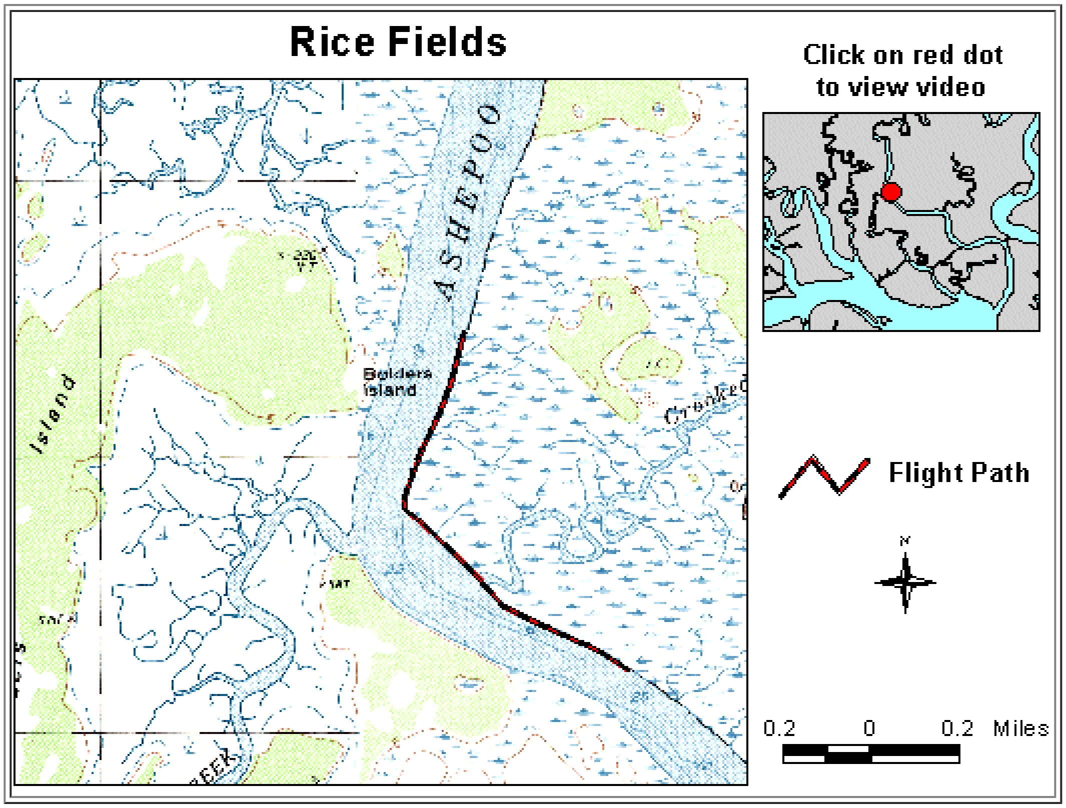

Edisto Beach
Click on red dot
to view video
Flight Path
Edisto Beach
Point
Bay Point
Tide Rips
0.1 0 0.1 0.2 Miles

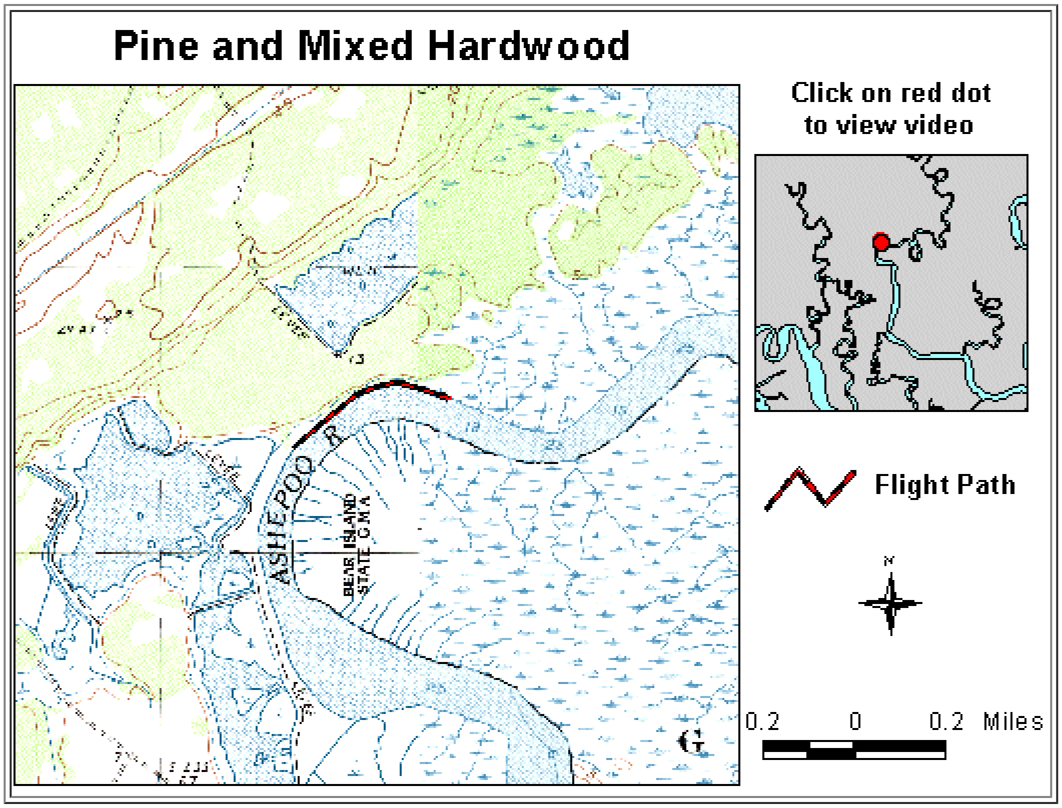

Otter Island
Click on red dot
to view video
Flight Path
0.2 0 0.2 0.4 Miles

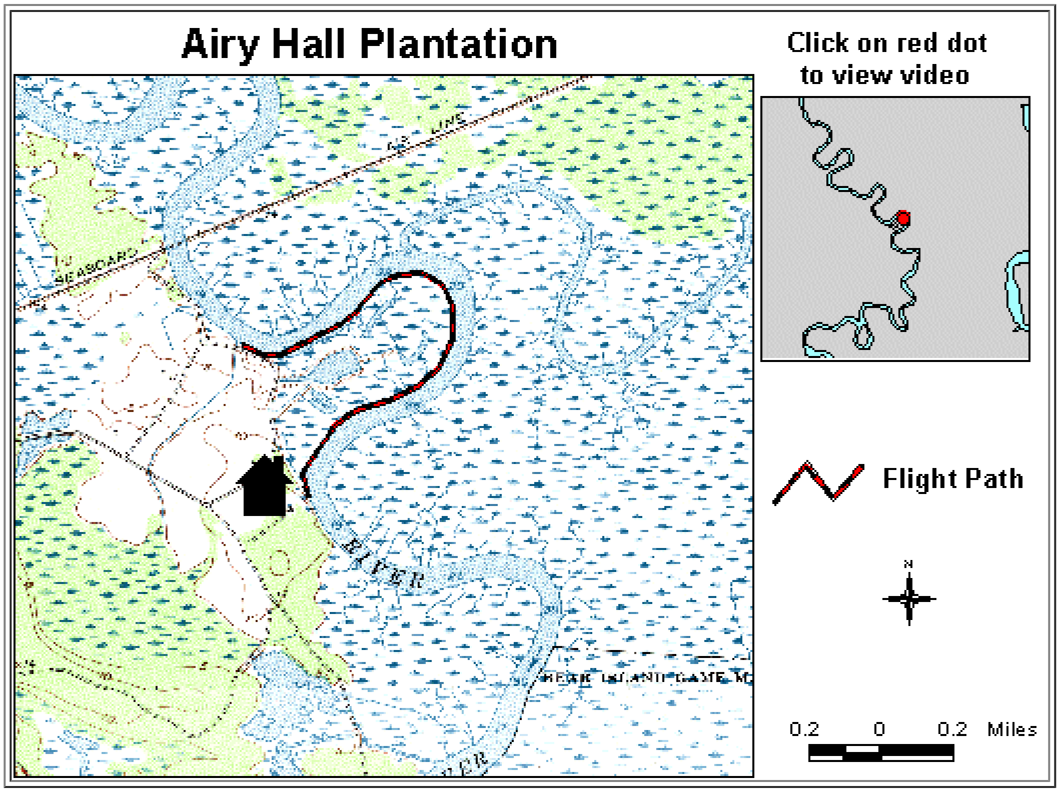

Salt Marsh
Click on red dot
to view video
Flight Path
0.2 0 0.2 Miles
ASHEPOO
RIVER

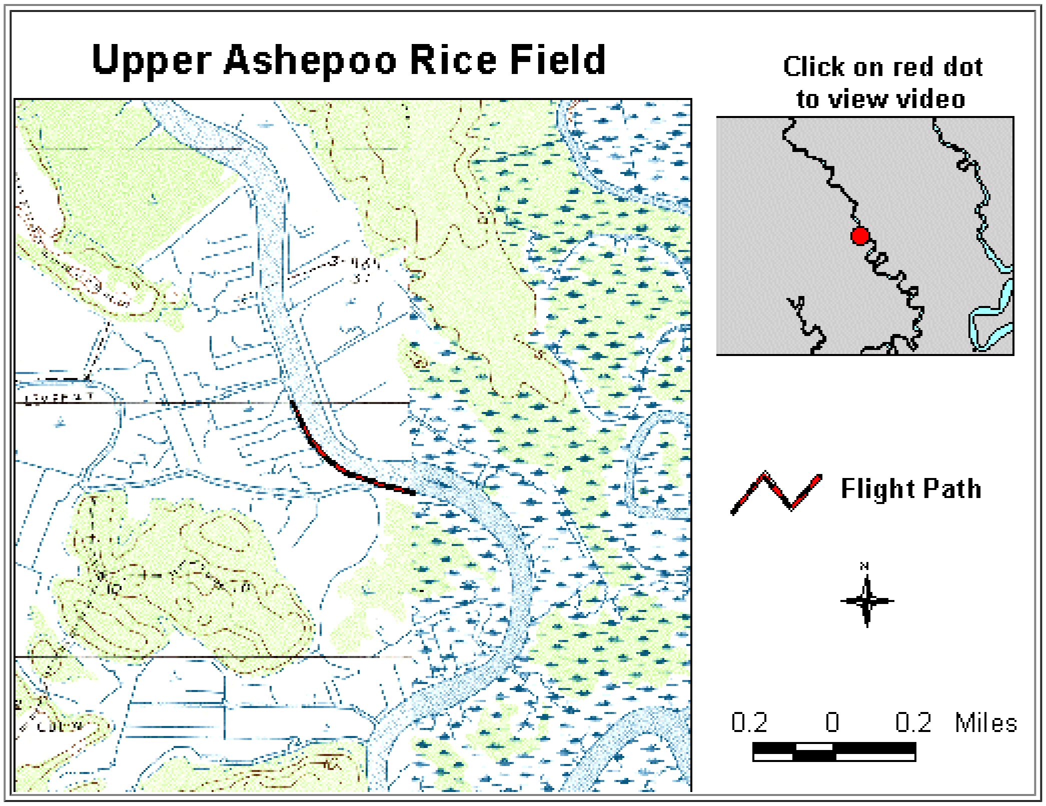

Fenwick Cut
Click on red dot
to view video
Flight Path
0.2 0 0.2 Miles
RIVER
Fenwick Cut
Seabrook

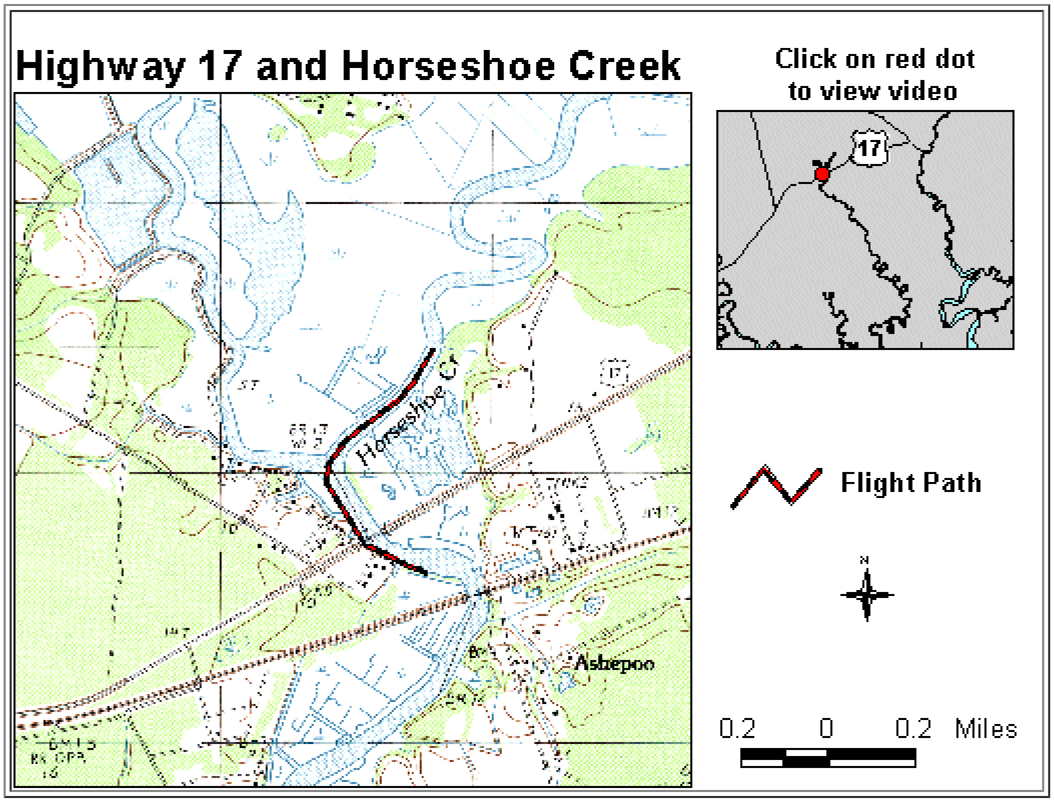

Bennetts Point
Bennetts Point
Bennetts Point
Click on red dot to view video
Flight Path
N
0.2 0 0.2 Miles

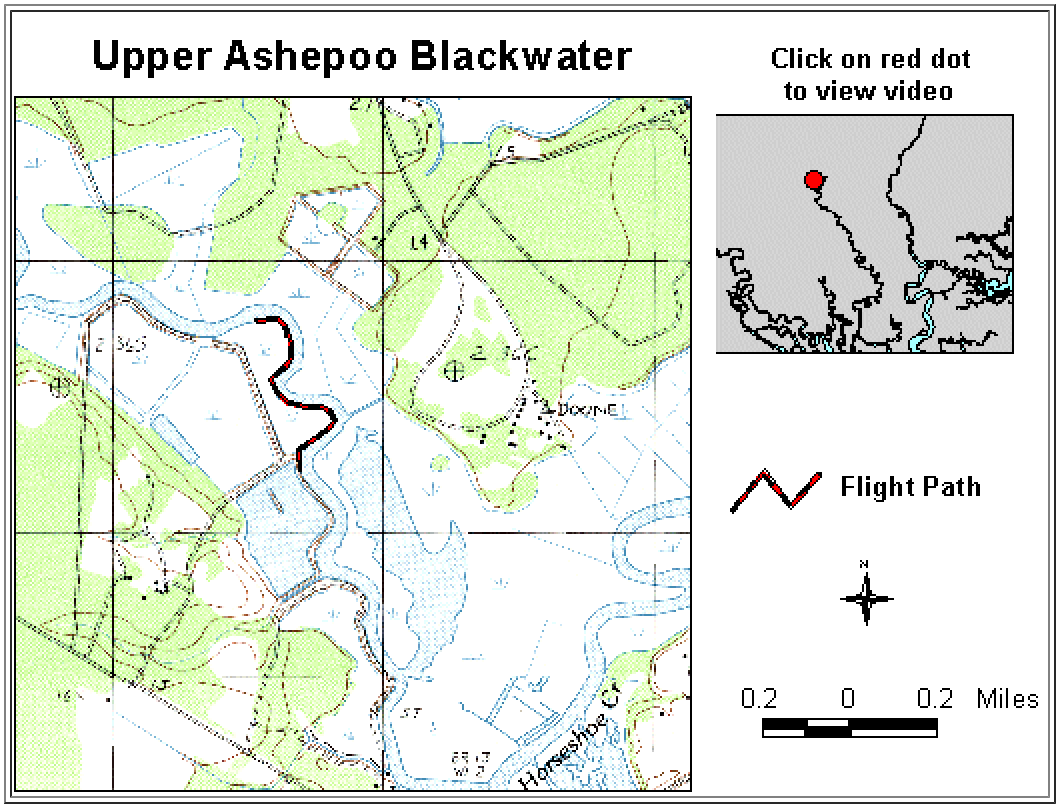

Rice Fields
Click on red dot
to view video
ASHEPOO
Bolders
Island
Island
Crooked
Flight Path
N
0.2
0
0.2
Miles

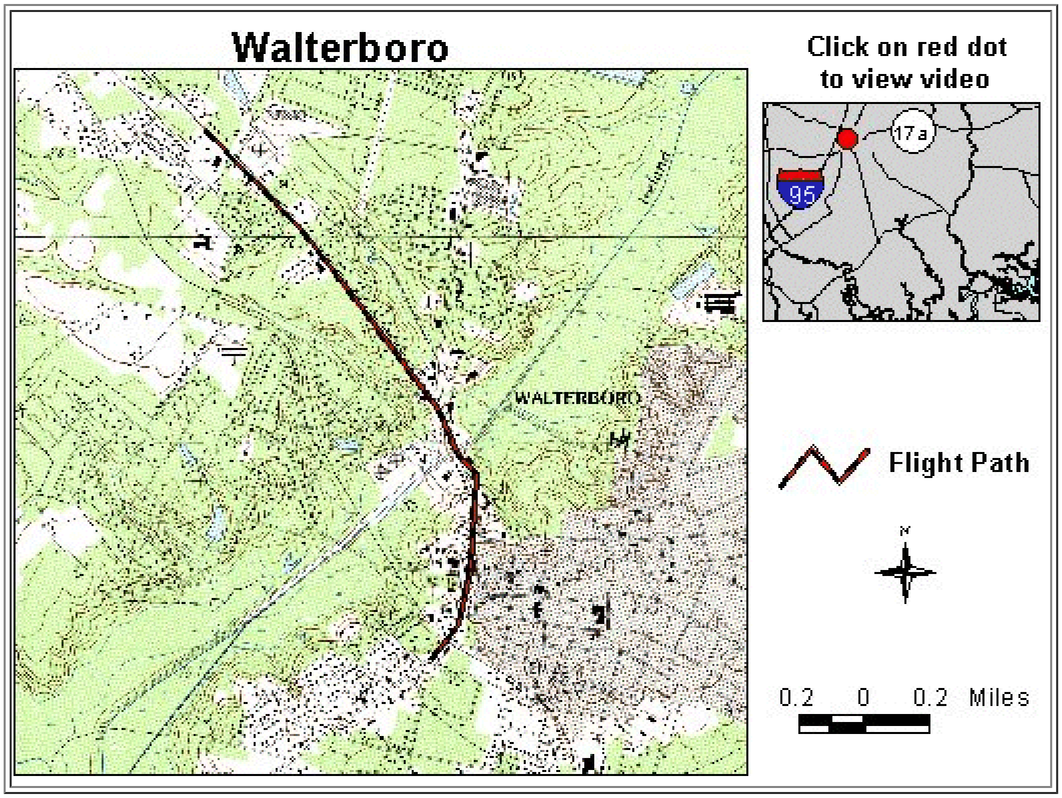

Pine and Mixed Hardwood
Click on red dot
to view video
ASHEPOO R
BEAR ISLAND
STATE G.M.A
Flight Path
0.2 0 0.2 Miles


Airy Hall Plantation
Click on red dot
to view video
Flight Path
N
0.2 0 0.2 Miles
SEABOARD
LINE
RIVER


Upper Ashepoo Rice Field
Click on red dot
to view video
Flight Path
N
0.2 0 0.2 Miles


Highway 17 and Horseshoe Creek
Click on red dot
to view video
17
Horseshoe Cr
Ashepoo
Flight Path
0.2 0 0.2 Miles


Upper Ashepoo Blackwater
Click on red dot
to view video
Horseshoe Cr
Flight Path
N
0.2 0 0.2 Miles


Walterboro
WALTERBORO
Click on red dot
to view video
17a
95
Flight Path
N
0.2 0 0.2 Miles

MENU

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

History

History of the ACE Basin | Archaeology | Cultural Resources
Interactive Map of Cultural Resources

Introduction

Pottery shard

The ACE Basin has a long history of human use beginning with Native Americans, approximately 6,000 years ago. Their occupation is evidenced by the presence of shell middens, pottery shards, and arrowheads that are scattered throughout the region. With the arrival of Europeans, native cultures were suppressed or displaced, and large-scale agriculture and timber production began. Willtown was established in 1682 on the shore of the Edisto River and numerous plantations developed along the rivers of the ACE Basin study area to take advantage of the tidally influenced fresh waters.

The growth of agriculture, especially through the use of slaves, expanded the size and number of plantations through the Civil War. The Civil War, and the recession immediately following, resulted in the abandonment of many of the plantations and the regrowth of pine and hardwood forests. Many of these plantations were purchased by wealthy individuals and used as hunting lodges, thus preserving the primarily forested nature of the landscape that is still evident in the ACE Basin study area. This renewable resource has been cultivated by a number of lumber companies over the previous 5-7 decades.

The 6,000 year pre-historic period and 300 year historic period have left a wealth of cultural resources in the ACE Basin study area. Over 400 archaeologically or culturally important sites have been formally documented by state and federal agencies. While most of these sites are restricted because they are on private land and are protected through the National Historic Preservation Act and Antiquities Act, many are open to the public. In addition, many sites are identified through roadside markers, scattered throughout the ACE Basin study area.

As development continues in the ACE Basin study area, it is significant that although hundreds of sites have been formally recognized, hundreds to thousands of sites have yet to be uncovered. Careful site planning, inventories, and management of land clearing can identify and preserve these cultural heritage resources for both future generations and the economic potential of these resources.(See Interactive Map of Cultural Resources).

NEXT SECTION: History of the ACE Basin

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

MENU

Native American Occupation

Early European Colonization

Early Cash Crops

Rice Culture

Willtown Settlement

Expansion of Rice Plantations

Indigo Culture

Cotton Production

Fragmented Plantation Culture

Early Towns and Transportation

Phosphate Mining

Lumber Industry

Interactive Map of Cultural Resources

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

History of the ACE Basin

Native American Occupation

Paleoindians, predecessors of modern-day Native Americans, were the first inhabitants of present-day South Carolina. The presence of Paleolithic tools (Clovis-, Suwannee-, and Dalton-type projectile points) along the middle portion of the Savannah River indicate they arrived during the late Pleistocene Age, as early as 10,000 B.C. (Goodyear et al. 1989, Goodyear et al. 1993, Rowland et al. 1996). Their culture was similar to that of Old World Upper Paleolithic cultures which dominated central Asia and Japan in 14,000 B.C. (Hudson 1976). Like their Asian counterparts, Paleoindians are believed to have lived in mobile hunting-gatherer groups and hunted large animals such as mammoths and mastodon. The groups hunted together, encircling feeding animals and killing the prey with their spears (projectile points). (See related section: Time Period.)

The decline of these large animal populations at the close of the Pleistocene Age (B.C. 9000 to 8000) forced the Paleoindian people to find other sources of food (Goodyear et al. 1989). Although smaller woodland animals and fish were abundant, these animals were not as easy to hunt as the larger animals. The traditional hunting ways were no longer productive; thus the people had to develop new and ingenious ways to catch and kill the smaller prey. They made new types of projectile points, the Suwannee and Dalton, that proved to be more suitable for small game hunting. In addition, they spent more time collecting wild plant foods, particularly acorns and nuts, that were abundant in the forests.

This new way of hunting and gathering marked the end of the Paleoindian period and the beginning of the Archaic period and the modern-day Native Americans. People in the Archaic became increasingly sedentary, hunting in smaller and smaller territories (Hudson 1976). Semi-permanent villages of several families were built near the hunting grounds. The shell middens near these ancient homesteads provide clues to the daily lives of Archaic Native Americans. The discovery of permanent tombs in the ACE Basin study area suggests the Archaic Native Americans practiced burial customs. (See related section: Shell Middens.)

Experimentations with horticulture and food storing techniques characterizes the Woodland cultural stage of the first South Carolinians. The Woodland period began to take shape in the eastern United States around 1000 B.C. and lasted until around 700 A.D. Many of the Archaic tradition customs were refined (i.e., pottery designs and tool construction) or combined with new traditions (i.e., statues near tombs and single-family shell middens).

The Mississippian cultural tradition began taking shape between A.D. 700 and 900 and reached its peak of development circa 1150 A.D. The Mississippi Native Americans developed complex political, religious, and social systems that were very similar to those of the Europeans of that time (Milling 1940). The political system, commonly referred to as a ranked chiefdom, was centralized and hierarchical. Similar to European culture, each chiefdom were ruled by one family, and power was passed from the ruler to his nephew. The chief led the people with the aid of a council and war chief, and appointed officials to oversee the maintenance of the villages. Medical practitioners served as both healers and religious leaders of the chiefdoms. Warriors, religious and community leaders, medical practitioners, craftsmen, and the elderly were the most revered members of the chiefdom.

Everyone in the chiefdoms was expected to do his share of daily activities. An early European explorer, La Jau, wrote that even the king "labours and fares with the rest" (Waddell 1980). General-use buildings and public grounds were cleaned by volunteer crews that were organized by maintenance officials. Villagers helped with tilling and planting crops such as corn, beans, and squash during the spring and with harvesting during fall. During the summer months, the entire village moved to the coast, where they subsisted on seafood and wild plants, particularly roots. Hunting was confined to fall and winter because Native American law stated "Do not hunt, the game not being in season till after their crops or harvest is gathered in..." (Waddell 1980).

Most permanent Native American towns were built near the courses or old channels of rivers and streams because the soil was suitable for farming. The towns were usually surrounded by ditches, which in some cases were filled with water and encircled by a wall. Elaborate temple mounds, which were pyramidal earthen structures, usually flat-topped, were constructed near the center of towns and served as political, religious, and social centers.

By 1150 A.D., eight tribes had established chiefdoms in the ACE Basin study area's coastal region: Wimbee, Toupa, Mayon, Stalame, Combahee, Kussoh, Ashepoo, and Edistow (Milling 1940, Hudson 1976, Waddell 1980). The largest chiefdom was controlled by the Edistow tribe, and it contained Edisto and Jehossee islands. These tribes were the exclusive inhabitants of the ACE Basin study area until the arrival of the Europeans in the 1500s.

Back to Top

Early European Colonization

The Spanish were the first Europeans to colonize South Carolina (Hudson 1990). In 1526, Lucas Vasquez de Allyon, Francisco Chicora, and 500 colonists left Santo Domingo aboard six ships. That summer, they landed on a coastal island (some historians believe it was Parris Island) in what is today Beaufort County and met the Escamucas tribe who inhabited land just south of the ACE Basin study area. These Native Americans helped the Spanish build their first settlement in South Carolina. The colony failed during the first year, but the Spanish returned in 1566 and re-established Spain's claim to South Carolina by starting the colony of St. Elena on Parris Island.

During the Spanish absence from South Carolina, the French arrived in 1562 at Parris Island and claimed the land for their king (Rowland et al. 1996). They built a settlement called Charles Fort

Spanish Conquistador

on Parris Island, next to the failed Spanish colony, and developed trade relations with the Escamucas. The French settlers were not prepared for the winter, and many died of starvation and disease. When help did not arrive, the survivors built a ship and left the island. The French, however, did not relinquish their claim to these lands.

During the next 20 years, the French, Spanish, and Native Americans fought for control over lands around Port Royal Sound (Rivers 1972). Three Native American tribes which occupied land adjacent to the ACE Basin study area in present-day Beaufort County were instrumental in these struggles for control. In 1576, the Escamucas, with the assistance of the Gaule and Orista tribes, attacked the St. Elena colony on Parris Island in retaliation for the assaults by the Spanish and started the Escamuca War of 1576. In 1577, the Spanish were able to end the war by re-establishing a good relationship with the Escamucas, but the Guales and Orista joined forces with the French and continued to attack Spanish settlements. By 1580, the Spanish had defeated the French and their Native American allies, and the St. Elena colony lived in peace with the Escamucas over the next seven years.

In 1584, England joined the struggle for a stronghold in America, and the king and Parliament approved a patent to establish the Roanoke colony in Virginia (Rowland et al. 1996). The colony was started in 1585 and served as a military base from which privateers operated against the Spanish holdings. In 1586, Sir Francis Drake, with ten ships and 10,000 men, sailed from Roanoke colony to Spanish territory and attacked Spain's St. Augustine colony in Florida. The men looted the colony for seven days, destroying crops and burning fields. It was Drake's intention to destroy the St. Elena colony, but for reasons unknown, he sailed by the settlement on his return trip to Roanoke colony. The Spanish king abandoned St. Elena colony in 1587 and concentrated his forces at the colony in Florida. Although the English had driven Spain out of South Carolina, they made no attempt to settle in the area until the 1660s, partly due to England's civil wars and wars with other European countries.

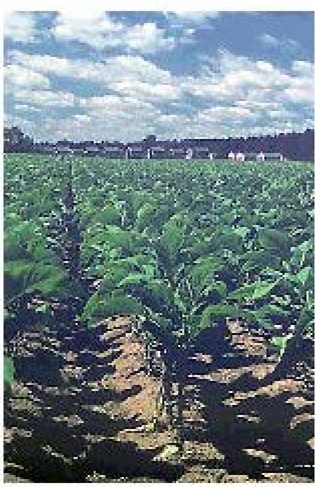
Back to Top

Early Cash Crops

Sir John Colleton, an English Barbadian, and seven English noblemen, known as Lords Proprietors, believed the climate in the present ACE Basin study area was suitable for growing Mediterranean crops such as grapes and sugar (R.F. 1682) and wanted to establish agricultural colonies in the region. In 1663, the king granted them the charter to settle "Carolana", a region that extended from Virginia to Spanish Florida (St. Augustine, Florida) (Rowland et al. 1996). The Lords Proprietors funded several expeditions to search for suitable farm land in the region. Robert Sandford was sent to survey the South Carolina coastal region, and he selected a site in the Charleston Harbor area. The Lords Proprietors offered land grants of 40 hectares (100 acres) to all white Barbadians who wanted to farm in the new colony. In 1669, about 150 settlers left Barbados and arrived at the Charles Town colony at Albemarle Point on the Ashley River in 1670. Ten years later the Charles Town colony was moved to its present location at Oyster Point, a peninsula between the Ashley and Cooper Rivers (Thomas 1930), and after the Revolutionary War, the name was changed to Charleston.

South End of East Bay St. (Late 1800's)
Charleston, SC

The Lords Proprietors supplied the colonists with seeds of various Mediterranean and tropical crops such as grapes, olive trees, sugar cane, ginger, and citrus. The plants flourished during the summer in the rich soils of the hardwood forests but were killed by the cold winter (Gray 1933). Carolinians had better success with tobacco, corn, and root crops.



Tobacco field

Tobacco grew well in the sandy soils of the coastal plain, and the Carolinians were able to produce tobacco for export within a few years. However, many abandoned the crop because cultivating and curing the plants proved more difficult than they expected. Others were discouraged by the cash crop because the market prices for tobacco were very low.

Impressed by the enormous corn stalks grown by the Native Americans, the colonists adopted the Native American method of planting (Hilton 1664). Fields were cleared in the hardwood forests, and alternate rows of Indian corn and beans were planted in order to improve yields. The corn yield from the first harvest was very good, producing a surplus. By 1674, Carolinians were exporting corn to the English West Indies (Clowse 1971).

Root crops, including several varieties of Native American, African and European root crops, also thrived in the sandy soils of the coastal plain (Otto 1989). The colonists planted American sweet potatoes and cassava, African yams and edoes, and European carrots, turnips, and parsnips. The roots provided food for the colonists as well as fodder for Carolina's livestock.

The Lords Proprietors supplied the colony with pigs and cattle from other American colonies.

The animals did well in the area because the winters were mild and food was available year-round. The farmers also adopted the Native American custom of burning the woodlands during the winter in order to improve native forage. The stock proved prolific, and the colonists had a surplus of animals within a few years. The Carolinians found a ready market in English West Indies for their surplus salted meats.

Corn and salted meat commodities had no value in the very profitable English market; thus Carolinians continued to search for suitable cash crops. Most of the Mediterranean and tropical crops planted in the colony failed, but experiments with the cultivation of indigo and rice proved successful. However, many planters abandoned indigo because they could not learn how to process the dye.

Back to Top

Rice Culture

Former intertidal swamp modified by human activity for use as rice fields

Spanning a 200-year period, rice cultivation was the most significant use of the tidewater region for crop agriculture ever attained in the United States (Hilliard 1975). Under the guidance of the experienced enslaved rice-growers from West Africa, the colonists were able to produce good yields of rice within a few years. The Africans were taken from rice-growing regions in Senegambia, Sierra Leone, and the Windward coast, a region known as Upper Guinea (Doar 1936, Rodney 1970, Wood 1974, Littlefield 1981). The planters employed the upland and swamp rice planting techniques that were developed by the people of Upper Guinea people. Upland fields were cleared in hardwood forests, and in the spring, rice seeds were planted. During the growing season, the upland fields were weeded frequently to remove opportunistic plants that out-competed the rice for water and nutrients. Fields were cleared in inland swamps near freshwater streams, and the felled trees were used to build dikes around the cleared fields. The tree trunks were used to build two dams: one along the side of the field adjacent to the stream and one along the downstream side of the field. To flood the field, the tree trunk adjacent to the stream was removed, and the trunk at the downstream side was removed to drain the field. Seeds were planted in the spring, and the fields were periodically flooded during the growing season to irrigate crops and destroy weeds. In the fall, the fields were drained and the rice crop was harvested. By 1674, the upland and swamp rice fields were producing good yields annually, generating great wealth for rice planters.

The success of the rice culture and cattle ranching contributed to the expansion of settlements along the coast. By the 1680s, the colonists were shipping over 100 barrels of rice to England and over 1,000 pounds of salted meat to English West Indies. Planters and ranchers began to disperse along the coastal plain in search of land.

Back to Top

Willtown Settlement

In 1682, Willtown, the first recorded settlement in the ACE Basin study area, was established by the Lords Proprietors (Linder 1995). The town was built as a trading center for the newcomers to the area. Trading with the Native Americans was the major economic activity in Willtown (Clowse 1971). The lucrative pelt market attracted many white Carolinians to the ACE Basin study area, probably as early as the 1670s. They exchanged textiles and manufactured goods for deerskins and furs from several tribes (Otto 1989), including the Wimbees who lived on Williman Island between Wimbee Creek and the Combahee River.

A few years later, cattle ranchers settled in the lush lands around Willtown, and the first ranchers crossed the South Edisto River at Jacksonboro in 1688 (Dunbar 1961, Otto 1986). By 1694, they had reached the Combahee River and the landscape was dotted with pig and cattle shelters. Between 1700 and 1715, the ACE Basin study area was considered a major cattle-raising region of South Carolina.

Some of the more popular historic attractions around the ACE Basin study area, including Willtown Bluff, are described in the Cultural Resources section.

Back to Top

Expansion of Rice Plantations

Rice planters reached the banks of the North and South Edisto River before 1700 (Linder 1995). The success of rice planting led to a dispersed settlement pattern (Otto 1989). During the seventeenth century, planters clustered around the Ashley and Cooper Rivers and the port of Charleston. But following the success of rice planting, Carolinians dispersed along the coastal plain in search of rice lands and navigable streams. The planters bought thousands of acres in the bottomland hardwood areas from the Lords Proprietors for 20 pounds sterling an acre (Otto 1989). By 1715, rice plantations were located along all the navigable rivers and creeks of the ACE Basin study area (McCrady 1897).

Cattle ranches and rice plantations in Carolina contributed to the demise of a number of Native American tribes living and near the ACE Basin study area (Rowland et al. 1996). In 1715, the lands of the Wimbee and Yemassee reservations were surrounded by cattle ranches and rice plantations. The Carolina assembly had set aside reservations for the two tribes in 1707 and had forbidden white colonists to graze their livestock on the Wimbee and Yemassee tribal lands. However, the colonists ignored the laws, and their free-ranging cattle destroyed the tribes' crops and competed with deer for woodland forage, causing the deer populations to wane. Betrayed and frustrated, the Native Americans attacked Carolinian settlements in the spring of 1715, starting the Yemassee War of 1715 (Haan 1981). Between 8,000 and 10,000 warriors descended on the settlements in Carolina (Lander and Ackerman 1973). Most settlements in the ACE Basin region were destroyed, with livestock killed (Glover 1962). The Proprietary government was powerless to stop the raids because the white Carolinians were outnumbered (Lander and Ackerman 1973). As the government appealed for aid from neighboring colonies and England, the raids on settlements continued.

Angered by the Lords Proprietors' inability to end the war and the lack of aid from England, the colonists overthrew the Proprietary government in 1719 and considered revolting against England (Lander and Ackerman 1973). During the next 20 years, it became evident to

England that intervention was needed. In 1730, the king sent new leadership and troops to Carolina. Within a year, the British army had defeated the Native Americans,and measures were taken to boost the failing economy.

The 15-year war had plunged Carolina into economic depression. In 1717, Carolina exported only 791 barrels of salted meat and 8,289 barrels of rice. This represented a decline of 2,413 barrels of salted meat and 4,438 barrels of rice from the 1712 totals (Clowse 1971). The salted beef and pelt markets never recovered after the war, but the rice and indigo planters profited from the economic incentive enacted by the new Royal government. To help the war-depressed economy, the new Royal government gave 20 hectares (50 acres) to new settlers and an additional 20 hectares for each imported laborer. The government also sold land to new settlers at a low rate of 20 pounds sterling per 405 hectares (1000 acres) (Clowse 1971, Ackerman 1977).

The industry expanded after the Revolution, and rice continued to be a major crop until 1860. Destruction of facilities, loss of slave labor, and inadequate capital caused a decline from which the industry never recovered. The impact of rice culture can readily be seen today in the ACE Basin study area. Many remnant fields and impoundments have been converted to waterfowl hunting and management areas. Others have reverted to colonization by fresh/brackish water plants, yet retain the dikes and ditches indicative of previous use in rice culture.

Back to Top

Indigo Culture

The indigo market was revived during the mid-1700s, due in part to improved methods in processing the dye (Kovacik and Winberry 1987). Indigo growers used vats, preferably wooden, to ferment and then oxidize the indigo. The precipitate generated by the oxidation process was dried, cut into small squares, and packed into barrels for export.

Sales of indigo were further augmented during King George's War (1739-1748) and the French and Indian War (1754-1763) (Kovacik and Winberry 1987). During these wars, the French and Spanish stopped exporting West Indian indigo to England, and the colonists became the sole suppliers of the blue dye to England. By the 1750s, Carolina's annual export of the crop was over 0.2 million kg (0.5 million lb) and it peaked at over 0.45 million kg (1 million lb) in the mid-1770's. Indigo planters along the coast grew wealthy during the years leading up to the Revolutionary War. After England closed its indigo market to America during the war, sales plummeted, and in 1783 the market crashed and never recovered.

Back to Top

Cotton Production

Long-staple type cotton was introduced in 1790 to replace the failing indigo market. Cotton production did not flourish, however, until prior to the Civil War when thousands of acres in the major river flood plains were cleared and cultivated. Planters all

Cotton Field

along the coast began to grow the crop, and cotton thrived in the sandy soils and salt air of the coast. The long, silky-textured fibers were in high demand and were used for making laces and the finest cloth. By the early 1800s, coastal planters were producing about 2 to 2.2 million kg (4.5 to 5 million lb) per year, which accounted for about 60 percent of the nation's total export production of the long-staple cotton (Kovacik and Winberry 1987). Sea island type cotton remained a major export commodity for coastal planters until the Civil War (1861-1865).

Back to Top

Fragmented Plantation Culture

Farming practices in the ACE Basin study area were drastically altered by the Civil War because landowners no longer had slave labor needed to maintain the large plantations. After the Civil War landowners subdivided their plantations into smaller parcels, and farmers, primarily ex-slave families, were offered a house and supplies in exchange for their labor (Harris et al. 1986). Starting in the 1880s, landowners began renting the small parcels to farmers, most often whites, who paid in cash or share-rent.

After the Civil War, production of long-staple cotton was resumed on Edisto Island, as well as on many other South Carolina islands (McKenzie et al. 1980). Land owned by freed African-Americans totaled 1620 hectares (4,000 acres), with an average holding of 4 to 10 hectares (10 to 25 acres), and it was estimated that these former slaves raised two-thirds of the cotton produced on the island (Moore 1989). John Thorne was considered the most prominent "colored" cotton planter on the island because he owned 65 hectares (160 acres) of land, a store, a storehouse, and a gin house.The planters began using commercial fertilizers in 1868, and annual cotton yields increased. However, cotton production was significantly lower than it was before the Civil War, largely due to loss of the slave labor force and inadequate capital to maintain operation of the large-scale cotton plantations. In the early 1900s, the sea island cotton industry was decimated by insect pests such as the leaf worm and boll weevil.

Edisto Island's African-American farmers were not devastated by the loss of cotton revenue because they began planting as much corn as cotton as early as the 1880s (Moore 1989). From 1880 to 1907 cotton production increased by 47% and corn production nearly doubled. Corn was the second largest cash crop in South Carolina, and agronomists noted in 1907 that corn production would soon rival cotton as the top cash crop (Watson 1907).

During the same time, farmers began growing garden produce (i.e., cabbage, tomatoes) for export to other communities. This practice, called truck farming, resulted in higher profits over a shorter time period for the farmers. In 1900, the acreage of land in five counties planted in truck crops was approximately 19,643 and increased to 30,000 by 1906. This 57% increase in vegetable farmland represented a 246% increase in profit. In 1900, the value of truck crops produced in five counties was estimated at $1,142,961. increasing to $3,953,569 by 1906.

Truck farming was mostly confined to coastal islands. Around the turn of the century, Edisto Island began producing vegetables as a cash crop. Cabbage and potatoes were the first truck crops grown on the island, and the farmers later added other vegetable crops such as cucumbers, beans, peas, sweet potatoes, strawberries, and lettuce (Puckette 1978). Crops such as corn, wheat, and beans were grown on upland soils of Colleton County.

Improvements in farming techniques, the construction of the Intracoastal Waterway, roads, and railways were instrumental in promoting the development of the farming industry during the early twentieth century. By the 1930s, about one-fourth of all Southerners were hired farmers, known as sharecroppers (Skees and Swanson 1986). Strong wartime demands, first from abroad and then at home, pushed farm product prices upward from 1941 to 1948. The modernization of farming practices after World War II resulted in extreme increases in profit and crop production (Gliessman 1998). The increased profits allowed owners of fragmented plantation farms to pay their debts and to operate the land without the monetary assistance of sharecroppers (Fite 1984). (See related section: Agriculture.)

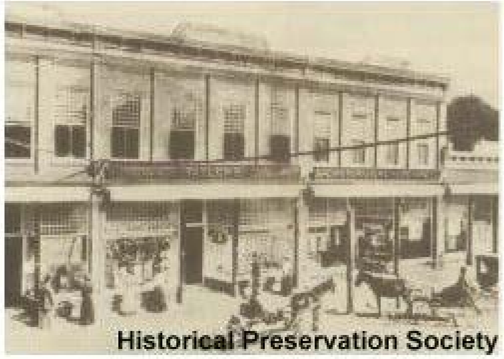
Back to Top

Early Towns and Transportation

Marsh wreck

The economy of Colleton County grew as a result of the growing wealth of its planters, who began to develop the infrastructure of the county (Bryan 1993). They built secondary roads from their lands to the main road from Charleston to Savannah, GA. The planters also started ferry services in navigable waters and built causeways over the Ashepoo, Combahee, and South Edisto Rivers. In 1860, a year before the Civil War began, a railroad which connected Charleston to Savannah was built through the ACE Basin (van Deusen 1928). Wealthy landowners built towns and resorts during the economic boom in the county (Glover 1962). ACE Basin rice planters started the town of Jacksonboro in 1735 as a retreat and trading center. By 1780, the plat of the town shows 113 town lots, each 100 feet wide (river frontage) by 218 feet long.

Jacksonboro also served as the government seat of the South Carolina colony while Charleston was under siege during the Revolutionary War. In



Historic Walterboro (Circa 1890)

January and February of 1782, the General Assembly met in the town and debated the Amercement and Confiscation Acts, which banished those loyal to England and confiscated their lands. In 1798, the town became the county seat with a courthouse and jail (Glover 1962).

A few years later, the residents of Jacksonboro started a summer resort near the present town of Walterboro when they realized that there was a link between malaria and the marsh mosquitos (Bryan 1993). The Walter family built the first summer home in the Walterboro area, today known as Hickory Valley. Other families living in Jacksonboro moved to the Walterboro area. By the following year, Walterboro had became the permanent summer colony for coastal planters. In 1817, the town of Walterboro became the county seat of Colleton County. (See related section: Urban Areas.)

Back to Top

Phosphate Mining

During the 1860s, phosphate beds were discovered in the ACE Basin study area (Chazal 1904). The richest and most abundant phosphate deposits were found in the bottomland hardwood communities along the South Edisto River, near the present-day US Highway 17. Most phosphate companies that started in the area were short-lived, however, because the deposits were not extensive, and many of the beds were not of high quality.

Phosphate mining

Small mining operations on Chisolm and South Williman Islands were not very profitable. High quality and extensive beds were found in the marsh and subtidal area of the Coosaw River, but the rough sea conditions made it hard to mine. Mining on South Williman Island ceased after the cyclone of 1893, and a few years later, Pacific Guano Company, the owner of Chisolm Island, sold its rights to the island and to the beds in the Coosaw River. The new owner of the phosphate beds eventually closed the operations in the early 1900s.

Back to Top

Lumber Industry

After the Civil War, many Southerners were reimbursed some of the money paid in taxes from 1862 to 1865, and most landowners were able to re-claim their lands (Linder 1995).

However, without their enslaved Africans, rice planters could not operate large plantations. Many planters lacked sufficient capital to hire workers and had to sell or lease their lands to timber companies or to northern capitalists who planned to use rice fields as hunting preserves.

Sawmill

The economy of Colleton County was revived after the Civil War by the lumber industry (Fetters 1990). By 1905, one of the larger coastal lumber mills was built at Wiggins in the ACE Basin study area. The company changed hands several times during its twenty years in business. Very little is known about the day-to-day operations of the mill under the first owner, Charleston Lumber Company. In 1905, the mill was sold to the Westmoreland Lumber Company and soon reached its peak production. The company could cut 30,480 meters (100,000 feet) of timber every 10 hours; and at times, it would run both day and night, cutting 60,960 meters (200,000 feet) of timber in a 24-hour period. All the lumber was dressed at the plant, and the mill produced tongue and groove flooring, roof boards, side boards, and beaded lumber. The mill was only accessible by boat, so company-owned steam tugs guided ships through the twists and turns of the Combahee River that led to the Wiggins Mill.

The last owner of the mill, the Savannah River Lumber Company, bought several antebellum plantations (Ball, Chisolm, Borothalia, March, Stock, and Chehaw Neck) in a nearby area, known as Tree Horn Neck. No timber had been cut in this area since the Civil War. The company logged both pine and cypress trees on the property, and the mill cut 22,680 meters (75,000 feet) of board per day. Shipping the lumber became too costly after World War I, so in 1924, the owner closed the Wiggins Mill, shipped his remaining lumber to his Savannah plant, and sold the scrap to a local logger. Most logging companies, including Colleton County's first logging firm, Stokes and Raysor Lumber Company, closed during the 1920s (Fetters 1990).

Two small mills were built near the modern Seaboard Air Line (SAL) railroad during the late 1910s. The Jacksonboro Lumber Company owned a small mill in Jacksonboro and operated three miles of track that ran from the mill to the nearby swamp. The logs were sawed into timber at the mill and then shipped by rail to a larger plant. Another large sawmill was built by Peter Bradley at Ashepoo. This mill could cut 30,480 meters (100,000 feet) per day and was operated by American Agricultural Chemical Company. The company supplied the timber, mostly bald cypress trees, from its 1,214 hectares (3,000 acres) of swamp land that lies to the north of Ashepoo.

The lumber companies built miles of rails from forests in the remote areas of the county to the main railroad line (Fetters 1990). The Charleston Lumber Company built a 34-kilometer (21-mile) main line from Wiggins to Hendersonville, crossing the Atlantic Coast Line (ACL) railroad at White

Railroad crossing

Hall, and operated four locomotives and 150 logging cars. The Savannah River Lumber Company built logging operations at Ashepoo Siding and at Fenwick, alongside the SAL line. Another line ran from the dock at Chisolm downstream from Wiggins and crossed Chisolm Island.

Towns sprouted up near mills during the forestry boom of the late 1800s and early 1900s (Fetters 1990). Westmoreland Lumber Company built one of the largest villages at Wiggins mill, along the Combahee River. There was a hotel, a two-story house for management personnel, and rows of houses for employees. The company also built a number of other buildings to support the manufacturing effort, including a machine shop, a foundry, a planing mill, a locomotive repair shop, and a powerhouse. Each building was supplied with running water and electric lights by the end of 1905. A post office was established in 1905, with Mary E. Wiggins as postmistress and Hector Hooginie as the mail carrier. There were a resident nurse and doctor at Wiggins, and four rooms were at a hospital in Savannah for emergencies. A jail was made from a passenger train car, and it was divided into several small rooms that were about 5 meters (15 feet) long.

The town of Ashepoo, founded by Peter Bradley, was also built during this period of economic boom (Fetters 1990). There was a large sawmill that was operated by the *American Agricultural Chemical Company*, as well as a church, school and housing for both black and white employees of the mill. After the logging boom of the early 1900s, many of the residents left the towns.

Many of the large plantations that once supplied the mills with timber were converted to hunting preserves. The abandoned rice fields and logged forests had attracted a rich abundance of game animals, including migratory waterfowl and deer to the area. The interest in hunting led to the evolution of sophisticated wildlife management techniques that help to preserve the natural quality of the ACE Basin study area that we enjoy today. (See related section: Hunting.)

NEXT SECTION: Archaeology

Author

S. Upchurch, SCDNR Marine Resources Research Institute

References

Ackerman, R.K. 1977. South Carolina colonial land policies. Tricentennial Studies, No. 9.

University of South Carolina Press, Columbia, SC.

Bryan, E.M.F. 1993. Colleton County, South Carolina: A history of the first 160 years, 1670-1830. Florentine Press, R.L. Bryan Company, Columbia, SC.

Chazal, P.E. 1904. The century in phosphates and fertilizers: A sketch of the South Carolina phosphate industry. Lucas-Richardson Lithograph and Printing Company, Charleston, SC.

Clowse, C.D. 1971. Economic beginnings in colonial South Carolina, 1670-1730. University of South Carolina Press, Columbia, SC.

Doa, D. 1936. Rice and rice planting in the South Carolina low country. Charleston Museum, Charleston, SC.

Dunbar, G.S. 1961. Colonial Carolina cowpens. Agricultural History 34:125-130.

Ferguson, R. 1682. The present state of Carolina with advice to the settlers. John Bringhurst Publishers, London, U.K.

Fetters, T. 1990. Logging railroads of South Carolina. Heimberger House Publishing Company, Forest Park, IL.

Fite, G.C. 1984. Cotton fields no more: Southern agriculture, 1865-1980. University Press of Kentucky, Lexington, KY.

Gliessman, S.R. 1998. Agroecology: Ecological processes in sustainable agriculture. Ann Arbor Press, Chelsea, MI.

Glover, B. 1962. Narratives of Colleton County: The land lying between the Edisto and Combahee rivers. Beulah Glover, Walterbro, SC.

Goodyear, A.C., III, J.L. Michie, and T. Charles. 1989. The earliest South Carolinians. *In*: A.C. Goodyear, III and G. Hanosn (eds.). Studies in South Carolina archaeology: Essays in honor of Robert L. Stephenson. Anthropological Studies 9. Occasional Papers of the South Carolina Institute of Archaeology and Anthropology, Columbia, SC.

Goodyear, A.C, T. Charles, and J. Michie. 1993. Early prehistoric peoples of South Carolina. *In*: C. Steen and K. Sassaman (eds.). 25 years of South Carolina archaeology. South Carolina Antiquities: 25(1-2).

Gray, L.C. 1973. History of agriculture in the southern United States to 1860. A.M. Kelley Publishers, Clifton, NJ.

Haan, R.L. 1981. The trade do's not flourish as formerly: The ecological origins of the Yemassee War of 1715. Ethnohistory 28:341-358.

Harris, C.K., J. Gilbert, and J. McAllister. 1986. The structure of farmland ownership in the United States: Change and continuity. Rural Social Monograph Series. Michigan State University, East Lansing, MI.

Hilliard, S.B. 1975. The tidewater rice plantation: An ingenious adaptation to nature. Geoscience and Man 12:57-66.

Hilton, W. 1664. A relation of a discovery lately made on the coast of Florida. J.C. Publishers, London, U.K.

Hudson, C. 1976. The southeastern Indians. University of Tennessee Press, Knoxville, TN.

Hudson, C.M. 1990. The Juan Pedro expeditions: Exploration of the Carolinas and Tennessee, 1566-1568. Smithsonian Institution Press, Washington, DC.

Kovacik, C. and J. Winberry. 1987. South Carolina: The making of a landscape. Westview Press, Boulder, CO.

Lander, E.M., Jr. and R.K. Ackerman. 1973. Perspectives in South Carolina history: The first 300 years. University of South Carolina Press, Columbia, SC.

Linde, S.C. 1995. Historical atlas of the rice plantations of the ACE river basin - 1860. South Carolina Department of Archives and History, Columbia, SC.

Littlefield, D.C. 1981. Rice and slaves: Ethnicity and the slave trade in colonial South Carolina. Louisiana State University Press, Baton Rouge, LA.

McCrady, E. 1897. The history of South Carolina under the proprietary government 1670-1719. Macmillan Company, New York, NY.

McKenzie, M.D, J.V. Miglarese, B.S. Anderson, and L.D. Barclay (eds.). 1980. Ecological characterization of the sea island coastal region of South Carolina and Georgia. Volume II: Socioeconomic features of the characterization area. Marine Resources Division, SC Wildlife and Marine Resources Department. FWS/OBS-79/41.

Milling, C.J. 1940. Red Carolinians. University of North Carolina Press, Chapel Hill, NC.

Moore, J.H. (ed.). 1989. South Carolina in the 1880s: A Gazetteer. Sandlapper Publishing Inc, Orangeburg, SC.

Otto, J.S. 1986. The origins of cattle ranching in colonial South Carolina, 1670-1715. South Carolina Historical Magazine 87:121-122.

Otto, J.S. 1989. The southern frontiers, 1607-1860: The agricultural evolution of the colonial and antebellum South. Contributions in American History, No. 133. Greenwood Press, Westport, CT.

Puckette, C.C. 1978. Edisto: A sea island principality. Seaforth Publications, Cleveland, Ohio.

Rivers, W.J. 1972. A sketch of the history of South Carolina to the close of the proprietary government by the Revolution of 1719. The Reprint Company, Spartanburg, SC.

Rodney, W. 1970. A history of the upper Guinea coast 1545-1800. Clarendon Press, Oxford, London, U.K.

Rowland, L.S., A. Moore, and G.C. Rogers, Jr. 1996. The history of Beaufort County, South Carolina. Vol. 1. University of South Carolina Press, Columbia, SC.

Skees, J.R and L.E. Swanson. 1986. Public policy for farm structure and rural well-being in the South. Report from the Office of Technology Assessment, United States Congress, Washington, DC.

Thomas, J.P., Jr. 1930. The Barbadians in early South Carolina. South Carolina Historical Magazine 31(April):75-92.

van Deusen, J.G. 1928. Economic bases of disunion in South Carolina. Columbia University Press, New York, NY.

Waddell, E. 1980. Indians of the South Carolina Lowcountry 1562-1751. Reprint Press, Spartanburg, SC.

Watson, E.J. (ed.). 1907. Handbook of South Carolina: Resources, institutions and industries of the state. The State Department of Agriculture, Commerce and Immigration, Columbia, SC.

Wood, P. 1974. Black majority: Negroes in colonial South Carolina from 1670 through the Stono Rebellion. W.W. Norton and Company, New York, NY.

M E N U

Archaeology in the ACE Basin

What is Archaeology?

Protection of Archaeological Sites

Economic Benefits

References

Interactive Map of Cultural Resources

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Archaeology

Archaeology in the ACE Basin

St. Helena Sound excavation site

For over 6,000 years, humans have occupied the South Carolina coast. From Paleoindian Native Americans to more recent European settlers, each group has left its distinctive and irreplaceable marks in the coastal area. Most of the more well-known archaeological sites date from the recent historic period. During the eighteenth and nineteenth centuries, the ACE Basin study area flourished as a prosperous agricultural region, resulting in extensive plantation grounds and impoundments that are still clearly evident. Since the early twentieth century, much of the land in the ACE Basin study area has come under protective easements or state ownership to preserve its natural beauty for future generations (see Protected Lands). A combination of easements and regulations for the use and development of archaeologically significant areas minimizes the impact on the area's cultural resources and natural environment.

What is Archaeology?

There are numerous mechanisms used to study past human behavior, including history, oral tradition, and archaeology, Archaeology is the investigation of historic and prehistoric cultures through the study of material remains. Archaeology provides us with information on how cultures in the past subsisted on a daily basis. For prehistoric times, the archaeological record is the only thing left by past cultures, and through this physical record archaeologists can reconstruct early human behaviors and lifestyles.

Generally, this record develops through the excavation of particular sites. There are three primary objectives of archaeology--chronology, lifeways and process. The initial objective of an archeological investigation is to

Systematic, controlled collection

determine the age or chronology of the site. The second objective is to understand culture and lifeways--what types of food, clothing, housing, material culture, technology and other objects were used during the period. Process, the third and final objective, is an attempt by archaeologists to explain the causes and consequences of changing human culture.

Remains discovered in the archaeological record aid an archaeologist in explaining past human behaviors and events and their context in past cultures. Archaeological remains can be classified into three distinct categories: artifacts or movable objects fashioned by humans, such as ceramics or projectile points (arrowheads); features or non-portable objects, such as hearths or grave sites; and ecofacts or natural remains not directly impacted or altered by humans, such as pollen and animal bones.

In examining the past, archaeologists work in three stages of interpretation. The first seeks to reveal and describe the form of the physical evidence of the past. This stage involves collection of information from an archaeological site and is followed by an assessment of the remains found. Most archaeology includes the collection of data using both intrusive and non-intrusive methods. Non-intrusive approaches include the analysis of aerial photography for landscape alterations, use of ground-penetrating radar to find buried anomalies, and the systematic, controlled collection of materials from surface contexts. Intrusive techniques include shovel testing (units 40 cm on a side), test units (1 or 2 meters on a side) or excavation blocks (anything larger than 2 meters on a side).

Archaeologists analyze these remains to determine their past purpose and function within the overall context of a site as well as the importance of the position of the artifacts within a site. The artifacts can also provide environmental clues about an area's floral and faunal composition (natural history) and temperature, which in turn can provide a temporal reference, or time period, for the specific site (See related section: History: Time Periods). Ecofacts such as plant seeds and animal bones can be used to reconstruct past subsistence activities. In the third and final process, the archaeologist attempts to understand cultural processes and behaviors, with the primary goal to interpret how and why the cultures changed through time (Ashmore and Sharer 1988).

While prehistoric archaeology is the study of the past largely through material remains, history and historical archaeology are the study of the past through written or textual remains such as diaries, legal documents, and maps. Historians examine written material such as personal records and correspondence, government documents, newspaper articles, and legal documents to interpret and understand past events and cultures. Since written records are subject to the original authors' interpretations and personal biases, historians analyze and compare different sources of information about particular events in order to minimize this bias. Once the material has been evaluated, the historian can reconstruct past events. The combination of the fields of archaeology and history allows us to view past people, events, and cultures through their physical and written remains.

Back to Top

Protection of Archaeological Sites

It is imperative to protect our archaeological sites and other cultural resources since there are a limited number of them. Archaeological site excavation is necessarily a destructive process; once a site is fully excavated and all its information extracted, it can never be put back together. For this reason archaeologists carefully record soil layers, textures, colors, and intrusive pits or features and document all this information with scaled drawings, photographs and narrative descriptions. Additional site loss or damage is caused by development, looting, or natural processes, such as erosion. The degradation of our cultural resources results in the loss of knowledge about our past. Adequate preservation protects important cultural resources for future generations. The unauthorized removal of artifacts can significantly affect the ability of archaeologists to interpret the archaeological record. Artifact collection by non-professional archaeologists is prohibited at all sites in the ACE Basin study area.

There are many government organizations responsible for the management of the cultural resources in the ACE Basin study area. These include the South Carolina Department of Natural Resources (SCDNR), State Historic Preservation Office (SHPO), a division of South Carolina Department of Archives and History, the South Carolina Department of Parks, Recreation and Tourism (SCPRT), and the South Carolina Institute of Archaeology and Anthropology (SCIAA).

Back to Top

Economic Benefits

In addition to the educational and informational aspects of archaeological sites, they also provide economic benefits to today's society. Historic places and prehistoric sites provide visitors with an interpretation of previous cultures and societies, while at the same time benefiting the economy of the surrounding area by encouraging tourism. Many archaeological/historical sites have successfully been made into tourist attractions, including Charlestowne Landing, Fort Sumter, Green's Shell Enclosure Heritage Preserve, and historic downtown areas of Charleston and Beaufort.

Some of the more popular historic attractions around the ACE Basin study area include the Colleton County Courthouse, Hunting Island Lighthouse, and the Edisto Beach State Park. Preservation of our cultural and historic resources provides better knowledge of our past and an economic benefit for our future.

NEXT CHAPTER: Environmental Conditions

Authors

T. Marcinko, SCDNR Marine Resources Research Institute

C. Judge, SCDNR Wildlife and Freshwater Fisheries

References

Ashmore, W. and R. Sharer. 1988. Discovering our past: A brief introduction into archaeology. Mayfield Publishing Company, Mountain View, CA.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

M
E
N
U

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Environmental Conditions

Geology | Geomorphology | Soils | Biogeochemistry | Climatology | Surface Water | Ground Water | Hydrochemistry and Pollution | Water Quality

Introduction

The chapter on Environmental Conditions describes the physical and chemical environment of the ACE Basin Characterization study area. Understanding the physical and chemical environment is critical to land use planners, scientists, and the general public. For example, soil characteristics in an area influence the distribution of plants and animals as well as the anthropogenic land use suitability (e.g., agriculture, forestry, residential). The topics discussed in this chapter are the geology, geomorphology, soil characteristics, biogeochemistry, climatology, hydrology, hydrochemistry and pollution, and water quality of the ACE Basin.

The Biological Resources and Species Gallery chapters of the ACE Basin Characterization provide further information about the environmental conditions of the Basin. The Biological Resources chapter describes the different types of biota from phytoplankton to mammals and the types of habitats that affect their distributions in the ACE Basin. The Species Gallery describes over 70 individual animal and plant species including their physical characteristics, habitat, and biology.

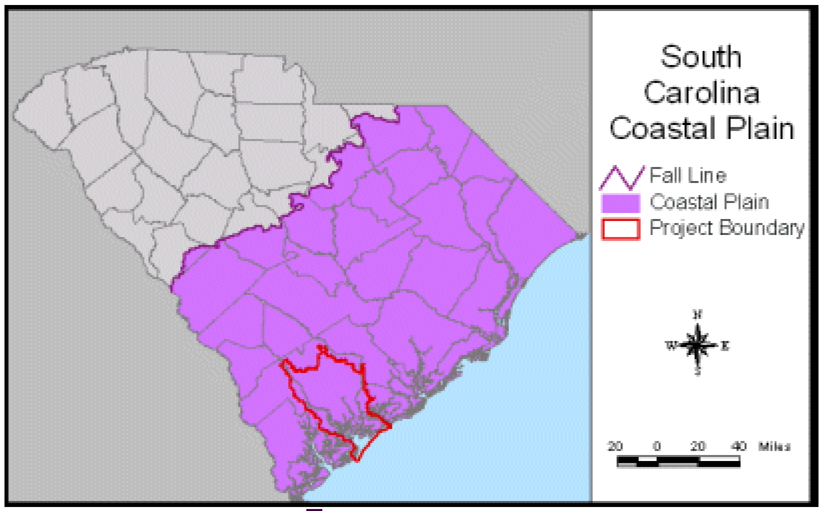
In addition, the Resource Use chapter of the characterization provides further information about the environmental conditions of the Basin. Historical and present resource use has and will change the environmental conditions of the Basin. For example, agriculture can impact the biogeochemistry, water quality and contaminant loadings of surrounding bodies of water as well as altering the geomorphology, soil, and hydrology. Descriptions of historical and present-day resource and land use within the Basin focuses on forestry, agriculture, protected lands, significant natural area/features, urban areas, natural resource value, fisheries, hunting, and tourism of the ACE Basin.

NEXT SECTION: Geology

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Geology

Introduction



The geology of the ACE Basin has a complex, long-lived history and covers a time period of 250 million years. This history, however, cannot be separated from the events that developed the preserved stratigraphy and geomorphology of the entire Coastal Plain of South Carolina. These events, like much of the geology of the earth, are related to the assembly and subsequent breakup of the supercontinent Pangea (see inset "a"). The breakup of Pangea at the beginning of the Mesozoic, approximately 250 million years ago (Ma), led to the opening of the Atlantic Ocean and to the development of the continental margins of what is now Europe, North America, Africa, and South America. Refer to the geologic time scale for the time period of the Mesozoic and other periods described in this section.

The breakup of Pangea also influenced climatic change. As the landmasses separated, different ones drifted into polar regions or collided again. Changes in oceanic and atmospheric circulation around polar landmasses led to glaciation (Kennett 1977). Collision of landmasses and the resulting younger orogenic uplift (mountain building) also influenced both oceanic circulation and regional weather conditions that subsequently triggered glaciation (Miall 1997). Different periods of climate change drove the physical processes that created much of the geomorphology of the Coastal Plain described in other sections of this product.

When viewed from the perspective of geologic time, physical processes within the earth initiate much of this change as oceanic and climatic feedback processes modify an area's geology. This review briefly discusses these changes and how they influenced the geology of the Coastal Plain of South Carolina over the last 250 million years. Particular emphasis is placed on the events and processes that define the geology of the ACE Basin.

Back to Top

Zones of Basement Weakness

The Piedmont basement of the Coastal Plain has not been well studied. Different writers have discussed the basement in general terms and identified the structural geology from different data sets. Both Heron and Johnson (1966) and Siple (1969) suggested that a structural feature exists in coastal Beaufort and Colleton Counties. In their atlas of the geology of the Coastal Plain, Colquhoun et al. (1983) showed a fault trending east-west from the mouth of St. Helena Sound to the Savannah River. These writers referred to the fault as the Garner-Edisto fault and implied that the fault extends into the basement. Such basement features are the foundation on which ecosystems develop; and in many situations, it is basement features that stimulate physical change, that is, subsidence, uplift, or earthquakes.

Colquhoun et al. (1983) mapped the Garner-Edisto fault only to the mouth of the St. Helena Sound. Eastward projections of the Garner-Edisto fault suggest that the fault becomes part of the offshore Helena Banks fault zone. The Helena Banks fault zone was identified with seismic-refection profiles during a study of young faults that may be earthquake sources in the Charleston area (Behrendt and Yuan 1987). Behrendt and Yuan (1987) proposed that these faults resulted from the movement of an older zone of basement weakness.

Westward projection of the Garner-Edisto fault connects with mapped structures in southern Georgia. Chowns and Williams (1983) had previously mapped a zone of basement weakness to the same locality where the Garner-Edisto fault in the Coastal Plain sediments crosses the Savannah River, and they proposed that this zone of basement weakness may represent a suture between the Piedmont rocks of North America to the north and rocks with similar to those in Africa to the south. If these interpretations are correct, this zone of basement weakness was created when Africa collided with North America 265 million years ago. The existence of a suture implies that a structurally complex zone is present in the basement and that rocks with both African and North American affinities underlie the ACE Basin.

Subsequent breakup of Pangea began to exploit such zones of basement weakness in eastern North America in the early Mesozoic (~250 Ma). Chowns and Williams (1983) had suggested that the location of the South Georgia rift that opened in the late Triassic to early Jurassic (Daniels and et al. 1983) was influenced by a zone of basement weakness. Swanson (1986) subsequently pointed out that Mesozoic basin development was accentuated by the reactivation of zones of basement weakness, particularly in the southern Appalachians.

Line drawings by Heck (1989) of Consortium of Continental Reflection Profiling (COCORP) seismic reflection profiles collected sub-parallel to the Savannah River in eastern Georgia show the South Georgia rift to consist of a series of fault-bounded valleys. These relations also imply that the axis of the South Georgia rift underlies the ACE Basin. The South Georgia rift may be related to the opening of the Gulf of Mexico as the North American and South American plates began to separate during the Triassic (Daniels et al. 1983). The rift may also connect spreading centers in the Gulf of Mexico and Atlantic Ocean (Chowns and Williams 1983). A jump in the spreading center in the middle Jurassic (~175 Ma) led to the opening of the Atlantic Ocean (Thomas et al. 1989).

Igneous activity began and increased over the future continental margin of South Carolina with the opening of the Atlantic Ocean. In the Coastal Plain region, igneous activity was characterized by surface basalt flows, the emplacement of diabase dikes, and large mafic-ultramafic intrusions (Daniels et al. 1983). A blanket-like basalt flow, approximately 250 m thick, is buried in southern South Carolina, and this period of volcanic activity was probably related to the opening of the Atlantic. Diabase dikes are the most easily recognized igneous features on geophysical maps and are abundant underneath the Coastal Plain of South Carolina (Daniels et al. 1983). One of the best-defined mafic-ultramafic intrusions under the South Carolina Coastal Plain is directly under St. Helena Sound.

Back to Top

Subsidence and Sedimentation

Students examining sedimentation and sea-level rise

During the late Jurassic, sea-floor spreading and continental drift separated North America and Africa (see inset "b") (Miall 1997). Continental margins began to evolve as sea-floor spreading led to the opening of the Atlantic Ocean. Marginal subsidence followed and provided accommodation space for the deposition of sediments. Subsidence was enhanced by rapid sediment deposition of materials from the Appalachians (Dewey 1982), and both processes contributed to flexure and coastal onlap. These processes led to a rise in sea level and a submergence of the area that has come to be known as the Coastal Plain. Coastal onlap spread the sediment load over a wider area of the margin and developed a sediment geometry that has come to be known as "the steer's head" (Dewey 1982). The geometry consists of a thick sedimentary pile near the continental margin (the head) that tapers inland (the horns). The Cretaceous stratigraphy of the Carolinas clearly shows this steer's-head geometry (Watts et al. 1982).

Regionally, the preserved Cretaceous sediments are a succession of sandstone layers (siliciclastics) deposited in a range of fluvial, deltaic, and marine environments (Colquhoun et al. 1983; Owens and Gohn 1985; Sohl and Owens 1991). Regional cross sections led Colquhoun et al. (1983) to divide these siliciclastics into four depositional sequences (depositional activity during submerged periods) separated by bounding unconformities (breaks in geologic time and deposition). Following the development of each unconformity, renewed onlap progressively moved each younger Cretaceous depositional sequence further inland across the Coastal Plain (Sohl and Owens 1991). Progressive onlap and sequence thinning defined the steer's-head geometry as each depositional sequence was spread over a wider area of the margin.

Tertiary sediments unconformably overlie Upper Cretaceous strata (Colquhoun et al. 1983; Nystrom et al. 1991; Colquhoun and Muthig 1991). Preserved stratigraphic relations indicate that fluvial to open-shelf deposition continued into the Lower Paleocene (Colquhoun and Muthig 1991; Nystrom and others 1991); and, in overview, Lower Paleocene depositional patterns seem to differ little from those of the Cretaceous. Mapping of Paleocene facies (depositional environments) also shows that carbonate deposition was localized in the St. Helena Sound area (Colquhoun and Muthig 1991). Carbonates had been previously deposited near the top of the preserved Cretaceous section over different parts of the Coastal Plain.

Carbonate Deposition

In the middle Eocene, carbonates deposited by chemical sedimentation spread over much of the Coastal Plain during periods of submergence. These carbonates never spread as far north-northwest as the Cretaceous sediments, and laterally equivalent siliciclastics are preserved in the Upper Coastal Plain (Nystrom and others 1991). Carbonate deposition continued episodically over the Coastal Plain into the late Oligocene and early Pliocene (Harris and Zullo 1991). Spread of carbonate deposition may indicate that the Suwannee Current was flowing over the South Carolina Atlantic margin (Huddlestun 1993). The Suwannee Current came into existence during the late Cretaceous and was a northward continuation of the ancient Caribbean Current that passed through the Central American seaway (Huddlestun 1993). Northward marginal flow of the Suwannee Current may have enhanced the expansion of carbonate sedimentation over the Coastal Plain as warm water flowed from the Gulf of Mexico into the Atlantic Ocean. The northern outlet of the Suwannee Current in South Carolina, however, was vulnerable to tectonism and glacioeustatic sea level falls (Huddlestun 1993).

Upper Eocene and Lower Oligocene depositional patterns mimic the lower and middle Eocene sedimentary patterns. Isopach maps of preserved strata show that the St. Helena Sound area continued to be a center of deposition, or depocenter (Colquhoun et al. 1983). Carbonate sedimentation again spread over the Lower Coastal Plain during this period as laterally equivalent siliciclastics were deposited in the Upper Coastal Plain (Nystrom et al. 1992). This depositional pattern changed, however, during the Lower Oligocene when glacioeustatic events were superimposed on the Coastal Plain.

Back to Top

Fault Reactivation

Stratigraphic data indicates that the Garner-Edisto fault developed during the Paleocene to Eocene (Colquhoun et al. 1983). Fault movements began in the basement during the Upper Paleocene and were characterized by southward draping, or down warping, of depositional sequences (Colquhoun et al. 1983). Faulting perpetuated upward through the overlying sedimentary pile during the middle Eocene and produced approximately 125 meters of down-to-the-south displacement.

Reactivation of pre-existing zones of basement weakness should be expected and may influence the locations of faulting (Etheridge 1986). The orientation of the east-west striking Garner-Edisto fault during the middle Eocene regime of northeast-southwest-oriented crustal compressive stress (Janssen et al. 1995) suggests that a component of strike-slip (crustal movement) also developed and that reactivation was characterized by oblique movement. Oblique down-to-the-south displacement would have produced additional accommodation space for sediment deposition along the margin of the coast.

Back to Top

Glacioeustatic Overprint

The continued breakup of Pangea and subsequent continental drift in the early Oligocene initiated a major glacioeustatic event (Miall 1997). Glaciation followed the breakup of Australia and Antarctica as Antarctica drifted into polar regions with the opening of the

Drake Passage and the Tasman seaway (Eyles 1993). The development of circumpolar currents essentially isolated Antarctic weather systems from the rest of the southern hemisphere (Kennett 1977), and this "icehouse" effect created a land-based ice cap. This sequence of feedback processes of oceanic currents and glaciation resulted in the major sea-level fall of the early Late Oligocene (Eyles 1993; Miall 1997).

Based on paleogeographic maps of Harris and Zullo (1991), sea-level fall related to the early Oligocene glaciation shifted the shoreline a minimum of 200 kilometers to the east-southeast across the Coastal Plain. At present, most Lower Oligocene units in the South Carolina Coastal Plain have been completely eroded (Harris and Zullo 1991). The erosion of these Lower Oligocene units may only be partially related to glacioeustatic exposure (i.e. sea-level fall). The location of preserved Lower Oligocene carbonate units in eastern Georgia and in the vicinity of St. Helena Sound (Huddlestun 1993) implies that uplift to the north-northeast tilted the region and protected the carbonates to the south-southeast from erosion.

Lower Oligocene erosion was extensive and cut channels in the underlying Eocene strata (Harris and Zullo 1991). These channels were filled by Upper Oligocene sediments prior to glacioeustatic sea-level fall at the beginning of the Miocene (Miller et al. 1985). The rate of sea-level fall decreased during this period, but margin subsidence exceeded the rate of fall and allowed onlap and deposition while sea-level was still low (Miller et al. 1985). Glacioeustatic sea-level fall occurred again in the middle Miocene when a large continental icemass became a permanent fixture of Antarctica (Eyles 1993). Erosion related to these events may explain why very few Miocene units are preserved in South Carolina.

In the middle Miocene, a flood of coarse fluvial siliciclastics spread southward from the Piedmont over the Coastal Plain. These rapidly deposited fluvial siliciclastics formed a broad apron of immature braided-stream and other riverine deposits and were the result of accelerated erosion caused by active uplift of the Atlantic margin. The appearance of these fluvial siliciclastics in the stratigraphic record represents an unparalleled event in the history of the margin (Nystrom et al. 1991). With the global changes that were occurring in the middle Miocene, a combination of tectonics and climate change probably produced the coarse fluvial siliciclastics (Nystrom et al. 1991) and the seaward tilting of the Coastal Plain (Watts et al. 1982).

Sea level progressively rose again in the early Pliocene and early late Pliocene, and subsequent high stands can be related to glacioeustatic change. During this time, Pliocene sea level rise out-paced the rate of subsidence on the margin. Submarine erosion of older sequences occurred as a result of a lack of accommodation space for the younger depositional sequences. Sea level rose to the approximate limits of the older middle Eocene carbonates as waves cut the Orangeburg scarp. Facies patterns show that carbonates were prominent in the four onlapping Pliocene sequences, and the most extensive sequence spread carbonates over a portion of the Coastal Plain below the Orangeburg scarp (Willoughby et al. 1999). These relations imply that during Pliocene onlap the Gulf Stream flowed over the Coastal Plain along the Atlantic margin from the Gulf of Mexico.

Glacioeustatic events began to intensify after the middle Miocene as climatic and oceanic conditions were modified by plate tectonic collision. In the middle Miocene, collision of India with Eurasia uplifted the Himalayan ranges and the Tibetan plateau (Miall 1997). Disruption of air masses above 16,000 feet led to regional cooling of the northern hemisphere (Helfert 1998, pers. commun.). At the beginning of the late Pliocene, the Isthmus of Panama collided with South America and closed the Central American seaway (Keigwin 1978). Separation of the Atlantic and Pacific Oceans modified both the directions and intensities of oceanic currents (Keigwin 1978; Denny et al. 1994). The sudden appearance of ice-rafted material in deep-sea North Atlantic sediments is interpreted as the first indication of northern hemispheric glaciation (Cronin 1981). The combination of climatic cooling and the closure of the Central American seaway is considered by some as the triggering mechanisms for northern hemispheric glaciation in the late Pliocene and Pleistocene.

Back to Top

Terrace Formation

Following the Pliocene high stand, progressive sea-level fall, or regression, from the Orangeburg scarp is marked by the eroded remnants of major transgressive-regressive cycles (Willoughby et al. 1999). Each younger offlap sequence is found seaward of the Orangeburg scarp and at a lower elevation over the Middle and Lower Coastal Plain (Colquhoun and Muthig 1991; Soller and Mills 1991). The landward extent of each younger transgressive-regressive cycle is commonly marked by a distinct scarp or a break in elevation (Colquhoun 1974; Colquhoun and Muthig 1991; Soller and Mills 1991). Such scarps are considered erosional, presumably wave-cut, but they may also be a shoreline, a barrier island shoreline, an estuary valley wall, or a riverbank (Colquhoun 1974). Since scarps may have compound origins, the toe of the scarp may mark more than one transgressive highstand (Soller and Mills 1991).

The offlap sequences are considered cyclic because each sequence consists of transgressive and regressive facies (Colquhoun 1974). The facies arrangement was determined by changes in sea level. As sea level increased, a deepening-upward sequence of marine sediments was deposited; and as sea level fell, a shallowing-upward sequence of marine, barrier, backbarrier (marsh), and fluvial sediments was deposited over the eroded remnants of the previous transgressive sequence (Colquhoun 1969; Colquhoun and Muthig 1991; Soller and Mills 1991). During protracted periods of standstill, deltaic deposition allowed the formation of secondary barrier islands (Colquhoun 1974). Fluvial systems that were part of the later, regressive sequence eroded their lateral equivalents of marine sediments of the shallowing-upward marine sequence (marsh, barrier island, and shelf sequences). In some areas, only eroded remnants of these facies are preserved on the depositional surface (Willoughby 1999).

Back to Top

Warping of the Coast Line

Soller and Mills (1991) report that, in the area of St. Helena Sound, elevations are quite low and estuaries are extensive C they also suggest that some sort of tectonic mechanism is responsible for this broad, complex area. The geomorphic study of Pliocene and Pleistocene shorelines by Winkler and Howard (1977) shows that the shorelines are gently warped or folded, from the "high" shoreline elevations in the Cape Fear Arch region to the "low" shoreline elevations in southern South Carolina and eastern Georgia. Such folding simply reflects vertical movement of one area relative to another (Cronin 1981).

Map patterns suggest that a "low" area was localized in the ACE Basin area in the late Pleistocene (Colquhoun 1969; McCartan et al. 1984). Map patterns show that, in the Lower Coastal Plain, late Pleistocene scarps that are sub-parallel to the coastline northeast of Charleston step landward approximately 40 kilometers in the St. Helena Sound area and only become subparallel to the coastline again near the mouth of the Savannah River. Older

Pliocene and Pleistocene scarps to the northwest do not show this landward indenting pattern, which suggests that active down warping in the late Pleistocene allowed onlap to occur in a regressive sequence.

The folding of the coastline in the vicinity of the ACE basin demonstrates the sensitivity of the Coastal Plain region to vertical movements. Vertical movements are also expressed in other ways. Subtle topographic highs and morphologic changes in rivers indicate a northeast-trending zone of tectonic uplift exists northwest of Charleston (Marple and Talwani 1993). Regional studies indicate that this zone of uplift is approximately 200 kilometer long and 15 kilometer wide. The zone of uplift appears to have deflected the Edisto River (Doar pers. comm.). The South Fork Edisto River flows southeast out of Saluda County; and past its confluence with the North Fork Edisto River, the Edisto River continues to flow in nearly a straight line southeast until it reaches the northwest margin of the zone of uplift. At this locality, the Edisto River was deflected abruptly to the south into the ACE Basin. If the zone of uplift were not present, the Edisto River would connect with the Ashley River and flow into Charleston Harbor (Soller and Mills 1991).

Back to Top

Summary

This review summarizes a series of stratigraphic, tectonic, climatic, and oceanic events that influenced the geology not only of the ACE Basin, but of the entire Coastal Plain of South Carolina. The message is that the earth is sensitive to physical change and that such changes control ecosystems. As the plate tectonic processes initiated physical change, oceanic and climatic feedback processes modified the preserved geology. The effects that these feedback processes had on the geology clearly indicate the sensitivity of the Coastal Plain to any type of change.

NEXT SECTION: Geomorphology

Authors

W. Clendenin, SCDNR Geological Survey

R. Willoughby, SCDNR Geological Survey

C. Niewendorp, SCDNR Geological Survey

References

Behrendt, J. C. and A. Yuan. 1987. The Helena Bank strike-slip (?) fault zone in the Charleston, South Carolina, earthquake area: Results from a marine, high-resolution, multichannel, seismic-reflection survey. Geological Society of America Bulletin 98:591-601.

Chowns, T. M. and C. T. Williams. 1983. Pre-Cretaceous rocks beneath the Georgia Coastal

Plain: regional implications. *In* G. S. Gohn (ed.). Studies Related to the Charleston, South Carolina Earthquake of 1886: tectonics and seismicity. U. S. Geological Survey Professional Paper 1313. U. S. Government Printing Office, Washington, DC.

Colquhoun, D. J. 1969. Geomorphology of the Lower Coastal Plain of South Carolina. Report MS-15. South Carolina Development Board, Division of Geology, Columbia, SC.

Colquhoun, D. J. 1974. Cyclic surficial stratigraphic units of the middle and lower coastal plains, central South Carolina. *In* R. Q. Oaks and J. R. DuBar (eds.). Post-Miocene Stratigraphy, Central and Southern Atlantic Coastal Plain. Utah State University Press, Logan, UT.

Colquhoun, D. J. and M. G. Muthig. 1991. Stratigraphy and structure of the Paleocene and Lower Eocene Black Mingo Group, South Carolina *In* J.W. Horton and V.A. Zullo (eds.). The Geology of the Carolinas. University of Tennessee Press, Knoxville, TN.

Colquhoun, D. J., I. D. Woolen, D. S. Van Niewenhuise, G. G. Padgett, R. W. Oldham, D. C. Boyland, J. W. Bishop, and P. D. Howell. 1983. Surface and subsurface stratigraphy, structure and aquifers of the South Carolina Coastal Plain: Report to the South Carolina Department of Health and Environmental Control, Ground Water Protection Division, Office of the Governor, State of South Carolina.

Cronin, T. M. 1981. Rates and possible causes of neotectonic vertical crustal movements of the emerged southeastern United States Coastal Plain. Geological Society of America Bulletin 92:812-833.

Daniels, D. L., I. Zietz, and P. Popenoe. 1983. Distribution of subsurface lower Mesozoic rocks in the Southeastern United States as interpreted from regional aeromagnetic and gravity maps. *In* G.S. Gohn (ed.). Studies related to the Charleston, South Carolina earthquake of 1886, tectonics and seismicity. U.S. Geological Survey Professional Paper 1313. U.S. Government Printing Office, Washington, D.C.

Denny, W. M. III, J. A. Austin, Jr., and R. T. Buffler. 1994. Seismic stratigraphy and geologic history of Middle Cretaceous through Cenozoic rocks, south Straits of Florida. American Association of Petroleum Geologists Bulletin 78:461-487.

Dewey, J. F. 1982. Plate tectonics and the evolution of the British Isles. Journal of the Geological Society, London, 139:371-412.

Doar, W. pers. comm. South Carolina Department of Natural Resources, Land, Water, and Conservation Division, Columbia, SC. 1998.

Etheridge, M. A. 1986. On the reactivation of extensional fault systems. Philosophical Transactions of the Royal Society of London A316:179-194.

Eyles, N. 1993. Earth's glacial record and its tectonic setting. Earth-Science Reviews 35:1-248.

Harris, W. B. and V. A. Zullo. 1991. Eocene and Oligocene stratigraphy of the outer Coastal Plain. *In*: J. W. Horton and V. A. Zullo (eds.). The geology of the Carolinas: Carolina Geological Society fiftieth anniversary volume. University of Tennessee Press, Knoxville, TN.

Heck, F. R. 1989. Mesozoic extension in the southern Appalachians. Geology 17:11-714.

Helfert, M. 1998. Personal Communication. South Carolina Department of Natural Resources, Land, Water, and Conservation Division, Columbia, SC.

Heron, S. D. Jr. and H. S. Johnson, Jr. 1966. Clay mineralogy, stratigraphy, and structural setting of the Hawthorn Formation, Coosawhatchie district, South Carolina. Southeastern Geology 7:51-64.

Huddlestun, P. F. 1993. A revision of the lithostratigraphic units in the Coastal Plain of Georgia: the Oligocene. Bulletin 105. Department of Natural Resources, Environmental Protection Division, Georgia Geological Survey, Atlanta, GA..

Janssen, M. E., R. A. Stephenson, and S. Cloetingh. 1995. Temporal and spatial correlations between changes in plate motions and evolution of rifted basins in Africa. Geological Society of America Bulletin 107:1317-1332.

Keigwin, L. D. Jr. 1978. Pliocene closing of the Isthmus of Panama, based on biostratigraphic evidence from nearby Pacific Ocean and Caribbean Sea cores. Geology 6:630-634.

Kennett, J. P. 1977. Cenozoic evolution of Antarctic glaciation, the circum-Atlantic Ocean, and their impact on global paleooceanography. Journal of Geophysical Research 82:3843-3860.

Marple, R. T. and P. Talwani. 1993. Evidence of possible tectonic upwarping along the south Carolina Coastal Plain from an examination of river morphology and elevation data. Geology 21:651-654.

McCartan, L., E. M. Lemon, Jr., and R. E. Weems. 1984. Geologic map of the area between Charleston and Orangeburg, South Carolina, 1:250,000 Scale. United States Geological Survey, Miscellaneous Investigations Series, Map I-1472.

Miall, A. D. 1997. The geology of stratigraphic sequences. Springer, New York, NY.

Miller, K. G., G. S. Mountain, and B. E. Tucholke. 1985. Oligocene glacioeustacy and erosion on the margins of the North Atlantic. Geology 13:10-14.

Nystrom, P. G., Jr., R. H. Willoughby, and L. K. Price. 1991. Cretaceous and Tertiary stratigraphy of the Upper Coastal Plain, South Carolina *In* The Geology of the Carolinas, University of Tennessee Press, Knoxville, TN.

Nystrom, P. G. Jr., R. H. Willoughby, and D. T. Dockery, Jr. 1992. Claibornian stratigraphy of the Savannah River Site and surrounding area. *In* V.A. Zullo, W.B. Harris, and V. Price (eds.). Savannah River Region, Transition between the Gulf and Atlantic Coastal Plains. Proceedings of the Second Bald Head Island Conference on Coastal Plain Geology, 6-11 November 1990, Hilton Head Island, SC. University of North Carolina, Wilmington, NC.

Owens, J. P. and G. S. Gohn. 1985. Depositional history of the Cretaceous Series in the United States Atlantic Coastal Plain: stratigraphy, paleoenvironments, and tectonic controls of sedimentation. *In* C.W. Poag (ed.). Geological Evolution of the United States Atlantic Margin. Van Nostrand Reinhold, New York, NY.

Siple, G. E. 1969. Salt-water encroachment of Tertiary limestones along coastal South Carolina. Geology Notes 13:51-65. South Carolina Geological Survey, Columbia, SC.

Sohl, N. F. and J. P. Owens. 1991. Cretaceous stratigraphy of the Carolina Coastal Plain. *In*:

J. W. Horton and V. A. Zullo (eds.). The geology of the Carolinas: Carolina Geological Society fiftieth anniversary volume. University of Tennessee Press, Knoxville, TN.

Soller, D. R. and H. H. Mills. 1991. Surficial geology and geomorphology *In*: J. W. Horton and V. A. Zullo (eds.). The geology of the Carolinas: Carolina Geological Society fiftieth anniversary volume. University of Tennessee Press, Knoxville, TN.

Swanson, M. T. 1986. Preexisting fault control for Mesozoic basin formation in eastern North America. Geology 14:419-422.

Thomas W. A., T. M. Chowns, D. L. Daniels, T. L. Neathery, L. Grover III, and R. J. Gleason. 1989. The subsurface Appalachians beneath the Atlantic and Gulf Coastal Plains. *In* A.W. Bally and A.R. Palmer (eds.). The Geology of North America. Geological Society of America, Boulder, CO.

Watts, A. B., G. D. Karner, and M. S. Steckler. 1982. Lithospheric flexure and the evolution of sedimentary basins. Philosophical Transactions of the Royal Society of London A-305:249-281.

Willoughby, R. H., P. G. Nystrom, Jr., L. D. Campbell, and M. P. Katuna. 1999. Cenozoic stratigraphic column for the coastal plain of South Carolina. South Carolina Geologic Survey, General Geologic Chart 1. South Carolina Geologic Survey, Columbia, South Carolina.

Winkler, C. D. and J. D. Howard. 1977. Correlation of tectonically deformed shorelines on the southern Atlantic coastal plain. Geology 5:123-127.

General Introduction | Cultural Resources | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perceptions | Image Atlas |Bibliography | Glossary | About This CD-ROM | Site Map | Search

MENU

Introduction

Atlantic Coastal Plain Physiographic Province

Physiographic Regions

Sources of Sediments in the ACE Basin

Phytogeomorphology

Upland Land Forms of the ACE Basin

Rivers of the ACE Basin

Sea Level Rise and the Formation of St. Helena Sound

Freshwater and Estuarine Areas

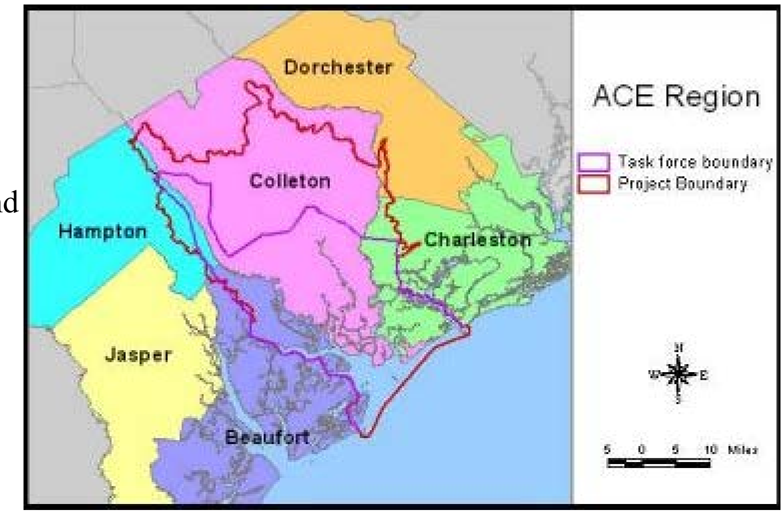
Summary

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Geomorphology

Introduction to the Land Forms of the ACE Basin



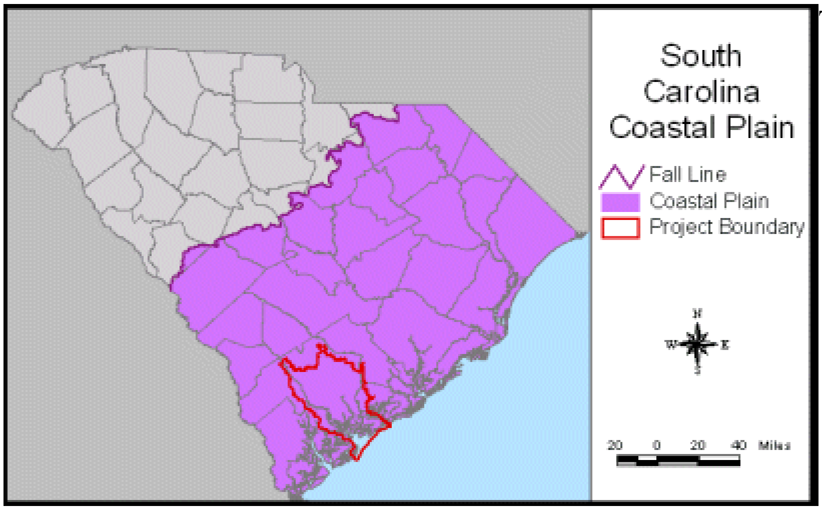
The ACE Basin region has a characteristically flat, low lying topography (Colquhoun 1969, Soller and Mills 1991) that includes rivers, streams, barrier islands, and bays and sounds, and is a result of thousands of years of a complex interplay of earth processes. The interactions between these processes have created the topography of the ACE Basin. Over the past few hundred years, human induced changes have become an important physical component in shaping coastal landscapes (Trenhaile 1997). In the ACE Basin, these activities include timber harvesting; agriculture; land clearing for development; building on or near the beachfront; and the dredging or filling of wetlands. Any change to the shape of the land, whether natural or anthropogenic, is the domain of those who study geomorphology.

Island Geomorphology

Physical geography, or geomorphology, is the study of the shape and composition of the upper surface of the earth (Fairbridge 1968, McIntyre 1991). Geomorphology encompasses earth processes such as changes in sea level, erosion, formation of rivers and flood plains, coastal dynamics of wind, water, and sediments, and island formation, as well as other processes. The geomorphic characteristics of a region have a profound effect on the hydrology and biological communities that occur there by providing a connection between the geology and the ecology of the plant and animal communities, including those of humans. Geomorphology integrates the study of the interactions of the physical components of the atmosphere, the earth (lithosphere), and water (hydrosphere) with the biological communities of plants and animals, and especially humans, that modify landforms.

Back to Top

Atlantic Coastal Plain Physiographic Province



The coastal plain of South Carolina is in the Atlantic Coastal Plain Physiographic Province (Sinha 1959; Colquhoun 1969; Soller and Mills 1991). This province is characterized by a general downward slope towards the sea punctuated by a series of fluvial and coastal terraces. The region reflects the interaction between terrestrial and marine processes and is characterized by relict marsh plains and barrier islands (ridges) (Colquhoun 1969, Mathews et al. 1980, Soller and Mills 1991).

The plains and ridges developed, in part, as a result of the relatively flat continental shelf that is associated with the trailing edge of the North American tectonic plate. The region has been modified by repeated cycles of submersion and emersion by changes in sea-level. As sea-level rose and fell in response to global changes in climate and movements of the earth's crust, coastal areas were periodically covered by the ocean. Long periods of submersion allowed deposition of marine sediments. Glaciation, and the associated drop in sea-level, results in a seaward shift in the shoreline, and erosion of marine sediments by rivers and streams. The periodic landward and seaward movement of the shore across the coastal plain can be seen in the landforms of the coastal plain and the ACE Basin such as relict dune ridges and marsh plains. (See related section: Geology: Terrace Formation.)

Back to Top

Physiographic Regions

The South Carolina coastal plain can be further divided up into three regions based on their morphology (Colquhoun 1969, Soller and Mills 1991). The upper coastal plain which extends from the fall line to the Orangeburg Scarp is underlain by sediments that date from the Cretaceous to the middle Miocene, approximately 11-135 million years ago (Ma) (See Geologic time scale) (Colquhoun 1969). The geomorphic characteristics of the Middle coastal plain are underlain by sediments that date from the Miocene to the Pliocene epoch. During periods of submersion, the lower coastal plain was shaped by coastal processes, and sediment deposition was dominated by marine-derived sediments (Soller and Mills 1991). During glacial periods, with sea-level tens to hundreds of meters lower than those during interglacial periods, deposition and erosion was dominated by fluvial processes. The repeated cycles of sea-level rise and fall has resulted in a complex three-dimensional mosaic of Pleistocene-age fluvial and marine sediments in the lower coastal plain of South Carolina. (See related section: Geology: Subsidence and Sedimentation.)

The ACE Basin lies within the lower coastal plain of South Carolina. The surficial sediments in this region are of relatively recent origin, having been deposited within the last 1.8 million years (Pleistocene to Holocene, Van Couvering 1997). The lower coastal plain reflects a series of submerged and emergent cycles that occurred during the Pleistocene and Holocene and are represented by at least 8 plain/ridge sequences or terraces including the present day

(Holocene) shoreline (Colquhoun 1965, Colquhoun 1969, Soller and Mills 1991). Each terrace consists of a flat inland portion (plain) that was the flooded area behind the primary strandline and the dunes that formed at the intersection of land and sea (ridge). The elevation of the terrace is measured as the height above sea-level of the line where the plain of the more seaward terrace meets the ridge of the more inland terrace. In South Carolina including the ACE Basin, the Talbot formation in South Carolina reflects two separate still-stands and is divided into the upper and lower Talbot terraces (Weems and Lemon 1984, R. Willoughby pers comm).

Back to Top

Sources of Sediments in the ACE Basin

The deposition of terrestrially derived sediments eroded from the Piedmont and carried to the ACE Basin by rivers, and the reworking and deposition of marine sediments during submerged periods are the primary sources of the sediments in the ACE Basin (McIntyre 1991, Soller and Mills 1991). Weathering processes erode sediments from the upper coastal plain and fluvial processes transport and deposit these products downstream and contribute to the formation of the lower coastal plain (Mathews et al. 1980, Soller and Mills 1991). In addition, wind-driven (eolian) processes transport and deposit sediments and are one of the primary mechanisms involved in dune formation. Marine sediments come from the reworking of previously deposited sediments, and the deposition of shells of marine animals and direct chemical deposition of carbonates during periods of submersion. (See related section: Geology: Carbonate Deposition.)

Fluvial Sediment Transport

Particles of rock, sand, and clay as well as dissolved minerals are carried onto the coastal plain from the piedmont by streams and rivers (Mathews et al. 1980, Soller and Mills 1991). Piedmont streams are often characterized by clear, rapidly moving water. As these streams combine into rivers, the transport of materials becomes more recognizable as the water becomes turbid with suspended particles and dissolved organic materials. As the rivers flow out over the lower gradient coastal plain, the water slows down and suspended materials begin to settle out. Sand and gravel continue to be transported downstream along the river bottom (bed load transport). During normal river flow periods, most of the lighter, fine clay particles, and dissolved nutrients are carried down river and are deposited in the ocean (Davis 1992).

During wet weather episodes, the rivers of the ACE Basin, and especially the Edisto River, may expand out into their flood plains carrying thousands of tons of sediment. As these floodwaters spread out of the channel and onto the flood plain the water velocity slows. Lower water velocities allow fine mud and organic materials to settle onto the soil and provide a fresh source of nutrients and minerals to the plant communities. These processes have a considerable positive impact on quality of the soils of a flood plain, making them very productive areas.

Berm Formation

As floodwaters carry sediments out of the river and over the flood plain, heavier sediment particles tend to settle first, closer to the river. This may cause berms or levees to form along the edges of creeks and rivers that can vary in height from a few centimeters to many meters (Wharton et al. 1982). In general, natural levees are more prominent further away from the coast where greater slopes result in the transport of coarser grained sand. In low gradient estuarine tidal creeks, berms or levees a few centimeters in height are a common characteristic. In freshwater systems, conditions can be slightly drier on these levees and may be utilized by plant species that need drier conditions and are often used by reptiles as haul-out areas. In the ACE Basin, artificial levees constructed to impound areas for rice culture provide similar functions as natural berms for haul-out and nesting for many animals. (See related section: Soil Composition and Formation.)

Sediments and nutrients carried downstream to the estuarine portions of St Helena Sound contribute to the formation of coastal marshes (see additional information on saltmarsh formation later in this section) or are transported out into the ocean where they contribute to barrier island formation and coastal biological communities such as the phytoplankton. The movement and deposition of sediments and the recycling of the nutrients contribute to the complex plant and animal communities that are a unique and productive part of the coastal environment of the ACE Basin.

Upland Areas of the ACE Basin

The relatively flat topography of the ACE Basin is a result of deposition and erosion of terrestrial and marine-derived sediments. During the Pleistocene Epoch, sea level regressed, punctuated by a series of still-stands or periods where sea-level remained relatively constant (Colquhoun 1969, Hoyt and Hails 1974, Soller and Mills 1991) . These still-stands resulted in eight terrace formations on the lower coastal plain as a result of dunes building up (ridge formation) and areas landward of the dunes filling with back-barrier sediments. The terrace formations are successively younger at lower elevations relative to current sea-level (Colquhoun 1969).

Back to Top

Phytogeomorphology

Just as geomorphic features are dependent on geologic processes such as uplift, down warping, and sea level change, the geomorphic characteristic of areas such as the ACE Basin are modified by the plants that establish themselves in newly formed habitats (Howard and Mitchell 1985). As a dune became high enough so as not to be flooded at high tide, plants begin to grow, stabilizing the dune. The succession of plant communities eventually may result in a complex community that may resist further changes by tides, winds, and storms. The plant assemblage for each community is governed by the characteristics of the soil and include grain size, water and nutrient content, and depth to water table. (See related sections: Ecosystem Processes: Succession, Soil Composition and Formation.)

Back to Top

Upland Land Forms of the ACE Basin

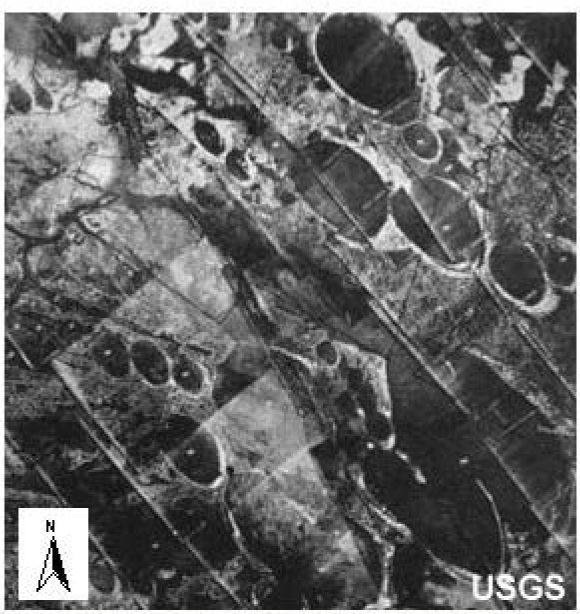
Pocosins and Carolina Bays

Pocosins are wetland areas often characterized by dense vegetation that makes them difficult to penetrate. They generally have limited water flow

A typical Carolina Bay wetland community

through the system. Often the only water supply is through rainfall or underground seeps. Pocosins may form above impermeable clays, in between relict dunes, or other areas where water drainage is blocked. They usually have a thick layer of saturated, highly organic soils, and often have characteristic plant and animal communities. Because of their rich organic soils, pocosins are often mined for peat or drained and cleared for agricultural uses.

Carolina bays are unique, elliptical depressions that occur throughout the coastal plain of Georgia, South Carolina, and North Carolina (Kaczorwoski 1976 and 1977, Mathews et al. 1980, Bennett and Nelson 1991). Although not termed Carolina bays, similar depressions occur from Florida to New Jersey. Carolina bays are usually wetland habitats with the long axis of the ellipse oriented from northwest to southeast. They are composed of sandy, unconsolidated materials lying on either “hard-bottomed” clay-based sediments (primarily South Carolina and Georgia) or peat-based sediments under-lain by humate-impregnated sand (primarily North Carolina). Humate is an organic material formed as a result of the decay of plant material. As humate accumulates in the underlying sand layer, an impermeable barrier forms. In both cases, these materials limit the subsurface movement of water, resulting in a higher water table within the Carolina bay that is “perched” above the water table in the surrounding area (Kaczorwski 1977, Bennett and Nelson 1991). In many cases, the bays do not have streams leading into or out of the depression, and depend on rainfall to supply water. During dry seasons or years, these bays may dry out, requiring wetland-dependant species to either move or hibernate until the rain refills the wetland.



Aerial photograph of a Carolina Bay. Note the northwest to southeast orientation.

During the wet weather period, shallow ponds formed in locations with poor drainage. Wave action caused by exposure to prevailing southwesterly winds tend to form the pond into an oval or elliptical shape in the unconsolidated surface sediments characteristic of the Atlantic coastal plain (Kaczorwski 1977). This wind driven process forms a sandy margin around the bay, a feature found in many Carolina bays. Although mostly overgrown, some of the bays still have small areas of open water in the center of the bay. Other theories for the formation of Carolina bays have been suggested but are not well supported (Kaczorwski 1977).

The age of the Carolina bays has been estimated to be between 250,000 and 6,000 years before present by Cooke (1936), Thom

(1970), and Soller and Mills (1991). Cooke (1936) and Thom (1970) have suggested that Carolina bays formed from a combination of wet weather and prevailing southwesterly winds during the late-Wisconsin period between 6,000 and 12,000 years before present. Soller and Mills (1991) have suggested ages between 100,000 to 200,000 thousand years before present based on the deposition of the Socastee (early Pleistocene) and Wando (late Pleistocene) Formations in South Carolina and North Carolina. Carolina bays occur on the former but not on the latter, implying an age earlier than the time of the deposition of the Wando Formation (68,000 to 100,000 years ago). Nystrom et al. (1991) have suggested that Carolina bays may be as old as the formation in which they developed. This is under the assumption that the eolian processes that form Carolina bays are not restricted to any particular period (Willoughby pers. comm.).

Carolina Bays in the ACE Basin

In a survey of Carolina bays in South Carolina, Bennet and Nelson (1991) identified 2,651 bays greater than 0.8 hectares with an overall mean length of 634 meters. There are approximately 20 Carolina bays in Colleton County that are larger than 0.8 hectares (Bennett and Nelson 1991). The mean length of bays in the southern coastal region is 890 meters. One bay in Colleton County exceeds 3,000 meters in length.

Most of the bays surveyed in South Carolina show anthropogenic impacts ranging from 10% to 100% of the area of each bay. The most common disturbance was agriculture, followed by ditches and logging operations. Carolina bays in the lower coastal plain were, in general, less disturbed than those in the upper coastal plain. The density of the vegetation and swampy nature of the bays have contributed to the inaccessibility, and has therefore limited both plant and animal surveys. For these reasons, it has only been relatively recently that the diversity of species found within Carolina bays has been described (Bennett and Nelson 1991).

Because of the isolated nature of these unique wetlands, they tend to serve as refugia for a wide number of plant and animal species. The change between the higher, usually drier, upland areas surrounding Carolina Bays and the bay itself is generally distinct. This tends to restrict wetland species to the bay. The lack of streams to feed or drain the bays limits the pathways which wetland dependent species can use to move from one area to another.

Back to Top

Rivers of the ACE Basin

The major rivers in the ACE Basin, the Ashepoo, Combahee, and Edisto (ACE Watersheds) each have extensive drainage areas. The Ashepoo and Combahee rivers originate from swamps on the coastal plain. Smaller than the Edisto river, they still contribute large amounts of freshwater, and dissolved and suspended materials to St. Helena Sound. The Edisto River, with its headwaters beginning below the fall line in South Carolina has the largest watershed of the three rivers. The Edisto River is the primary source of materials eroded from upland areas and supplied to the ACE Basin.

Within the ACE Basin study area, the rivers have characteristics of low gradient rivers. The Edisto River and its primary tributaries cover approximately 400 kilometers (250 river miles where a river mile is one statue mile following the center of the river) and drain the Edisto River Basin, an area of approximately 800,000 hectares (1.98 million acres) (Marshall 1993). The Edisto originates in the north to northwestern part of South Carolina, well outside the ACE Basin boundaries. As the river enters the lower coastal plain, it begins to meander with extensive bends and twists. The Edisto River is one of the longest free-flowing black-water rivers in the United States. Although development may be changing the nature of the river, it is currently a relatively pristine system when compared to other highly developed riverine areas on the East Coast of the United States (Marshall 1993).

The Ashepoo and Combahee rivers originate in the lower coastal plain of South Carolina Project area and watersheds. They are slow flowing rivers with many large bends and a wide flood plain. The drainage basin for the Ashepoo River includes the City of Walterboro and is mostly contained within the study area. The Combahee river is fed by the Salkehatchie River that drains portions of Barnwell and Bamberg counties, just north and west of the ACE Basin.

Combahee River near Highway 17 overpass

River Shape

The rivers in the ACE basin are characterized by relatively slow water flow, frequent flooding of the flood plain during rainy periods, and extreme meanders of the rivers. The meandering of the river bed is a result of hydraulic processes active in the unconsolidated sediments of the coastal plain. The river bed slowly moves laterally by cutting on the outside of the curve and depositing on the inside. The river may abandon one channel completely when extreme bends result in the river cutting through the narrow separation between curves. These cutoff ox-bows may persist for hundreds of years but are eventually filled in by sediments. Ox-bows are readily apparent on aerial photographs. These meanders are especially apparent in the Spartina marshes in the estuarine portions of the ACE Basin.

Back to Top

Sea Level Rise and the Formation of St. Helena Sound

During the late Pleistocene, the Wisconsin glacial event lowered sea level 100-125 meters (330- 410 feet) below current levels. During this period, rivers flowing from inland cut valleys in the landscape. As sea level rose during the Holocene epoch, these valleys were slowly flooded or drowned. Concurrent sedimentation filled in the inundated valleys to their present-day depths. These processes have contributed to the formation of the present-day St. Helena Sound estuary, which extends from the tidally influenced lower reaches of the rivers to the near-shore coastal waters. In addition to eustatic sea-level rise, the coastal areas south of Charleston subsided relative to areas in northern South Carolina and North Carolina during the Pleistocene. The result of the down-warp is that the estuarine area of St. Helena Sound is second only to that of Winyah Bay.

In general, estuaries are one of the most productive ecosystems when compared to all other ecosystems (Stickney 1984, Odum 1997). This is reflected in the myriad of uses by humans ranging from obvious ones such as the consumption of fish and shellfish, recreation, and housing; to some not so readily apparent functions such as the disposal of treated sewage enabled by the rapid assimilative capacity of estuaries, as habitat for commercially important species, and as a storm buffer between the open ocean and terrestrial habitats. Estuaries provide a wide variety of benefits to the coastal system as well as to the humans living in the system.

Estuaries can be defined as a semi-enclosed body of water, with a free connection to the ocean, that is measurably diluted by freshwater (Pritchard 1967, Trenhaile 1997). The estuary, based on using estuarine /bay and non-forested wetland categories below the saltwater/freshwater dividing line on the 1994 National Wetlands Inventory, comprises approximately 25% of the ACE Ecological Characterization study area. The primary freshwater sources are the Edisto and Combahee rivers with the Ashepoo, Coosaw, and Morgan rivers making smaller contributions.

Back to Top

Freshwater and Estuarine Areas

The wetland portions of the ACE Basin can be roughly divided into two regions based on the salinity of the sounds and rivers. The estuarine portions are those areas where the salinity exceeds approximately 0.5 to 1 ppt while the freshwater portions include all other areas (Orlando et al. 1994, Trenhaile 1997). Boundaries have been established to separate freshwater areas from saltwater areas for legal purposes (freshwater-saltwater dividing line). In the ACE Basin, these boundaries are set where the rivers cross U.S. Highway 17 or the old Seaboard Railroad line. From an ecological point of view, this boundary is better described as a transition zone because at high tide the boundary may be 16-24 kilometers (10-15 miles) further up the river than at low tide. This transition zone, often visible as a tidal front, may shift upstream or downstream in response to the amount of rainfall and the concomitant volume of water flowing down the rivers (Orlando et al. 1994). During wet weather periods, the boundary moves towards the ocean with the reverse happening during dry weather periods. Vincent and Haag (1975) identified a boundary based on changes in vegetative cover as a function of salinity using aerial photography.

Formation

Estuaries are formed through a variety of mechanisms including the drowning of river valleys by sea-level rise, the enclosing of a river by the development of a sand bar, and by tectonic processes. The St. Helena Sound Estuary is an example of a drowned river valley (Mathews et al. 1980). During the last glacial period (Wisconsin between 15-20,000 years before present), sea-level has been suggested to be 100-125 meters (330-410 feet) below its current level (Nummedal 1983). Following the Wisconsin glacial period, sea-level began to rise as a function of the melting of the glaciers. In addition, a down-warping or subsidence of the local landscape occurred. The combination of these factors resulted in the formation of St. Helena Sound and the extensive estuarine and freshwater marsh areas within the ACE Basin.

Back to Top

Estuarine Classification

Estuaries can be classified using a variety of methods that are generally based on the amount of mixing and circulation patterns. Pritchard (1967) proposed three classes of estuaries based on the stratification of freshwater and saltwater layers. These classes are: stratified, partially mixed, and well mixed. These classifications are not distinct, completely separate classes, but should be considered a continuum with one class merging into the next. Any particular estuary can generally be placed in one of the classes but may show characteristics of the other classes depending on the amount of freshwater coming into the estuary and the effect of tides and winds (Orlando et al. 1994, Trenhaile 1997).

Stratified estuaries are generally characterized by large freshwater inputs, greater depth, and little vertical mixing. The result is the less dense freshwater coming down the rivers, flowing over the denser saltwater that is moving in and out of the bay with the tides. Some mixing of freshwater and saltwater occurs at the boundary between the two water masses but overall the stratification remains. Examples of this type of estuary are the deep fjords (greater than 30 to 100 meters or 100 to 330 feet) of Norway where the depth of the water, as well as other structural features, results in a primarily freshwater layer resting on top of a high salinity layer. These types of estuaries are characterized by a large amount of freshwater compared to the tidal encroachment. In extreme cases, such as the Mississippi and Amazon rivers, the freshwater volume is so great that the river is fresh all the way to the ocean where mixing begins to occur (Trenhaile 1997).

St. Helena Sound is a partially mixed estuary (Mathews et al. 1980, Orlando et al. 1994) that tends towards a completely mixed estuary. The fresh water supplied by the Edisto, Ashepoo and Combahee rivers is more easily mixed with marine waters due to the shallower depth of the estuary (generally less that 20 meters or 65 feet) and strong tidal currents relative to freshwater discharge. The shallow depth and the irregular bottom contours results in better mixing between the overlying freshwater layer and oceanic waters as vertical currents are created by water deflecting off of irregularities on the bottom. In addition, the effects of wind-driven water circulation is greater in shallow water systems, resulting in significant mixing during windy conditions (Orlando et al. 1994).

A well mixed or completely mixed estuary generally has a relatively low freshwater input relative to tidal currents resulting in little to no stratification. The dominant tidal currents have the strength and time to completely mix the lower amount of freshwater throughout the water column. Portions of the estuary may mix completely depending on the amount of rainfall. The North Edisto river is considered to be a well mixed river with a limited halocline while the halocline in the South Edisto is generally well developed (Wenner et al. 1991).

Salinity Zones: The Venice System

Areas within an estuary are often classified based on salinity. The distribution of many estuarine organisms is driven by salinity and salinity variations. One of the more widely used classifications is the Venice System (Symposium on the classification of brackish waters 1958). The Venice system divides the spectrum of salinities into 11 categories ranging from freshwater or limnetic of less than 0.5 parts per thousand to hypersaline of greater than 40 parts per thousand.

Venice System of Salinity Classification (ppt=parts per thousand)

Category			ppt
Limnetic			<0.5
	Oligohaline	Miooligohaline	0.5-3
		Pliooligohaline	3-5

Mixohaline	Mesohaline	Miomesohaline	5-10
		Pliomesohaline	10-18
	Polyhaline		18-30
Euhaline			30-40
Hyperhaline			>40

These salinity zones usually are found in the same region of any particular river system. However, there is some variability in response to rainfall. During periods of high rainfall, any given zone may move a few kilometers downstream in response to increased river flow. During drought conditions, saline waters may occur further upstream from the normal due to reduced river flow.

Tides

Most of the ACE Basin is affected in some way by oceanic tides. Historically, Native Americans harvested oysters and clams at low tide, European settlers used the tide to help barges move up and down the rivers, and tides in the freshwater reaches of rivers were used to fill and drain the expansive rice impoundments that helped fuel the economy until the Civil War.

Tides are defined as "... periodic changes in the elevation of the ocean surface generated by the pull of the moon and, to a lesser extent, the sun." (Trenhaile 1997). Tides are considered waves with an oceanic amplitude of 0-1 meters (0-3 feet) and a period of 12 hours and 25 minutes. The fluid surface of the ocean is primarily affected by a combination of the moon's gravitational forces and the rotation of the earth. This combination creates two peaks (high tide), one on the side of the earth facing the moon and one on the opposite side of the earth. Two troughs are created that are one quarter of the way around the earth from the peaks. In theory, if the earth were completely covered in water, as the moon rotated around the earth (one rotation every 24 hrs and 50 minutes), the peaks and troughs would pass any given point on the earth once per day resulting in two high tides and two low tides per day (See moon tide) . In practice, because there are continents, islands, and rivers that impede the water, there may be only one tide (peak to trough or high tide to low tide) per day (diurnal) or two tides of different or similar magnitudes (semi-diurnal) per day. South Carolina is characterized by semi-diurnal tides, with one tide having slightly greater amplitude than the other.

The effect of the gravitational pull of the sun, although much smaller than that of the moon, can either increase or decrease the amplitude of the earth's tides depending on the alignment of the earth, moon, and sun. Increases in amplitude (spring tides) occur around the new moon and the full moon, when the sun and moon are either on the same side of the earth or on opposite sides. Decreases in amplitude (neap tides) occur around the quarter moons when the sun and moon are at right angles to each other relative to the earth.

Tidal amplitude in the open ocean is relatively small, ranging from 0 to 1 meter (0-3 feet). However, when this shallow wave approaches a coast, the wavelength shortens and the wave height increases. This is the same phenomenon that occurs when an ocean wave that may only be a meter or so in amplitude in the ocean but as it approaches the beach, friction with the bottom causes the wave to slow down and increase its height until it breaks on the beach and expends its energy moving sand around. In the ACE Basin, this interaction between the oceanic wave and the land results in a mean amplitude of approximately 2 meters (6.5 feet) at the coast. For tide predictions, consult the NOS/NOAA tide tables EXIT found on the web.

Back to Top

Coastal Marshes

One of the dominant features of the coastal plain of South Carolina is its extensive salt marshes. These highly productive areas serve as nursery areas for many commercially and ecologically important plant and animal species. They also serve as filters to remove organic wastes from the water and as a physical buffer between the ocean and upland areas. In addition to their value from an ecological standpoint, the aesthetic and economic value of these areas for nature-based tourism, eco-tourism, and residential development is high. Coastal marshes are characterized by very low slopes from upland areas to open water and include an extensive, dendritic system of tidal creeks. These tidal creeks provide a pathway for water, sediments, and animals to get to and from the marsh.

Salt Marsh Formation

Coastal marshes are formed during periods of inundation by the sea and formation involves sea-level change, sedimentation, tidal action, plant growth, and other processes. Marshes develop when sea level rise is slow enough to allow sedimentation to increase the elevation of the mud surface relative to mean high tide (Stickney 1984). As the surface of the sediment reaches mean high water, halophytic plants such as smooth cordgrass (*Spartina alterniflora*) become established. Smooth cordgrass exists in a narrow range between mean high water (neap tides) and extreme high water (spring tides) . The growth of this species, as well as others, helps to stabilize the sediments just as terrestrial plants stabilize soils. In addition, the plants may slow water flow and trap sediments brought in with the tides and, thereby increase sediment deposition rates and the elevation of the marsh surface (see cross section of tidal creek).

As the marsh develops, water movements onto and off the surface erode pathways. Because of the very low slopes, these developing creeks may follow meandering paths, initially guided by minor irregularities on the marsh surface. As the creeks develop, fluvial erosion and deposition processes operate to increase the bends of the creek (Stickney 1984). Cut-throughs and the formation of ox-bows are common features in salt marsh habitats.

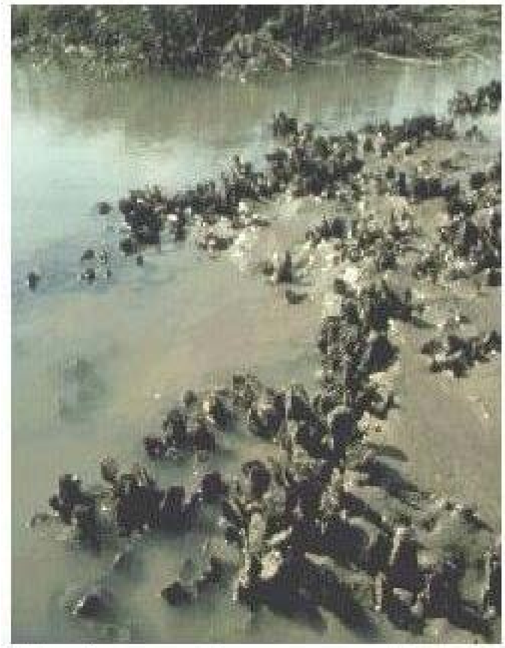
If the elevation of the marsh increases as a result of sedimentation or sea level fall, less salt-resistant plants such as black needle rush (*Juncus)* and glasswort (*Salicornia*) may become established. The trapping of rainfall in these sediments begins to displace saltwater, creating a freshwater lens in the soil. Other plant species characteristic of high marsh habitats may then become established, slowly changing the Spartina-dominated community to one dominated by species characteristic of estuarine salt shrub thicket communities. (See related section: Estuarine Community.)

Back to Top

Oyster Reef Development

In estuarine areas, oyster reefs have a considerable influence on the morphology of the estuary. Constructed by larval oysters settling and growing on hard substrates, these formations block the mouths of tidal creeks, change currents and provide essential habitat for numerous species. These reefs provide an extensive amount of structure in what would otherwise be a blanket of sand and soft sediments. Occurring in medium to high salinity areas, oyster beds line banks and shallow sub-tidal areas that are protected from oceanic waves. In turbid, light-limited water conditions such as those that occur in the ACE Basin, oyster beds serve similar functions to the coral reefs of tropical waters and the submerged aquatic vegetation (sea grasses, kelps) of temperate waters.

Oyster reefs develop initially from some type of hard substrate. As oysters settle and grow, they modify the habitat by changing water flow patterns as a result of slowing water flow near the reef. This allows particulate material to settle among the oysters. Additionally, oysters are suspension feeders, filtering detritus, phytoplankton, and zooplankton from the water column. Their feces and pseudofeces settle on the reef, further increasing the deposition of materials. One generation of oysters provides hard substrate for the next generation. As additional generations of oysters settle on the existing oysters, the surface of the oyster reef increases in height and area, slowly burying the previous generations. The upward growth of the reef is limited by the length of exposure during low tide.



Eastern oyster community
(Crassostrea virginica)

In both name and function, oyster reefs are similar to coral reefs of Florida and Australia. In areas with warm high saline clear waters, corals shelter symbiotic algae that require light to photosynthesize and therefore coral reefs do not develop in turbid waters. In coastal South Carolina where habitats are characterized by turbid waters, oyster reefs serve the same functions of providing shelter and forage areas for other species, serve as nutrient traps, and shield areas from wave action. Predatory fish utilize the water above the oyster reef during high tide; smaller fish and crustaceans utilize the interstitial spaces within the reef as refuge and nesting areas; and worms and copepods live within the deposited sediments of the reef.

Oyster beds provide a wide range of services to the systems existing where they develop. These services include filtering suspended particles, including bacteria, from the water column during feeding; providing habitat for a wide variety of fishes and invertebrates including commercially and recreationally important species such as gag grouper and penaeid shrimp; and protecting saltmarsh habitats from wave action. Oyster beds serve as forage areas for birds and mammals at low tide and for various fish and crustacean species at high tide. Commercial and recreational oyster fisheries are directly dependent on the extent and health of oyster beds in the ACE Basin. (See related sections: Oyster and Clam Fisheries, Saltwater Fisheries.)

Back to Top

Summary

The geomorphology of the ACE Basin is a reflection of many natural as well as anthropogenic processes. The low relief, low-lying areas of the ACE Basin are sensitive to changes in eustatic sea-level, geologic changes such as those brought about by earthquakes, and to increasingly significant anthropogenic modifications. Many of these modifications, such as deforestation and land development on barrier islands, can reduce the capacity of the ACE to recover from natural impacts such as severe storms and hurricanes. With the potential of rising sea-levels, and increased frequency of storms related to global warming, the ACE Basin and the southeastern coast of the United States can expect to be exposed to increasingly destructive natural phenomena. Vegetative buffers, which absorb energy and stabilize coastal environments, may become increasingly important to the protection of natural as well as human habitats. Other human-induced impacts such as eutrophication, pollution, and erosion of topsoil, may require mitigation by careful, responsible management and planning of land uses. Implementing land use plans that work within the geomorphic constraints of the ACE Basin can minimize anthropogenic impacts to Basin environments.

NEXT SECTION: Soil Composition and Formation

Author

G. Riekerk, SCDNR Marine Resources Research Institute

References

Bennett, S. H. and J. B. Nelson. 1991. Distribution and status of Carolina Bays in South Carolina. South Carolina Wildlife and Marine Resources Department, Nongame and Heritage Trust Publications, No. 1.

Colquhoun, D. J. 1965. Terrace sediment complexes in central South Carolina. Atlantic Coastal Plain Geological Society Field Conference. University of South Carolina, Columbia, SC.

Colquhoun, D. W. 1969. Coastal plain terraces in the Carolinas and Georgia, USA. Quaternary Geology and Climate 16:150-162.

Colquhoun, D. W. 1969. Geomorphology of the lower coastal plain of South Carolina. Division of Geology State Development Board, Columbia, SC.

Cooke, C. W. 1936. Geology of the coastal plain of South Carolina. U.S. Geological Survey Bulletin 867. U.S. Government Printing Office, Washington, DC.

Davis, R. A., Jr. 1992. Depositional systems: An introduction to sedimentology and stratigraphy. Prentice Hall, Englewood Cliffs, NJ.

Fairbridge, R. W. 1968. The encyclopedia of geomorphology. Reinhold Book Corporation, New York, NY.

Howard, J. A. and C. W. Mitchell. 1985. Phytogeomorphology. John Wiley and Sons, New York, NY.

Hoyt, J. H. and J. R. Hails. 1974. Pleistocene stratigraphy of southeastern Georgia. p. 191-205. *In*: R. Q. Oaks and J. R. Dubar (eds.). Post-miocene stratigraphy: Central and southern Atlantic coastal plain. Utah State University Press, Logan, UT.

Kaczorwski, R. T. 1976. The origin of Carolina bays. *In*: M. O. Hayes and T. W. Kana (eds.). Terrigenous clastic depositional environments: some modern examples. University of South Carolina, Department of Geology, Coastal Research Division Technical Report No. 11-

CRD. Columbia, SC.

Kaczorwski, R. T. 1977. The Carolina bays and their relationship to modern oriented lakes. Ph.D. Thesis. University of South Carolina, Columbia, SC.

Marshall, W. D. 1993. Assessing change in the Edisto River basin: An ecological characterization. SC Water Resource Commission Report No. 177, Columbia, SC.

Mathews, T. D., F. W. Stapor Jr., C. R. Richter, J. V. Miglarese, M. D. McKenzie, and L. A. Barclay (eds.). 1980. Ecological characterization of the sea island coastal region of South Carolina and Georgia. Volume I: Physical features of the characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-79/40.

McIntyre, M. P., H. P. Eilers, and J. W. Mairs. 1991. Physical geography. Wiley and Sons, New York, NY.

Nummedal, D. 1983. Barrier islands. *In*: P. D. Komar (ed.). Handbook of coastal processes and erosion. CRC Press, Boca Raton, FL.

Nystrom, P. G. Jr., Willoughby, R. H., and L. K. Price. 1991. Cretaceous and tertiary stratigraphy of the upper coastal plain, South Carolina. *In*: J. W. Horton and V. A. Zullo (eds.). The geology of the Carolinas: Carolina Geological Society fiftieth anniversary volume. University of Tennessee Press, Knoxville, TN.

Odum, E. P. 1997. Ecology: A bridge between science and society. Sinauer Associates Inc., Sunderland, MA.

Orlando, S. P., Jr., P. H. Wendt, C. J. Klein, M.E . Pattillo, K. C. Dennis, and G. H. Ward. 1994. Salinity characteristics of south Atlantic estuaries. Office of Ocean Resources Conservation and Assessment, National Oceanic and Atmospheric Administration, Silver Spring, MD.

Pritchard, D. W. 1967. What is an estuary: Physical viewpoint. p.3-5. *In*: G. H. Lauff (ed.). Estuaries. American Association for Advanced Science Publication 83.

Prouty, W. F. 1952. Carolina bays and their origin. Bulletin of the Geological Society of America 63:167-224.

Willoughby, R. 1999. Personal communication. SC Department of Natural Resources, Columbia, SC.

Sinha, E. Z. 1959. Geomorphology of the lower coastal plain from the Savannah River area, Georgia to the Roanoke River area, North Carolina. Ph.D. Thesis. University of North Carolina, Chapel Hill, NC.

Soller, D. R. and H. H. Mills. 1991. Surficial geology and geomorphology. *In*: J. W. Horton and V. A. Zullo (eds.). The geology of the Carolinas: Carolina Geological Society fiftieth anniversary volume. University of Tennessee Press, Knoxville, TN.

Stickney, R. R. 1984. Estuarine ecology of the southeastern United States and the Gulf of Mexico. Texas A&M University Press, College Station, TX.

Symposium on the Classification of Brackish Waters. 1958. The Venice system for the classification of marine waters according to salinity. Oikos 9:311-312.

Thom, B. G. 1970. Carolina bays in Horry and Marion counties, South Carolina. Bulletin of the Geological Society of America 81:783-813.

Trenhaile, A. S. 1997. Coastal dynamics and landforms. Oxford University Press, New York, NY.

Van Couvering, J. A. 1997. Preface: The new Pleistocene. *In*: J.A. Van Couvering, E. Aguire, M.N. Alekseev, and G. Pasini (eds.). The Pleistocene boundary and the beginning of the Quaternary. Cambridge University Press, New York, NY.

Vincent, R. K. and R. D. Haag. 1975. Delineation of the South Carolina coastal zone by use of vegetative guides. Report to the South Carolina Coastal Zone Planning and Management Council. Geospectra Corp., Ann Arbor, MI.

Weems, R. E. and E. M. Lemon, Jr. 1984. Geologic map of the Mount Holly quadrangle, Berkeley and Charleston counties, South Carolina. U.S. Department of Interior, Geological Survey, Reston, VA.

Wenner, E. L., W. P. Coon, P. A. Sandifer, and M. H. Shealy, Jr. 1991. A comparison of species compositions and abundance of decapod crustaceans and fishes from the North and South Edisto Rivers in South Carolina. SC Wildlife and Marine Resources Department Technical Report No. 78.

Wharton, C. H., W. M. Kitchens, and T. W. Sipe. 1982. The ecology of bottomland hardwood swamps of the southeast: A community profile. US Fish and Wildlife Service Publication, FWS/OBS-81/37.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Soil Composition and Formation

What is Soil?

The definition of soil varies depending on the person considering it. To a civil engineer planning a construction site, soil is whatever unconsolidated material happens to be found at the surface. To a miner, it is just some worthless material that is in the way and must be removed. To a farmer, it is the medium that will nourish and supply water to the crops. Even soil scientists may hold differing definitions, depending on their area of study.

Soil erosion

For the purposes of this paper, the definition of the Soil Survey Staff (1975) will be used:

> Soil... is the collection of natural bodies on the earth's surface, in places modified or even made by man of earthy materials, containing living matter and supporting or capable of supporting plants out-of-doors. Its upper limit is air or shallow water. At its margins it grades to deep water or to barren areas of rock or ice. Its lower limit to the not-soil beneath is perhaps the most difficult to define. Soil includes the horizons near the surface that differ from the underlying rock material as a result of interactions, through time, of climate, living organisms, parent materials, and relief. In the few places where it contains thin cemented horizons that are impermeable to roots, soil is as deep as the deepest horizon. More commonly soil grades from at its lower margin to hard rock or to earthy materials virtually devoid of roots, animals, or marks of other biological activity. The lower limit of soil, therefore, is normally the lower limit of biological activity, which generally coincides with the common rooting depth of native perennial plants. Yet in defining mapping units for detailed soil surveys, lower layers that influence the movement and content of water and air in the soil or the root zone must also be considered.

Back to Top

Soil Composition

While a nearly infinite variety of substances may be found in soils, they are categorized into four basic components: minerals, organic matter, air and water. Most introductory soil textbooks describe the ideal soil (ideal for the growth of most plants) as being composed of 45% minerals, 25% water, 25% air, and 5% organic matter. In reality, these percentages of the four components vary tremendously. Soil air and water are found in the pore spaces between the solid soil particles. The ratio of air-filled pore space to water-filled pore space often changes seasonally, weekly, and even daily, depending on water additions through precipitation, throughflow, groundwater discharge, and flooding. The volume of the pore space itself can be altered, one way or the other, by several processes. Organic matter content is usually much lower than 5% in South Carolina (typically 1% or less). Some wetland soils, however, have considerably more organic matter in them (greater than 50% of the solid portion of the soil in some cases).

Back to Top

Soil Minerals

Almost any mineral that exists may be found in some soil, somewhere. The broad and deep subject area of soil mineralogy can barely be touched upon here. Only some of the elementary basics shall be discussed.

The mineral portion of soil is divided into three particle-size classes: sand, silt, and clay. [Note: Sand, silt, and clay are collectively referred to as the *fine earth fraction* of soil. They are <2 mm in diameter. Larger soil particles are referred to as rock fragments and have their own size classes (pebbles, cobbles, and boulders). Rock fragments do not play a significant role in ACE Basin soils.] The three particle size classes are defined as follows:

Particle name	Size range
sand	2 mm-0.05 mm
silt	0.05 mm-0.002 mm
clay	<0.002 mm

Mineralogically, sand, and silt are just small particles of rock and are largely inert. The two important differences among them are their relative capacity to hold water that is available for uptake by plants and their effects on soil drainage.

Clay particles are mineralogically different from sand and silt. Clay minerals form at or near earth's surface, in soil or in water. Most clays belong to a class of minerals called phyllosilicates, which have formed from the breakdown products of other minerals. Like all phyllosilicates, clay minerals have a sheet-like structure, which is revealed when the crystals are observed through a scanning electron microscope. More familiar phyllosilicate minerals that are often large enough to be seen with the naked eye are the micas such as muscovite and biotite.

Due to isomorphous substitution, in which one ion is substituted for another in the crystal structure of a mineral, many clays have a *net negative charge*. That is, if all the protons and all the electrons that are part of the clay mineral's crystal structure were counted, there would be more electrons than protons. Another source of negative charge on clays is the ionization of hydroxyl groups at the edge of crystal (called *broken edge* charge).

The net negative charge of clay minerals is responsible for a property called *cation exchange capacity* , or CEC. When placed in a solution, clay minerals attract cations (positively charged particles) to their surfaces. The bonds between the clay mineral surface and the cations are relatively weak, and these cations can be exchanged for other cations that are dissolved in the solution.

The significance of CEC is that cations moving through a soil in solution may be held by the soil. Sometimes these cations (usually metals) are plant nutrients, like potassium, calcium, and magnesium. The loosely held nutrients can then be taken up by plant roots or by other soil organisms. This is one of the ways that soils store nutrients for future biological use. The cation exchange property is also responsible for the soil's ability to filter some environmental contaminants from water.

There are many different phyllosilicate clay minerals. Two that are commonly found in the soils of the ACE Basin study area include kaolinite and members of the smectite group of clay minerals. (Montmorillonite is one of the better known smectites.) Kaolinite does not shrink and swell when dried or wet, which makes it ideal for making bricks and pottery. It also has many other commercial uses. Kaolinite has a very low CEC. Smectites, on the other hand, have a high CEC and a very high shrink-swell capacity. Soils with a high smectite content are known to cause problems with the construction of buildings, roads, and other infrastructure. Most soils in the ACE Basin study area have only low to moderate shrink-swell potentials, however. The few soils with high shrink-swell potential also happen to be saltwater wetlands.

Back to Top

Soil Texture

The relative combination of sand, silt, and clay in a soil defines its texture. From the discussion of the properties of the soil particle sizes above, it should be obvious that soil texture is important in determining the nutrient-holding abilities of a soil. Along with soil structure (the arrangement of soil particles in aggregates), the texture of soil is also important to water-holding capacity, water movement, and the amount and movement of soil air in a given soil. All of this is important to the health and type of plants and other organisms that can exist in a particular soil.

Once the percent by weight of sand, silt, and clay are known (or, rather, any two of them), the soil texture can be plotted on the triangular graph known as the soil textural triangle. The region on the graph where the three particle size percentages meet is the soil's texture. Loam has been determined to be the texture best suited to the growth of most agricultural crops, having the optimum combination of *heavy* and *light* soil qualities.

Soil Organic Matter

Soil organic matter (SOM) is a complex mixture of substances that can be highly variable in its chemical content. It ranges from freshly deposited plant and animal parts to the residual humus —stable organic compounds that are relatively resistant to further rapid decomposition.

The elemental composition of SOM includes carbon, oxygen, hydrogen, nitrogen, phosphorus, and sulfur. Nitrogen, phosphorus, and sulfur are plant nutrients that are slowly released during decomposition and are then available to plants, as well as other soil organisms. Other elemental nutrients may also be held in complex SOM. (See related section: Decomposers.)

Like the phyllosilicate clays, SOM has CEC. By weight, SOM has a much higher CEC than clays, and is, therefore, an important source of this soil property, especially in wet soils and soils low in clay minerals. SOM can also form complexes with metals and organic materials (including insecticides and herbicides), sometimes rendering them immobile and/or inert.

An important physical property of SOM is its ability to absorb and hold large quantities of water. The mass and volume of water that can be absorbed by SOM often exceed the mass and volume of the SOM itself.

The Soil Profile

There are between 15,000 and 20,000 soils in the United States, 265 of which are found in South Carolina. Of those, about 100 are found in the ACE Basin study area. These soils are differentiated from one another by the characteristics and properties of their profiles.

A soil profile is a physical and chemical description of the layers (called *horizons*) that make up the soil, from the surface to the depth where pedogenic (soil forming) processes are no longer evident. If a person digs a hole in the ground and looks at the wall of that hole, he is looking at the soil's profile. The horizons of the profile have formed and differentiated from the original parent material in place—they are not the result of geologic processes, although some features of a profile may be caused by geologic events (faults, lithologic discontinuities, buried soils, etc.).

A typical profile of a mature soil in South Carolina includes the following horizons:

1. *O horizon* (O stands for organic) includes litter layer, duff, and sometimes a humus layer. These materials are differentiated by the degree of decomposition of the organic matter. This horizon is often missing in cultivated soils, manicured lawns, and severely eroded soils.
2. *A horizon* contains a mixture of organic and mineral components. This layer most closely resembles the ideal soil; commonly referred to as topsoil.
3. *E horizon* (E stands for elluvial) is stripped of much of its clay and sometimes staining agents, and is thus often lighter in color than the others. It is lower in organic matter than the A horizon.
4. *B horizon* is a zone of illuviation (accumulated substances—clays, organic matter, iron and aluminum compounds) that have been leached from overlying horizons.
5. *C horizon* is lightly weathered parent material.

Specific types of the above-mentioned horizons are denoted by a subscript letter. For example, a B horizon with a certain amount of illuviated clay in it is called a B_t horizon. Other specific horizons will be mentioned, as needed, in later sections. These horizons are also often subdivided further; a B horizon may have several parts if characteristics such as texture or color change with depth. These subhorizons are denoted by an Arabic number. For example, a sequence of B horizons found in a soil may be B_t1, B_t2, B_{tg}.

In addition to the soil horizons mentioned in the text (O, A, E, B, C), a reader may find other horizon designations mentioned in published soil surveys or in the USDA's Official Soil Descriptions (http://www.statlab.iastate.edu/soils/osd/) EXIT .

Back to Top

Soil Formation

A number of conceptual models of soil formation have been postulated over the years. The two that have been key in our basic understanding of soils and soil formation are those of Hans Jenny (1941) and Roy W. Simonson (1959).

Five Factors of Soil Formation

Jenny (1941) addressed the question of which environmental factors are responsible for the soils we have today. Recognizing these factors is extremely useful for field scientists when looking over a landscape and predicting the soil types that are found upon it. These factors include the following:

1. *Parent Material* - What was there before soil formation began?(Possibilities include mud deposited by a river, sand deposited by ocean, rock that weathers and breaks down, etc.);
2. *Organisms* - usually refers to vegetation and microorganisms, but includes the complete biological community;
3. *Climate*- on both large and small scales;
4. *Relief*, or landscape position;
5. *Time*.

How do these factors determine the types of soils found in the ACE Basin study area?

Parent Material

Parent materials in the ACE Basin study area were mostly deposited by the ocean or rivers and streams. In some cases these sediments were reworked by wind. The principle to remember is that fluids with higher energy (fast-moving and/or large waves) can hold larger particles than fluids with lower energy. Muds high in silt and clay were deposited by slow-moving or still air and water, while the fluids that deposited sandy sediments were moving fast enough to retain suspended silts and clays. (Fluids, in this context, include both liquids and gases.) Sandy, non-alluvial soils in the ACE Basin study area were likely once beach and dune deposits. Finer textured soils were probably once marshes and other backwater areas that were protected from strong ocean waves and currents.

Soils of alluvial origin (flood plain soils) also vary in texture, from sands to clays. When a stream of water is concentrated through a small channel, its flow rate is more rapid than when the same amount of water on the same slope is spread out over a wider area. (This is the reason sluices were constructed for old water-powered mills.) River water confined within the river's banks moves at a higher velocity than when the river floods and its waters spread over the flood plain. When a river floods and

Typical flood plain

overflows onto its flood plain, its velocity immediately decreases and it starts dropping its sediment load. The larger, heavier sand particles drop out first, near the banks. In some cases, a natural sandy levee forms on either bank of the river. Finer and finer particles are dropped the farther out the floodwaters' reach. Floodwaters often create ponds on the outer margins of flood plains. Clay-sized particles settle out in these areas.

The deposition of soil parent materials on flood plains is further complicated because the stream meanders back and forth. Sandy stream channel sediments may be buried by the finer sediments of ponded backwaters and oxbow lakes. Finer sediments in the flood plain may also be buried or eroded away by a meandering channel. All these scenarios result in differences in the soils that subsequently form on these sites.

Other important parent materials in the ACE Basin study area are those high in calcium carbonates. A plethora of marine organisms leaves some sort of calcareous remains that have a profound effect on soils that form in sediments that include these materials. The presence of calcium carbonate in soil drastically changes the soil chemistry, and thereby the chemical processes that occur, and the community of organisms that colonize the soil. Dwarf palmetto (*Sabal minor*) is a well-known indicator species used by soil scientists to identify calcareous soils in the field, since this species requires soils with a near neutral to alkaline pH.

Organisms

Organisms affect the type of organic matter that is added to the soil, the rate at which the organic matter is decomposed, the part of the soil to which the organic matter is added and translocated, and the types of chemical reactions that occur in the soil.

One of the most notable effects that soil organisms have on soils in the ACE Basin study area is on the amount of organic matter that is present. In wetland soils, SOM tends to build up because the anaerobic soil bacteria are less efficient than their aerobic cousins at decomposing it. (See related section: Decomposers.)

Climate

Climate affects soils by governing the rate at which chemical reactions can take place and the amount of percolating water that translocates materials from one part of the soil to another. The climate and its effects on soil change on a regional basis in areas of low relief like the ACE Basin study area and the rest of the Southeastern Coastal Plain. Differences in soil types from one part of the Basin to another are not attributed to climatic change. The whole area has a warm, moist climate most of the year, which is conducive to relatively high chemical reaction rates responsible for chemical weathering and biological activity. This is all conducive to relatively rapid rates of soil formation. (See related section: Climatology.)

Relief

Local relief is the environmental factor that has the greatest effect on the soils of the ACE Basin study area. Changes in elevation of only a few feet produce major changes on soil properties in this region, all attributable to the topography 's effect on soil water.

Simply stated, water runs downhill. When water drains from the soil on local topographic highs, it drains into the low areas on the landscape. Soils in low-lying areas are saturated closer to the surface for longer periods of time than soils on higher ground.

The organisms living on or in these wetter soils must have ways of adapting to the limited availability of soil air. Vegetation has hydrophytic characteristics, and soil bacteria are either anaerobes or facultative anaerobes.

On the other hand, organisms living on the topographic high points must be adapted to xeric conditions. Often, the origins of the landforms making up these topographic highs are old, sandy beach and dune ridges. Soils that form there drain quickly and retain very little water. These two different soil conditions affect both the soil chemistry and the amounts of organic matter added to the soil each year.

Time

All pedogenic (soil forming) processes occur over time. Young soils show only minimal profile development—often only an A horizon overlying a C horizon. As the soil matures with time, additional subsurface horizons form.

The development of soil through time can be easily observed in the Southern Coastal Plain. The youngest landforms and soils are closest to the ocean gradually increasing in age inland. While the soils of the ACE Basin study area are all fairly young, this increase in soil development is still evident.

The original intent of Jenny's factors of soil formation model was to develop a numerical equation that used information on each factor to determine the characteristics of the resultant soil. It is unlikely that this will come to pass. Obviously, these five factors are not always independent of each other. In addition, soil is a highly complex system that is only partly understood. However, Jenny's model has proved invaluable to field soil scientists and landscape ecologists the world over.

Generalized Theory of Soil Genesis

Roy W. Simonson's conceptual model of soil genesis takes a different approach. Instead of concentrating on the external factors that influence the type of soil that forms in a given location, he considers the pedogenic processes that occurred within the soil body.

First, he divides soil formation into two steps:

1. the accumulation of parent materials, and
2. the differentiation of horizons in the profile.

   Horizon differentiation is divided into four basic categories of changes:

   1. additions,
   2. removals,
   3. transfers,
   4. transformations.

Simonson (1959) uses the changes that organic matter undergoes in soil as an example. Organic matter is added to soils as plant and animal remains, often at the surface. The action of organisms removes some of this SOM as it decays, usually in gaseous forms that escape to the atmosphere. Some SOM may leach with percolating rainwater to deeper horizons. The processes of decay also transform the organic matter into different organic substances. Similar examples can be made with mineral substances.

Simonson (1959) further postulates that all the changes that occur in our many different soils occur in ALL soils, only at different rates. The rate of these changes is controlled by environmental factors, such as those outlined by Jenny (1941). The ultimate result of the pedogenic changes is the soil that exists today, and the differences among soils are due to the varying rates of all these processes.

Stages of Soil Formation

All soil formation begins with the *accumulation of parent material*. The next step is the *buildup of organic materials* at the surface. Pioneer species (most often grasses and alga in this area) live and die, and organic matter begins to build up on the surface of the material and also beneath the surface in the rooting zone.

The A horizon starts to form once enough organic matter has been transformed by soil biota into humic materials. The humic materials coat the soil particles, coloring them brown and black. The formation of a recognizable A horizon takes decades or, in some cases, centuries.

The B horizon begins to form as dissolved and suspended materials are carried downward to greater depths with percolating rainwater. These materials include humic substances, suspended clays, salts, and metals, including iron and aluminum. It is likely that the largely insoluble iron and aluminum cations and oxides move in complex with dissolved organic material (chelation), and also in complex with suspended clay minerals.

The A horizon continues to increase in thickness, and the B horizon continues to develop. The A horizon will increase in thickness and SOM content, until it reaches a steady state in which the rate of fresh organic matter additions equals the losses by decay, illuviation, and erosion. This steady state is affected by certain environmental changes, including climatic change and vegetational succession (or cultivation). The B horizon will continue to receive illuviated material as it is formed in the A horizon, or sometimes as it is deposited on the surface (especially wind-blown clays).

The E horizon forms as the top of B horizon moves deeper into the soil. In some forested areas, such as the Southeast region of the United States, the movement of illuvial materials occurs at a faster rate than the illuvial materials are formed (largely clays and organic matter). This results in a “gap” between the A horizon and the B horizon. The E horizon is usually the same texture as the A horizon, and the soil particles are largely stripped of staining agents, such as organic matter and metal oxides. These materials have elluviated from the E into the B horizon.

Minerals continue to weather. Clays in B horizon weather to less active minerals (kaolinite).

"Bases" are leached from soil. Certain cations are referred to as acids or bases in soil science, even though they do not fit any chemical definition of the term. The acidic cations, including aluminum and iron cations, are so called because their presence in the soil tends to decrease pH. (The reactions responsible for this will not be explained here.) The presence of the basic cations in large amounts usually coincides with neutral to high pH soil systems. These bases are often plant macro-nutrients, like calcium, potassium, and magnesium. The loss of basic cations results in low fertility soils.

Silicate clay minerals completely break down into iron and aluminum oxides. Soil is extremely infertile. This occurs in tropical climates. While some of these metal oxide clays exist in South Carolina soils, they do not dominate.

Back to Top

Soils and the ACE Basin/Low Country Landscape

- Dune Ridge and Trough Landscapes
- Floodplain/Salt Marsh Landscapes
- High Sandy Ridges
- Low Relief Uplands

The general soil map of the ACE Basin study area depicts the different kinds of landscapes of the area, and the soil associations found on them. Before describing these soils, some explanation is in order.

A soil association is a group of soils that are geographically related and found in a characteristic repeating pattern across a landscape. They are grouped together in a single map unit on the general soil map. The soils for which the association is named are rarely, if ever, the only soils that exist in the soil association. Sometimes as much as half the area of a map unit includes what are referred to as soils of minor extent. The soil that covers the most land area in an association is named first, the next most common soil second, and so on. A soil association map gives soil scientists an idea as to what the landscape is like. It should not be used for detailed land use planning. (See related section: Soil Survey.)

Dune Ridge and Trough Landscapes

These landscapes are found just inland from beaches or land that was near a beach during late Pleistocene or Holocene times. They consist of long sand dunes with low-lying troughs between them, paralleling the coastline, or former coastline. The dominant soil orders found in this type of landscape are the Entisols, Inceptisols, and Spodosols. Entisols exhibit the least amount of profile development, followed by Inceptisols. Spodosols can form quickly, given the right conditions. (See related section: Soil Taxonomy.)

These soil associations have moderate and severe limitations for urban use, but since they are found in prime oceanfront locations, homes are often built on them.

Fripp-Baratari: This association is found on Hunting Island and the northeastern part of Helena Island. Both are sandy throughout their profiles. Fripp series soils (Typic Quartzipsamments) are found on the dunes and have no subsurface horizon development, just a gray-brown A horizon that is a few inches thick. They are excessively drained. Baratari series soils (Aeric Alaquods) are found in the low troughs and may be occasionally flooded. Baratari soils, being of the Spodosol order, have a dark B_h horizon that is stained with illuviated organic material. This horizon exists at the level of the water table. The soil is poorly drained.

Wando-Seabrook-Seewee: This association is found on Helena, Lady, and Port Royal Islands. (NOTE: This association does not always have dune and trough topography,) All three soils are sandy throughout their profiles. Wando series soils (Typic Udipsamments) are excessively drained and are found on the tops of the dune ridges. Seabrook series soils (Aquic Udipsamments) are moderately well drained and are found at intermediate levels and on the top of lower ridges. Neither soil has any subsurface profile development. The somewhat poorly drained Seewee series soils (Aeric Alaquods) are at the lower parts of the landscape and have the characteristic dark Bh horizon beneath the surface, at about the level of the water table.

Kiawah-Seabrook-Dawhoo: This association is found on Edisto Island and in other parts of Charleston County to the east. Seabrook and Dawhoo soils are sandy throughout, and Kiawah soils have just enough silt and clay in them to make the texture a loamy sand. Seabrook series soils (Aquic Udipsamments) are moderately well drained and occupy the highest parts of the landscape. Kiawah series soils (Aeric Ochraqualfs) are somewhat poorly drained and are found at intermediate elevations. There is some horizon development in these soils. Dawhoo series soils (Typic Humaquepts) are poorly drained. Due to their wetness, the A horizons have accumulated fairly high amounts of organic matter.

Flood Plain/Salt Marsh Landscapes

The extensive and contiguous flood plain/salt marsh landscape is the heart of the ACE Basin study area. No soils are more productive and have a greater impact on the ecosystem, the economy, and the history of South Carolina than those found on this landscape. The sediments and organic materials in which these soils formed are all of Holocene age. These landscapes are almost perfectly level. They are often flooded, and these flood waters deposit new sediments regularly. The dominant soil orders found here include Entisols, Inceptisols, and Histosols. As previously noted, the Entisols and Inceptisols are young soils. Histosols contain large amounts of organic matter, as might be expected in wet soils. The soils of this landscape would present severe limitations for any urban use. (See related section: Wetland Soils.)

Torhunta-Osier-Pickney: This association is found on the valleys of the upper Combahee River and the Salkehatchie River. It typifies the sort of sediments and soils found on flood plains throughout the world. Osier series soils (Typic Psammaquents) are poorly drained, very limited in profile development, and sandy throughout. They are found in former stream channels and right alongside streams, wherever swiftly moving water has deposited sediment. Torhunta series soils (Typic Humaquepts) are extremely poorly drained and contain high amounts of organic matter in the A horizon. They are found in broad drainage ways that are frequently flooded for short durations with slowly moving water. Pickney series soils (Cumulic Humaquepts) are very poorly drained and contain high amounts of organic matter in a thick A horizon. They are often flooded by slowly moving water and are usually saturated. They are often found along the outer margins of the flood plain.

Santee-Argent-Cape Fear: This association is found in the valley of the upper Ashepoo River and its tributaries. The whole association is often flooded, and all three soils have a loamy surface and clay subsoil. The Santee series (Typic Argiaquolls) is very poorly drained and is one of South Carolina's few Mollisols. Mollisols are more typical of the prairies and high plains of the Midwest. They are quite fertile and high in bases. They are most abundant nearer to the sea in this map unit, rather than inland, and are underlain by a layer of marl. The Argent series (Typic Endoaqualfs) are poorly to very poorly drained. They, too, are more abundant near the sea than inland. They may have calcium carbonate accumulations in the subsoil. Some areas covered by this soil were drained and diked for use as rice fields prior to 1893. Cape Fear series soils (Typic Umbraquults) are very poorly drained and are more abundant inland than near the sea. They have a surface horizon high in organic matter. These soils are quite fertile but cannot be used for typical agricultural crops due to flooding and saturated conditions. Drainage, if it were legal, would rarely be possible since there would be no place to drain the water. Most of the area is in mixed hardwoods.

Pungo-Levy: This association is found in a large area between the Edisto and Ashepoo Rivers, and up the Ashepoo valley, beyond the town of the same name. This association is adjacent to areas flooded with salt water. (However, this association is not.) The Pungo series soils (Typic Medisaprists) are very poorly drained and occasionally flooded. These are rich soils with mucky organic surface horizons several feet thick. The very poorly drained Levy series soils (Typic Hydraquents) are high in organic matter in this area, but not enough to call them organic soils (Histosols). Levy series soils are continuously wet. Although flood waters are often affected by tides, the waters flooding Levy soils are fresh. Most of the area covered by this association was once diked and drained for rice fields prior to 1893. Some of the area is now maintained as waterfowl habitat. Today, most of the association is covered by marsh grasses and water-tolerant shrubs. That probably developed under forest vegetation.

Bohicket-Capers-Handsboro: All the land bordering the St. Helena Sound, as well as much of the land surrounding the lower portions of the three rivers and the sea islands, is within this soil association. All three major soils in this association are very poorly drained. Bohicket series soils (Typic Sulfaquents) are flooded by salt water twice daily with the tides and may be covered with between 15 and 91 cm (6 and 36 inches) of water. They are usually highly dissected by tidal streams. New sediments are periodically added to this soil. Bohicket series soils are found at the lowest points on this landscape. Capers series soils (Typic Sulfaquents) are very similar to Bohicket series soils, with the difference between the two beyond the scope of this work. Capers soils are found at slightly higher elevations than Bohicket soils (a matter of inches) and are not greatly dissected by tidal streams. Some areas covered by Capers soils are flooded twice daily by tides, while other areas are only flooded by extremely high tides. One of the big differences between the two, from an agricultural standpoint, is that Capers soils can bear the weight of cattle. Handsboro series soils (Typic Sulfhemists) are found in areas between lands that are flooded by salt water and lands that are flooded by fresh water. They are composed of thick layers of organic material interspersed with horizons of mineral material. They are usually flooded twice daily. A few areas were once diked and drained for rice cultivation. The vegetation of this entire association is dominated by *Spartina* grass. Some small areas that have been used to deposit dredge material form small wooded "islands" within the marsh. As the taxonomic names of these soils suggest, these soils contain abundant amounts of reduced sulfur, produced during the respiration of anaerobic soil organisms. Hydrogen sulfide gas (H_2S), or marsh gas, is responsible for the characteristic odor of these areas. The association is unsuitable for any urban and most agricultural uses. Its most important uses are as wildlife habitat, nurseries for marine organisms, and buffers between the ocean and the land.

High Sandy Ridges

These landscapes are found both near the present day Atlantic coast and further inland, on older marine terraces. Since they are relatively well drained, land use capabilities are significantly different from those of the rest of the ACE Basin study area. Only slight to moderate limitations for many urban uses exist on many of these soils. Generally speaking, the degree of profile development in these soils increases with distance from the present-day coastline.

Echaw-Blanton-Chipley: This association is found on a wide ridge that stretches across Colleton County, between the Combahee and Edisto Rivers. Most of Interstate 95 follows this ridge across the county. The association is also found above the flood plain of the Salkehatchie River. Of the two associations labeled High Sandy Ridges, this one is on an older landscape. Echaw series soils (Oxyaquic Alorthods) are moderately well drained and are found at slightly lower elevations than the other soils. Like all Spodosols, they have a dark B horizon, stained with organic matter. Blanton series soils (Grossarenic Paleudults) are excessively drained to well-drained soils that occupy the highest ridges on this landscape. They have extremely thick sandy horizons (>100 cm or 40 inches) over sandy loam B horizons. The parent material is likely partially aeolian in origin (sand dunes).

Chipley series soils (Aquic Quartzipsamments) are moderately well drained and occupy the intermediate elevations in this association. They are sandy throughout and have little horizon development. Subsurface horizons are stained with varying amounts of iron oxides. Plinthite nodules (semi-hard iron concretions) are commonly found at the depth of the fluctuation water table. Nearly half of the area in this association is covered by soils of minor extent.

Chipley-Eddings-Lakeland: This association is found between the Ashepoo and Combahee Rivers on high ridges bordering the salt marshes of the Bohicket-Capers-Handsboro association. It is also found in the interior of Edisto Island and on a few long ridges in Charleston County. This association's proximity to the coast indicates that it is on younger landscapes than the association described above. Chipley soils, described in the preceding association, are found at intermediate elevations. Eddings series soils (Grossarenic Paleudults) are well drained and occupy the higher elevations in this association. Similar to the Blanton series, they have thick, sandy surface horizons (>100 cm or 40 inches) over sandy loam subsoils. Lakeland series soils (Typic Quartzipsamments) are excessively drained. They are at similar elevations to Eddings soils, but are most commonly found adjacent to tidal streams. Like all Entisols, they have little horizon development, aside from the A horizon.

Low Relief Uplands

The soil associations grouped in this category have many similarities to each other, as well as similarities to soil associations throughout the Southern Coastal Plain. The main similarity is that most of them represent toposequences, which are groups of soils that have different landscape positions, but the other four environmental factors influencing their development are the same. That is, they formed in the same parent material, exist in the same climate, are approximately the same age, and are influenced by the same organisms. Landscape position is the reason for differences found among members of a toposequence. The key here is the landscape position's influence on soil drainage. (Low-lying soils are wet; elevated soils are dryer.) This is a good way to think about the landscape of the Southern Coastal Plain in general; however, the five factors of soil formation are not completely independent of each other. For example, landscape position and drainage have a powerful influence on the types of organisms that can live in these soils, especially in the case of microorganisms. The different populations of microorganisms cause many of the chemical differences among these soils. [Note: Several of the other associations in the other landscape groups are also toposequences.] Only two representative soil associations will be described in this section. Only relative landscape position and drainage will be mentioned for the other associations.

Ogeechee-Yemassee-Yauhannah: This association is found in several places in Colleton County, between Walterboro and the coast. The towns of Ritter and Hendersonville are found in this association. The landscape is nearly level, and an untrained eye might find it difficult to discern the ridges from the depressions. The difference in elevation among these three soils is often a matter of inches. Ogeechee series soils (Typic Endoaquults) are poorly drained and are found in upland depressions and in poorly defined drainage ways. The surface horizon is dark gray loam, underlain by gray, sandy clay loam B horizons. This gray coloration is typical of wetland soils. Yemassee series soils (Aeric Endoaquults), somewhat poorly drained, are found at the tops of low ridges and at intermediate elevations on higher ridges. The surface horizon is dark gray loamy sand, underlain by a mottled-gray sandy-clay-loam subsoil. Yauhannah series soils (Aquic Hapludults) are moderately well drained and are found on the higher ridges in this association. The subsoil is a brown or yellow sandy clay loam. Large portions of this association are covered by soils of minor extent. The colors of the subsoils are mentioned here because they allow field soil scientist to differentiate between them.

Bladen-Argent-Wahee: This association covers large areas of Colleton County, between the major river flood plains of the ACE Basin study area. The town of Jacksonboro lies in this association. The landscape is nearly level, and like the one above, many might find it difficult to discern the ridges from the depressions. Bladen series soils (Typic Albaquults) are poorly drained and occupy the intermediate elevations of this association. The surface is a black loam, underlain by gray clay subsoil. Argent series soils (Typic Endoaqualfs) are very poorly drained soils that occupy the lowest elevations on this landscape. These wetland soils have clayey subsoil that sometimes contains calcium carbonate concretions at depth. They are higher in bases than the other two soils in this association, perhaps as a result of the translocation of these materials from the higher elevation soils. Wahee series soils (Aeric Endoaquults) are somewhat poorly drained and occupy the highest elevations in this landscape. The surface horizon is somewhat sandier than those of Bladen and Argent soils, possibly due to aeolian deposits of sand. The subsoil is mottled gray clay.

Goldsboro-Lynchburg-Rains: Goldsboro series soils (Aquic Paleudults) are moderately well drained and are found at the highest elevations on this landscape. Lynchburg series soils (Aeric Paleaquults) are somewhat poorly drained and are found at intermediate elevations on this landscape. Rains series soils (Typic Paleaquults) are poorly drained and are found in depressions and drainage ways.

Lynchburg-Rains-Paxville: Lynchburg series soils (Aeric Paleaquults) are somewhat poorly drained and are found on top of low ridges. Rains series soils (Typic Paleaquults) are poorly drained and are found at intermediate elevations on broad, low areas and depressions. Paxville series soils (Typic Umbraquults) are very poorly drained and are found in drainage ways at the lowest elevations.

Coosaw-Williman: Coosaw series soils (Aquic Arenic Hapludults) are moderately well drained and occupy higher elevations. Williman series soils (Arenic Endoaquults) are poorly drained and occupy the lower elevations.

Coosaw-Williman-Ridgeland: Coosaw series soils (Aquic Arenic Hapludults) are moderately well drained, and occupy the higher elevations. Williman series soils (Arenic Endoaquults) are poorly drained, and occupy the lower elevations. Ridgeland series soils (Oxyaquic Alorthods) are somewhat poorly drained, and occupy intermediate elevations.

Bladen-Coosaw-Wahee: Bladen series soils (Typic Albaquults) are poorly drained and occupy the lowest elevations. Coosaw series soils (Aquic Arenic Hapludults) are moderately well drained and occupy higher elevations. Wahee series soils (Aeric Endoaquults) are somewhat poorly drained and occupy the intermediate elevations.

Mouzon-Brookman-Wahee: Mouzon series soils (Typic Albaqualfs) are poorly drained and occupy the intermediate elevations of this landscape. Brookman series soils (Typic Umbraqualfs) are very poorly drained and occupy the lowest elevations of this landscape. Wahee series soils (Aeric Endoaquults) are somewhat poorly drained and occupy the intermediate elevations of this landscape.

Wadmalaw-Yonges-Meggett: Wadmalaw series soils (Umbric Endoaqualfs) are poorly drained and occupy the lowest elevations on this landscape. They are commonly covered with water. Yonges series soils (Typic Endoaqualfs) are poorly drained and are on the higher elevations on this landscape. Meggett series soils (Typic Albaqualfs) are also poorly drained and are found on intermediate elevations on this landscape.

Yonges-Eulonia-Edisto: Yonges series soils (Typic Endoaqualfs) are poorly drained and are found at the lowest elevations on this landscape. Eulonia series soils (Aquic Hapludults) are moderately well drained and are found at the higher elevations. Edisto series soils (Glossaquic Hapludalfs) are somewhat poorly drained and are found at intermediate elevations on this landscape.

NEXT SECTION: Biogeochemistry

Author

R. Scharf, SCDNR Land, Water, and Conservation Division

References

Jenny, H. 1941. Factors of soil formation. McGraw-Hill, New York, NY.

Simonson, R.W. 1959. Outline of a generalized theory of soil formation. Soil Science Society of America Proceedings 23:152-156.

Soil Survey Staff. 1975. Soil taxonomy: a basic system of soil classification for making and interpreting soil surveys. US Department of Agriculture, Soil Conservation Service. U.S. Government Printing Office, Washington, DC.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Introduction

Background

Nutrient Cycling in Salt Marshes

Carbon Cycling

Factors That Affect Nutrient Cycling

Conclusion

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Biogeochemistry

Introduction

Maritime Forest

Biogeochemistry is a field of science that deals with chemical reactions of elements in nature that are mediated by both biological and geological factors. 'Biogeochemistry' is a relatively new term for a field of research that has been in existence for quite some time. A study in biogeochemistry is one that recognizes the importance of both the biology (organic or living component) and the geology (inorganic or non-living component) of a particular environment in controlling chemical transformations. These chemical transformations store or release energy, which, in turn, drives the ordering of the components of an estuarine ecosystem.

Biogeochemical processes in the ACE Basin study area can be considered on a variety of scales. A biogeochemical study on a relatively small scale, such as a mud flat, may focus on the effect of burrowing activity by polychaete worms on nitrogen fluxes (e.g., Kristensen et al. 1985). On the other hand, a study on a much larger scale, like that of the entire Edisto River watershed, may track the transformation of nitrogen through the aquatic food web. For instance, stable isotopes could be used to infer the contribution of nitrogen from wastewater treatment facilities upstream to the nitrogen found in estuarine organisms residing at the mouth of the Edisto River in St. Helena Sound, as has been done by McClelland et al. (1997) in the Waquoit Bay estuarine ecosystem. Both the mud flat and the watershed in these examples represent ecological systems (ecosystems). Depending on the point of reference, one may consider the mud flat a subsystem within the watershed system. In general, however, a system is defined as a group of interacting parts with a collective function or process. One prominent process in ecosystems is the flow of energy that is gained or released during chemical reactions. This flow of energy drives the interactions among the ecosystem parts, including the cycles of elements. The focus of biogeochemical studies is to understand these chemical reactions and the regulatory functions involved as they pertain to specific chemical elements or compounds that are important determinants of ecosystem function.

The geographical boundaries that would define a biogeochemical study in an estuarine ecosystem such as the ACE Basin study area are the river channels to the maximum upstream extent of tidal influence; the surrounding freshwater, brackish, and salt marshes; and the ocean waters affected by the addition of fresh water (see salinity gradient). Upland habitats such as maritime forests that receive no tidal subsidy may also be considered important to estuarine biogeochemistry especially during periods of precipitation when rain water washes materials into the water column.

Estuarine scientists divide estuaries into zones based on the relative distribution of salts. This points to the importance of salinity in controlling estuarine biological processes. Biogeochemical studies in estuaries also consider the cycling of elements specific to these salinity zones. Because of their complexity, rarely are studies broad enough to encompass the entire estuarine system.

The major elements studied in biogeochemistry include carbon (C), hydrogen (H), nitrogen (N), oxygen (O), phosphorous (P), and sulfur (S),because these make-up the bulk of both plant and animal tissue. Studies tend to focus on the cycling of one or more of these elements between their organic and inorganic states. The biogeochemistry of trace metals such as lead, cadmium, and mercury is also important to consider because their presence in high concentration can be toxic to both fish and humans. (See related section: Hydrochemistry.) Therefore, the reactions that metals undergo may also be a considerable determinant for estuarine health.

In this section, the biogeochemistry of C, N, P, and S and the role these elements play in determining the function of the estuarine ecosystem will be discussed. The concentration of these elements in different abiotic (non-living) and biotic (living) components of the estuary, and the rates at which they undergo chemical transformation during processes like plant production and decomposition regulate environmental quality. Studies in biogeochemistry are important to estuarine management because their goal is to describe the underlying chemical processes that dictate the function of the ecosystem and the response it may have to man-induced changes at the watershed level.

Back to Top

Background

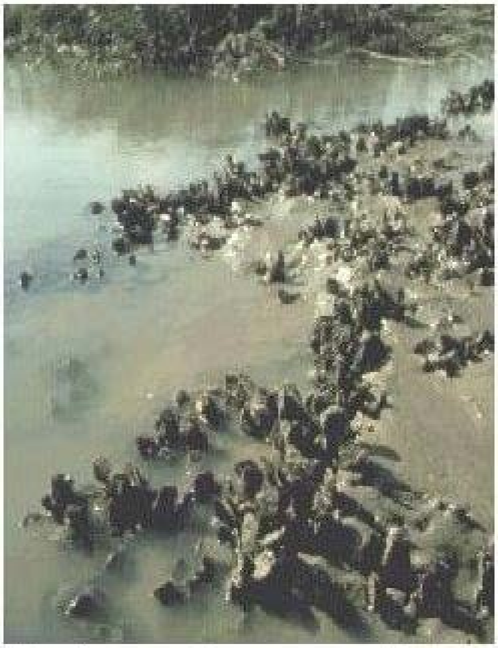
In living tissue most of the bonds between C, H, N, O, P, and S are reduced, or electron rich. It takes a great deal of energy to synthesize the reduced compounds that comprise living tissue. The sun is the ultimate source of this energy. Once created, organisms have to expend energy to maintain the integrity of their tissues because according to the laws of thermodynamics a spontaneous reaction should result in the oxidation of products to a lower energy state. This is why plants photosynthesize, fish eat shrimp, and shrimp eat dead plant material so that energy can be generated to maintain their living tissues at the high-energy state. When living tissue dies and begins to decay the reduced biomolecules are oxidized to their simple inorganic constituents. Bacteria that live in the water column and sediments of estuaries mediate the rate of oxidation of dead tissues. This process of biological oxidation, referred to as decomposition, returns the organic constituents of biogeochemicals back to their inorganic states such as CO_2, H_20, and NO_3. (See related section: Decomposers .)

Biogeochemistry and Ecosystem Models

A common goal of biogeochemical studies is to determine the quantitative relationships among system components for a specific element as a means of understanding the role each component plays in regulating elemental cycling. Once all the relationships, which are represented by mathematical equations, are determined a model of the system is constructed. The model of biogeochemical transformations can then be used to better understand ecosystem level affects of environmental changes. For example, a conceptual representation of a numerical model of carbon flow was generated for the Barataria Bay, Louisiana, estuarine ecosystem (see Carbon flow). This model accounts for flows between primary producers to consumers and couples the marsh subsystem with carbon transformations that occur in the water column. The model predicts that, although the standing stocks of plant-derived carbon are much greater in the marsh compared to the water column, the flow of carbon to consumers is nearly equal in both subsystems.

Linkages Among Subsystems in Estuaries

The interrelatedness of the biogeochemical cycles discussed above point to the significance of studying elemental cycling as it relates to ecosystem function. Although the explanation of the major biogeochemical cycles above was specific to salt marshes, these represent only one component of the estuarine ecosystem. In the ACE Basin study area, saltmarsh habitats comprise a significant amount of the total estuarine area, but because the ACE is an estuarine system that receives large freshwater riverine inputs, brackish and freshwater marshes also make considerable contributions to the total area. Much less is known about biogeochemical processes in these habitats compared to salt marshes. Also, the same chemical cycles discussed for salt marshes take place in intertidal unvegetated sediments (i.e. mudflats) and in subtidal sediments (benthic sediments). The elemental cycling that takes place in upland habitats, which is affected by land use, determines the quantity and quality of materials that are loaded to the estuary during periods of runoff. Biogeochemicals cycle within the water column as well. Hence, all of these components of the estuarine system need to be considered if statements are to be made in regard to the importance of biogeochemical processes to ecosystem functioning.



Eastern oyster community *(Crassostrea virginica)*

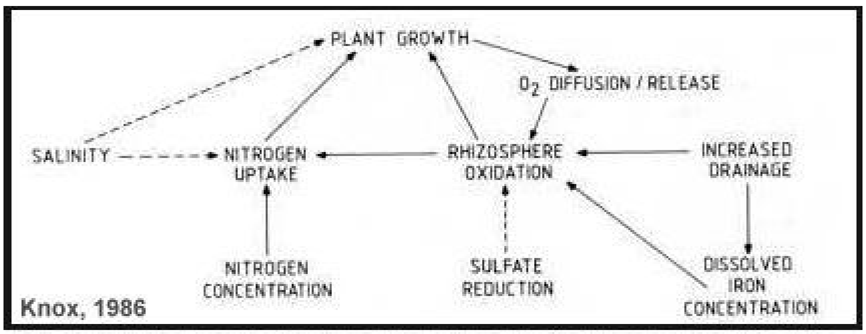
As specific aspects about biogeochemicals in the ACE are discussed, keep in mind that the elements of biogeochemistry cycle among primary producers, consumers, and inorganic constituents in estuaries. Primary producers transform inorganic carbon in the atmosphere or seawater to organic biomolecules to make living tissues. During this process other inorganic nutrients (N, P, and S) must be incorporated, and frequently one of these constituents limits the carbon transformation rate. Examples of primary producers in the ACE Basin study area include phytoplankton that reside predominately in the water column (See related sub-section: Phytoplankton: Marine Phytoplankton); macroalgae that adhere to bottom sediments in shallow areas or plant stems, piers, and other semipermanent structures; and marsh macrophytes represented by *Spartina alterniflora* in salt marshes and numerous other species in the diverse brackish and freshwater marsh communities upstream.

Consumers can not synthesize organic carbon from its inorganic form. They rely on the primary producers to provide the building blocks for their living tissues. Zooplankton, fish, snails, crabs, shrimp, worms, and water column and sedimentary bacteria represent consumers in the estuarine ecosystem of the ACE Basin study area. From a biogeochemical perspective, the consumers that have the greatest influence on elemental transfer rates are the most important to system functioning. In this regard, the heterotrophic bacteria are the most important. As organic matter synthesized by primary producers is degraded by bacteria, the biogeochemical elements cycle back to their inorganic forms, and nutrients are regenerated for new production. The end result of biogeochemistry determines how the estuary functions as a commercial fishery, a contaminant sink, or a recreational waterway.

Back to Top

Nutrient Cycling in Salt Marshes

- Sulfur Cycling
- Nitrogen Cycling
- Phosphorus Cycling



Relationship between factors directly or indirectly affecting growth of *Spartina alterniflora*. Solid lines are positive effects; dashed lines are negative effects

Figure 3 p 239, "Soil dynamics and the productivity of Spartina alterniflora". pp. 231-242 by A.G. Chalmers in ESTUARINE COMPARISONS edited by V.S. Kennedy. (c) Copyright 1982 by Academic Press. Reprinted with permission.

The salt marsh stores huge quantities of organic carbon in the form of marsh plant material. This material serves as the energy source for shellfish production, and, therefore holds a dominant place at the base of the estuarine food web. Studies in salt marshes have focused on measuring the rates of marsh plant production and decomposition. Much of the information on these processes has been obtained from controlled studies in saltmarsh habitats of North Inlet, SC and Sapelo Island, GA, to the north and south of the ACE Basin study area, respectively. Although there are differences in the zonation patterns of vegetation (see Vegetation zonation) in salt marshes with latitude, *Spartina* species (the salt marsh cordgrass) are common to all saltmarsh types. Research has determined the major factors that regulate *Spartina* growth and decay. Plant growth and decay are tightly coupled to the biogeochemical cycles of sulfur (see Sulfur transformation) and nitrogen (see Energy flow model).

Sulfur Cycling

Sulfur cycling is important in estuaries, in general, due to the high concentration of sulfate in seawater, which drives sulfate reduction in the anoxic sediments of salt marshes and mudflats. Sulfate reduction is one process by which carbon degradation occurs. Bacteria use sulfate as an acceptor for electrons in place of oxygen under anaerobic conditions. As the reduced organic tissue is oxidized to CO_2 the sulfate is reduced to sulfide. Sulfide is a volatile compound that under high concentrations can be toxic, and is responsible for the 'rotten egg-like' smell characteristic of saltmarsh habitats. Reduced iron (Fe) can react with the sulfide and precipitate as iron monosulfides or pyrite as a mechanism of sulfur burial. Hence, the process of sulfate reduction dominates the sulfur cycle in salt marshes, and is a significant controlling process for carbon degradation and, therefore, the cycling of carbon and energy in these environments. The amount of energy that flows through the sulfate reduction pathway is an order of magnitude higher than the flow to aerobic oxidation processes and estuarine fauna. Although sulfur is a necessary nutrient for plant growth, it never limits carbon production in the estuarine habitat. Nitrogen, however, does limit primary production in saline environments. Where sulfur is important to organic matter breakdown nitrogen is a major control for organic matter production.

Nitrogen Cycling

The chemical reactions involving nitrogen in estuarine wetlands are well characterized (see Nitrogen transformation). Nitrogen transformations in estuaries as a whole are the focus of much research in estuarine biogeochemistry. Along the estuarine gradient, reactions in bottom sediments are very important to the cycling of nitrogen in the water column (see Nitrogen cycling). The N cycle interacts with the C cycle in two major ways. The presence of inorganic nitrogen as nitrate (NO_3) and ammonium (NH_4) can control the rate of organic carbon production and degradation. Plant productivity in the saline regions of estuaries is limited by nitrogen (See related subsection: Phytoplankton: Effect of Nutrients). Thus, nitrogen loading to surface waters or marshes from upland runoff in urbanized or agricultural areas is expected to increase plant production or the amount of carbon that is converted from its inorganic state (CO_2) to its organic state (plant tissue). Elevated productivity on the one hand may mean more food to support larger shellfish production, but on the other hand translates to greater carbon inputs to the water column upon plant death, which can result in degraded water quality, and is the major indicator of eutrophication of the system.

The bacterial process of denitrification plays a similar role to sulfate reduction in that it represents a pathway used by microbes to oxidize organic carbon. Denitrification converts NO_3 to nitrogen gas (N_2). In estuaries, denitrification is now recognized as an important natural attenuation mechanism for nutrient pollution in the form of terrestrial runoff from agricultural land, golf courses, or sewage (Seitzinger 1988). In order for denitrification to be a dominant process in the nitrogen cycle an aerobic / anaerobic interface must be maintained. $NO_3$is produced from NH_4 in the presence of oxygen. The NO_3 then diffuses downward to the anoxic sediment layers where it is denitrified.

Phosphorus Cycling

Phosphorus is next to nitrogen as the element most often limiting primary production. Indeed, if enough nitrogen is available P will become the limiting nutrient. Maximum plant biomass per area of salt marsh is obtained when both N and P are provided in unlimiting quantities (Morris 1988). Transformations of P in estuarine sediments as a whole do not appear as complicated as the reactions involving sulfur and nitrogen (see Phosphorus transformation). This is because P has no gas phase. P cycling is strongly controlled by the mineral composition of the sediments. It is strongly adsorbed onto sediment particles under freshwater conditions. In saline environments phosphorus is desorbed from colloidal particles as the result of the presence of stronger ionic species, higher pH, and mechanisms in the sulfur cycle that act to sequester metal ligands involved in phosphorus adsorption reactions.

Back to Top

Carbon Cycling

At the system level, carbon transformations appear relatively simple but the underlying biogeochemistry involved in the carbon cycle is quite complex (see Carbon transformations). Understanding the chemistry of carbon cycling in estuaries helps explain how these systems can generate the huge amounts of organic matter in the form of marsh plant and phytoplankton production, and process the large inputs of terrestrially derived organic carbon from freshwater river discharge.

Scientists who study the C cycle are biogeochemists who measure the transfer rate of carbon between its organic and inorganic forms. By determining the rate of transfer and the factors that control that rate, researchers can arrive at residence times for C in its different pools. Then predictions can be made about the effect that changes in residence time will have on different system components if the natural environment was perturbed in some way. When carbon undergoes chemical transformation, energy is stored or released, and this change in energetics drives the system. For instance, scientists have used the current consumption rate of fossil fuels (dead organic C) by humans to predict the rise in global temperature that will result from returning organic carbon from its sedimentary pool to its inorganic pool, represented by CO_2, in the atmosphere. This example represents a biospheric response to perturbations to the carbon cycle as the system function changes from a greater source of atmospheric CO_2.

At the scale of an estuary, carbon cycle perturbations may result in degraded water quality. This can occur when there is increased algal production as a result of elevated nutrient loading in the form of point sources of wastewater discharge or non-point sources of agricultural runoff or when organic inputs from the surrounding watershed are high. More organic input to the estuarine water column translates to more food for bacteria that are responsible for the decomposition of this material. Oxygen is consumed during decomposition. The concentration of dissolved oxygen in the water column decreases drastically during these periods of high organic carbon input and can become so low that shellfish and other macroorganisms migrate to more favorable areas or die.

If oxygen becomes so low that the system becomes anoxic, which occurs frequently in shallow turbid estuaries in the summer time, anaerobic mechanisms for decomposition become important. Anaerobic C turnover occurs continuously in subtidal and intertidal sediments where oxygen is depleted just a few millimeters below the sediment surface.

It is easy to recognize that there are potentially complex interactions between the biogeochemistry of C and other elements, such as oxygen in the previous example, that feedback to control the overall response of the estuarine ecosystem to environmental changes. Physical properties of the environment, such as temperature and salt concentration, can regulate the rates of biogeochemical cycling as well. Thus, it is extremely difficult to control all the possible regulatory factors in biogeochemical experiments. This is why studies in estuarine biogeochemistry tend to focus on one component of the ecological system at a time. There is an extensive knowledge on the biogeochemistry of salt marshes, for instance, which makes this subsystem good for explaining the cycling of the remaining elements.

Back to Top

Factors That Affect Nutrient Cycling in the ACE Basin

- Black Water River
- Landscape Characteristics and Nutrients
- Wetland Biogeochemistry and the Source/Sink Potential for Nutrients

Now that the framework for biogeochemical investigations in estuaries has been described, the next consideration is what makes the ACE Basin study area a unique ecosystem, and how this uniqueness may influence biogeochemical cycles in its estuarine habitat. Because no research on biogeochemical cycles has been conducted in the ACE Basin study area, one must draw on knowledge gained from other estuarine ecosystems in the region like the Cooper River and the Winyah Bay/North Inlet estuaries located near Charleston and Georgetown, SC, respectively, then make educated guesses about how the nature of the ACE Basin study area may cause responses that approximate or differ from these other areas. There are three qualitative observations that can be made about the ACE Basin study area that make it a unique estuarine system compared to others in the region: 1) black water; 2) low urbanization for a river dominated system; and 3) wetlands (freshwater, brackish, and salt marsh) that are a dominant feature of the landscape. The potential effect these characteristics have on biogeochemical cycling will be discussed below.

Black Water River

The Edisto River, the dominant conduit for freshwater inflow into the ACE Basin study area, encompasses approximately 250 unobstructed river miles. This makes the Edisto unique in that it is one of the longest free-flowing black water rivers in the United States. The description of the Edisto as a black water river means that the surface water draining into the estuarine portion of the river is laden with dissolved organic matter, the bulk of which (humic acids) is refractory to metabolic breakdown by heterotrophic bacteria. This characteristic is potentially important to the nature of biogeochemical cycling in the estuary. The high concentration of humic substances in the black water act to sequester phosphorus by a metal-ligand bridge, usually iron, aluminum, or manganese. When the organo-metallic complex comes into contact with saltwater a precipitation/flocculation event occurs, the phosphorus desorbs from the complex and is released as orthophosphate. The chemical event of phosphorus desorption in the mixing zone of the estuary exemplifies an important biogeochemical reaction that occurs because of the complex physiochemical structure of the estuarine environment. The biological structure of estuaries, in turn, responds to the underlying chemical structure (see Conceptual model). In this generalized model of the estuary, the chlorophyll (chl a) maximum occurs just downstream from the mixing zone in response to the nutrient release. Chl a is an acceptable approximation of phytoplankton biomass.

Tidal freshwater marsh

Phosphorus desorption is a contributing factor to differences in nutrient limitation between upstream and downstream primary producers. Phytoplankton and marsh vegetation are limited by phosphorus in the tidal freshwater regions of estuaries. Here bioavailable phosphorus is intensely removed from the water column by adsorption processes. Thus, phosphorus loading in this region of the estuary would be expected to enhance primary production and the potential for phytoplankton blooms. In the higher salinity regions of the estuary where phosphorus has desorbed and becomes bioavailable, primary production is limited by nitrogen. This shift in the limiting nutrient along the salinity gradient is important to estuarine biogeochemical function. Imagine a point source of nitrogen fertilizer from a golf course. Nitrogen loading in the high salinity estuary will be more important to carbon biogeochemistry than in the low salinity estuary. Results of a physical and ecological characterization of the Cooper River north of the Edisto River support this generalized estuarine model for nutrients. There is a maximum in water column nitrogen and phosphorus in the mid-estuary (McKellar et al. 1990). Pore water in the brackish-water marsh (salinity=4.4 (g/l)) in this region of the estuary also has elevated levels of ammonium compared to the freshwater and saline marshes up and down river (see Ammonia and Phosphorus in marsh pore water).

The marsh and water column is extremely fertile in the mid-estuary due to geochemical transformations that occur with mixing. Consequently, the biology responds with increased carbon fixation in the form of elevated Chl a. Plant biomass in the mid-estuary marsh is also high compared to the upstream and downstream extremes (data not shown).

One might hypothesize that on an estuarine-wide scale, the black water nature of the waters in the Edisto River supply more bound nutrients to the estuarine system than in a system such as the Cooper River where the headwaters derive from Lake Moultrie. In the case of the Cooper, Lake Moultrie acts as a large settling basin for allochthonous inputs from the upland watershed. The type of river flowing into the estuary may influence the nature of nutrient loading. The Edisto drains the coastal plain. Rivers that drain the Piedmont, like the Congaree River or the Pee Dee which flow into the Cooper River and Winyah bay, respectively, are flashy due to the impermeability of clay sediments. High fluctuations in discharge with storm events are a characteristic of flashy rivers. Water discharge from the storms deliver organic matter to the receiving estuary in pulses whereas in the Edisto the sandy sediments of the coastal plain dampen fluctuations in discharge allowing humic substances to concentrate. Nutrients in marsh pore water along the Edisto River tend to be higher than the concentrations observed in the Cooper River and Winyah Bay/ North Inlet systems. Could the nutrients carried in the black water discharge that dominates the ACE Basin study area impart estuarine wide eutrophication in a relatively pristine estuary? Do the elevated nutrient levels make the system more or less sensitive to nutrient pollution?

Landscape Characteristics and Nutrients

Perhaps a more easily recognized characteristic of the ACE Basin study area that makes it unique compared to other southeastern estuarine systems is the relative absence of urbanization. According to 1989 land use data (SCWRC 1983) the entire Edisto River Basin was 56% forested. Native forestlands comprised 14% of the basin area. Agricultural land uses made up 34% of the basin area. Urbanization in the entire basin accounts for only 4% of the area. The significance this has to estuarine biogeochemistry is hard to quantify but speculations can be made based on comparisons of surface water nutrients in more and less urbanized estuaries in the region.

Inland maritime forest

Differences in water quality and water column community structure are currently being investigated in the North Inlet and Winyah Bay estuarine ecosystem in Georgetown County, SC. North Inlet has no inflow of freshwater from major rivers. This fact alone makes comparison between this system with river dominated estuarine systems like Winyah Bay interesting from a biogeochemical point of view. Another important point about the North Inlet estuarine ecosystem is the absence of urbanization in the watershed.

A comparison of nitrogen species and chl a between the North Inlet and Winyah Bay estuaries highlights the extreme difference in fertility (see Nutrient concentrations). North Inlet is dominated by ammonium, whereas nitrate is the dominant nitrogen species in Winyah Bay. Chl a, is inversely related to nitrate concentration suggesting a nitrogen limitation to primary production in Winyah Bay. Water column primary production in North Inlet, however, is limited by zooplankton predation (top down control) (Lewitus et al. 1998). The trend for Winyah Bay is typical of a eutrophic estuary. A similar relationship is found in the Chesapeake Bay, a highly eutrophic system (Magnien et al. 1992).

In relation to the ACE Basin study area, nitrate concentrations in the Edisto River are similar to those found in North Inlet, though slightly higher. Nitrate concentrations in Winyah Bay, for comparison, are on average greater by a factor of 10. The high nitrate concentrations in Winyah Bay may be attributed to the large proportion of industrial activity and high rate of non-point source nutrient run-off from agriculture and other land uses. Ammonium nitrogen in surface and pore water in the Edisto, however, is quite large compared to the other river-dominated estuaries. One hypothesis is that the differences between nitrogen concentrations and the dominant nitrogen species among estuaries is a result of landscape scale differences between watersheds.

The large proportion of forested and emergent wetlands in the ACE Basin study area may act as a sink to nitrates entering the watershed via land surface run-off. Recall that microbial denitrification is an important loss mechanism for nitrate in wetland sediments (see background and Seitzinger 1988). Wetland vegetation also intercepts nitrate converting it to organic nitrogen in plant tissues. Although a potential sink for nitrate nitrogen, the wetlands in the ACE may be a source for the high concentrations of ammonium found in the water column. Ammonium accumulates in wetland sediments as a result of organic matter decomposition. One mechanism of ammonium release to the water column is via diffusion. This process, however, would be slow compared to a second mode of transfer, wetland seepage (see Exchange process). Marsh pore waters drain when the water table drops below the sediment surface at low tide and slopes toward the low water level in the adjacent river channel. Nutrient rich pore water mixes with surface waters during these events (Whiting and Childers 1989). Since the relative contribution of wetland and forested area is high and the area occupied by non-impervious surfaces (i.e roads, parking lots, etc) is low in the total land use/ land cover pattern for the ACE Basin study area, ammonium dominates the inorganic nitrogen signal. It has been hypothesized that the differences in nutrient profiles between North Inlet and Winyah Bay may regulate the phytoplankton and bacterial communities in the water column due to differences in nutrient uptake physiology among species (Morris pers. comm.). It is likely that the high concentration of ammonium in the ACE, regardless of it source, plays an important part in structuring the biotic community in this ecosystem as well.

The high ammonium concentrations in the Edisto River may be typical of un-urbanized, pristine river dominated estuaries. Unfortunately, there are very few pristine systems like the ACE to which comparisons could be made. As an example of how sensitive biogeochemical processes in the ACE Basin study area may be to anthropogenic disturbance, however, a recent study found that the effect of a timber harvest on the south fork of the Edisto River was to increase rates of organic matter decomposition, possibly due to an increase in soil temperature after clear cutting (Perison et al. 1997). An elevated level of ammonium and dissolved organic carbon in the ground water at the harvest site was attributed to the higher decomposition rates.

Although ammonium levels appear relatively high in the pristine Edisto River, phosphorus levels are also high (see Ammonia and Phosphorus in marsh pore water). This keeps the ratio of total nitrogen to phosphorus near 12 over the entire basin, as reported by Eidson (1993). This ratio is reflective of a balanced ecosystem based on the ratio in living plant tissue of 10 to 15. Nitrogen limits production of living tissue at ratios below 15 and phosphorus is limiting at ratios above 15. With the extant data it is difficult to make comparisons of the N/P ratio among estuaries, because it is debatable whether to use the inorganic nutrients or the total nutrients, which account for dissolved and particulate organic fractions, to compute N/P ratios. Spatial and temporal patterns in the N/P ratio are likely to be important in regulating production as well.

Runoff from agricultural fields may contain high levels of nutrients

Eutrophication, however, seems to be the result of a rise in one of the limiting elements relative to the other. In the Chesapeake Bay it is nitrogen. In the Florida Everglades it is phosphorus. Therefore, it makes sense to manage the system under the ratio that promotes the most favorable function. In the case of the Chesapeake, seagrass beds have declined drastically in the face of nitrogen pollution. In the Everglades, the native sawgrass plant community is being replaced by cattails, which are less favorable due to their high rates of transpiration. Hence, it may seem paradoxical to consider the ACE Basin study area pristine when the concentrations of important nutrients are relatively high in the water column and marsh pore water. But the underlying biogeochemical transformations of these nutrients that dictate production and carbon recycling in the system appear to keep the system functioning in a non-eutrophic condition. Landscape characteristics influence biogeochemical processes on a system wide scale, such as the proposed nitrate dissimilation scenario that may take place in the vast mosaic of wetlands that comprise the ACE Basin study area. Increased urbanization or enhanced forest clear-cutting and agricultural activity would likely increase nitrogen levels more than to phosphorus due to the high adsorption capacity of saturated sediments. Elevated nitrogen would increase the N/P ratio, and potentially throw the system out of balance, to a more eutrophic condition.

Wetland Biogeochemistry and the Source/Sink Potential for Nutrients

In the previous section, the relation between abundance of wetland habitats in the ACE Basin study area as an important landscape characteristic and its influence on estuarine function was discussed. Further mention of the importance of biogeochemical processes in wetlands to the open waters of the estuary is warranted. Rates of carbon turnover in wetland sediments elevate the levels of pore water nutrients relative to surface water. Considerable attention has been put toward understanding the source/sink relationship of salt marshes, in particular, with respect to the estuarine water column. From a managerial perspective it is important to determine the link between saltmarsh processes and coastal productivity so that the impact of wetland loss or gain can be assessed quantitatively.

Several methods have been used to quantify the source/sink relationship with respect to nutrients all of which have specific advantages and disadvantages (see Nutrient Flux) (Carpenter 1997). Partly due to the disparity among methods, marsh systems appear to process nutrients in different ways. For example, Nixon (1980) concluded that salt marshes intercept dissolved inorganic nitrogen in runoff from the surrounding land and convert it to organic forms that then exchange with the waters in the tidal channels. Other investigators have shown that intertidal marshes tend to import particulate matter and export dissolved fractions of nutrients and carbon to adjacent estuarine water (Valiella et al. 1978, Jordan et al. 1983, Correl et al. 1991). North Inlet salt marshes, in particular, are nutrient exporters (Whiting et al. 1987), although there appears to be considerable seasonality to this relationship (Whiting et al. 1989). Quantification of the source or sink nature of marshes with respect to nutrients integrates both the biogeochemical processes within the wetland and the geomorphologic characteristics that regulate hydraulic fluxes between the water column and marsh sediments.

Salt marshes are characterized as one of the most productive ecosystem types in the world. In the Southeast, the salt marsh cordgrass, *Spartina alterniflora*, can have a net primary production up to 1,400 g $C/m^2/yr$ according to recent estimates (Dai and Wiegert 1996). Root growth accounts for a large portion of this production. In the short form of *Spartina*, roots represent 50% of the total plant biomass. The large proportion of roots translates to an abundant reservoir of reactive carbon that fuels the metabolism of microbial communities that live in marsh sediments. Much of the organic matter oxidation undergoes decomposition in an anaerobic environment via sulfate reduction. Therefore, the biogeochemistry of sulfur in salt marshes is tightly linked to energy flow and, hence, carbon and nutrient turnover (see Energy flow model). Models of wetland carbon cycling highlight the complexity of chemical interactions among components of the marsh ecosystem that ultimately determine the concentration of nutrients in marsh pore waters.

Research is on-going in the ACE to determine relative differences in bulk sediment carbon metabolism in tidal marshes situated along a salinity gradient in the Edisto River. Although much work has been done to understand biogeochemistry of carbon and nutrients in salt marshes, little is known about how these constituents behave in marshes located in lower salinity waters. Chemical constituents in marsh pore water are currently being monitored at sites in the Cooper River, North Inlet, Winyah Bay and the Edisto River (see Ammonia and Phosphorus in marsh pore water) to gain a better understanding of the variability in pore water carbon and nutrient reservoirs within and between estuarine marshes. In the ACE Basin study area, salt marshes and other lower salinity tidal marshes have long been recognized as important sources of carbon to shellfish and juvenile fish production. Now scientists are beginning to recognize their role in regulating water quality as important determinants for the fertility of open water habitats via nutrient exchanges.

Back to Top

Conclusion

Our understanding of changes currently taking place in estuarine ecosystems and our management of these systems can benefit from a thorough evaluation of the underlying biogeochemical cycles. Physiochemical processes that affect biotic responses drive these cycles. The ultimate goal of studying biogeochemical cycles in estuaries is to understand the chemical processes controlling the underlying function of the estuarine ecosystem. The lack of urbanization and the extensive network of wetlands in the ACE Basin study area make this a unique estuarine system with biogeochemical parameters that are quite different compared to other estuaries along the South Carolina coast. The low levels of nitrate /nitrogen in the estuary and the balanced N/P ratio are indicative of a healthy ecosystem. The lack of symptoms of eutrophication in the face of relatively high concentrations of ammonium and phosphorus in the water column and marshes suggests that future management of the ecosystem should be directed at keeping the existing ratio of these nutrients constant.

NEXT SECTION: Climatology

Author

C. Nietch, University of South Carolina

References

Carpenter, K. 1997. A critical appraisal of the methodology used in studies of material flux between salt marshes and coastal waters. *In*: T. D. Jickells and J. E. Rae (eds.). Biogeochemistry of intertidal sediments. Cambridge Environmental Chemistry Series. Vol. 9.

Correll, D. L., T. E. Jordan, and D. E. Weller. 1991. Nutrient flux in a landscape: Effects of coastal land use and terrestrial community mosaic on nutrient transport to coastal waters. Estuaries 15(4):431-42.

Dai, T. and R. G. Wiegert. 1996. Estimation of primary productivity of Spartina alterniflora using a canopy model. Ecography 19:410-423.

Eidson-Pickett, J. 1993. Water quality. *In*: W. D. Marshall (ed.). Assessing change in the Edisto River Basin: An ecological characterization. South Carolina Water Resources Commission.

Jordan, T. E., D. L. Correl, and D. F. Whigham. 1983. Nutrient flux in the Rhode River: Tidal exchange of nutrients by brackish marshes. Estuarine Coastal and Shelf Science 17:651-667.

Knox, G. A. 1986. Estuarine ecosystems: A systems approach. Volumes I-II. CRC Press Inc. Boca Raton, FL.

Kristensen, E., M. H. Jensen, and T. K. Andersen. 1985. The impact of polychaete (*Nereis virens* Sars) burrows on nitrification and nitrate reduction in estuarine sediments. Journal of Experimental Marine Biology and Ecology 85:75-91.

Lewitus, A. J., E. T. Koepfler, and J. T. Morris. 1998. Seasonal variation in the regulation of phytoplankton by nitrogen and grazing in a salt-marsh estuary. Limnology and Oceanography 43(4):636-646.

Magnien, R. E., M. Summers, and K. G. Sellner. 1992. External nutrient sources, internal nutrient pools, and phytoplankton production in Chesapeake Bay. Estuaries 15:497-516.

McClelland, J. W., I. Valiela, and R. H. Michener. 1997. Nitrogen-stable isotope signatures in estuarine food webs: A record of increasing urbanization in coastal watersheds. Limnology and Oceanography 42:930-937.

McKellar, H. N., E. R. Blood, T. Sicherman, K. Connelly, and J. Hussey. 1990. Organic carbon and nutrient dynamics. *In*: R. F. Van Dolah, P. H. Wendt, and E. L. Wenner (eds.). A physical and ecological characterization of the Charleston Harbor estuarine system. South Carolina Coastal Council, Charleston, SC.

Morris, J. T. 1988. Pathways and controls of the carbon cycle in salt marshes. p. 497-510. *In*: D. D. Hook (ed.). The ecology and management of wetlands. Croom Helm, UK.

Morris, J. T. Personal Communication. University of South Carolina, Columbia, South Carolina. 1998.

Nixon, S. W. 1980. Between coastal marshes and coastal waters-a review of twenty years of speculation and research on the role of salt marshes in estuarine productivity and water chemistry. p. 437-525. *In*: P. Hamilton and K. B. MacDonald (eds.). Estuarine and Wetland Processes. Plenum Press, New York, NY.

Perison, D., J. Phelps, C. Pavel, and R. Kellison. 1997. The effects of timber harvest in a South Carolina blackwater bottomland. Forest Ecology and Management 90:171-185.

Seitzinger, S. P. 1988. Denitrification in freshwater and coastal marine ecosystems: Ecological and geochemical significance. Limnology and Oceanography 33:702-724.

[SCWRC] South Carolina Water Resources Commission. 1983. South Carolina state water assessment. Water Resources Commission. Columbia, SC.

Valiela, I., J. M. Teal, S. Volkmann, D. Shafer, and E. J. Carpenter. 1978. Nutrient and particulate fluxes in a salt marsh ecosystem: Tidal exchanges and inputs by precipitation and groundwater. Limnology and Oceanography 23:798-812.

Whiting, G. J., H. N. McKellar, Jr., B. Kjerfve, and J. D. Spurrier. 1987. Nitrogen exchange between a southeastern U.S.A. salt marsh ecosystem and the coastal ocean. Marine Biology 95:173-182.

Whiting, G. J., H. N. McKellar, Jr., J. D. Spurrier, and T. Wolaver. 1989. Nitrogen exchange between a portion of vegetated salt marsh and the adjoining creek. Limnology and Oceanography 34:463-473.

Whiting, G. J. and D. L. Childers. 1989. Subtidal advective water flux as a potentially important nutrient input to southeastern U.S.A. saltmarsh estuaries. Estuarine, Coastal, and Shelf Science 28:417-431.

M
E
N
U

Introduction

Temperature

Precipitation

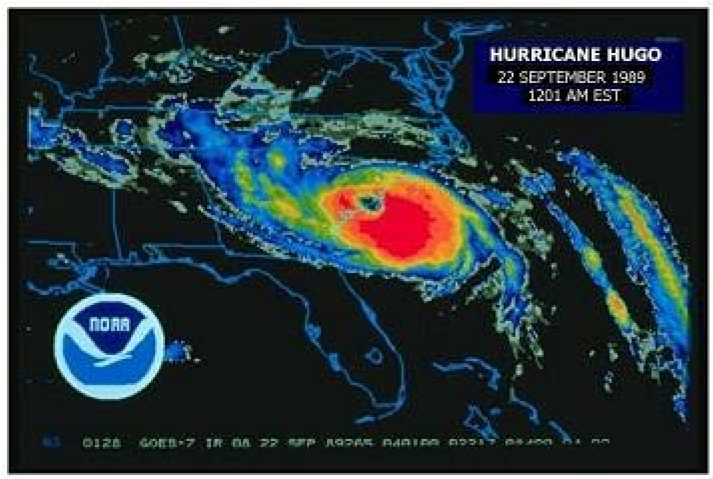
Wind

Severe Weather

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Climatology

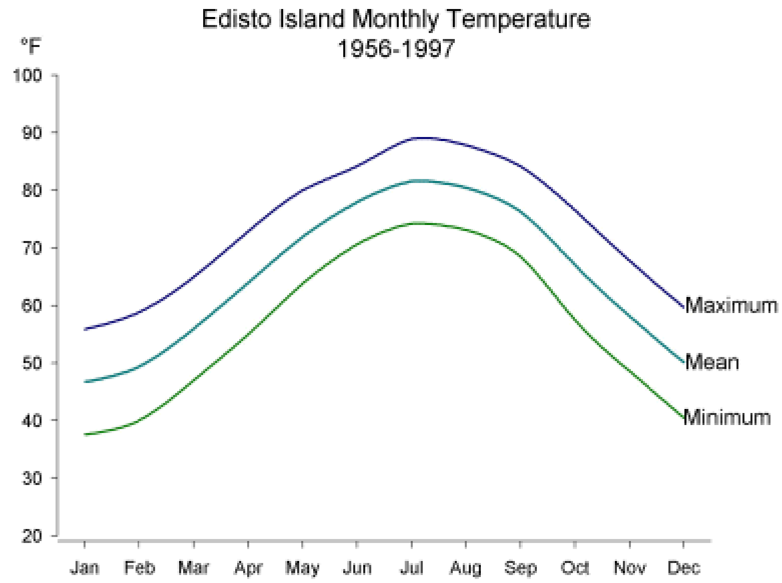
Introduction



Hot, humid summers, mild winters, and ample precipitation throughout the year characterize the climate of the ACE Basin. These patterns result from a combination of factors including latitude, prevailing pressure and wind systems, the southern Appalachian Mountains, and the proximity of the Gulf Stream. Three weather stations, Edisto Island (1956-present), Walterboro (1948- present), and Yemassee (1896-present), provide data to describe the subtropical climate of the Basin. A weather station also exists at the ACE Basin National Estuarine Research Reserve (NERR) field station at Bennett's Point, but data have only been collected there since 1995 (NERR weather data).

Temperature

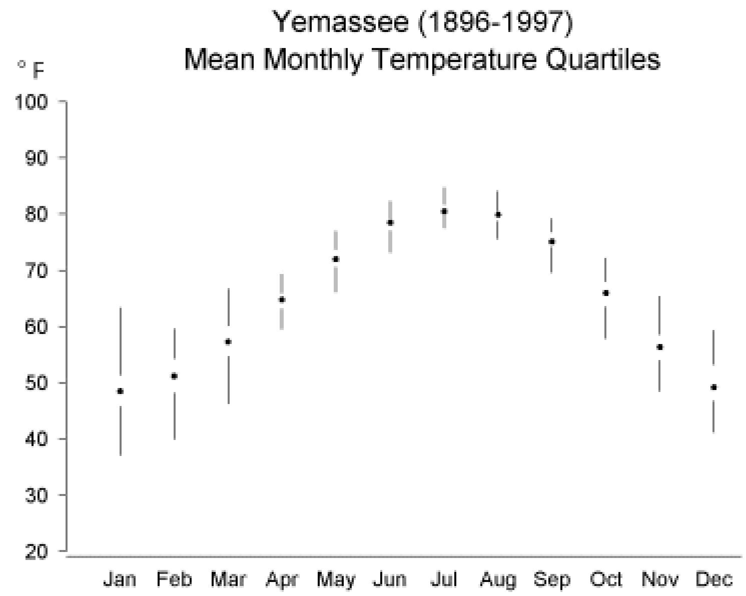
High solar intensity during the summer months leads to high temperatures in the ACE Basin. Maximum temperatures in July and August average approximately 32°C (90°F); morning minimum temperatures average close to 21°C (70°F) (Edisto temperatures) (Walterboro temperatures) (Yemassee temperatures). Daily high temperatures in the summertime are moderated along the immediate coast, where sea breezes draw cooler air inland from the Atlantic



Ocean, as can be seen by the comparison of temperatures in Yemassee and Edisto. There is very little year-to-year variability in summer temperatures as maritime tropical air dominates the region. Winters in the Basin are cooler than summers because of shorter daylight hours and less intense solar radiation. With the noon sun approximately 35° above the horizon on December 21-22, solar intensity is only half that of the summer solstice. In addition, the Atlantic subtropical high weakens, limiting the delivery of mild subtropical air.

Despite these circumstances, the region is warmer than it could be. For example, mean January temperatures are close to 10°C (50°F). Several factors contribute to the relatively mild winter temperatures. First, the warm Gulf Stream along the Atlantic coast supplies energy to the overlying atmosphere. The contrast in temperature between Edisto Island and Yemassee, only 48 kilometers (30 miles) inland, provides evidence that this moderating effect occurs even on a relatively local scale (see the previous figure). Second, the Southern Appalachians limit the flow of air from interior portions of the continent and alter the flow's character when it does move past the range. The mountains are high enough to retard and, in some cases, prevent the intrusion of winter polar air masses. When air does move over the range and sink on the leeward side, it is compressed and warmed.

Of course, average monthly temperatures tell only part of the story. The long-term temperature record of Yemassee illustrates how mean monthly temperatures in the Basin have fluctuated from year to year. Interannual fluctuations are quite large in winter. In January, for example, the highest mean monthly temperature 17°C (62°F) in 1937 is 12°C (25°F) warmer than the coolest January (3°C or 38°F in 1940). These winter fluctuations result from differences in upper-air circulation, which redistributes energy across the mid-latitudes. During some periods, upper-level winds over North America orient themselves in such a way as to bring a strong influx of cold continental air to the



southeastern United States. During other times, milder flow from the southwest dominates the circulation pattern. The strong interannual variability in winter months expresses itself even in the 100-year mean annual temperature record at Yemassee (Yemassee temperature bar). The persistent presence of maritime tropical air and weak circulation in the subtropics limit variability in summer temperatures.

Within the interannual temperature variability, some general trends are noteworthy. These include an increase in temperature during the early part of the twentieth century a gradual decrease during the 1940-1970 period; and an increase during the past 25 years. This pattern is typical of most Northern Hemisphere locations.

Back to Top

Precipitation

The ACE Basin has high humidity during much of the year because of its proximity to large moisture sources, the Atlantic Ocean and the Gulf of Mexico, and the wind systems that carry moisture inland from these water bodies. These winds, typically from the south or southwest, are often part of a semi-permanent subtropical high pressure cell in the Atlantic, called the “Bermuda High." The large quantity of moisture provides an abundant source for precipitation which ranges from 100-130 centimeters (40 to 50 inches) during most years (Yemassee precipitation bar) (Yemassee precipitation quartiles).

On average, precipitation is plentiful during every month, but the summer months receive the maximum (Edisto precipitation) (Walterboro precipitation) figure. Most summer precipitation comes from thunderstorms that develop as intense surface heat forces warm, moist air aloft. Precipitation from these thunderstorms can be intense, but is usually of short duration. Thunderstorms are essential in sustaining water resources during the summer, when temperature and evaporation rates are high. During some years, the Bermuda High moves westward, establishing itself over the Southeast. When this happens, drier air develops, vertical lifting weakens, and clouds and precipitation are suppressed. Warm season precipitation can also come from hurricanes (discussed below).

Winter precipitation comes predominantly from mid-latitude cyclones. These are very large storm systems resulting from the convergence of warm moist air from the Gulf of Mexico or the Atlantic Ocean with cooler and drier air from the interior United States and Canada. Usually originating east of the Rocky Mountains and moving eastward with the prevailing winds, mid- latitude cyclones move across the Southeast every five to seven days in the winter. They can bring prolonged periods of drizzle or steady rain. Cold fronts also occur with these mid-latitude lows, and lifting along these fronts often produces thunderstorms. The Nor'easter is an intense form that develops typically in the western Gulf of Mexico or just east of the southern Rocky Mountains. These storms are characterized by extremely low pressure and feed on latent heat from evaporation off the relatively warm Gulf of Mexico and contrasting subtropical and polar air masses. They usually move eastward along the Gulf Coast and then turn northward along the Atlantic Coast, producing strong winds, high waves and storm surges, severe thunderstorms, and heavy precipitation.

Back to Top

Wind

While no weather station in the ACE Basin has a sufficient record of wind data, winds recorded at Charleston can be used to approximate the wind climatology of the Basin (Wind rose per year). The dominant wind direction in Charleston varies seasonally. Between September and February, winds commonly come from the north, northeast, or west (See Monthly wind rose). By March the predominant directions are west, southwest, and south, a tendency that persists through August. Average speeds are greatest from December through May.

Back to Top

Severe Weather

Severe thunderstorms produce heavy rainfall, lightning, hail, and, on occasion, tornadoes. While tornadoes have occurred infrequently in the ACE Basin and have been less severe than those typical of the Central United States, they have produced casualties and caused considerable damage. Review the summary of tornadoes documented in Colleton County. As with the general U.S. pattern, the majority of tornadoes have struck during the spring and summer months (Tornadoes). During these months that the warm land surface enhances vertical lifting, and subtropical air commonly clashes with cold polar air invading from the northern interior part of North America. Tornadoes most frequently develop between noon and 10 PM, peaking between 4 and 6PM, the time of maximum atmospheric heating and instability.

Hurricanes provide another source of warm-season rain. When they, or their remnants, strike the Southeast, they can drop several inches of rain over a short period of time. The storms that have affected the ACE Basin developed as low pressure systems in the trade winds west of Africa, in the Atlantic Ocean, over the Caribbean Sea, or in the Gulf of Mexico (Hurricanes). Hurricane season extends from June 1 to November 30, but peak strike time is from mid-August to mid-September when ocean temperatures in the source regions are warmest. Hurricane damage results from winds, flooding, heavy rainfall, and storm surge. Hurricanes also often spawn tornadoes. The threat each hazard poses depends on a variety of factors including the intensity of the storm, the resulting storm surge height, and its landfall timing with respect to natural tides. While improved forecasting has reduced human casualties in recent decades, extensive building in coastal areas has made the human landscape more susceptible to damage. Damage also affects natural environments by altering the shoreline, killing wildlife, or damaging habitat.

NEXT SECTION: Surface water

Authors

G. Carbone, University of South Carolina

M. Brown, Southeast Regional Climate Center

D. Yow, Southeast Regional Climate Center

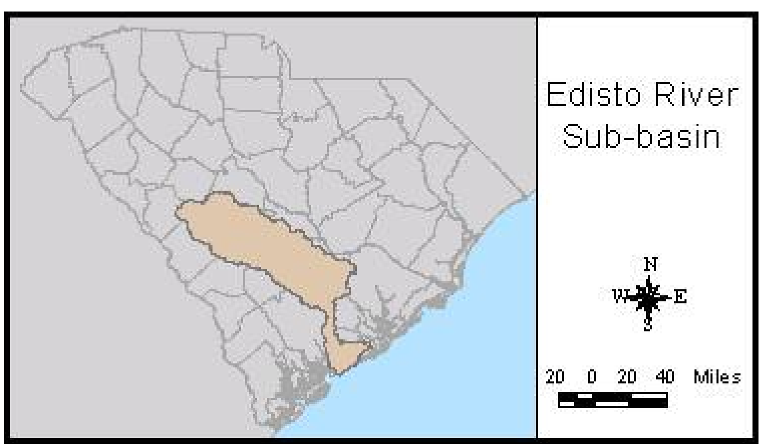
Surface Water

Introduction

The ACE Basin Characterization study area is entirely contained within the lower coastal plain of South Carolina. However, the headwaters of many of the streams within the study area originate in the middle or upper coastal plain. The topographic slope of this region is moderate. All of the surface water in the ACE Basin study area eventually flows into St. Helena Sound and the Atlantic Ocean (South Carolina Water Resources Commission 1972). Drainage is southeasterly with a principal stream gradient of about 69 cm/km (3.5 ft/mi) (Bloxham 1979). Stream gradients range from about 375 cm/km (20 ft/mi) near the upper boundary to 19 cm/km (1 ft/mi) near the coast (Bloxham 1981). The Land, Water, and Conservation Division of the South Carolina Department of Natural Resources has divided the ACE Basin into two river sub-basins, the Edisto and the Combahee-Coosawhatchie. Approximately 32 km (20 miles) of the Intracoastal Waterway flows through the study area and connects the North Edisto River to St. Helena Sound at the mouth of the Combahee River (Intracoastal waterway). (See related section: Geomorphology: Physiographic Regions.)

Edisto River Sub-basin

- Saltwater Intrusion
- Streamflow Measurements
- Water Use
- Water Quality
- Development



The Edisto River sub-basin extends northward from St. Helena Sound and lies entirely within South Carolina (U.S. Army Corps of Engineers 1991). The Edisto River sub-basin is drained by four tributary rivers: the South Fork Edisto River, North Fork Edisto River, Edisto River, and Four Hole Swamp (See the surface water sites). The North and South Fork Edisto rivers originate within and pass through the sandhills of Aiken and Lexington Counties in the upper coastal plain and join near Orangeburg to form the Edisto River in the middle coastal plain (U.S. Army Corps of Engineers 1991). Four Hole Swamp is a system of creeks which drains extensive swamp land. This swamp originates in Orangeburg County in the upper coastal plain and discharges into the Edisto River near Givhans. Near the coast, the Edisto River diverges to form the North and South Edisto rivers. These tidally influenced estuaries drain bordering salt marshes and tidal creeks (South Carolina Water Resources Commission 1983).

There are no large reservoirs in the sub-basin, and the largest, lake (unnamed) is located in Dawhoo Swamp and has a surface area of 160 hectares (395 acres) and a volume of 1 cubic kilometer. The second largest lake, Reynolds Pond in Giddy Swamp, is smaller in area, 80 hectares (198 acres), but larger in volume (2.5 cubic kilometers) (South Carolina Water Resources Commission 1983).

Saltwater Intrusion

The Edisto River is tidally-influenced below river mile 38 (river miles are statute miles measured upstream from the mouth and follow the curves of the river) and the saltwater interface extends to river mile 19.5 during high tide. For any given tidal stage, lower freshwater inflow allows saltwater intrusion farther upstream. Thus, during periods of very low flow, the saltwater interface can intrude to river mile 32, near Jacksonboro (Johnson 1977).

Streamflow Measurements

Presently, streamflow and water quality are monitored by U.S. Geological Survey at eight gaging stations: three on the South Fork Edisto River, and one each on the Edisto River, the North Fork Edisto River, Cow Castle Creek, Dean Swamp Creek, and McTier Creek (Gaging stations). Streamflow on the Edisto River is substantial and fairly consistent. These well-sustained flows are due primarily to discharge from ground-water reserves in the upper coastal plain region, in which over one-half the Edisto sub- basin is located (South Carolina Water Resources Commission 1983). Average annual streamflow on the Edisto River near Givhans is 74 m^3/s (2,614 cubic feet per second (cfs)). Average flow in the major tributary streams is 21.6 m^3/s (766 cfs) on the South Fork Edisto near Denmark and 22.1 m^3/s (783 cfs) on the North Fork Edisto at Orangeburg. Cow Castle Creek exhibits variable flows typical of most middle and lower coastal plain streams, where flow is more dependent on rainfall and direct runoff. Average flow on this stream is 0.57 m^3/s (20.3 cfs) (Edisto streamflow) (Cooney et al. 1998).

Water Use

The Edisto River and tributary streams in the upper coastal plain exhibit well-sustained flows and provide a reliable water supply. Tributary streams in the middle and lower coastal plain region, however, have more variable flows and provide limited surface-water during periods of low rainfall (South Carolina Water Resources Commission 1983). In 1983, total gross use in the Edisto sub-basin was 999 million liters per day (mld) (264 million gallons per day (mgd)), and 36 percent of this was "lost". Surface water can be lost through evapotranspiration, transfer to another watershed, or leaching into groundwater systems. Surface water supplied 93 percent of total water demand excluding thermoelectric-power water use. Leading water users in the Edisto sub-basin are thermoelectric power, public supply (domestic, industrial, or commercial uses), and agricultural irrigation. A thermoelectric plant near Givhans operated by South Carolina Electric and Gas accounted for 60% of the gross water use in 1983. Large withdrawals by the City of Charleston, upstream of Givhans, accounted for most of the water use. Approximately 246 mld (65 mgd) of Edisto River water was diverted into the Ashley-Cooper sub-basin for public water supply and industrial use by the City of Charleston. Agricultural irrigation accounted for about six percent of gross water use in 1983. Surface water withdrawals for irrigation in 1983 were the greatest in the state with over a quarter of the irrigated acreage in the state located in this sub-basin (South Carolina Water Resources Commission 1983). Total water use in the Edisto sub-basin is projected to increase by 52% (1,518 mld or 401 mgd) by the year 2020.

Agricultural and thermoelectric power plant uses are expected to remain the leading gross water users (South Carolina Water Resources Commission 1983).

Only one public facility that uses more than 1.1 mld (0.3 mgd) occurs in the study area portion of the Edisto sub-basin. The town of Edisto Beach uses 2.9 mld (0.76 mgd). Ground water is, however, the source for this user (Newcome 1995).

Water Quality

The Department of Health and Environmental Control (DHEC) monitors water quality at 37 stations in the study area of the Edisto River sub-basin (Monitoring stations). In most of the ACE Basin region, no major water quality problems have been identified, although high levels of fecal coliform bacteria have occurred near the highly populated areas of Edisto Island.

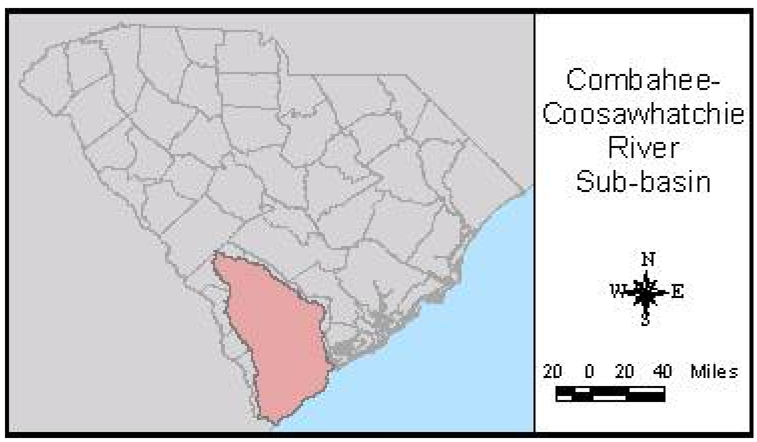
Development

Surface-water resource development in the Edisto River sub-basin is limited to several navigation and flood control projects. Three navigation projects have been undertaken by the U.S. Army Corps of Engineers in this sub-basin, but none of these projects is maintained (South Carolina Water Resources Commission 1983). Three small flood control projects, two in St. George and one in Givhans, have been supervised by the Natural Resource Conservation Service (NRCS) in this sub-basin. The NRCS provides engineering assistance and funding appropriation assistance for municipalities. These projects are designed to prevent flooding in rural communities and are maintained by the municipalities (Edwards, pers. comm.).

Back to Top

Combahee-Coosawhatchie River Sub-basin

- Saltwater Intrusion
- Streamflow Measurements
- Water Use
- Water Quality
- Development



The Combahee-Coosawhatchie River sub-basin is contained primarily in the middle and lower coastal plain. The major freshwater streams draining this sub-basin are the Salkehatchie River, the Coosawhatchie River, and the Ashepoo River (Site map). The Salkehatchie River and the Little Salkehatchie are the major tributaries to the tidally influenced Combahee River. The Combahee and Ashepoo rivers drain into St. Helena Sound but the Coosawhatchie River drains outside of the study area, into Port Royal Sound. The coastal area of this sub-basin contains the most extensive estuarine waters in the state. These coastal waters are dominated by St. Helena Sound and Port Royal Sound and include numerous locally interconnecting tidal creeks and rivers (South Carolina Water Resources Commission 1983). There are no large reservoirs and only five lakes greater than 80 hectares (200 acres) in this sub-basin. An unnamed lake on the Ashepoo River is the largest lake at 324 hectares (800 acres) in the sub-basin (South Carolina Water Resources Commission 1983).

Saltwater Intrusion

The Combahee River is tidally influenced for most of its length, and, during periods of low freshwater flow, salt water can intrude as far inland as Yemassee (Hazen and Sawyer Engineers 1956). The Ashepoo River is also tidally influenced, and, during periods of low flow, salt water can intrude to the headwaters beyond U.S. Highway 17 (Johnson 1977).

Streamflow Measurements

Streamflow has been monitored on the Salkehatchie since 1951. Average annual streamflow on the Salkehatchie River near Miley is 9.8 m^3/s (346 cfs) and 90 percent of the time, it is at least 2.8 m^3/s (98 cfs) (Cooney et al. 1998). This well-sustained flow is probably due to discharges from several ground-water fed headwater streams located in the upper coastal plain region (South Carolina Water Resources Commission 1983). Other than these ground-water fed streams, the amount of fresh surface water available within the sub-basin is limited. Flow in the tributary and main stem regions of the Combahee and Ashepoo rivers is more variable than in the Salkehatchie River, and, in the Great Swamp region of the Ashepoo River, flow is often non-existent during the summer and fall (Combahee streamflow).

Water Use

In 1983, total water use within the Combahee sub-basin was estimated at 110.9 mld (29.3 mgd), with 50 percent of the withdrawal being lost. Major water users were public supply, agricultural irrigation, self-supplied domestic, and self-supplied industrial. Ground water supplied the majority of the water for these uses. Only 18 percent of the gross use was supplied by surface water. Approximately 23.5 mld (6.2 mgd) of surface water from the Lower Savannah River sub-basin was diverted into this sub-basin for public supply use. Agricultural irrigation supply was the largest surface water withdrawal in this sub-basin, with 46% of irrigation water being supplied by surface water. When averaged over the five-month growing season, irrigation water use accounted for 41% of the gross use and 66% of the 'lost' water. Total use in this sub-basin is projected to increase by 220% by the year 2020. Most of this increase will likely be due to increases in agricultural irrigation and most of the demand in the Combahee-Coosawhatchie sub-basin will be supplied by ground water (South Carolina Water Resources Commission 1983).

Irrigation

Within the ACE Basin study area of this sub-basin there is only one facility, the city of Walterboro, that uses more than 1.1 mld (0.3 mgd). Walterboro uses 7.3 mld (1.92 mgd), all of which is supplied by ground water (Newcome 1995).

Water Quality

The DHEC monitors water quality at 24 sites within the study area of this sub-basin. As in the Edisto River sub-basin, no major water quality problems have been identified at these stations except for high levels of fecal coliforms in the Ashepoo River downstream of Walterboro and in the Coosaw River near Beaufort.

Development

Surface-water resource development in the Combahee-Coosawhatchie River sub-basin consists primarily of navigation projects in the coastal waters, although some flood-control projects occur throughout the area. The U.S. Army Corps of Engineers has been involved in seven navigation projects in this sub- basin, four of which were within the study area. None of these is currently active. A number of flood-control projects have been undertaken in the sub-basin. Since 1980, the Natural Resource Conservation Service (NRCS) has conducted four flood control projects (White Hall, Campus A Middle School, Highway 363 Church of God, and Yemassee) to provide flood prevention to rural communities (Edwards, pers. comm.). The Willow Swamp region of Colleton and Bamberg Counties is the site of the only large completed flood control project conducted by NRCS in this sub-basin (South Carolina Water Resources Commission 1983).

Back to Top

Future Water Demands

Surface water demands in both the Edisto and Combahee-Coosawhatchie River sub-basins will increase substantially by the year 2020. However, the streamflows in these regions are projected to adequately meet these demands at least 95% of the time. Although no gaging stations exist in the lower reaches of streams in the ACE Basin study area, estimations of water availability in the lower reaches indicate that water supplies in the Combahee-Coosawhatchie could be limited in some tributary streams during periods of low flow. A site-specific hydrologic analysis to determine the quantity of streamwater available during rainfall events should be performed where small tributary streams are considered for water supply sources (South Carolina Water Resources Commission 1983).

NEXT SECTION: Ground Water

Authors

B. Badr, SCDNR - Land, Water, and Conservation Division

L. Zimmerman, SCDNR - Marine Resources Research Institute

References

Bloxham, W. M. 1979. Low-flow frequency and flow duration of South Carolina streams. South Carolina Water Resources Commission Report No. 11. Columbia, SC.

Bloxham, W. M. 1981. Low-flow characterization of ungaged streams in the piedmont and lower coastal plain of South Carolina. South Carolina Water Resources Commission, Report No. 14. Columbia, SC.

Cooney, T. W., K. H. Jones, P. A. Drewes, J. W. Gissendanner, and B. W. Church. 1998. Water resources data, South Carolina, water year 1997, U.S. Geological Survey, Columbia, SC.

Edwards, S. personal communication. Natural Resource Conservation Service. 1999.

Hazen and Sawyer Engineers. 1956. Report to the Bureau of Yards and Docks, Department of the Navy, on water supply in the vicinity of Beaufort, South Carolina. New York, NY.

Johnson, F. A. 1977. A Reconnaissance of the hydrology of the Edisto and Ashepoo estuaries, South Carolina. South Carolina Water Resources Commission, Report No. 6. Columbia, SC.

Newcome, R., Jr. 1995. The 100 largest public water supplies in South Carolina-1995. SC Department of Natural Resources, Water Resources Division Report No. 3.

South Carolina Water Resources Commission. 1972. ACE framework study: Ashley-Combahee-Edisto River Basin. Columbia, SC.

South Carolina Water Resources Commission. 1983. South Carolina state water assessment. Report No. 140. Columbia, SC.

United States Army Corps of Engineers. 1991. Water resources development in South Carolina 1991. U.S. Army Corps of Engineers, Charleston, SC.

MENU

Introduction

Previous Investigations

Hydrogeologic Framework

Summary

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Ground Water

Introduction

Six aquifer systems underlie the ACE Basin. They encompass rocks of the Late Cretaceous-age Cape Fear, Middendorf, and Black Creek formations, the Tertiary-age Black Mingo Formation, Santee and Ocala limestones, Cooper Formation, and a veneer of Quaternary-age deposits mainly associated with barrier-island formation. Review the Geologic Time Scale for geologic ages. Each aquifer system has unique and diagnostic combinations of lithology, hydraulics, and water chemistry, and the aquifer systems are separated by confining units 18 to 76 meters (60 to 250 feet) thick. The six aquifer systems also share the characteristic condition of localized saltwater intrusion. Ground water supplies almost all water demand. The public water supply systems for Edisto Beach and Walterboro are the largest users. Private domestic wells are used elsewhere and account for most of the water pumped.

Information provided in this summary is derived principally from the publications listed at the end of the section. Files of the South Carolina Department of Natural Resources (SCDNR) Land, Water, and Conservation Division provided supplemental information on well depths and yields, aquifer hydraulics, and water chemistry. (See hydrologic sections and selected wells)

Previous Investigations

There are no reports devoted specifically to the hydrogeology of the ACE Basin, but a number of ground-water study areas include, overlap, or lie near the basin, and they provide insight into local conditions. Siple (1965 and 1967) summarized saltwater encroachment along the South Carolina coast and presented geologic sections, an Eocene-limestone structure map, and a chloride-distribution map, all of which included the ACE Basin. The ACE Framework Study (South Carolina Water Resources Commission 1972) was a planning study that summarized geologic, water-resource, and climate conditions in the basin and surrounding counties. Ground-water conditions in the South Carolina Low Country were investigated by Hayes (1979), and his geologic sections, structure maps, and water-level maps extend into the basin. Potential contamination sites and lithologic and background water-quality data for shallow aquifers of the lower coastal plain were described in a nine-volume report (Glowacz et al. 1980). A Trident-area ground-water study included a geologic section; and structure, water-level, and water-quality data for the Santee Limestone at Edisto Island and Edisto Beach (Park 1985) . A hydrologic framework of the South Carolina coastal plain was presented by Aucott et al. (1987), and their extensive atlas defines six principal aquifer systems with hydrologic sections and depth-to-aquifer maps that encompass the ACE Basin. Potentiometric-data for the basin are included in water-level atlases for the Floridian aquifer (Crouch et al. 1987; DNR file data), the Black Creek aquifer (Hockensmith 1998), and the Middendorf aquifer (Hockensmith and Waters 1998). Pre-development water level maps for the South Carolina coastal plain were published by Aucott and Speiran (1984) and Aucott (1988). Aucott and Speiran (1985) and Stringfield and Campbell (1993) published isodecline maps and potentiometric maps for 1982 and 1989, respectively.

Useful reports on areas near the ACE Basin include Hassen (1985), Speiran (1985), Dale (1995), and Hockensmith (1997). Hassen presented detailed water-level and water-quality data for the Floridian aquifer in northeastern Beaufort County, and he mapped ground-water movement from Ladies and St. Helena islands into the St. Helena Sound estuary, Speiran (1985), Dale (1995), and Hockensmith (1997) made water-table aquifer studies and constructed ground-water flow models for parts of Wadmalaw and Hilton Head Islands. The reports included information on geology, ground-water behavior, and chemical quality that are representative of the shallow aquifer in much of the ACE Basin.

Back to Top

Hydrogeologic Framework

The SCDNR Hydrology Section, using recent hydro-stratigraphic nomenclature proposed by Aadland et al. (1995) and core-drilling data, is revising its definitions for coastal plain aquifers. Until the reclassification process is completed, the hydrogeologic framework defined by Aucott et al. (1987) is being used for regional projects such as potentiometric mapping (Hockensmith 1997; Hockensmith and Waters 1998), and it is used for this report.

Six aquifer systems and three principal confining beds have been defined in the lower coastal plain (Aucott et al. 1987). The principal aquifer systems, in ascending order, are as follows:

- Cape Fear Aquifer System
- Middendorf Aquifer System
- Black Creek Aquifer System
- Tertiary Sand Aquifer System
- Floridian Aquifer System
- Shallow Aquifer System

Cape Fear Aquifer System

The Cape Fear aquifer system was described as typically consisting of sand, silt, and gravel separated by thick silt and clay layers (Aucott et al. 1987). The appendix of McLean (1960) includes a lithologic description of cuttings from a -1,052-m (-3,450-ft) well at Parris Island, 19 kilometers (12 miles) south of the basin. The rock correlating to the Cape Fear aquifer system, below about -820 m (-2,700 ft) mean sea level (msl), is described as marine and non-marine, Woodbinian, light gray, fine-to-coarse, micaceous or argillaceous quartz sand and sandstone; and multicolored, gray, purple, tan, yellow, greenish, and red, micaceous silty to sandy clay and shale. Cuttings and sidewall-core descriptions from the interval at a Hilton Head Island test well are similar. The surface of the Cape Fear aquifer dips southward from -610 to -850 m (-2,000 to -2,800ft) along the basin axis, and its base rests on pre-Cretaceous basement rock at depths of -700 to -1,040 m (-2,300 to -3,400 ft).

Pilot holes at Fripp, Parris, and Hilton Head islands penetrated the Cape Fear, and about 30 m (100 ft) of screen is set in the aquifer at the Hilton Head Island test well. Poor sorting, the prevalence of silt and clay, and interbeded clay within the sand units limit the transmissivity of screened intervals to less than 186 m^2/day (2,000 ft^2/day) in spite of the section's thickness. Transmissivity estimates based on aquifer tests range from 288 to 400 m^2/day (3,100 to 4,300 ft^2/day) for 58 m (190 ft) of screen open to the Middendorf and Cape Fear systems (Anonymous 1993). Sidewall cores in the thin sand and gravel layers had hydraulic conductivities of 3 to 10 m/day (10 to 20 ft/day) in the upper half of the system and 1 to 3 m/day (3 to 10 ft/day) in the lower half (DNR file data; Anonymous 1993). Cape Fear wells can be expected to produce more than 1,900 L/min (500 gpm), owing to the depth available for drawdown.

Chemical analyses of water samples from -844 m (2,786 ft) and -862 m (2,831 ft) were reported at two Parris Island wells (Siple 1960). The water chemistry is typical of Cretaceous aquifers along the South Carolina coast: soft, moderately basic, sodium bicarbonate type water with total dissolved-solids concentrations of about 1,000 mg/L (milligrams per liter) and fluoride concentrations of 4.0 to 5.0 mg/L. Dissolved iron concentrations are less than 100 mg/L and chloride concentrations are about 60 mg/L. U. S. Geological Survey (USGS) analyses of samples squeezed from sidewall cores at Hilton Head reported chloride concentrations of about 1,500 mg/L near the top of the Cape Fear (-965 m or -3,164 ft) and 260 mg/L at the base (-1,108 m or -3,634 ft). The ground-water temperature is about 110°F near the base of the system at Hilton Head. Review the analyses of Cape Fear aquifer water samples.

Middendorf Aquifer System

The Middendorf aquifer system, at Parris Island, consists of gray, commonly calcareous, micaceous, glauconitic clay and siltstone and beds of poorly sorted, fine- to moderately-coarse grained, micaceous, argillaceous sand and soft sandstone (McLean 1960). The section appears predominantly marginal marine with continental facies toward its base. The corresponding hydrologic section at Kiawah Island exhibits similar characteristics, and a DNR-file faunal summary (author unknown) describes the interval as marginal marine to inner neritic at the top and continental(?) near the bottom; fauna in the interval are Santonian. The top of the Middendorf system dips southward from about -460 m (-1,500 ft) msl near Walterboro to -700 m (-2,300 ft) msl at Fripp Island (See Middendorf Aquifer). Its base is separated from the top of the Cape Fear system by a 18- to 21-m (60- to 70-ft) section of clay and silt.

The Middendorf system is tapped by wells at Walterboro and at Kiawah, Seabrook, Fripp, Parris, and Hilton Head islands. A transmissivity of 325 m^2/day (3,500 ft^2/day) and a specific capacity of 23 L/min/m (1.7 gpm/ft) was calculated at Kiawah Island well 20FF-v1 (Aucott and Newcome, 1986). They reported specific capacities of 220 to 290 L/min/m (16 and 22 gpm/ft) for two 488 to 537-m (1,600 to 1,760-ft) wells having 18 m (60 ft) of screen at Walterboro. Transmissivity at the Walterboro site probably exceeds 558 m^2/day (6,000 ft^2/day). Tests of sidewall cores taken between -854 and -915 m (-2,800 and -3,000 ft) at Hilton Head measured hydraulic conductivities of 1.4 to 6.4 m/day (4.7 to 6.4 ft/day) (DNR files; Anonymous 1993). The reported well yield at Kiawah Island was 1,600 L/min (430 gpm); 4,500 to 5,300 L/min (1,200 to 1,400 gpm) is reported for Middendorf aquifer wells at Walterboro (Newcome 1989).

Analyses of composite samples from wells at Walterboro and Fripp and Parris islands indicate that the water is soft, basic and high in fluoride, sodium, and bicarbonate. Salinity ranges from fresh in the northwestern part of the basin to brackish along the coast. Total dissolved solids increase coastward from about 200 mg/L to more than 1,000 mg/L. Fluoride concentration increases coastward from less than 1.0 to more than 4.5 mg/L.

Total dissolved solids and chloride concentrations typically increase with depth in coastal, brackish-water aquifers. Discrete-interval samples from Middendorf wells near the eastern ACE Basin do not display this tendency everywhere, however--probably owing to relatively effective bed separation, to differences in hydraulic conductivity, and to variations in the continuity of individual sand beds. Total dissolved solids concentrations of 1,660 to 2,577 mg/L and chloride concentrations of 60 to 464 mg/L were reported at Kiawah Island between -619 and -677 m (-2,030 and -2,220 ft) (Park 1985). The highest concentrations occur at the top of the aquifer and the lowest occur in the middle. Discrete samples at Hilton Head Island show chloride increasing from about 150 to 1,500 mg/L between the middle Middendorf and the upper Cape Fear and decreasing with depth to 260 mg/L about 61 m (200 ft) from the base of the Cape Fear. Ground-water temperature ranges between 80 and 104° F.

Black Creek Aquifer System

The Black Creek aquifer system encompasses mainly marginal-marine sediment generally described from cuttings as gray to blue-gray, fossiliferous, glauconitic, sandy clay, shale, and silt, and gray fine-grained sand. Electric logs, a generic term for any electrical measurement made within the borehole of an uncased well, are used to measure the characteristics of the sediment and pore water in wells. It typically refers to a log suite consisting of a spontaneous-potential log, which measures millivoltages generated by the electrochemical interaction of drilling mud, rock, and pore water, and (1) electrical resistance measurements between an electrode in the well bore and an electrode at ground surface; or (2) electrical resistivity measurements, the electrical resistance of a cubic meter of rock as ohm-meters^2/meter (or ohm-meters), between closely spaced electrode pairs (typically 40 - 160 cm or 16 and 64 inches) within the well bore. In the Black Creek aquifer system, these logs indicate high-resistance zones of sand and limestone throughout the lower two-thirds of the system near Walterboro, but thickness diminishes coastward and is negligible on the basin's southern side. At Kiawah Island, the Black Creek aquifer system sediments are of an early Maestrichtian-Campanian, middle neritic environment (V. V. Vanstrum, written communication). Elevations on the top of the system are approximately 300 m (1,000 ft) below MSL near northern edge of the ACE Characterization project area and dip generally southeastward (See Black Creek Aquifer).

Few wells are known to be completed in the aquifer system near the ACE Basin. They probably would produce sodium bicarbonate type water with high fluoride concentrations throughout most of the basin. High chloride concentrations are likely to extend farther inland than in the underlying systems, owing to low hydraulic conductivity and consequently poor circulation. Well yields will be impracticably small except in the western extent of the basin because of poor hydraulic characteristics and system depth.

Tertiary Sand Aquifer System

The Tertiary sand aquifer system consists of the permeable part of the Early Eocene-age and Paleocene-age Black Mingo Formation. The upper Black Mingo Formation and lower Santee Limestone are hydraulically connected owing to similar water levels and water chemistry (Park 1985). The upper Black Mingo Formation is considered to be part of the Floridian aquifer system for lack of an intervening confining bed (Aucott et al. 1987). The Black Mingo is a heterogenous, fossiliferous sequence of white to pale-gray limestone, green to gray argillaceous sand, carbonate- and silica-cemented sandstone, and dark-gray to black clay (Park 1985). A sequence of gray, fine-grained sand, sandstone, and sandy limestone and dark-gray to black clay in the upper 15 m (50 ft) of the formation constitutes the permeable section in the western two-thirds of the basin. It thickens and grades into an impure limestone in southeastern Charleston County. The underlying, low-permeability section of the Black Mingo Formation and the Peedee Formation are delineated as a confining unit.

Wells open only to the Tertiary sand aquifer system are rare, for the system is tapped by open-hole wells that also obtain water from the overlying Floridian aquifer system. Tertiary sand/Floridian wells are ubiquitous in Charleston, Berkeley, and Dorchester counties (Park 1985), and they are common in the northeastern half of the ACE Basin. The Tertiary sand aquifer yields water to wells more consistently than the Floridian, and drillers use it routinely to assure the success of their wells. Caliper logs show relatively smooth, bit-diameter boreholes through the Floridian section of the well and wider diameter washouts in the sandy section of the Tertiary sand. Sand pumping is seldom a problem in open-hole Floridian/Tertiary sand wells, even where pumping rates exceed 1,000 L/min (300 gpm). At least one well in the basin has a recorded yield of 2,500 L/min (660 gpm); several screened wells near the western reach of the basin have reported yields of 280 to 760 L/min (75 to 200 gpm); and yields adequate for domestic supply are found everywhere in the basin. Specific capacities typically are 55 to 81 L/min/m (4 to 6 gpm per foot of drawdown).

Water in the Tertiary sand aquifer is of the sodium bicarbonate type and grades into the sodium chloride type coastward. The highest known chloride concentration, about 6,000 mg/L, was measured in a well just north of Edisto Beach. Hardness and high iron concentrations rarely cause problems, but fluoride concentrations increase coastward and range from 2.0 to 4.0 mg/L at and southeast of Edisto Island. Dissolved-silica concentrations exceeding 25 mg/L occur in the Black Mingo Formation section of the Tertiary sand aquifer, and the silica is attributed to the presence of silica-cemented sandstone, cristobalite, and clinoptilite (Park 1985). Water temperatures are about 68° F throughout the ACE Basin.

Floridian Aquifer System

In the ACE Basin, the Floridian aquifer system is formed by the Santee Limestone, the Ocala Limestone, and the Cooper Formation. The Santee Limestone underlies the entire basin and typically is a creamy-white to gray, fossiliferous, Eocene limestone. Two members northeast of the basin have been identified; the lower, biosparitic, Middle Claiborne-age Moultrie and the upper, biomicritic, late Claiborne Cross (Ward et al. 1979). The Ocala Limestone consists of a thick, silty to clayey, glauconitic limestone overlain by a clean, permeable, bioclastic limestone of Jackson (Late Eocene) age. The upper limestone thins northeastward and is present only along the southwestern boundary of the ACE Basin. The Cooper Formation was divided into the late Eocene Harleyville, late Eocene Parkers Ferry, and Oligocene Ashley Members by Ward et al. (1979). At their type localities, the members respectively are described as: compact, phosphatic, calcareous clay and clayey calcarenite; glauconitic, clayey, fine-grained, fossiliferous limestone; and glauconitic, calcareous, muddy, fine sand. Elevations on top of the Floridian aquifer system (Hayes 1979) begin at about 20 feet above mean sea-level at the northern end of the ACE Basin and dip generally coastward.

The Floridian aquifer system is composed principally of fine-grained and impure limestone in which permeability is poorly developed, and wells open to the Floridian commonly are also completed in the top of the Tertiary sand system. Locally, thin water-yielding zones may be associated with geologic contacts, but such zones are less continuous than the contacts. A relatively clean,

Edisto Beach public works well head

permeable section occurs at about 150 m (500 ft) msl beneath eastern Edisto Island and produces as much as 1,900 L/min (500 gpm) to wells. Poor yields from wells of similar depth can occur locally, although yields of at least 380 L/min (100 gpm) probably can be obtained in most of the basin. Yields of 380 to 760 L/min (100 to 200 gpm) also can be obtained from wells less than 30 m (100 ft) deep along the southeastern boundary of the basin: they tap the upper permeable zone of the Ocala Limestone, which thickens southward to more than 30 m (100 ft) and becomes the most productive aquifer in South Carolina.

Specific capacities through most of the basin probably range from 15 to 80 L/min/m (1 to 6 gpm/ft), but are 135 to 270 L/min/m (10 to 20 gpm/ft) at Edisto Island and in the northwestern reaches of the basin. Aucott and Newcome (1986) reported 230 L/min/m (17 gpm/ft) for a Floridian (and Tertiary sand aquifer) well at Walterboro. Hayes (1979) reported 14 to 54 L/min/m (1 to 4 gpm/ft) and as much as 2,000 L/min (530 gpm) from eight Floridian wells in Colleton County. The hydraulic conductivity of the Ocala upper permeable zone ranges from 15 to 45 m/day (50 to 150 ft/day) on northern Port Royal Island; transmissivity is less than 46 m^2/day (500 ft^2/day) (Hughes et al. 1989). Similar values of hydraulic conductivities probably occur at geologic contacts within the Santee Limestone section of the Floridian aquifer, but the thickness of the permeable sections is small.

The potentiometric surface of the Floridian aquifer dips southeastward across the basin. The hydraulic gradient is 0.5 m/km (2.5 ft/mile) across the northwestern reach of the basin and abruptly diminishes to 0.1 m/km (0.4 ft/mile) across the southeastern three quarters. Comparison of November 1982 (Park 1985) and July 1986 (Crouch et al. 1987) potentiometric surface maps show 0.3- to 1.2-m (1- to 4-ft) declines across the eastern half of the basin--much of the difference is the result of seasonal differences in ground-water use, but part is the result of increased withdrawals. Water levels were measured in November 1990, and these suggest that levels in southern Charleston County are 0.7 to 1.4 m (2.3 to 4.6 ft) lower than measurements made during November 1982. The levels at Edisto Island declined to -1.2 to -2.4 m (-4 to -8 ft) below MSL by November 1990 (Dale, pers. comm.).

Floridian aquifer water typically is a hard, calcium bicarbonate type with low iron concentrations. On the southeastern side of the basin, high iron concentrations are prevalent in the upper permeable zone. Water at the base of the system in southern Charleston County is similar to that from the Tertiary sand aquifer. Chloride concentrations increase coastward and exceed 500 mg/L at Edisto Beach. Chloride concentrations there can be expected to increase with time owing to pumping-induced upconing and saltwater intrusion.

Additional selected chemical analyses are available for the Floridian aquifer.

Shallow Aquifer System

The shallow aquifer system encompasses a thin, laterally and vertically variable system of Quaternary-age sediment. It includes marine, estuarine, and fluvial facies; averages about 15 m (50 ft) in thickness near the coast; and thins to less than 6 m (20 ft) in the upper reaches. The areal geology as mapped by McCartan et al. (1990) indicates the extent of depositional lithofacies and the approximate time of deposition. They broadly categorized lithofacies as swamp, fluvial, backbarrier, and beach in accordance with the environment of deposition.

Holocene fluvial deposits predominate along the major streams of the ACE Basin and were described as "fine gravel at the base of a sequence, through coarse to fine, locally muddy sand...to overbank mud at the top" (McCartan et al. 1990). Aquifers, mainly channel-lag and point-bar deposits, can have relatively high hydraulic conductivities but are laterally discontinuous. Extensive backbarrier and beach facies, whose ages increase landward, occur within stream interfluves. Backbarrier deposits are muddy sand with clay, shell, and sand layers. Little or no yield will be typical of wells completed in backbarrier deposits, although good yields are likely where wells are screened in tidal-inlet and -channel deposits. Beach deposits include barrier island depositional environments ranging from dune to shelf (McCartan et al. 1990) . They encompass the most hydraulically consistent and laterally extensive aquifers owing to the well- to moderately well-sorted sand of dune and beach environments and to their typical history of progradation, (See related sections: Geology, Geomorphology.)

Data on the hydraulic characteristics of the system are scant within the basin, but data from nearby, geologically similar areas have been published in several reports. Smith (1987) reported hydraulic conductivity values for a site on northern Port Royal Island, apparently located over backbarrier deposits. Horizontal and vertical conductivities (K and K_v) of 0.1 to 0.3 m/day (0.3 to 0.9 ft/day) and 6 x 10^{-5} to 2 x 10^{-1} m/day (2 x $10^{-4}$to 7 x 10^{-1} ft/day), respectively, were measured through an alternating sequence of fine sand and clay. Shallow-aquifer test results are published for areas underlain by beach facies at Wadmalaw, Hilton Head, and Edisto islands. At Wadmalaw Island where 4-6 m (14-20 ft) of beach sand overlies backbarrier deposits, 18 tests indicated hydraulic conductivities of 1.2 to 6.7 m/day (4 to 22 ft/day) and averaging 2.7 m/day (9 ft/day) (Hockensmith 1997). M. W. Dale and A. D. Park (unpublished data) obtained nearly identical results at two sites on Hilton Head Island: 16 tests indicated hydraulic conductivities of 1.8 to 7.3 m/day (6 to 24 ft/day) and averaging 3.0 m/day (10 ft/day). The K/K_v was about 20. The U. S. Navy Department (1993) and Landmeyer et al. (1996) reported hydraulic conductivities of 2.7 to 5.2 m/day (9 to 17 ft/day) for sandy Holocene deposits on Port Royal Island. Saturated thicknesses of 9 m (30 ft) or more occur in many such areas, and transmissivities of 25 to 45 m^2/day (250 to 500 ft^2/day) should be common. An average hydraulic conductivity of 5.8 m/day (19 ft/day) and a transmissivity of 56 m^2/day (600 ft^2/day) was reported for a pumping-test at Edisto Island (Park 1985).

The maximum yield of individual wells is probably about 200 L/min (50 gpm). Public-supply wells 15-17 m (50-55 ft) deep on eastern Edisto Island produced 100 to 180 L/min (25 to 48 gpm): a four-well header system was used at one time and probably pumped 280 to 380 L/min (75 to 100 gpm). Lower yields will be more typical but should be adequate for domestic supply. Domestic irrigation wells having 3 to 6 m (10 to 20 ft) of screen at Hilton Head Island produce 40 to 150 (10 to 40 gpm); 5- to 6-m (15- to 20-ft) observation wells with 1.5 to 3 m (5 to 10 ft) of screen produced 7 to 20 L/min (2 to 5 gpm) there. However, wells screened in backbarrier deposits are likely to produce little water. Yields from fluvial facies will be variable but generally low.

Seasonal fluctuations usually are less than 1.8 m (6 ft), and the range of fluctuation decreases with increasing proximity to streams. The hydrograph shows water-table depths at Edisto Island from October 1989 through September 1991 and reflects the seasonal range typically expected in the shallow system.

Water chemistry data is available for the shallow-aquifer, mainly from Glowacz et al. (1980) and Park (1985). Shallow-aquifer water is soft with low total dissolved solids and high iron concentrations in most of the basin. The iron is ubiquitous owing to iron-bearing heavy minerals. Hard, basic water is common in the lower third to half of the basin where fossil-shell material is present: soft, slightly-acidic water occurs farther inland where deposits are older and leaching has removed shell. In beach facies, total dissolved solids, pH, and hardness increase with depth where water moves from dune sand into fossiliferous sections of beach and backbarrier facies.

Back to Top

Summary

The ACE Basin contains six aquifer systems, and three are used; the Tertiary sand, the Floridian, and the shallow. The Tertiary sand and Floridian aquifer systems are the principal sources of domestic, commercial, and public water supplies, and well yields as great as 1,900 L/min (500 gpm) are reported for most of the basin. The shallow aquifer system is the least consistent with respect to well yield. However, wells drilled in areas underlain by beach facies provide enough water for domestic supply and produce up to 190 L/min (50 gpm) locally. The upper part of the Cape Fear aquifer system and the Middendorf aquifer system should yield more than 3,800 (1,000 gpm) to individual wells screened in both systems. Wells screened in the Middendorf aquifer system should produce 1,900 to 3,800 (500 to 1,000 gpm).

Water quality generally is good in the northwestern half of the basin, where low dissolved-solids concentrations are prevalent. Treatment is likely to be required for hardness in water from the Tertiary sand and Floridian aquifer systems and for dissolved iron in water from the Floridian and shallow systems. Fluoride, sodium, bicarbonate, and chloride increase coastward in all but the shallow system. The shallow aquifer produces water with low dissolved solids concentrations except where it contacts saltwater marshes and streams. Saltwater intrusion occurs in the Floridian aquifer system at Edisto Beach owing to water-level declines. The saltwater wedge is diffuse, hydraulic conductivities and gradients are small, and intrusion consequently is slow.

NEXT SECTION: Hydrochemistry and Pollution

Author

D. Park, SCDNR Land, Water, and Conservation Division

References

Aadland, R. K., J. A. Gellici, and P. A. Thayer. 1995. Hydrogeologic framework of west-central South Carolina. South Carolina Department of Natural Resources Water Resources Report 5.

Anonymous. 1993. Well completion report on Cretaceous aquifer test well (BFT-2055), Hilton Head, South Carolina. Report 89-1601. Atlanta Testing and Engineering, Columbia, SC.

Aucott, W. R. 1985. Potentiometric surfaces of the coastal plain aquifers of South Carolina prior to development. U.S. Geological Survey, Water Resources Investigations Report 84-4208. U.S. Geological Survey, Columbia, SC.

Aucott, W. R. 1988. The predevelopment groundwater flow system and hydrologic characteristics of the coastal plain aquifers of South Carolina. U. S. Department of Interior, Geological Survey, Columbia, SC.

Aucott, W. R., M. E. Davis, and G. K. Speiran. 1987. Geohydrologic framework of the coastal plain aquifers of South Carolina. U.S. Geological Survey, Water Resources Investigations Report 85-4271. U.S. Geological Survey, Columbia, SC.

Aucott, W. R. and R. Newcome, Jr. 1986. Selected aquifer-test information for the coastal plain aquifers of South Carolina. U.S. Geological Survey, Water Resources Investigations Report 86-4159. U.S. Geological Survey, Columbia, SC.

Aucott, W. R. and G. K. Speiran. 1984. Water-level measurements for the coastal plain aquifers of South Carolina prior to development. U.S. Geological Survey Open-File Report 84-803. U.S. Geological Survey, Columbia, SC.

Aucott, W. R. and G. K. Speiran. 1985. Potentiometric surfaces of November 1982 and declines in the potentiometric surfaces between the period prior to development and November 1982 for the coastal plain aquifers of South Carolina. U.S. Geological Survey Water Resources Investigations Report 84-4215. U.S. Geological Survey, Columbia, SC.

Crouch, M. S., W. B. Hughes, W. R. Logan, and J. K. Meadow. 1987. Potentiometric surface of the Floridian aquifer in South Carolina, July 1986. South Carolina Water Resources Commission Report 157.

Dale, M. W. 1995. Evaluation of the shallow aquifer, Hilton Head Island, South Carolina. South Carolina Department of Natural Resources, Water Resources Division Open-File Report 2. Columbia, SC.

Dale, M. W. [not dated]. pers. comm. South Carolina Department of Natural Resources, Land, Water, and Conservation Division, Columbia, SC.

Glowacz, M. E., C. M. Livingston, C. L. Gorman, and C. R. Clymer. 1980. Economic and environment impact of land disposal of wastes in the shallow aquifers of the lower coastal plain of South Carolina. South Carolina Department of Health and Environmental Control, Ground Water Protection Division, Columbia, SC.

Hassen, J. A. 1985. Ground-water conditions in the Ladies and St. Helena Islands area, South Carolina. South Carolina Water Resources Commission Report 147. Columbia, SC.

Hayes, L. R. 1979. The ground-water resources of Beaufort, Colleton, Hampton, and Jasper Counties, South Carolina. South Carolina Water Resources Commission Report 9. Columbia, SC.

Hockensmith, B. L. 1997. Effects of pond irrigation on the shallow aquifer of Wadmalaw Island, South Carolina. South Carolina Department of Natural Resources, Water Resources Report 17. South Carolina Department of Natural Resources, Water Resources Division, Columbia, SC.

Hockensmith, B. L. 1997. Potentiometric surface of the Black Creek aquifer in South Carolina - November 1995. South Carolina Department of Natural Resources, Water Resources Report 16. South Carolina Department of Natural Resources, Water Resources Division, Columbia, SC.

Hockensmith, B. L. and K. E. Waters. 1998. Potentiometric surface of the Middendorf aquifer in South Carolina - November 1996. South Carolina Department of Natural Resources, Water Resources Report 19. South Carolina Department of Natural Resources, Water Resources Division, Columbia, SC.

Hughes, W. B., M. S. Crouch, and A. D. Park. 1989. Hydrogeology and saltwater contamination in the Floridian aquifer in Beaufort and Jasper Counties, South Carolina. South Carolina Water Resources Commission Report 158. Columbia, SC.

Landmeyer, J. E., F. H. Chapelle, and P. M. Bradley. 1996. Assessment of intrinsic bio-remediation of gasoline contamination in the shallow aquifer, Laurel Bay Exchange, Marine Corps Air Station, Beaufort, South Carolina. Water Resources Investigations Report 96-4026. U.S. Geological Survey, Reston, VA.

McCartan, L., R. E. Weems, and E. M. Lemmon. 1990. Studies related to the Charleston, South Carolina, earthquake of 1889, Neogene and Quaternary lithostratigraphy and biostratigraphy. U.S. Geological Survey Professional Paper 1367 A.

McLean, J. D. 1960. Stratigraphy of the Parris Island area, South Carolina. McLean Paleontological Laboratory Report 4. McLean Paleontological Laboratory, Alexandria, VA.

Newcome, R., Jr. 1989. Ground-water resources of South Carolina's coastal plain - 1998 - an overview. South Carolina Water Resources Commission Report 167. Columbia, SC

Park, A. D. 1985. The ground-water resources of Charleston, Berkeley, and Dorchester Counties, South Carolina. South Carolina Water Resources Commission Report 139.

Siple, G. E. 1960. Geology and ground-water conditions in the Beaufort area, South Carolina. Report to the Department of the Navy. U. S. Geological Survey, Columbia, SC.

Siple, G. E. 1965. Salt-water encroachment of Tertiary limestones along coastal South Carolina: hydrology of fractured rocks. Proceedings of the symposium at Dubrovnik, Yugoslavia. International Association of Scientific Hydrology

Siple, G. E. 1967. Salt-water encroachment in coastal South Carolina. Geologic Notes No. 2(2). South Carolina State Development Board, Division of Geology, Columbia, SC.

Smith, B. S. 1987. Vertical hydraulic conductivity, porosity, and vertical gradient of sediments above the upper Floridian aquifer at a site at the Marine Corps Air Station, Beaufort, South Carolina. Administrative Report for the Department of the Navy, Southern Division Naval Facilities Engineering Command. U. S. Geological Survey, Columbia, SC.

South Carolina Water Resources Commission. 1972. ACE framework study - Ashley-Combahee-Edisto River Basin. South Carolina Water Resources Commission, Columbia, SC.

Speiran, G. K. 1985. Effects of high-rate wastewater spray disposal on the water table aquifer, Hilton Head Island, South Carolina. Water Resources Investigations Report 84-4291. U.S. Geological Survey, Reston, VA.

Stringfield, W. J. and B. G. Campbell. 1993. Potentiometric surfaces of November 1989 and declines in the potentiometric surfaces between November 1982 and November 1989 for the Black Creek and Middendorf aquifers in South Carolina. Water-Resources Investigations Report 92-4000l. U.S. Geological Survey, Reston, VA.

U.S. Department of the Navy, Southern Division Naval Facilities Engineering Command. 1993. Contamination assessment report, Laurel Bay Exchange Service Station, Marine Corps Air Station, Beaufort, South Carolina, Ground-Water Protection Site #A-07-AA-13575. (cited in Landmeyer et al. 1996).

Vanstrum, V. V. [not dated]. pers. comm. South Carolina Department of Natural Resources, Hydrology Section file.

Ward, L. W., B. W. Blackwelder, G. S. Gohn, and R. Z. Poore. 1979. Stratigraphic revision of Eocene, Oligocene, and Lower Miocene formations of South Carolina: Geologic Notes. South Carolina State Development Board, South Carolina Geological Survey 23(1):2-32.

MENU

Introduction

Contaminants

Hydrochemistry

Pollutants

ACE Basin NERR

EMAP-CP

Historical Trace Metals

Other Contaminant Studies

Nutrient Contamination

Summary

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Hydrochemistry and Pollution

Introduction

The health of terrestrial and estuarine biota in the ACE Basin is vulnerable to pollution, since many contaminants are toxic. A common definition of pollution is "an undesirable change in the physical, chemical, or biological characteristics of air, water, soil, or food that can adversely affect the health, survival, activities of humans or other living organisms" (Miller 1994). There is a wide range pollutants including chemical contaminants, nutrients, and biopollutants. This section will concentrate on chemical contamination of the ACE Basin. (See related section: Water Quality.)

Vegetation dieoff

The effects of chemical contaminants are often insidious, occurring at low concentrations, which may be difficult to observe directly in the environment. All chemicals can be toxic to an organism depending on the dose of chemical to which the organism is exposed. Contaminants can cause a range of biological effects including cellular abnormalities (dysplasia and lesions), reduced growth, declining fertility and reproductive rates, behavioral abnormalities, shortened life spans, and death. Some consequences may be as mild as having vegetation die over a limited geographical area or as severe as a population decline of one or more important estuarine species over a broad geographical area. Behavioral modifications may occur that could limit an animal's ability to avoid a predator or, conversely, to catch prey. In addition, some species may avoid chemical contaminants by leaving or avoiding a contaminated area.

A well-known example of a chemical effect on biota occurred with the wide use of the insecticide DDT. DDT was considered a "wonder" pesticide that was widely used to control insects in the United States until its ban in the 1970s (Leary and others 1946). DDT was found to cause mortality of non-target organisms, to be persistent in the environment, and to bioaccumulate in organisms. Application of DDT increased mortality in numerous bird species and reduced their reproductive success (Blus 1995).

The brown pelican is one of the most sensitive species to DDT (and its metabolites DDD and DDE), which can cause embryo mortality from both tissue degradation and eggshell thinning. In the most extreme case of reproductive impairment reported, only five baby pelicans hatched on Anacapa Island in 1969 out of 1300 nesting attempts. The use of DDT was predominantly responsible for the decline in the brown pelican populations in the US (Blus 1995).

Back to Top

Contaminants

The chemicals of primary concern are trace metals and organic contaminants. Numerous trace metals are an essential dietary component at low concentrations for aquatic organisms; however, trace metals also pose a threat to organisms due to their persistence in sediments, toxicity at high concentrations, and tendency to bioaccumulate in biological tissue. Trace metals are naturally occurring elements that are influenced by the natural weathering of basement rock (Williams and others 1994). In addition, trace metal concentrations can be enhanced from industrial and urban associated activities. Lead, chromium, cadmium, copper, zinc, and mercury are trace metals that are commonly enriched in sediments due to anthropogenic activities (Bruland and others 1974, Erlenkeuser and others 1974, Goldberg et al. 1977, Kennish 1992). When a trace metal enters the environment from a natural process it is generally at low levels and not biologically harmful; however, when a trace metal enters the environment from anthropogenic processes, then the increased trace metal levels have the potential to cause biological harm.

The organic chemicals commonly associated with anthropogenic processes are polycyclic aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs). PAHs are chronically toxic, carcinogenic, and mutagenic to a wide range of biota including aquatic organisms and humans. PAHs are a major component of lubricating oils and fossil fuels. They are released into the environment when these products are spilled or combusted to produce energy. PAHs are also produced during the combustion of naturally occurring organic matter such as during a forest fire. Potential sources of PAHs to streams, rivers, and estuarine tidal creek systems include runoff from highways and parking lots, vehicle exhaust, street dust, fuel spills, marina and recreational boating activities, and atmospheric fallout (Weinstein 1996).

Pesticides are organic contaminants of concern particularly in aquatic environments with watersheds that are used for agricultural production (Scott et al. 1994). Pesticides are used to produce a desired effect, usually death, on target organisms. The problem arises when these intentionally used chemicals produce a nondesired effect on non-target organisms. The effects that DDT had on birds as previously described, is one example. Pesticides can cause a wide range of adverse effects on non-target organisms. PCBs are another persistent organic contaminant banned in the 1970s that have been reported to accumulate in estuarine environments (Weinstein 1996). PCBs were commonly used in cooling agents and insulators for capacitors, transformers, gaskets, caulking compounds, paints, and oils (Hutzinger and others 1974, Kennish 1992).

PCBs have been found to cause reproductive abnormalities, skin lesions, liver damage, and cancer in various organisms (Kennish 1997).

Sources of Contaminants

Storm water outfall

Atmospheric deposition, terrestrial runoff, and aquatic inputs are sources of contaminants in aquatic systems. Contaminants may originate from point and nonpoint sources. Point sources are defined inputs such as sewage and industrial outfalls. There are only 13 point source dischargers with NPDES permits in the ACE Basin. (See related section: Water Quality.) In rural areas, such as the ACE Basin, permitted point source discharges are less than in highly-developed areas of the coast. Nonpoint sources, as the name implies, are much more diffuse and widespread. Examples of nonpoint source inputs are sheet runoff from impervious surfaces and agricultural fields, automobile exhaust emissions, and stack emissions from distant industrial plants and incinerators. Any of these input sources can affect the overall chemistry and, consequently, the health of the ecosystem. Contaminants can be introduced via any of these routes, depending on the solubility and volatility of the chemical.

Atmospheric Inputs

Boat engine exhaust

Gases and particles found in the atmosphere are a source of contamination to waterbodies. The influence of the atmosphere on water chemistry is poorly understood because of the difficulty in studying the air-water interface. Numerous chemicals are introduced into the atmosphere as gases from the exhaust of boats, automobiles, wood-burning stoves, incinerators, and factories. These gases can easily dissolve in natural waters at the air-water interface. PAHs are one compound commonly found entering the atmosphere and subsequently the aquatic environment from the exhaust smoke of internal combustion engines and wood-burning stoves. In addition, oxides of nitrogen and sulfur are generally the most common atmospheric pollutants and are the main components of acid rain.

Gases are not the only atmospheric components influencing water chemistry. Particles from numerous sources also occur in water. These can be insoluble, unreactive dust particles or relatively soluble compounds, such as gypsum (calcium sulfate) or limestone (calcium carbonate). Numerous compounds are found in both gaseous and particulate forms. One example is mercury, which can also be introduced via natural sources, industrial outfalls, sewage discharges, and via the atmosphere from incinerators (Windom and others 1975). Mercury is a very toxic compound, which has been linked to a wide range of toxic effects including nervous system damage, reduced growth, and inhibited reproduction (Wren and others 1995). The mercury problem has been well documented in a number of freshwater environments throughout North Carolina and South Carolina. Freshwater environments typically have low pH levels that keep the mercury in solution and hence, bioavailable. The mercury threat to the marine or estuarine environment is less clear due to higher pH values that reduce mercury solubility.

Terrestrial Inputs

Industrialized area

Terrestrial inputs of pollution to the aquatic environment include runoff from impervious surfaces, agricultural fields, golf courses, and lawns as well as point source discharges from land-based factories and sewage treatment plants. An impervious surface is an impenetrable surface. Contaminants in runoff from impervious surfaces generally include (1) PAHs from highways and parking lots, vehicle exhaust, street dust, and fuel spills; (2) gasoline additives (e.g., thickeners, extenders, and anti-knock ingredients); and (3) trace metals from vehicle and tire wear. Runoff from agricultural fields, golf courses, and lawns include pesticides and nutrients. (See related sections: Agriculture and Water Quality.)

Aquatic Inputs

Fish kill

The rivers, creeks, and ocean all serve as sources of either clean or potentially polluted water. Chemical contaminants are often introduced to rivers and streams, which serve as conduits of pollution from cities, towns, farms, golf courses, and a myriad of other sources to an estuary. For example, an oil or chemical spill upstream could disperse contaminants throughout the ACE Basin. Presently, the potential for contaminants entering the ACE Basin from upstream rivers is low considering the low levels of development presently in the SCDHEC Savannah-Salkehatchie and the Saluda-Edisto watersheds. However, if the 31% increase in urban land cover observed from 1977 to 1989 on the upper Edisto River continues at this high rate of development in the future (Marshall 1993), then riverine inputs of contamination to the ACE Basin may become a problem. This contamination may be in the form of toxic chemicals such as pesticides, petroleum products, or industrial by-products, or sewage. Sewage can have high levels of organic matter and chemicals that may not be particularly toxic themselves, but can consume large amounts of oxygen leaving little or none for aquatic organisms. This depletion of oxygen can kill finfish, shellfish, and crustaceans or cause migrations out of the ACE Basin of those animals capable of movement.

Back to Top

Hydrochemistry

The hydrochemistry influencing the level of contamination and partitioning of contaminants in the environment is complex. All of the research examining the contamination of the ACE Basin has primarily been conducted in the aquatic environment. In general, contaminants that are deposited on land can leach into groundwater or enter an aquatic system through runoff from the terrestrial environment during a rain event. Once pollutants enter the aquatic environment, particularly an estuarine environment, a series of complex factors determine the location of the contaminants in the environment. Most contaminants do not remain dissolved in water, instead they will adsorb to particle surfaces present in the bottom sediment or within the water column, which eventually settle to the bottom sediments. A change in the environmental condition or hydrochemistry can alter the partitioning of contaminants in the environment (e.g., water, sediment, tissue) and the ultimate fate of the contaminant.

Blackwater Stream

For example, the solubility and stability of many compounds are affected by pH, which is a measure of the acid balance of a solution and is defined as the negative log to the base 10 of the hydrogen ion concentration ($-\log10[H+]$). The pH is considered neutral at 7, acidic between 0 and 7, and basic between 7 and 14. The pH of seawater averages 8.3, while a blackwater river like the Edisto River may have a pH of 5.5 to 6.0. Estuaries naturally reflect their source waters. A lower pH is found near the river input and a higher pH is found near the ocean. In general, the pH is above 7 throughout an estuary. The pH of the water can affect chemical contaminant concentrations in water and sediments of a system. In basic water (pH>7), many metallic hydroxides are either insoluble or only slightly soluble. These compounds usually form precipitates that settle out with the bottom sediments. For example, iron hydroxide is a precipitate with an enormous surface area that tends to adsorb other compounds on its surface as it settles out of the water column. Iron is present at relatively high concentrations in most river water and forms the hydroxide when acidic river water meets basic seawater. In addition, basic water encourages the breakdown of a number of organic chemicals, particularly pesticides. Malathion is a classic example of a pesticide which breaks down faster in basic water (~ 48 hours).

Relatively high concentrations of metals are found in acidic water, since most metals are soluble at low pHs. The so-called blackwater rivers are black or dark brown due to the presence of humic acids, which come from leaves and other sources. In these environments, some metals are found at concentrations hundreds of times greater than those in seawater. For example, the iron concentration in river water is 670 ppb, but in seawater it is <5 ppb (Goldberg 1967).

Back to Top

Pollutants

Most of the data presented in this section will involve the level of sediment contamination present in the ACE Basin. Emphasis on sediment chemical contamination is related to the fact that sediments are an environmental sink for chemical contaminants. In order to understand what the level of contamination in the ACE Basin indicates, the chemical concentrations found in the ACE Basin will be compared to the contaminant concentrations in other estuarine systems as well as to contaminant concentrations known to cause biological effects. This potential for a biological effect from sediment chemical concentrations will be described using the effects range-low (ER-L) and the effects range-median (ER-M) as defined by Long and Morgan (1990) and Long and others (1995). The ER-L and ER-M are concentrations associated with biological effects from a large collection of biological experiments and field assessments. The ER-L and ER-M values are defined as the concentrations at which 10% and 50% of the studies showed a biological effect at specific concentrations, respectively. Values below the ER-L would rarely be expected to be associated with measurable biological effects. Values between the ER-L and ER-M represent a range in which there are possible biological effects for a wide range of organisms. Values above the ER-M represent a range above which there are probable biological effects for a wide range of organisms. In the description of data for the ACE Basin, ER-L and ER-M values will be used to identify those sites with the highest potential for biological effects.

Back to Top

ACE Basin NERR

In 1994 to 1996, a study funded by the ACE Basin National Estuarine Research Reserve (NERR) and the National Oceanic and Atmospheric Administration, National Ocean Service (NOAA-NOS) was performed to determine recent sediment contamination in the ACE Basin NERR (Scott et al. 1998). Data collected for this study were designed to serve as a baseline of chemical concentrations in the relatively undeveloped and pristine ACE Basin. The chemical concentrations are expected to increase as development in the ACE Basin occurs. The study design involved sampling eight sites in the Combahee River, eight sites in the Edisto River, eight sites in the Ashepoo River, three sites in St. Helena Sound, and seven sites in the Intracoastal Waterway or adjoining small tidal creeks in the region for both trace metals and organic contaminant concentrations. Two of these sites, A and B, are located in Big Bay Creek and St. Pierre Creek, respectively. These two sites are part of the ACE Basin NERR long-term monitoring stations for water quality (See sediment sampling sites).

The level of sediment contamination was low throughout the Basin study area; however, there was some variability in the contaminant concentrations among sites (Scott et al. 1998). In general, the sites with the highest contaminant concentrations were also the sites with high clay content. These findings are not surprising since contaminants preferentially bind to clay over sand particles. Therefore, the increased contaminant levels at these sites is probably due to the sediment type and not a contaminant source. For example, 62% and 55% of the sediment in Big Bay Creek (A) and St. Pierre Creek (B), respectively, was clay particles. These two sites generally had higher contaminant concentrations compared to the majority of sites sampled. Water quality research at these two sites has not found any abnormal values for the various variables measured.

Scott et al. (1998) found the level of sediment trace metal contamination in the ACE Basin NERR to be low. Only arsenic was found in high enough concentrations to exceed the ER-L level. Ten of the 34 sites had sediment arsenic concentrations exceeding the ER-L level but not the ER-M level (Comparison of bottom sediment contaminants). This indicates that there is the possibility for some adverse biological effects from the levels of arsenic found in the ACE Basin; however, arsenic concentrations are naturally high in the southeastern United States. Several studies in pristine systems have also found high arsenic concentrations in the southeastern United States (Scott et al. 1994, Long et al. 1998, Sanger 1998). These naturally high levels are due to the high arsenic concentrations in the basement rock within the region. Therefore, these findings generally indicate that trace metal concentrations in the ACE Basin are indicative of that which one would expect from the natural weathering of basement rock within the region (Scott et al. 1998).

The overall level of sediment organic contamination in the ACE Basin was also found to be low. Sediment concentrations of PAHs were similar to concentrations reported at other pristine NERR sites (i.e., North Inlet NERR). Scott et. al. (1998) concluded the concentrations of PAHs found in the ACE Basin are reflective of atmospheric inputs into the region. None of the PAHs were found to exceed the ER-L or ER-M levels. The maximum total PAH concentration found in the ACE Basin was only 299 ppb while the ER-L level is 4,022 ppb. This indicates that there is little potential for a toxic effect in the ACE Basin due to PAHs. The PCB and organochlorine pesticide concentrations were also found to be very low in the ACE Basin. All 34 of the sites sampled had PCB and organochlorine pesticide concentrations well below the ER-L or ER-M levels. There appears to be little input of these types of contaminants into the ACE Basin (Scott et al. 1998). This is not surprising considering PCBs are an urban-derived contaminant that was banned in the US in the 1970s. Organochlorine pesticide use also appears to be very low in the area considering the level of contamination found in the sediment. Therefore, there is a low likelihood that any biological effects would be observed in relation to the organic contamination of the sediment.

Back to Top

The Environmental Monitoring and Assessment Program – Carolinian Province (EMAP-CP)

The Environmental Monitoring and Assessment Program – Carolinian Province (EMAP-CP) is another study that sampled in the ACE Basin. One of the objectives of the EMAP-CP was to assess the estuarine sediment contamination from North Carolina to Florida (Hyland et. al. 1996 and 1998). Over a two-year period, the EMAP-CP sampled six sites located in the ACE Basin for trace metals and organic compounds. Overall, the level of sediment contamination was low. In general, the chemical contamination in the ACE Basin is less than the contamination found in the other estuarine areas studied. One of the 6 sites sampled had 5 chemical concentrations that exceeded the ER-L level (Comparison of bottom sediment contaminants). The five chemicals that exceeded the ER-L were arsenic, chromium, nickel, P,P'-DDD, and Total DDT, which indicates that there is some possibility of an adverse biological effect at this site. As previously described, arsenic concentrations are generally higher in the southeastern United States and may not constitute a problem. The reason for the elevated levels of chromium and nickel are unknown, but they may have come from mining activities or industrial activities upstream from this site. DDT and its derivative (P'P'-DDD) have soil half-lives of at least several years. These pesticides were banned in the US in 1972, but their residues tend to be very stable and reside in bottom sediments. As a consequence, these residues probably date from applications made decades earlier and do not reflect any recent activities. The site with slightly elevated levels of some contaminants is located in the South Edisto River near Bear Island Wildlife Management Area (CP95156). This site also had a high silt-clay content of the sediment indicating that the contaminants may have preferentially deposited there. As mentioned previously, the upland area around the upper Edisto River has increased in urban land cover by 31% from 1977 to 1989 (Marshall 1993). The chemical contamination will potentially increase in the aquatic environment as development continues.

Back to Top

Historical Trace Metals

Alexander and Wenner (1995) evaluated the historical record of trace metal flux into the ACE Basin from nonpoint sources of pollution. To perform this study, 40 to 55 cm (16 to 22 in) deep sediment cores were collected at two different sites. The first site was subtidal in the Fenwick Cut, which joins the South Edisto and Ashepoo Rivers. The second site was intertidal on a nearby salt marsh. The sediment accumulation rate (> 5 cm/mo, > 2 in/yr) at the subtidal site limited the historical record to the last year of metal and sediment flux. This subtidal core indicated that there were pulses of sediment and metals, especially chromium and zinc, throughout the year. The intertidal core showed approximately 130 years of sediment and metal accumulation at a rate of 0.42 cm/yr (0.17 in/yr). This core demonstrates a gradual increase in trace metal concentrations to the region for the last 80 years. The fluxes of all metals, except arsenic, exhibit a 1.5 to 3.0 times increase in metal concentrations over the length of the core (Alexander and Wenner 1995).

Back to Top

Other Contaminant Studies

- Other Contaminant Data

In addition to these large-scale studies, several other research projects on contaminants have been performed in the ACE Basin. Both sediment and oyster tissues collected in St. Helena Sound were generally lower in all contaminants than those from the

Charleston Harbor system (Mathews unpubl. data). Similar results were reported for pesticides in samples taken on St. Helena Island (Knowles 1983). Although pesticides might be expected to be reasonably high in St. Helena Sound due to farming in the area, this does not appear to be the case. One explanation for lack of pesticide contamination is that circulation in the sound may not allow for their accumulation. The volume of freshwater flowing into St. Helena Sound is 362 m^3/s (1188 ft3/s) (NOAA 1985). This flow rate is the third highest in the state following Charleston Harbor and Winyah Bay. Such a high volume of water may effectively flush the sound of contaminants. In addition, the pesticides used by agricultural operations may have naturally degraded over time. A decrease in the agricultural industry in the ACE Basin will presumably keep the level of pesticide contamination in the area low. (See related section: Agriculture.) However, an increase in urban development may counteract the decrease in agriculture considering pesticides are applied to lawns and golf courses.

Despite the low level of contamination in the ACE Basin, a few studies have found limited areas of sediment contamination. Marcus and Mathews (1987) found a mixture of PCBs in the sediments of Campbell Creek on Whale Branch, which connects with St. Helena Sound via the Coosaw River. A chemical plant is located near this creek. Sediment PCB concentrations at this site were up to 24,200 ppb, or almost 2500 times greater than those found downstream near the sound (Marcus and Mathews 1987). This concentration of PCBs is over a 130 times higher than the ER-M value. An adverse biological effect from PCB concentrations in the sediment is highly probable. PCB concentrations in blue crabs ranged from an average of 861 ppb near the chemical plant outfall to below detection limits <20 ppb for those from the South Edisto River (Marcus and Mathews 1987). In addition, a wide variety of synthetic organic chemicals rarely found along our coast were detected both in the sediments and oyster tissues of Campbell Creek, including diphenyl-methanone, 1,2,3-trichlorobenzene, and 9,10-anthracendione (Marcus and Swearingen 1985). This indicates that controlling the levels of chemical contaminants entering the aquatic environment from industrial development is very important as the ACE Basin continues to be developed.

Wood for docks and bulkheads is usually treated with an antifouling agent to increase the longevity of the structure. One antifouling agent is chromated copper arsenate or CCA. Weis and Weis (1995) explored the impacts of CCA on the biota adjacent to CCA-treated docks and bulkheads in four NERR sites, including the ACE Basin. Sediment and polychaete tissue samples were taken immediately adjacent to the treated surface and at intervals of 1, 3, and 10 m (3.3, 9.8, and 32.8 ft) from the structure to determine whether chromium, copper, or arsenic concentrations could be detected. Elevated levels of the three constituents, chromium, copper, and arsenic (CCA) were found in some sediments and polychaetes near a CCA-treated bulkhead in a residential canal in the North Inlet, SC NERR. They also recorded reduced diversity and biomass of benthic organisms. In the same area, but near an aluminum bulkhead, these deleterious effects were not observed. In the three other NERRs, including the ACE Basin NERR, with only docks and no bulkheads, the negative effects of the CCA-treated wood were absent. Therefore, it appears if only pilings are present and the system is well flushed, then there are no negative biological effects (Weis and Weis 1995).

Other Contaminant Data

In addition to the data presented, a Contaminant Data was compiled by SCDNR-MRRI using the USEPA STORET (www.epa.gov/OWOW/STORET/index.html) database and other information not in the database including some of the studies previously described in this section. The STORET database is a repository for water quality data collected in the United States waterways from a wide range of agencies. The data in the available table were collected by the South Carolina Department of Health and Environmental Control (SCDHEC), National Oceanic and Atmospheric Administration (NOAA), US Environmental Protection Agency (USEPA), South Carolina Department of Natural Resources (Formerly SC Wildlife and Marine Resources Division) (SCDNR), and US Geological Survey (USGS) over the last decade. Organic compounds and trace metals are listed along with minimum and maximum concentrations for chemicals in the water, sediment, and biological tissues. It is important to note that the level of contamination was low enough that the detection limits were often not exceeded. Therefore, the maximum concentration reported, particularly for the PAHs, may be the detection level of the machine measuring the concentration and the true chemical concentration may be substantially less than the maximum value in the table. For example, the maximum concentration for acenaphthene is 300 ppb, which is the detection limit for the data collected by SCDHEC. The overall picture of contamination is similar to what has been described above with most of the contaminants present at very low concentrations.

Back to Top

Nutrient Contamination

Application of fertilizer is planned to provide needed nutrients but protect water quality

An additional area of concern is eutrophication, especially in zones where agriculture or housing developments are common and fertilizers are frequently utilized . (See related sections: Water Quality and Water Quality Synthesis Module.) As mentioned in the water quality section, nutrient-rich runoff from agricultural fields and yards may enter sluggish tidal streams, resulting in algal blooms and fishkills. Data from NOAA's eutrophication study indicate medium levels of nitrogen (>0.1, <1 mg/L) and phosphorus (>0.01, <0.1 mg/L) in St. Helena Sound with a downward trend for nitrogen and no trend for phosphorus since 1970 (NOAA 1996). This might be due to lack of development and decreasing numbers of working farms in the ACE Basin. Whether the trend towards constant or decreasing nutrient concentrations will continue or reverse is difficult to predict. However, as pressure for development increases, inputs of nutrients and other chemicals that promote eutrophication will likely increase.

Back to Top

Summary

The ACE Basin is a unique system that is presently a pristine environment with regard to its levels of chemical pollution. The potential for pollution is, however, present due to the likelihood of chemical contaminants entering the ACE Basin from outside sources. The two main outside sources of contaminants are atmospheric inputs and aquatic inputs from upstream anthropogenic activities. These external pressures cannot be controlled to any great extent from within the Basin. In the near future, there is also the potential for pollution to enter the ACE Basin from development of the terrestrial environment in the surrounding watershed. Unlike outside sources, these internal contaminant sources can be regulated by land use planning and government regulations. As pressure for more residential and industrial development increases, controlling point and nonpoint sources of pollution will need to be a high priority. A study by the SCDNR/Marine Resources Research Institute (SCDNR/MRRI) found adverse effects on the South Carolina tidal creek biological community when the amount of impervious surface was greater than 30-35% (Holland and others 1997, Lerberg 1997). In addition, this study found a significant correlation between the amount of impervious surface and contaminant concentrations in the sediments of tidal creeks (Sanger 1998). This indicates that as impervious surface on land increases, then contaminant loadings in creek sediments increase. Therefore, land use planning in the ACE Basin study area will be a very important aspect of keeping chemical concentrations low.

NEXT SECTION: Water Quality

Authors

T. Mathews, SCDNR Marine Resources Research Institute

D. Sanger, SCDNR Marine Resources Research Institute

References

Alexander, C. and E. Wenner. 1995. Evaluating the historical record of nonpoint source pollution in the ACE Basin and Sapelo Island National Estuarine Research Reserves. Final Report, SC Sea Grant Consortium, Charleston, SC.

Blus, L. J. 1995. Organochlorine pesticides. *In*: Hoffman, D. J., B. A. Rattner, G. A. Burton, Jr., and J. Cairns, Jr. (eds.). Handbook of ecotoxicology. CRC Press, Inc., Boca Raton, FL.

Bruland, K. W., K. Bertine, M. Koide, and E. D. Goldberg. 1974. History of heavy metal pollution in Southern California coastal zone. Environmental Science and Technology 8:425-432.

Erlenkeuser, H. E., D. R. Suess, and H. Willkomm. 1974. Industrialization affects heavy metal and carbon isotope concentrations in recent Baltic Sea sediments. Geochimica et Cosmochimica Acta 38:832-842.

Goldberg, E. D. 1967. Minor elements in sea water. *In*: Riley, J. P. and G. Skirrow (eds.). Chemical oceanography, Vol. I. Academic Press, London.

Goldberg, E. D., E. Gamble, J. J. Griffin, and M. Koide. 1977. Pollution history of Narragansett Bay as recorded in its sediments. Estuarine and Coastal Marine Science 5:549-561.

Holland A. F., G. H. M. Riekerk, S. B. Lerberg, L. E. Zimmerman, and D. M. Sanger. (1997). Assessment of the impact of watershed development on the nursery functions of tidal creek habitats. *In*: Stepan C. D. and K. Beidler (eds.). Management of Atlantic coastal marine fish habitat: proceedings of a workshop for habitat managers. Atlantic States Marine Fisheries Commission, Philadelphia, PA.

Hyland, J. L., T. J. Herrlinger, T. R. Snoots, A. H. Ringwood, R. F. Van Dolah, C. T. Hackney, G. A. Nelson, J. S. Rosen, and S. A. Kokkinakis. 1996. Environmental quality of estuaries of the Carolinian Province: 1994. Annual statistical summary for the 1994 EMAP-Estuaries Demonstration Project in the Carolinian Province. NOAA Technical Memorandum NOS ORCA 123. NOAA/NOS, Office of Ocean Resources Conservation and Assessment, Silver Spring, MD.

Hyland, J. L., L. Balthis, C. T. Hackney, G. McRae, A. H. Ringwood, T. R. Snoots, R. F. Van Dolah, and T. L. Wade. 1998. Environmental quality of estuaries of the Carolinian Province: 1995. Annual statistical summary for the 1995 EMAP-Estuaries Demonstration Project in the Carolinian Province. NOAA Technical Memorandum NOS ORCA 97. NOAA/NOS, Office of Ocean Resources Conservation and Assessment, Silver Spring, MD.

Hutzinger, O., S. Safe, and V. Zitko. 1974. The chemistry of PCBs. CRC Press Inc., Cleveland, OH.

Kennish, M. J. 1992. Ecology of estuaries: anthropogenic effects. CRC Press Inc., Boca Raton, FL.

Kennish, M. J. 1997. Practical handbook of estuarine and marine pollution. CRC Press Inc., Boca Raton, FL.

Knowles, S. C. 1983. Pesticide analyses at selected drainages on St. Helena Island, Beaufort County, to Trenchards Inlet. Technical Report 0200-83. SC Department of Health and Environmental Control, Columbia, SC.

Leary, J. C., M. I. Fishbein, and L. C. Salter. 1946. DDT and the insect problem. McGraw-Hill Book Company Inc., New York.

Lerberg, S. B. (1997) Effects of watershed development on macrobenthic communities in the tidal creeks of the Charleston Harbor Estuary Master's Thesis. University of Charleston, Charleston, SC.

Long, E. R. and L. G. Morgan. 1990. The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. Seattle, WA.

Long, E. R., D. R. MacDonald, S. L. Smith, and F. D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environmental Management 19(1):81-97.

Long, E. R., G. I. Scott, J. Kucklick, M. Fulton, B. Thompson, R. S. Carr, J. Biedenbach, K. J. Scott, G. B. Thursby, G. T. Chandler, J. W. Anderson, and G. M. Sloane. 1998. Magnitude and extent of sediment toxicity in selected estuaries of South

Carolina and Georgia. NOAA Technical Memorandum NOS ORCA 128. Silver Springs, MD.

Marcus, J. M. and T. D. Mathews. 1987. Polychlorinated biphenyls in blue crabs from South Carolina. Bulletin of Environmental Contamination and Toxicology 39:857-862.

Marcus, J. M. and G. R. Swearingen. 1985. A summary of water quality sampling activities at Campbell Creek, Beaufort County, South Carolina-November 14-15, 1983 through December 5, 1984. SC Department of Health and Environmental Control, Technical Report 003-85.

Marshall, W. D. (ed.). 1993. Assessing change in the Edisto River Basin: an ecological characterization. South Carolina Water Resources Commission, Report No. 177, Columbia, South Carolina. 149p.

Mathews, T. Unpublished data. South Carolina Department of Natural Resources, Marine Resources Research Institute, Charleston, South Carolina.

Miller, G. T. 1994. Living in the environment: principles, connections, and solutions, 8th edition. Wadsworth, Belmont, CA.

NOAA. 1985. National Estuarine Inventory-Data Atlas, Volume I: Physical and Hydrologic Characteristics. US Department of Commerce, NOAA, Washington, DC.

NOAA. 1996. NOAA's estuarine eutrophication survey, Volume 1: South Atlantic Region. Office of Ocean Resources Conservation and Assessment, NOS, Silver Spring, MD.

Sanger, D. M. 1998. Physical, chemical, and biological environmental quality of tidal creeks and salt marshes in South Carolina estuaries. Dissertation. University of South Carolina, Columbia, SC.

Scott, G. I., M. H. Fulton, D. W. Moore, G. T. Chandler, P. B. Key, T. W. Hampton, J. M. Marcus, K. L. Jackson, D. S. Baughman, A. H. Trim, L. Williams, C. J. Louden, and E. R. Patterson. 1994. Agricultural insecticide runoff effects on estuarine organisms: correlating laboratory and field toxicity testing, ecophysiology assays, and ecotoxicological biomonitoring. Report EPA/600/R-94/004; Report PB94-160678. University of South Carolina, School of Public Health, Columbia, SC.

Scott, G. I., M. H. Fulton, R. F. Van Dolah, P. B. Key, J. W. Daugomah, P. P. Maier, E. F. Wirth, M. Levison, N. Hadley, S. Layman, B. C. Thompson, E. D. Strozier, and P. L. Pennington. 1994. Ecotoxicological assessment of effluent and sediments from the Savannah Harbor dredged materials disposal areas in Wright River Estuary of South Carolina. USDOC/NOAA/NMFS/SEFSC/Charleston Laboratory, Marine Ecotoxicology Division, Charleston, SC.

Scott, G. I., M. H. Fulton, D. Bearden, M. Sanders, A. Dias, L. A. Reed, S. Sivertsen, E. D. Strozier, P. B. Jenkins, J. W. Daugomah, J. DeVane, P. B. Key, and W. Ellenberg. 1998. Chemical contaminant levels in estuarine sediment of the Ashepoo-Combahee-Edisto River (ACE) Basin National Estuarine Research Reserve and Sanctuary Site. US Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Charleston, SC.

United States Environmental Protection Agency, Office of Water. 1998. STORET Database. http://www.epa.gov/owow/storet/index.html (accessed August 1998).

Weinstein, J. E. 1996. Anthropogenic impacts on salt marshes. *In*: Vernberg F. J., W. B. Vernberg, T. Siewicki (eds.). Sustainable development in the southeastern coastal zone. University of South Carolina Press, Columbia, SC.

Weis, J. S. and P. Weis. 1995. Benthic impacts of wood treated with chromated copper arsenate (CCA) in estuaries. Final Report for Grant #NA470R0200, National Oceanic and Atmospheric Administration, Silver Spring, MD.

Williams, T. P., J. M. Bubb and J. N. Lester. 1994. Metal accumulation within salt marsh environments: a review. Marine Pollution Bulletin 28:277-290.

Windom, H. L., F. E. Taylor, and E. M. Waiters. 1975. Possible influence of atmospheric transport on the total mercury content of southeastern Atlantic Continental Shelf surface waters. Deep-Sea Research 22:629-633.

Wren, C. D., S. Harris, and N. A. Harttrup. 1995. Ecotoxicology of Mercury and Cadmium. *In*: D. J. Hoffman, B. A. Rattner, G. A. Burton, Jr., and J. Cairns, Jr. (eds.). Handbook of Ecotoxicology, CRC Press Inc., Boca Raton, FL.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

M
E
N
U

Introduction

Water Quality Variables

Water Quality Monitoring

Additional Parameters Monitored by SCDHEC Programs

Study Area Dynamics

Water Quality Sampling Programs

Water Quality Criteria and SCDHEC Station Excursions

Water Quality Trends in SCDHEC Stations

Temporal Variability in NERR Water Quality Monitoring Data

Conclusions

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Water Quality

Introduction

Water quality is a term used to describe the condition or environmental health of a water body or resource. It is defined in the Clean Water Act as the standard of purity that is necessary for the protection of fish, shellfish and wildlife populations in the aquatic environment, and for recreational uses in and on the water. It is the shared responsibility of the United States Environmental Protection Agency (USEPA), states, and local governments to meet the goals of the Clean Water Act. Each state must ensure that its waters support beneficial uses that are important to its citizens, such as the primary contact recreation of swimming and fishing. The states also establish water quality criteria, which are levels of physical, chemical and biological variables that are required to meet beneficial uses (e.g. drinking water, recreational use, and support of aquatic life). Physical and chemical standards are set for maximum acceptable concentrations of pollutants, acceptable ranges for physical variables, and minimum and maximum values of other water quality parameters. Numeric biological criteria describe expected attainable community attributes and establish criteria based on measures such as species richness, presence or absence of indicator taxa, and distribution of classes of organisms. Narrative water quality criteria define, rather than quantify, conditions and attainable goals that must be maintained to support a designated use. These criteria establish a positive statement about aquatic characteristics expected to occur in a water body, and they may also describe conditions that are desired in a water body (National Research Council 1993).

Water Quality Variables

Water quality monitoring involves taking measurements that provide information on conditions and allow scientists and managers to estimate trends. Monitoring provides the information needed for an assessment of the conditions of the water in relation to natural variability, human effects and

Deploying water quality monitoring instrumentation

intended uses (Chapman 1992). Although an assessment is a cumulative evaluation of overall system conditions, it is difficult to measure all the physical, chemical and biological properties of a water body. Instead, a few variables that provide general indications of environmental conditions are selected (Robertson and Davis 1993).

Many water quality variables are subject to large fluctuations in space and time. Understanding these fluctuations in the physical environment and determining whether such changes are natural or a result of anthropogenic influences can be a difficult problem. An ideal variable provides unambiguous information about the condition of the environment in relation to reference conditions and is relatively easy and inexpensive to measure (Wenner and Geist unpublished).

Back to Top

Water Quality Monitoring

Storm water outfall

Variables being monitored in the ACE Basin by both the National Estuarine Research Reserve (NERR) and South Carolina Department of Health and Environmental Control (SCDHEC) programs include pH, conductivity (salinity), temperature, dissolved oxygen (DO), turbidity and water level. The importance of these variables as indicators of water quality has been well-documented (Chapman 1992). For example, dissolved oxygen levels are strongly influenced by point source discharges and for that reason the U.S.

Environmental Protection Agency (EPA) uses DO in preliminary evaluation of in-stream water quality. Due to its sensitivity as an indicator of estuarine water quality, dissolved oxygen may provide reliable assessments of the efficacy of management efforts to control non-point source discharges and improve habitat conditions. Water quality conditions can deteriorate rapidly in response to non-point source pollutants that are often pulsed through estuarine systems by short-term episodic storm events. In urban areas, pollutants drain off of hard surfaces such as parking lots and streets, flow into storm drains and drainage ditches, and then into creeks and rivers. Pollutants from storm water runoff and point-source wastewater discharges contain organic materials and nutrients that contribute to consumption of dissolved oxygen. Dissolved oxygen concentrations below 4 milligrams per liter (mg/l) are considered to be unhealthy for many aquatic community inhabitants. When the level of dissolved oxygen falls to 2 mg/l, severe physiological stress to marine organisms occurs and death may result. Fish and other estuarine organisms also react poorly to rapid changes in dissolved oxygen levels. For these reasons, the amount of dissolved oxygen in water is a good indicator of its "quality". Some habitats such as tidal creeks undergo regular periods of low dissolved oxygen (<2 mg/l) but these instances are usually short-lived (2-3 hours) and are part of the natural fluctuation in dissolved oxygen.

The oxygen content of estuarine waters varies with temperature, salinity, turbulence, atmospheric pressure and the photosynthetic activity of algae and submerged plants (Chapman 1992). Temperature affects the amount of dissolved oxygen that water can hold. Solubility of gases such as oxygen, carbon dioxide, and nitrogen decreases as the temperature rises (See gas solubility). Temperature also controls the rate at which planktonic organisms use oxygen. In some climates, the amount of dissolved oxygen in summer can be half of that found during the winter , but this is not solely caused by temperature and can be related to higher organic matter concentrations and increased biological activity. Temperature affects the rate of chemical reactions and increases evaporation and volatilization of substances. The metabolic rate of estuarine organisms is related to temperature so that in warm waters, respiration rates increase leading to increased rates of oxygen consumption and decomposition of organic matter. Growth rates of bacteria and phytoplankton increase in warmer temperatures, and can contribute to increased water turbidity, macrophytic growth and algal blooms (Chapman 1992). (See related section: Decomposers.)

Salinity or the total quantity of dissolved salts in water is a useful indicator of estuarine hydrography and habitat potential. It provides a direct measure of the relative influence of the sea and freshwater sources in an estuary. Salinity affects the distribution, abundance and composition of biological resources. A common misinterpretation is that much is known about the salinity structure of the nation's estuaries. In fact, data on salinity exist for only the most studied systems, while salinity distributions and variation in most estuaries have not been sampled (Orlando et al. 1994).

Conductivity is used to determine salinity and is actually a measure of the ability of water to conduct an electrical current. Conductivity is proportional to the concentrations of total dissolved solids and major ions, and its measurement is influenced by the amount of electrical charge on each ion, ion mobility and temperature of the water (Chapman 1992). Conductivity has proven to be useful in determining the extent of influence of run-off and effluent discharges in aquatic systems.

The pH of most healthy estuaries is between 6.0 and 8.5, ranging from slightly acidic to slightly basic. Most estuarine organisms are adapted to live within a narrow range of pH, so changes in pH can affect the population and distribution of the estuarine inhabitants. pH influences the availability and toxicity of contaminants. Marked changes in pH over time can indicate the presence of effluents and atmospheric deposition of acid-forming substances; however, diel variation in pH also occurs and can be caused by photosynthesis and respiration cycles of algae in eutrophic waters.

Turbidity, an indicator of sediment load and water clarity, is an important variable that generally ranges from 1 to 1000 NTU (Nephelometric Turbidity Units). Levels can be increased by the presence of organic matter, effluents, or run-off with high concentrations of suspended solids. Turbidity is highly variable on a temporal scale, with seasonal changes occurring due to biological activity and surface run-off. Heavy rainfall can also result in hourly variations in turbidity.

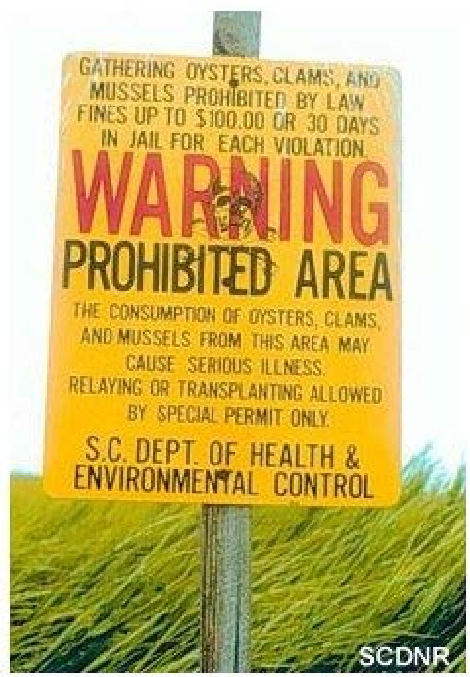
Back to Top

Additional Parameters Monitored by SCDHEC Programs

- Pathogens
- Nitrogen
- Phosphorus
- Biological and Chemical Oxygen Demand

Pathogens

Human and animal feces contain a number of intestinal pathogens which cause various diseases. Contamination of water by human or animal excrement introduces the risk of infection to those who consume or come into contact with the water. Monitoring for the presence of pathogenic bacteria is an essential part of any water quality assessment where direct or indirect water use leads to human contact (Chapman 1992). Analysis of water for the presence of fecal coliform bacteria is most commonly used to determine the presence of pathogens. Fecal coliforms are a group of bacteria commonly found in the intestinal excrement of humans and animals. Counts of fecal coliform bacteria in waters that have little human impact range from 0 to 3,000 organism, per 100 ml sample. Counts in waters near centers of high population density may be millions of organisms per 100 ml (Chapman 1992).



Shellfish contamination warning sign

The World Health Organization recommends a drinking water standard of 0 per

100 ml.

The SCDHEC shellfish monitoring program has selected water quality parameters which describe the sanitary conditions of the shellfish environment. This is necessary to prevent the harvest of animals unsuitable for consumption. Analysis for fecal coliform is the primary indicator used to determine shellfish water quality. Water is determined to be acceptable for shellfish harvest if sampling indicates the median number of fecal coliforms per 100 ml water sample does not exceed 14 and not more than 10 percent of the samples exceed 43/100 ml (SCDHEC 1995). The SCDHEC shellfish monitoring program also monitors salinity and temperature, as each of these variables affect the normal growth and behavior of shellfish.

Water samples collected at SCDHEC primary and secondary water quality stations are analyzed for indication of nonpoint and point-source pollutant loads to the watersheds. Nutrient and organic loadings are monitored in addition to pathogens, pH, salinity, temperature and dissolved oxygen.

Nitrogen

Nitrogen (N) is an essential constituent of proteins and genetic material in living organisms. Plants and microorganisms convert inorganic nitrogen to organic forms. In the natural environment, inorganic forms of nitrogen include nitrate, nitrite, ammonium ion and atmospheric nitrogen. Transformations between forms occur due to biological and non-biological processes. Organic forms include protein substances and protein byproducts formed by phytoplankton and bacteria. (See related section: Biogeochemistry.)

The SCDHEC primary water quality stations monitor total ammonia, unionized ammonia, total Kjeldahl nitrogen (TKN), and nitrate/nitrite. Ammonia (NH3) occurs naturally in water bodies as a result of the breakdown of organic and inorganic matter in soil and water, excretion from biota, and reduction of atmospheric nitrogen by microorganisms. Also, some industrial processes discharge ammonia products. In an aqueous solution, un-ionized ammonia exists in equilibrium with the ammonium ion, the distribution of forms depending upon pH. Total ammonia is the sum of unionized and ammonium forms. Total ammonia concentrations in surface waters are typically less than 0.2 mg/l but may reach 2-3 mg/l (Chapman 1992). Higher concentrations could be an indicator of pollution such as domestic sewage, industrial waste, or fertilizer runoff. Seasonal fluctuations in ammonia concentrations are natural due to varying rates of organic loading and biological decay.

The nitrate ion (NO3) is the common form of nitrogen found in natural waters. It may be biochemically reduced to nitrite (NO2), usually under anaerobic conditions. The nitrite ion is rapidly oxidized to nitrate (Chapman, 1992). Natural levels of nitrate in surface waters seldom exceed 0.1 mg/l as N, but waters influenced by human activity normally contain up to 5 mg/l as N with levels over 5 mg/l as N indicating pollution by animal or human waste or fertilizer runoff. National drinking water standards for nitrates are 10 mg/l as N.

The Kjeldahl method for TKN tests for the presence of nitrogen in the tri-negative state. The subtraction of ammonia nitrogen from TKN gives "organic nitrogen". Organic nitrogen consists mainly of protein substances and their byproducts. Organic nitrogen is typically formed within the water column by phytoplankton and bacteria and cycled within the food chain, and is subject to seasonal fluctuations in the biological community (Chapman 1992). Concentrations of TKN are affected by both point and non-point sources.

Phosphorus

Phosphorus is an essential nutrient for living organisms and is often the limiting nutrient for algal growth (primary production). Phosphorus is rarely found in high concentrations in fresh waters as it is actively taken up by plants. Seasonal fluctuations are normal due to fluctuations in primary production (Chapman 1992). Natural concentrations of phosphorus in surface waters usually range from 0.005 to 0.020 mg/l.

Biological and Chemical Oxygen Demand

The amount of organic matter present within a water sample and the relative biodegradability of the organics may be estimated by analyzing samples for biochemical oxygen demand (BOD). Biochemical oxygen demand is an approximate measure of the amount of biochemically degradable organic matter within a sample (Chapman 1992). It is defined as the amount of oxygen microorganisms require to oxidize the material to an inorganic form. Typically, unpolluted surface waters have BOD values of 2 mg/l or less. Industrial wastes may have BOD values of 25,000 mg/l or more. BOD values above normal may indicate pollution by industrial, domestic or agricultural sources, and may cause low dissolved oxygen conditions within a water body.

Chemical oxygen demand (COD) is a measure of the oxygen equivalent of the organic matter in a water sample that is susceptible to oxidation by a strong chemical oxidant. COD is greater than BOD for any given sample and is typically less than 20 mg/l in unpolluted waters.

Back to Top

Study Area Dynamics

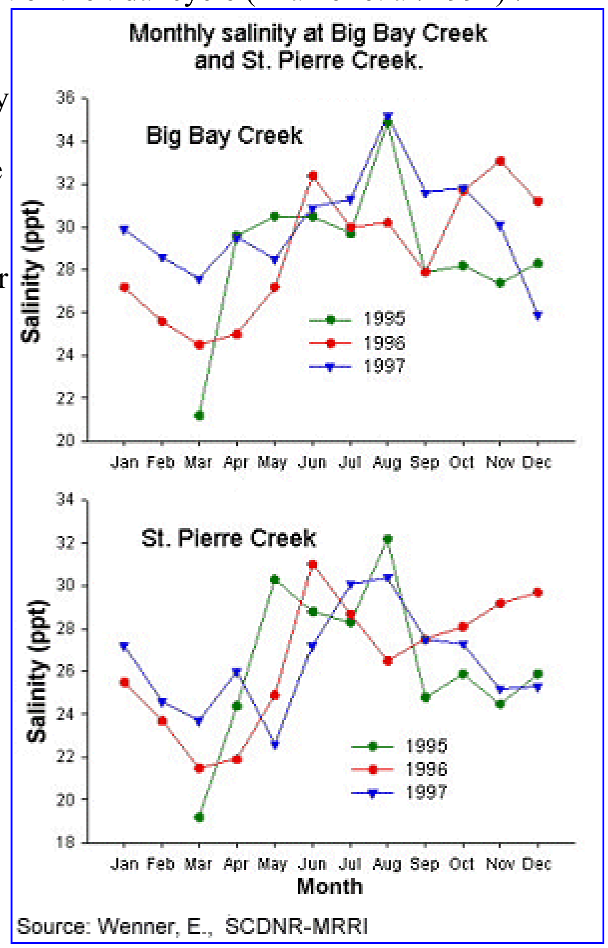
- Tides
- Point Source Dischargers
- Nonpoint Source Contributors

The ACE Basin study area includes coastal, estuarine, brackish and freshwater habitats within its watersheds. A majority of the water habitat is saline to some extent with measurable salinity 32.2 or more kilometers (20 miles) upstream in a number of the river systems (Eidson 1993). The mesotidal, low country of the study area experiences tidal influences 64.4 km (40 miles) upstream in some of the river systems. Most of the ACE Basin's naturally flowing water habitat is categorized as estuarine habitat and experiences daily tidal fluctuations.

Estuaries are dynamic zones of transition between purely marine waters and fresh water habitats. They have been described as an inlet of the sea reaching into a river valley as far as the upper limit of the tidal rise, normally divisible into three sectors: a marine or lower estuary in direct connection with the sea; a middle estuary subject to strong fresh and saltwater mixing; and an upper estuary characterized by freshwater but subject to daily tidal action (Kramer et al. 1994). The Venice system of estuarine classification segregates zones according to salinity concentrations: euhaline is 30 to 40 parts per thousand (ppt); polyhaline is 18-30 ppt; mesohaline is 5 to 18 ppt; oligohaline is 0.5 - 5 ppt. Tidal variation, fresh water flow and climatological changes result in significant temporal and spatial variation within an estuary. Specific conditions at any one point in space and time will always be different, providing a challenge to water quality monitoring programs. The ACE Basin has estuarine habitat located within a wide range of salinities. The temporal and spatial variability of estuarine water quality is discussed in a following section.

Tides

Tides have a major effect on the circulation of materials (dissolved and suspended) within an estuary. Tidal movement will not only be visible in currents but can be identified by changes in water quality variables such as salinity, turbidity and pH. Currents reach maximum velocities at mid-tide and a minimum of zero near tide change. This affects the suspension and resuspension of sediments and pelagic organisms. A sinusoidal pattern in many water quality parameters may be seen as a result of the tidal cycle (Kramer et al. 1994) . A comparison of parameter concentrations taken at random periods during the tidal cycle may be biased when these cyclic effects are not accounted for. The semi-diurnal tidal regime of the South Carolina coast results in a complete cycle within a 12.5 hour period. The two daily high tides are unequal in height. A secondary lunar component of tidal fluctuation results in a 14-day cycle commonly producing noticeable differences in concentrations of variables between the spring and neap tide period.



Cyclic variations in turbidity, salinity, suspended solids, and organic matter are common, due to resuspension of matter which has accumulated in the higher elevations of the intertidal region (salt marsh). The ideal strategy for long-term sampling would be to collect each sample at a mid-tide on a daily scale and at a mid point in the lunar cycle (midway between neap and spring tide) or to sample continuously (Kramer et al. 1994). The SCDHEC shellfish and primary/secondary station sampling protocols do not sample at a consistent tidal stage or lunar phase. This introduces additional variability into the sampling strategy and data.

The NERR Monitoring Program utilizes self-contained water quality monitoring units that sample basic water quality parameters every 30 minutes, twenty four hours a day. Data from this program show semidiurnal patterns in salinity, turbidity, pH, dissolved oxygen, and temperature corresponding to the tidal cycle. In addition, variations in salinity, turbidity and dissolved oxygen patterns may be correlated to spring tide conditions that facilitate resuspension of organic matter and sediments from upper intertidal regions.

Point Source Dischargers

Yemassee waste water treatment plant

The existing rural character of the study area is evident in the small number of facilities that hold National Pollutant Discharge Elimination System (NPDES) permits issued by the SCDHEC. The major point source dischargers of concern in the study area include: the City of Walterboro wastewater treatment facility at Ashepoo River mile 36 (57.6 km), the Yemassee wastewater treatment facility at Combahee River mile 30 (48.3 km), the SCE&G Canadys power station on Edisto River mile 38 (60.8 km), and the CCX Fiberglass Products plant in Walterboro on Ashepoo river mile 30 (48.3 km). There are a total of 13 NPDES permit holders within the study area. By comparison, Charleston County has 47 NPDES permit holders and Beaufort County has 20 permit holders.

Waste load is the flow-based calculation of pollutant mass discharged daily by a point or non-point source. Waste assimilation and mixing models developed by SCDHEC estimate the maximum daily pollutant load a section of stream may assimilate and still meet designated use criteria. Direct dischargers are issued permits with loading limitations based upon modeling results or existing regulations. Under the SCDHEC Watershed Water Quality Management Strategy, all permits within the project area are scheduled to be reissued on a five-year basis. All ACE Basin permits, except those issued for the Edisto River drainage basin, were issued/reissued in 1998. Edisto River dischargers had their permits issued/re-issued in 1999 (SCDHEC 1993).

Nonpoint Source Contributors

Runoff from cleared construction site

Nonpoint source contributions are generally introduced into a water body during a storm event and enter over a broad area, not through a discrete point source such as a pipe. Major nonpoint sources include agriculture, forestry, construction, urban development, and mining facilities.. Commonly monitored water quality parameters particularly affected by changes in land use are turbidity (suspended particulates), nitrate and total Kjeldahl nitrogen, pesticides, herbicides, total phosphorus, and fecal coliform from animal feed lots.

Land coverage within the study area is primarily forest (56%), with a moderate amount of wetlands (17%) and agricultural land (12%) . Urban development is estimated to cover 2% of the area, but is likely to increase. Since 1978, Colleton County has experienced an average annual decrease in farm acreage of 5.7%. Much of this land has been converted back to timberland. The decrease in agricultural land area may have a measurable impact on nonpoint-source water quality parameters within the study area. (See related sections: Agriculture and Forestry.)

Forestry is the largest industry within the project area. Some major forestry companies have voluntarily begun to implement best management practices on managed lands. Best management practices will hopefully have a positive impact on nonpoint stream pollutant loadings.

Several organizations such as the Lowcountry Open Land Trust, Edisto Island Open Land Trust , and The Nature Conservancy provide incentives to private land owners in the ACE Basin to protect their lands from future development. Additionally, state and federal holdings within the project area protect a significant land area. Participation in land trust and conservation easement programs may have future beneficial impacts on nonpoint source pollutant concentrations. (See related section: Protected Lands.)

Effects of urban development are likely to increase in the characterization project area as they have in nearly every area of the world. Construction of roads (e.g. the widening of highway 17) and the conversion of forest, wetlands, and agricultural land to housing and commercial establishments within the project area encourages additional development and increases nonpoint source pollutant loadings. Furthermore, lack of a comprehensive land use planning strategy can produce a landscape that is least suitable for controlling nonpoint source runoff. Eidson (1993) found increasing trends in nitrate/nitrite concentrations associated with urbanized sections of watersheds upstream of the study area on the Edisto River. (See related section: Urban Areas.)

Back to Top

Water Quality Sampling Programs

The Clean Water Act grants the states authority to set their own water quality standards but requires that the state's beneficial uses, numeric and descriptive criteria comply with national goals. The South Carolina Department of Health and Environmental Control (SCDHEC) has the primary responsibility for setting and enforcing standards needed to attain water quality goals within the state of South Carolina.

The South Carolina Department of Health and Environmental Control

The South Carolina Department of Health and Environmental Control's (SCDHEC) Water Quality Monitoring Program was developed to fulfill monitoring requirements specified in regulations promulgated by USEPA under federal Pollution Control and Clean Water Act mandates. The implementation of this program is intended to provide managers with the tools necessary for determining the present state of watershed water quality, assessing trends, identifying types and sources of pollution, and developing water quality control criteria for pollution prevention (SCDHEC 1995). (See related section: SCDHEC Water Quality Assessment.)

SCDHEC data analyzed within this section was obtained from the EPA STORET (STOrage and RETreival) database maintained by the USEPA. This database serves as a central repository for environmental data collected by federal, state, local and private entities nationwide. SCDHEC provides water quality monitoring data to STORET. All evaluations made within this section are based on data from the period from 1985 through 1995.

National Estuarine Research Reserve Monitoring

Retrieval of continuous water quality data logging device

Monitoring of water quality is also included in a program developed by the National Estuarine Research Reserve System (NERRS). Begun in 1995, the NERR system-wide monitoring program is a nationally coordinated effort to identify and track short-term variability and long-term changes in representative estuarine ecosystems and coastal watersheds. The initial phase of the program focuses on monitoring water quality and atmospheric variables over a range of spatial and temporal scales. Two stations are located within the ACE Basin NERR (See NERR water quality station sites).

Collecting long-term trend data that capture natural variability requires adequate temporal and spatial coverage. To address the temporal coverage, the NERR system-wide monitoring project employs YSI TM model 6000 sondes to collect water quality data. These data loggers record at 30-minute intervals, relay measurements to internal memory, run unattended for weeks at a time, and can operate in depths of a few centimeters. The salinity and temperature-compensated dissolved oxygen sensor provides accurate readings with little drift for extended periods, although deployment duration may differ during the year due to seasonal fouling.

In terms of spatial coverage, two data loggers are deployed in tributaries of the South Edisto River. One is located on a tidal marsh creek off Big Bay Creek. Surrounded by residential and commercial development and likely subject

Big Bay Creek

to non-point source pollution, this station was selected to monitor anthropogenic impacts. There are several boat ramps, a marina, and commercial seafood docks. Big Bay Creek is subject to heavy boat traffic. The creek is closed to shellfish harvesting because fecal coliform concentrations exceed state guidelines for shellfish waters. In contrast, there is little development or agriculture near the St. Pierre Creek deployment site, although new development on adjacent Bailey's Island may have long term impacts on the site. This station is surrounded by a wide expanse of *Spartina alterniflora* marsh. Upland areas are dominated by maritime forest. The creek is subject to light boat traffic.

To augment the NERR water quality data, an automated weather station, located at Bennetts Point, provides continuous information on meteorological conditions that influence water quality variables. As pointed out above, rainfall influences salinity in estuaries and can increase runoff of sediment and organic material that in turn may influence dissolved oxygen and turbidity levels as well.

Back to Top

Water Quality Criteria and SCDHEC Station Excursions

Sampling results at the SCDHEC primary and secondary monitoring stations were compared to current state or federal water quality criteria for each parameter subject to guidelines. (See Water Quality Means and Frequency with which Samples Exceeded Standards).)South Carolina has classified all waters in the project area into the following use categories:

1. **Class ORW**, or outstanding resource waters, are fresh waters or saltwaters that constitute an outstanding recreational or ecological resource or those fresh waters suitable as a source for drinking water supply;
2. **Class "trout waters"**; are waters suitable for supporting reproduction, essential habitat, growth of stocked populations, or put and take populations of trout.
3. **Class FW**, are fresh waters suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional

treatment. Suitable for fishing, and survival and propagation of a balanced indigenous aquatic community.

4. **Class SFH**, or shellfish harvesting waters, are tidal saltwaters protected for shellfish harvesting. Suitable for all uses specified for Class SA and SB.
5. **Class SA** are tidal saltwaters suitable for primary and secondary contact recreation. Suitable for all uses listed for Class SB.
6. **Class SB** are tidal saltwaters suitable for primary and secondary contact recreation, crabbing and fishing, except harvesting of clams, mussels, or oysters for market purposes or human consumption. Also suitable for survival and propagation of a balanced indigenous aquatic community.

Each use category has a set of water quality criteria which define compliance with the proposed use.

- Dissolved Oxygen
- Fecal Coliform
- pH
- Total Phosphorus
- Total Kjeldahl Nitrogen
- Nitrate/Nitrite

To determine if streams within the project area meet the use classification criteria, individual parameter values from the SCDHEC monitoring sites were compared to state water quality standards, federal criteria, or guidelines. Excursions are designated as values higher than standards. The percentage of sampling results considered to be an excursion was determined for 55 monitoring stations.

Dissolved Oxygen

Dissolved oxygen (DO) concentrations are a function of temperature, microbial and biotic respiration, photosynthesis, and salinity. Stream classifications ORW, SFH, FW and SA require the average daily dissolved oxygen to be no less than 5.0 mg/l and individual readings should never be less than 4.0 mg/l. Stream classification SB requires the dissolved oxygen concentration to be at least 4.0 mg/l at all times. When DO standards are not met due to natural conditions, a DO deficit of 0.1 mg/l below the natural concentration which is caused by anthropogenic activities will be allowed (SCDHEC 1998).

Eleven primary and secondary monitoring station water samples were tested for noncompliance with SCDHEC standards at time of sampling. Stations were located on the Combahee, Ashepoo, S. Edisto, N. Edisto, and Coosaw Rivers (Monitoring stations). In general, all samples were in compliance over 90% of the time except for those at the two stations on the Ashepoo River and two of the three stations on the Combahee Rivers. Noncompliance at the two Ashepoo River stations was near 40%. The Combahee River stations had excursion rates of 0%, 12% and 26%. The stations collecting samples with excessive rates of noncompliance are located in areas of high natural organic input and limited tidal water exchange. These low DO concentrations are most likely naturally occurring events which would be expected during periods when low photosynthetic activity relative to respiration occurs in combination with high natural organic loadings.

The NOAA National Estuarine Eutrophication Survey has classified water quality samples as anoxic if they are 0 mg/l, hypoxic if they are below 2 mg/l, and stressed if they are between 2 and 5 mg/l (NOAA 1996). Samples at the eleven stations evaluated for compliance with SCDHEC standards were evaluated to determine their classification according to these criteria. Anoxic conditions were not seen in any samples but hypoxic conditions were reported 3% of the time at one Ashepoo River station and one Combahee River station, and one percent of the time at one S. Edisto River station. A large proportion of samples from all eleven stations within the ACE Basin fell within the "stressed" classification. The Ashepoo River stations fell within stressed conditions 80 and 59 percent of the time; the Combahee River stations fell within the stressed classification 45, 25 and 32 percent of the time; the S. Edisto River stations fell within the stressed classification 28 and 8 percent of the time; the Coosaw River station was stressed 48% of the time; while the N. Edisto and Dawhoo River stations were stressed 100, 9 and 30 percent of the time.

Fecal Coliform

Fecal coliform concentrations for Class ORW, FW, SA and SB waters are required to remain below a geometric mean of 200 per 100 ml , based on five separate samples during a 30-day period, and no more than 10 percent of all samples may exceed 400 per 100 ml. Class SFH waters require a geometric mean of 14 per 100 ml or less, with not more than 10 percent of samples exceeding 43 per 100 ml.

Excursion rates at the 53 stations analyzed ranged from 0% to 97%. The Ashepoo River downstream of Walterboro had the highest rates of noncompliance. Average fecal coliform concentrations at this station were also the highest within the study area. Numerous point and and non-point sources associated with the Walterboro area are the likely cause of the high excursion rates.

The Big Bay and Fishing Creek estuaries located adjacent to the town of Edisto Beach exhibited high rates of fecal coliform noncompliance. Average sample concentrations for the seven shellfish stations in the area ranged from 23 to 117 per 100 ml. Possible sources of contamination include expansive residential and commercial development and associated runoff, failing septic systems, area marinas and boat docks, and runoff/infiltration from the town's no-discharge wastewater treatment facility. Treated, chlorinated/dechlorinated, wastewater from this facility is used for spray irrigation on the island's Fairfield Golf Course.

The six South Edisto River stations located downstream of Highway 17 were found to have relatively high mean values of fecal coliform concentrations and excursion rates ranging from 4% to 67%. The general rural development of Edisto Island, with associated livestock and agricultural practices, are likely explanations for these high values. The Dawhoo Creek stations located on the north side of Edisto Island detected similar high average fecal coliform concentrations and excursion rates ranging from 2-57%.

One additional area of frequent fecal coliform excursions was at station CSTL 98 located on the Combahee River at Highway 17. New development in the area with associated septic systems and a boat landing may contribute to these excursions.

pH

The pH standard for Class ORW, SFH, SA, and SB waters is between 6.5 and

8.5 standard units. For Class FW waters the pH must fall within the range of 6 to 8.5. Eleven stations were evaluated for sample pH compliance with four having excursion rates exceeding 10%. The four stations that found high noncompliance rates were all located within swampy areas with high natural production of humic acids associated with detritus loadings. These naturally occurring acids can lower the pH to levels below standards.

Total Phosphorus

There are no official standards for phosphorus, but the USEPA suggests a 0.1 mg/l maximum to prevent accelerated eutrophication. Eleven stations were evaluated for sample compliance with this guideline. Nine of the stations exceeded 0.1 mg/l for more than 10% of the sampling events. Rich natural deposits of phosphate are common within the study area, and are located along the S. Edisto, Combahee, and Ashepoo Rivers. Large quantities of phosphate are also present in the intertidal zone of the Coosaw River. The average total phosphate concentrations at stations on the Coosaw, Combahee and Ashepoo Rivers were greater than 0.1 mg/l . Average concentrations above guideline levels and frequent excursions are likely related to inputs from these natural sources. Natural background levels, however, have not been established and phosphorus concentrations at anytime may be related to anthropogenic discharges. The National Estuarine Eutrophication Survey classifies samples with over 0.1 mg/l phosphorus as high, and samples with 0.01 to 0.1 mg/l as moderate in phosphorus content. Those samples under 0.01 mg/l are classified as low in phosphorus content. All samples collected at the eleven stations examined which did not have concentrations greater than 0.1 mg/l fell within the moderate classification.

Total Kjeldahl Nitrogen

The National Estuarine Eutrophication Survey classifies water samples containing greater than 1 mg/l TKN as high, samples containing between 0.1 and 1 mg/l as moderate and those containing less than 0.1 mg/l as low in TKN. None of the seven stations for which data were available had samples in the low category. Two Ashepoo River stations had the highest percentage of samples in the high classification with 42 and 30%. A Dawhoo River station had 17% of the samples within the high classification while the two S. Edisto River stations had 17 and 11% of their samples within the high category.

Nitrate-Nitrite

It has been found that nitrate-nitrite concentrations of 0.2 mg/l or greater encourage eutrophication (Eidson 1993, Chesapeake Bay Program 1991). Values were compared to this guideline to determine hypothetical noncompliance with quality criteria.

Only one of the eleven stations evaluated displayed excursion rates exceeding 10% and all stations averaged less than 0.2 mg/l. Station MD 119 on the South Edisto River at Highway 17 exceeded the guideline value 26.5 % of the time. Possible sources of inorganic nitrogen in this area are not known, although the sampling station is located at Jacksonboro, a small roadside community with several fuel stations and restaurants.

Back to Top

Water Quality Trends at SCDHEC Stations

ACE Basin water quality data from nine primary and secondary fixed stations, and 29 shellfish stations were analyzed for historical trends (Trends in water quality). Parameters analyzed included:

- Trends in Fecal Coliform Concentrations
- Trends in Biochemical Oxygen Demand
- Trends in Nitrate/Nitrite
- Trends in Kjeldahl Nitrogen
- Trends in Total Phosphorus
- Trends in Temperature
- Spatial Trends in Salinity

Dissolved oxygen, turbidity, salinity and temperature were not analyzed for the primary and secondary stations because the sampling regime does not take into account semidiurnal, monthly and seasonal variability in these parameters. Continuous monitoring (as performed at the NERR stations) is required to assess trends in these parameters. SCDHEC station data were available for 1985 through 1995. Some stations, however, were not monitored over this entire period, so analyses were performed during periods for which data were available. Analyses were based on individual grab samples taken monthly, bi-monthly, or as specified in the sample schedule . Kendall's Tau was used to test the significance of trends at an alpha level of 0.05. All stations sampled within the project area are tidally influenced and evaluated parameters were not adjusted for variability due to flow or tidal stage before treatment.

Spatial trend analyses were performed on fecal coliform concentrations for the three major watersheds in the project area: the South Edisto, Ashepoo and the Combahee Rivers, plus the North Edisto River and the Coosaw River estuarine systems. An upstream/downstream concentration gradient was tested for significant trend using Kendall's Tau test and an alpha value of 0.05.

Since passage of the Clean Water Act in 1972, municipal loads of BOD to the nation's waterways have been reduced at least 46% while industrial loadings have been reduced 71% (Smith et al. 1987). Additionally, a general decreasing national trend in fecal coliform, and total phosphorus was noted. Trends in these parameters are most strongly associated with point source reductions, while nonpoint-source contributions remain unidentified. Nitrate concentrations within the nation's rivers have generally been on the increase due to nonpoint sources such as agriculture, animal feed lots, atmospheric deposition, and urbanization (Smith et al. 1987). Changes in nitrate concentrations may well reflect land-use changes within an area of study.

Trends in Fecal Coliform Concentrations

Samples at twenty-nine stations were tested for trends in fecal coliform concentrations. Seven stations showed a significant increasing trend in concentrations while the remainder showed no significant trend as evidenced by Kendall-Tau test results and plots of fecal coliform levels by station . Four of the stations with increasing trends were located on the Coosaw River. The south bank of the Coosaw River has undergone extensive development in the past decade reflecting the rapid growth of the Beaufort area. Sewer service is not available in the area and widespread housing development depends upon septic tank/drain field installations for treatment of domestic wastewater. The city of

Beaufort has a sludge application farm on Edding Creek, which may be an additional source of fecal contamination (SCDHEC 1993). A dairy farm with 25- 50 cattle and a moderately-sized marina also operate near the south banks of the Coosaw River. Whale Branch Creek which flows into the Coosaw River approximately 10 miles (16.1 km) upstream of the mouth, receives point sources discharges from an elementary school waste water treatment plant, a chemical manufacturing facility, and nonpoint discharges from a cattle farm. These potential sources of fecal coliform contamination and the continuing conversion of natural areas to residential and commercial development are probable explanations for increasing fecal coliform concentrations in this area.

The three additional stations (Big Bay Creek, Fishing Creek and S. Edisto River) with significant increasing fecal coliform trends were located adjacent to the town of Edisto Beach. Continued development of the area, increased recreational boating and dockage, and failure of existing septic tank installations are possible explanations for the trend.

Fecal coliform concentrations were tested for correlation to river mile (as measured from river mouth upstream in the center of the river) for the three major river systems (Ashepoo, Combahee and S. Edisto Rivers) and two estuarine systems (N. Edisto and Coosaw Rivers) within the study area (See fecal coliform correlations). The Combahee and S. Edisto Rivers were found to have a significant increasing trend in fecal coliform proceeding upstream (Kendall-Tau correlation for Mile vs. Coliform). Ashepoo River data suggested the same trend, but the relationship was not found to be significant at the 95% confidence level. The two estuarine systems displayed no significant upstream trend. Fecal coliform sources are human and animal discharges into otherwise fecal coliform-free waters. Ocean waters, which are characteristically free of appreciable concentrations of fecal coliforms, dilute river waters that have become contaminated with fecal coliforms as they pass through zones inhabited humans and livestock. Dilution of estuarine sections of rivers by ocean tides most likely produces the positive correlation of fecal coliforms with upstream river mile.

Trends in Biochemical Oxygen Demand

Concurrent with decreasing national trends in stream biochemical oxygen demand (BOD) concentrations, a general decreasing trend is noticeable at river stations within the project area (See BOD trends). Seven of the nine stations tested suggested decreasing BOD concentrations over the sampling periods. A statistically significant decreasing trend was found at Ashepoo station CSTL 69 (river mile 22 or 35.3 km) and Combahee River station CSTL 98 (river mile 18 or 28.9 km). Testing at all other stations indicated no significant trends were present. Decreasing trends in BOD might be more apparent in watersheds with greater point-source contributions, since the Clean Water Act initially concentrated on point source pollution reduction. The greatest impact of Clean Water Act point-source regulations may have occurred between 1975 and the mid to late 1980s. The data presented here may reflect a period after the greatest reduction in BOD loadings had occurred. Station MD-194 on the Coosaw River showed a non-significant positive slope, yet SCDHEC analysis of data through 1992 showed a significant increasing trend in BOD at this station (SCDHEC, 1993). Point and nonpoint source contributors, as outlined in the previous Fecal Coliform Trends section, explain increasing river BOD values.

Trends in Nitrate-Nitrite

All nine of the stations tested for trends showed apparent decreasing nitrate/nitrite concentrations. The decreasing trends were statistically significant at seven of the nine stations. Decreasing trends may reflect improvements in point-source treatments in areas which have had little change in land use. These trends may also reflect a change in land-use and land-use management practices. Agricultural runoff has been identified as one of the most significant contributors of nitrate /nitrite loadings to a water body (Smith et al. 1987). A net conversion of agricultural land to timberland and natural vegetative cover has occurred within the project area during this decade. The decrease in agricultural land usage, the implementation of best management practices by timber companies, and incentives to enroll land parcels in conservation easements and land trusts, may help explain the decreases in nitrate/nitrite concentrations.

Trends in Total Kjeldahl Nitrogen

Only three of the monitoring stations were tested for TKN frequently enough to be analyzed for significant trends. Station CSTL 98 on Combahee river mile 18 (28.9 km) showed a significant decreasing trend in TKN over the period. Conversion of agricultural land areas to forested areas and the implementation of best management practices in forest management may account for the decreasing trend at this station.

Trends in Total Phosphorus

Seven of nine fixed monitoring stations displayed a decrease in total phosphorus concentrations through the period. Decreasing trends were shown to be statistically significant at station MD 119 on S. Edisto River mile 23 (37 km), MD 211 on N. Edisto River mile 0 (0 km) and MD 210 on N. Edisto River mile 2 (3.2 km) . Trends in total phosphorus concentration are thought to reflect changes in point source loadings as well as changes in agricultural management practices. The decrease in the domestic usage of phosphorus-containing detergents and the increase in pollution control on municipal wastewater discharges upstream of these sampling sites is a probable explanation for the downward trends.

Trends in Temperature

Four primary monitoring stations and two shellfish stations which were located within St. Helena Sound were analyzed for temperature trends over the ten-year data collection period. Annual mean temperature was calculated from monthly grab samples and then tested for significant correlation to time. The increased interest in the global warming hypothesis was catalyst for this analysis. The two stations in St. Helena Sound showed a significant increasing trend while the four remaining river stations had no significant trends (See DHEC temperature readings). The St. Helena Sound stations are adjacent to open ocean waters which have a greater influence on the mean temperatures recorded there. If a general warming trend is evident in ocean waters, these stations are more likely to reflect the trend.

Spatial Trends in Salinity

The distribution of organisms within an estuary is determined by salinity range and mean. Some organisms will stay within a very limited salinity range and move as salinity fluctuates with tide and season. Other organisms have adapted to large and rapid periodic changes in salinity. Mean salinity data from stations on the three major river systems and two estuary systems within the study area were plotted against river mile (from mouth) to determine the approximate locations of euhaline, polyhaline, mesohaline and oligohaline zones. The Ashepoo, Combahee and S. Edisto Rivers displayed similar salinity zone locations, with mesohaline habitat 4 to 19 miles (6.4 to 30.6 km) upstream, oligohaline habitat 17 to 25 miles (27.4 to 40.2 km) upstream and freshwater above that (Salinity zones). The freshwater zone for the S. Edisto River began slightly less distance upstream (22.5 miles or 36 km). Stations within the Coosaw and North Edisto estuary systems were completely within the polyhaline and euhaline regimes.

Back to Top

Temporal Variability in NERR Water Quality Monitoring Data

Monitoring instruments have been deployed by National Estuarine Research Reserve (NERR) staff since March 1995 in St. Pierre and Big Bay Creeks. Data from these sites and others nationwide are available over the Internet at http://inlet.geol.sc.edu/nerrscdmo.html EXIT along with graphs and summary statistics. Automated data loggers recording at short time intervals over extended periods provide a unique means of capturing the episodic as well as cyclical nature of water quality variables. Having a time series of data available for the ACE Basin is important in further understanding underlying periodicities in the data. The following discussion of trends in water quality at the NERR monitoring stations is based on data collected from March 1995 through December 1997. Hourly means of this data are available in Excel spreadsheets for each creek and year: St. Pierre 1995 (sp95hr.xls), St. Pierre 1996 (sp96hr.xls), St. Pierre 1997 (sp97hr.xls), Big Bay 1995 (bb95hr.xls), Big Bay 1996 (bb96hr.xls), Big Bay 1997 (bb97hr.xls). [Note: Clicking on these files will launch Excel; return to browser using the back button. The water quality parameter column headings for each table are defined as: Meandep=depth in meters, Meandomg=dissolved oxygen in mg/l, Meandosa=dissolved oxygen in % saturation, Meancond=conductivity in microsiemens /cm, Meanturb=turbidity in nephelometric turbidity units (NTU), Meansal=salinity in parts per thousand (ppt), Meantemp=temperature in degrees C.]

- Water Temperature
- Salinity
- Specific Conductivity
- pH
- Turbidity
- Dissolved Oxygen

Water Temperature

Water temperature fluctuations at monitoring sites in the ACE Basin may be influenced by a number of factors including season, time of day, cloud cover, and the flow and depth of the surrounding water body. At monitoring sites in the ACE Basin NERR, water temperature exhibited a seasonal pattern with lowest values occurring in December-January (See NERR water temperature readings). The lowest monthly water temperature observed was 8.9°C which occurred in February 1996 at St. Pierre Creek. Temperature maxima occurred in

July and August with the highest monthly water temperature (30.9°C) occurring in July 1995 at Big Bay Creek (See temperature extremes for Big Bay and St. Pierre). Diurnal variation in temperature was evident with warmest temperatures occurring during the time interval of 1300-1800 hrs for each month at both sites (Temperature at Intervals). This diel variation in temperature is illustrated for Big Bay Creek .

Salinity

Salinity was highly variable at the monitoring sites. For all years, extremes ranged from 0.3-41.7 parts per thousand (ppt) at Big Bay and from 0-41.7 ppt at St. Pierre Creek. Average annual salinity for both sites was in the polyhaline regime, with a mean of 29 .4 ppt at Big Bay Creek and 26.3 ppt at St. Pierre Creek. Salinities exhibited seasonal variability with lowest values occurring in March at St. Pierre Creek. The Big Bay site also had low salinity in March 1995 and 1996, and another period of low average monthly salinity in December 1997. Local precipitation and evaporation is most likely a major contributor to monthly variability.

An hourly plot of mean salinity for a selected period in August 1995 and January 1996 revealed that salinity was strongly influenced by tidal stage (indicated by water depth). As expected, highest values of salinity occurred on the flood tide (See SP hourly salinity). Spectral analysis which is a type of time series analysis that is useful for exploring data and determining if periodicity is present, confirmed that a sinusoidal period occurred at ~ 12 h, representing tidal periodicity . This tidal periodicity was also supported by spectral analysis of water depth in a 500 h record.

Another statistical technique, periodic regression analysis, was used to determine whether significant seasonal, tidal and diurnal components were present in the data (Lorda and Saila 1986). This regression analysis hypothesizes a known period and removes its component from the data if found to be significant. By detrending hourly salinity data using this method, it was revealed that seasonal periodicity was significant and accounted for most of the variation in salinity at both sites (Periodic Regression). Tidal periodicity was also significant but accounted for less than 5% of the total variation, while the diurnal component accounted for less than 1% of the total variation although the slope was significant.

Specific Conductivity

Conductivity, expressed as microsiemens per centimeter (Fcm^{-1}), averaged 45.4 in Big Bay Creek, while the average value for St. Pierre was 36.4 Fcm^{-1}. Frequency distributions differed between St. Pierre and Big Bay Creeks, with a bimodal distribution occurring at the St. Pierre site .

pH

Values of pH varied from 5.4-8.3 at Big Bay and from 5.3-8.4 at St. Pierre Creek; however, the preponderance of measurements were >7 at both sites (See pH for St. Pierre and Big Bay). Time series plots of pH indicated variability of ~1 standard unit (su) on a daily basis (See Big Bay pH and salinity . These excursions coincided with similar trends in salinity suggesting a relationship to tidal influence. Spectral analysis revealed a periodicity for pH, salinity and water depth with a sinusoidal period at ~ 12 hrs. indicating tidal periodicity.

Marked variations in pH can also occur diurnally due to changes in primary production and respiration. The excursions in pH found at the NERR monitoring sites in the ACE Basin appear to be attributable to natural conditions.

Turbidity

Examination of monthly mean turbidity values (NTU) revealed considerable variability at NERR monitoring sites. There was no indication of a distinct seasonal trend nor of major differences in average turbidity conditions between St Pierre and Big Bay creeks. However, monthly variability appeared to be greater at the St. Pierre site and may be due to fluctuations in the amount of detritus being washed from the extensive salt marsh and upland sites that surround St. Pierre Creek. Turbidity is affected when detrital and sediment runoff occurs as the tide ebbs and water flows off the marsh surface. This tendency is illustrated by high values of turbidity that correspond with low water depth in a plot of conditions at Big Bay Creek. Tidal periodicity was confirmed by spectral analysis in which a sinusoidal peak occurred at 12 h.

Dissolved Oxygen

Dissolved oxygen values at the two NERR monitoring sites were generally high with averages of 83.6% saturation and 6.6 mg/l for Big Bay Creek and 78.5% saturation and 6.3 mg/l for St. Pierre Creek (See DO in St. Pierre and Big Bay). Frequency distributions of hourly mean dissolved oxygen indicated that hypoxic conditions (<28% saturation or 4 mg/l) did occur but were infrequent at both sites. Supersaturation also occurred with values >120% at both creeks.

At St. Pierre Creek, a simple plot of dissolved oxygen concentrations and water depth showed that DO tracked depth for part of the cycle, with lowest values occurring on low tides. Afternoon and evening values were not as low as early morning values, suggesting a diurnal component (See hourly DO at St. Pierre). By applying periodic regression analysis (Lorda and Saila 1986), significant seasonal, tidal and diurnal components in dissolved oxygen were confirmed (Periodic Regression). The first step in the analysis was to quantify seasonal variations at each site. A quadratic model was fit to the data and it was determined that there were seasonal trends in dissolved oxygen. Similarly, diel and tidal variation were quantified with results finding both components significant; diel variation, however, accounted for a greater portion of the total variance in the model than tidal variation. It appears then that most of the variation in dissolved oxygen is explained by seasonal periodicity.

Spectral analysis was also used to indicate periodicity in dissolved oxygen. Two sinusoidal periods for DO were found in a 100 h record at both sites and in a 500 h record at Big Bay Creek (See spectral analysis of DO). The large peak at 12 hours represents tidal periodicity, and the peak at 24 hours represents diel periodicity. The size of the peaks is a measure of their relative importance in explaining variance in dissolved oxygen (Wenner et al. 1998).

Monthly mean dissolved oxygen varied with season. Highest mean values occurred in winter, while lowest mean values occurred in summer at both sites (See monthly DO) Monthly mean plots also indicated differences among years in % saturation at the two creeks. Scatter plots of hourly dissolved oxygen values at the two sites further illustrated annual differences . Hypoxic events, as indicated by points below the reference line at 28% saturation (~2 mg/l), occurred most frequently in summer, although few hypoxic events occurred at either site in 1995. Over all years, hypoxic conditions were observed in every season but summer was clearly the season with the greatest percent of time that DO was # 28%. There were clearly differences among the sites with hypoxic conditions occurring over a greater percent of time at St. Pierre Creek . July and August were the months when hypoxia occurred >10% of the time at St. Pierre Creek, while Big Bay had hypoxic conditions for 17% of the time in September (See seasonal differences in dissolved oxygen levels). These differences among creeks most likely reflect physiographic and circulation differences among the two sites and are not likely due to anthropogenic influences.

Why hypoxia was common in some years and not others is not clear. Many investigators have suggested that natural factors (e.g. degree of stratification, circulation patterns) and human development (e.g. nutrient loadings) contribute to the development and maintenance of low DO events. Further evaluation of long-term water quality monitoring data for the NERRS sites in conjunction with information on weather patterns, rainfall, sea-level rise, nutrient loadings, habitat differences, and land cover will be required to understand long-term trends and year-to-year differences in low DO.

Back to Top

Conclusions

Long-term water quality monitoring in the ACE Basin provides a unique opportunity to increase our understanding of how various environmental factors influence estuarine processes. Frequent measurements are important if one is to determine variability and the temporal dynamics of water quality, with the eventual goal of partitioning natural variability from that influenced by human activities.

Thus far, there are few indications of major problems in water quality within the Reserve portion of the ACE Basin. Dissolved oxygen concentrations often dropped below 4 mg/l at stations along the Ashepoo and Combahee Rivers, but these excursions are thought to be natural phenomena. Dissolved oxygen at the two NERR continuous monitoring sites also drops below 4 mg/l, a critical threshold for growth, reproduction and survival of living resources (Diaz and Rosenberg 1995). As coastal watersheds surrounding the ACE Basin develop, the frequency and duration of low DO events are expected to increase due to increased nutrient loadings.

Monitoring stations on the Ashepoo River downstream of Walterboro, SC; adjacent to Edisto Beach; and adjacent to Edisto Island on the S. Edisto River and Dawhoo Creek all had high instances of non-compliance with fecal coliform standards. The Coosaw River and Big Bay Creek adjacent to Edisto Beach also had statistically significant increasing concentrations of fecal coliform. Stations indicating fecal coliform problems were located in areas of human development where septic systems are the primary domestic wastewater treatment schemes and sources of animal waste, urban runoff and land application of wastewater are found. The continued rapid growth of the Beaufort area, and expansion of Edisto Beach and Walterboro will certainly affect ACE Basin water quality in the future.

The concentrations of nitrates/nitrites and phosphorus are generally stable or decreasing. Values of these nutrients are generally below levels of concern for nutrient enrichment, except in those areas of natural phosphate deposits. Improvements in forestry and agricultural management practices, the conversion of agricultural land to natural cover, and improvements in the treatment of point source discharges have contributed to these findings. As urban development continues to spread on the outskirts and within the project area, these trends will likely be reversed and concerns about eutrophication may increase.

Continuous, long-term data sets for estuarine water quality, like those collected for the ACE Basin NERR, will be required to establish baseline conditions against which the degree and magnitude of changes can be measured. While point data are useful in evaluating water quality, they do not provide information on short-term temporal variability. Estuarine water quality naturally varies on many spatial and temporal scales (e.g. tidal, diel, lunar, seasonal, annual, by region and by creek). Alterations to estuarine water quality that are associated with development of coastal watersheds affect the amplitude and type of periodicity as much as it alters the mean of observed values (Wenner et al. in press). With increasing urbanization, water quality in the ACE basin may decline unless sound management principles are applied.

NEXT CHAPTER: Biological Resources

Authors

E. Wenner, SCDNR Marine Resources Research Institute

M. Thompson, SCDNR Marine Resources Research Institute

D. Sanger, SCDNR Marine Resources Research Institute

References

Chapman, D. 1992. Water quality assessments. Chapman and Hall, London, UK.

Diaz, R. J. and R. Rosenberg. 1995. Marine benthic hypoxia: A review of its ecological effects and the behavioural responses of benthic macrofauna. Oceanography and Marine Biology: An Annual Review 33:245-305.

Eidson, J. P. 1993. Water quality. *In*: Assessing change in the Edisto River basin, an ecological characterization. South Carolina Water Resources Commission Report 177.

Funderburk, S. L. (ed.). 1991. Habitat requirements for Chesapeake Bay living resources. Habitat Objectives Workgroup, Chesapeake Bay Program, U.S.

Environmental Protection Agency. Annapolis, MD.

Kramer, J. M., U. H. Brockman, and R. M. Warwick. 1994. Tidal estuaries: Manual of sampling and analytical procedures. Balkema Publishing, Brookfield, VT.

Lorda, E. and S. B. Saila. 1986. A statistical technique for analysis of environmental data containing periodic variance components. Ecological Modeling 32:59-69.

National Oceanic and Atmospheric Administration. 1996. NOAA's eutrophication survey. Vol. 1: South Atlantic region. Office of Ocean Resources Conservation Assessment, Silver Spring, MD.

National Research Council. 1993. Managing Wastewaster in Coastal Urban Areas. National Academy Press, Washington, DC.

Orlando, S. P., P. H. Wendt, C. J. Klein, M. E. Pattilo, K. C. Dennis, and G. H. Ward. 1994. Salinity characteristics of the south Atlantic estuaries. Office of Ocean Resources Conservation and Assessments, National Oceanic and Atmospheric Administration, Silver Spring, Maryland.

Robertson, A. and W. Davis. 1993. The selection and use of water quality indicators. p. 119-128. *In*: Water Environment Foundation (ed.). Challenges facing environmental laboratories: methods, quality, media, and liability. Specialty Conference Series, Santa Clara, CA. Water Environment Foundation, Alexandria, VA.

Smith, R. A., R. B. Alexander, and M. Wolman. 1987. Water quality trends in the nation's rivers. Science 235:1607-1615.

South Carolina Department of Health and Environmental Control. 1998. South Carolina General Assembly, Document 2218, Chapter 61. http://www.lpitr.state.sc.us/regs/2218.htm. Accessed September 1998.

South Carolina Department of Health and Environmental Control. 1998. Water classifications and standards. Bureau of Water, Columbia, SC.

South Carolina Department of Health and Environmental Control. 1993. Watershed water quality management strategy Savannah-Salkehatchie watershed. Technical Report 002-93. Bureau of Water Pollution Control.

South Carolina Department of Health and Environmental Control. 1996. The state of South Carolina water quality assessment pursuant to section 305(b) of the federal Clean Water Act. Bureau of Water Pollution Control.

South Carolina Department of Health and Environmental Control. 1995. Watershed water quality management strategy Saluda and Edisto River basins. Technical Report 003-95. Bureau of Water.

South Carolina Department of Health and Environmental Control. 1995. State of South Carolina monitoring strategy for fiscal year 1996. Technical Report 002-95. Bureau of Water Pollution Control.

Wenner, E. L, A. F. Holland, and D. Sanger. 1998. Assessing short-term variability in dissolved oxygen and other water quality variables in shallow water estuarine habitats. *In* Marine Technology Society (ed.). Proceedings of the Ocean Community Conference, November 1998, Baltimore, MD. Marine Technology Society, Washington, DC.

Wenner, E. L. and M. Geist. unpublished. Reserved for the future: A national system to preserve estuarine waters.

Biological Resources

Introduction

The Biological Resources chapter of the ACE Basin Characterization introduces the types of organisms found in the ACE Basin. The primary producers discussed in this component are phytoplankton and representative plant communities. Animals inhabiting the Basin which are discussed in this section are the decomposers, zooplankton, benthic invertebrates, insects, decapod crustaceans, fish, reptiles and amphibians, birds, and mammals. In addition, the biological resources chapter discusses ecosystem processes as well as endangered and threatened species.

For detailed information on individual species, the reader is referred to the Species Gallery chapter of the ACE Basin Characterization. In the Species Gallery, pictures and descriptions of over 70 species can be found. The gallery provides information on the physical characteristics, ecology, habitat, biology, commercial value, and recreational value of each species.

Forest and wetland habitats

In general, the types of habitats utilized by organisms depends on the physical and chemical conditions of the habitat. The Environmental Conditions chapter of the ACE Basin Characterization provides additional information on the factors that may regulate where and how successfully an organism lives in the ACE Basin.

The biological resources in the ACE Basin have historically and are currently being used by humans who inhabit and visit the area. The Resource Use chapter of this characterization provides the reader with information about the use of these biological resources. In particular, the importance and status of resource uses such as forestry, agriculture, protected lands, significant natural areas /features, commercial fisheries, recreational fisheries, hunting, and tourism are discussed.

NEXT SECTION: Ecosystem Processes

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

MENU

Introduction

Habitat

Succession

Biodiversity

Biological Populations

What is a Community?

Energy and Trophic Levels

Ecosystem Services

Wetlands as Contaminant Filters

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Ecosystem Processes

Introduction

The following section describes some of the basic ecological concepts that underlie the ACE Basin ecosystem. Descriptions include an introduction to ecology and ecosystems, habitats, succession and biodiversity, populations and communities, energy flow through ecosystems, and ecosystem services. Many of these concepts are applicable to the habitats, communities, and ecosystems that are described in the Biological Resources Section and other sections of this product.

What is Ecology?

Ecology is the study of living organisms and their interactions with the physical and biological environment. While this involves an incredibly complex network of species, habitats, climates, physical environments, and human uses and concerns, the field of ecology has continued to advance the explanation of biological distributions, chemical cycles, and the interlinked nature of ecosystems. Some of these biological distributions and ecosystem processes (e.g. fish and decapod communities, carbon and nitrogen cycling) are described in other sections of this characterization.

What is an Ecosystem?

The ACE Basin contains a diversity of habitats that range from subtidal areas and vast wetlands to uplands. These habitats are populated by many different plant and animal species that interact with the physical environment to create the ACE Basin ecosystem. Ecosystems are defined as “a set of organisms (community) living in an area, their physical environment, and the interactions between them” (Daily 1997). For example, the ecology of Edisto Beach consists of organisms such as fish, insects, shellfish, birds, raccoons, and humans that make up the community; natural features such as the surf zone, front beach, dunes, forested areas and the created infrastructure of roads, buildings, and utilities that constitute the physical environment; and the interactions between the community and physical components.

Although it has not always been clearly recognized, we are completely dependent on the ecosystems in which we live. The myriad processes that integrate energy and nutrients flowing through the ACE Basin ecosystem provide its human inhabitants a variety of services. Besides providing food and shelter, the ecosystem provides waste treatment (by way of carbon dioxide consumption; oxygen production; and breakdown of sewage), a water filtration system (by the soil), recreational opportunities, and a basis for economic development. Remove any one of these "services" and the character and function of the other components can be compromised. See the discussion of ecosystem services below.

Natural geomorphic, as well as episodic, events have shaped the overall diversity of habitats and the services they provide. Over the last 10,000 years as early human societies created shell middens and set fires intentionally to capture game, and especially over the last 200 years with the advent of extensive forestry and agricultural practices, ecosystems have been significantly altered by anthropogenic factors. These factors will likely continue to pressure ecosystems in the future. (See related section: History.)

As habitats are modified, ecological processes in these habitats also change and some of these changes may be significant. For example, estuarine marshes are effective traps for many pollutants. When pollutants are introduced at low levels, they may be bound to sediments or degraded through natural processes, and they are less likely to be transferred up the food chain. If the ability of sediments to trap such pollutants is exceeded, however as has happened in some places in the Charleston Harbor Estuary (DHEC 1998), then pollutants may move up the food chain. Some of the changes may not be immediately obvious, such as a reduction in populations of benthic infauna (small worms, crustaceans, and bivalves). Other impacts, such as the loss of oyster beds resulting in the reduced availability of oysters for recreational or commercial harvest, are much more obvious. Part of the solution to these problems lies in appropriate management decisions made at the federal, state, and local governmental levels, as well as by individual property owners and residents of the ACE Basin. (See related section: Management.)

Back to Top

Habitat

- Habitat Fragmentation
- Ecotonal Habitat

Forest and wetland habitats

A habitat is defined in relation to a plant or animal species and is the location where the species lives. It is a combination of the physical and biological components of the location and ranges from very large and stable (the earth or the open ocean) to very small and ephemeral (a pond in the dunes). A habitat may be a stand of loblolly pine trees with heart-rot where red-cockaded woodpeckers are found, the estuarine pluff mud where mud snails and polychaete worms thrive, or the town of Edisto Beach where humans reside. Usually, the more diverse the habitat types within a region, the greater will be the variety of species being supported. Coastal areas, such as the ACE Basin, located between the open ocean and upland areas, have a high diversity of habitats and microhabitats, supporting diverse and abundant communities of plants and animals. However, one of the greatest threats to habitat diversity in the ACE Basin is the conversion of existing habitats to structurally and biologically simpler habitats such as agricultural fields, pine plantations, and urban or residential areas. In addition to the direct loss of existing habitat, the resulting fragmentation of the remaining forested and wetland areas results in decreased species diversity (Odum 1997; Meffe and Carroll 1994).

Habitat Fragmentation

Habitats are always patchy and fragmented, to some extent, by natural disturbances and subsequent succession (see text below). While some of these processes can have global impacts, such as climate change and sea level rise, most disturbances occur on a more local scale. Local examples may include forest fires, hurricanes, and disease. Through successional processes, these habitats revert back to pre-impact states over time periods ranging from years to decades. Low-level patches of disturbance can increase the variety of habitats and therefore provide additional habitat for opportunistic species.

Roads, clearcutting and agriculture fragment a tract of forested land in the ACE Basin.

In contrast, due to anthropogenic influences much of the change has become much more long-lasting. Forests have been converted to agricultural fields and suburban and urban land, and seldom have the opportunity to revert back to a “natural” state. Depending on the land use, anthropogenically altered habitats tend to have a simpler structure with lower habitat diversity and increased “edge” habitats than do natural systems. As a result, biotic communities shift to favor those species that can utilize open, edge, agricultural, or suburban habitats. Species that require interior forest habitats have a harder time finding appropriate food and other required resources. Thus, there has been an overall reduction in populations dependent on these habitats (Meffe and Carroll 1994).

Ecotonal Habitats

An ecotone is an area of transition between two different environments or habitats. Some ecotones are extreme, such as the shift from an estuarine or riverine environment to a forested habitat . In other places, the transition

Fragmented habitat

may take place more gradually, shifting from open rivers to forested wetlands and upland areas. One of the most obvious characteristics of an ecotone is the shift in vegetation that occurs between adjacent habitats. These changes reflect similar gradients in less obvious properties such as salinity, moisture, flooding regime, altitude, and other physical and chemical properties. Ecotonal or "edge" habitats often have a higher diversity of plants and animals relative to the more homogenous habitats on either side. In addition to edge-selected species, species native to each adjacent habitat may occasionally be found in these transition habitats.

One result of fragmented habitats arising from development in the ACE Basin is the change of the character of ecotonal habitats. Ecotones where the vegetative communities previously shifted slowly from wetland to upland forest have been changed to sharper boundaries between wetland areas and what are now agricultural fields or suburban developments. Many game species utilize these edge habitats and a common practice of wildlife managers is to create edge-habitat. However, many non-game species require less abrupt transition areas and have declined as a result of the loss of these gradual transition zones (Meffe and Carroll 1994).

Back to Top

Succession

Succession is a process that encompasses the dynamic biological and physical changes that lead to the development of complex, interlinked, biological communities. For example, habitats that are disturbed by fire or storm go through a series of community changes as the habitat recovers from the disturbance. Succession has been viewed as a step-wise process, whereby early communities typically are dominated by a few opportunistic species. The transfer of energy from primary producers (plants) to herbivores to predators (each is considered a trophic level, see discussion of energy flow through ecosystems below) tends to be less efficient during these early stages. The number of trophic levels also tends to be lower. Early colonizers may change the environment, facilitating later communities of other species to develop and eventually become dominant species. The community of organisms at the final stage of succession is called the "climax community". These communities are generally characterized by a wider range of species, a higher number of trophic levels, and more efficient transfer of energy between trophic levels. In some cases, a sequential process that changes the community of plants and animals occurs in which there is initial colonization by fast growing, opportunistic species followed by species that may grow more slowly but which compete better for limited resources (light, moisture, nutrients). The final climax stage reached is dependent on the pool of species available to colonize the area, and the type, frequency, and intensity of initial disturbance (Christensen 1988). Community succession, therefore, is dependent on both predictable and stochastic events.

A successional series begins when some type of disturbance sets back the "clock". Landslides, hurricanes, avalanches, catastrophic forest fires, volcanic eruptions, and meteorite impacts may set the clock back to "zero" by completely destroying the existing communities. These types of events are relatively rare and there are usually some species (e.g. fire-resistant seeds) adapted to surviving these severe types of disturbances. Less severe disturbances from localized storms, hurricanes, or burned forests are more common and generally result in only partial damage to the community.

In coastal forests of South Carolina, including the ACE Basin, this progression commonly starts with communities dominated by grasses and other fast growing opportunistic "weedy" species that colonize the area within the first few weeks or months after a disturbance. Over the next year or so, the community is slowly taken over by woody shrubs and young pine trees that grow more slowly than the opportunistic species. Over the next 20-30 years, as the pines begin to grow large enough to shade the ground beneath, shade-tolerant species may become established. Shade-intolerant plants that colonized the open habitat, including young pine trees, can no longer establish themselves under a closed canopy. Shade-tolerant species such as hardwood species (e.g. beech and oak) become established, and the community develops into a Southern mixed hardwood community. Between 50 and 100 years after the disturbance, pine trees begin to slowly die, and the community gradually shifts towards a hardwood dominated community, the common climax community of coastal South Carolina upland areas. (See related section: Plants.)

Although fires and storms still may cause significant disturbance in ACE Basin communities, humans' impacts through agriculture and forestry practices and urban development have far greater impact on succession in the ACE Basin. One of these anthropogenic influences is the regulation of fire which may result in changes in communities that are dependent on seasonal fires. Management plans usually prescribe burns during the winter without regard to the natural requirements of the species, because this is a period when areas are wetter and fires are less likely to get out of control. This, in part, explains the reduced dominance of longleaf pine forests that require spring and summer fires in the early part of the growing season. Another impact is the clearing of fields (the initial disturbance) and their maintenance as agricultural land (repeated disturbances) preventing the successional sequence that would return them to a forested landscape if left undisturbed. While some areas have been allowed to develop back into forests, more frequently land has been shifted from forest to agriculture and then on to suburban or urban uses. There are extreme cases, fortunately outside the ACE Basin, where habitats have been so severely impacted through salinization, erosion, or pollution that the areas would take thousands of years to recover and may never revert to the habitat that was there originally (Odum 1997). There is a field of study called restoration ecology that deals with restoration and reclamation of severely degraded habitats.

Back to Top

Biodiversity

One of the more important characteristics of a habitat is its biodiversity. Individual species in a habitat fill different roles or niches including primary production, herbivory, predation, and decomposition. In most communities these roles are filled by many species with varied characteristics.

Biologically diverse communities, often occurring in stable environments where complex assemblages of species have time to develop, can provide a wide variety of services to the ecosystem as well as to humans interested in the services. As an example, the potential medicinal value of the plants in the biologically rich tropical regions is well recognized, and the loss of these communities through deforestation may reduce this source of alternative medicines. As another example, the loss of habitat for the Red-cockaded woodpecker is directly related to current forest management practices of harvesting pine forests before they have time to age to the point that woodpeckers can utilize them.

The diversity of a community or habitat is, in part, dependent on the stability of the environment surrounding the habitat. If environmental conditions remain relatively constant, the available resources tend to be divided up between many different species. The transfer of energy between trophic levels tends to be more efficient in communities that have a number of trophic levels. These conditions are characteristic of climax communities at the late stages of succession. Examples of climax communities are the maritime forest on barrier islands and hardwood forests in inland areas that do not burn regularly.

In environments where disturbances are relatively frequent, the diversity of plant and animal species may be less. Frequent disturbance may keep the development of the community in the early stages of succession, which tends to have fewer species and a less efficient transfer of energy between trophic levels. An example of this type of community is the pine flatwood community where forest fires occur every 2-5 years, setting back the successional clock.

Back to Top

Biological Populations

The thousands of species and billions of individual plants and animals that occupy the ACE Basin can be organized into groups by species (populations), trophic levels (position in food chain), or habitats (communities). The simplest level of organization of individuals is the population, a group of individuals of one species living in a specific area. Every population has attributes associated with it such as number of individuals (or density), range, habitat requirements, reproductive rates, and dispersal characteristics.

Reproductive Rate

The reproductive rate of a population is the inherent or intrinsic growth rate of a population in an unlimited environment. Most environments impose limits to population growth, whether it be nutrients, space or water supply. However, some habitats such as newly formed ponds or newly plowed fields may provide enough nutrients and space that they are functionally unlimited for a short period of time. In these cases, populations with high growth rates and a high reproductive potential can experience explosive population growth and rapidly colonize the habitat.

Growth Rate and "r" and "k" selected species

The growth rate of a population is a combination of the number of individuals in the population, the death rate, the reproductive rate, and whatever limiting factors act on the population. Growth rate or reproduction rate strategies can be classified along a continuum between two endpoints. Species that are "r-selected" have a high reproductive potential, producing many offspring. These species, however, devote little energy to protecting their offspring and they experience high mortality rates. Examples of organisms that are "r-selected" include many plants that are considered "weeds" as well as many aquatic worms and crustaceans that can rapidly colonize unoccupied habitats. In general these species release large numbers of gametes with minimal parental care. Species that are "k-selected" have a lower reproductive potential, producing fewer offspring but devote much of their energy towards protecting their offspring until they are ready to fend for themselves. These species may have only one or two offspring every year, mature slowly, and are relatively long-lived. The Florida manatee and humans are examples of "k- selected" species, with low reproductive potential and long periods of parental care for individual offspring. Other species fall somewhere along the continuum between these two reproductive strategies.

In general, "r-selected" species tend to be opportunists, rapidly expanding their populations in temporarily unlimited habitats. These species can rapidly establish themselves in newly formed or recently disturbed habitats. After a catastrophic forest fire for example, it is "r-selected" species that first colonize the site. Similarly, the "weeds" that attempt to invade a corn field (disturbed every year by site preparation) are usually "r-selected" species. The conditions these species exploit are often characterized by an abundant resources with a limited number of consumers. While able to rapidly invade an area, "r-selected" species generally do not compete as well as "k-selected" species when resources become limited. In the absence of frequent disturbances, "r-selected" species are out-competed for limiting resources by "k-selected" species that utilize limited resources more effectively. "K- selected" species tend to dominate stable habitats such as climax communities, where competition for space, light, and nutrients may be important.

Carrying capacity: How many is too many?

The carrying capacity of an environment is a theoretical maximum density of individuals that a particular environment can support. In terrestrial habitats, limiting factors are usually temperature, moisture regime, food, space, or predation. In aquatic systems, especially in small streams and tidal creeks, dissolved oxygen may also limit the number of individuals. Populations tend to fluctuate around the carrying capacity, by exceeding the maximum carrying capacity for short periods and then dropping below it. For food-limited populations, as their population exceeds their food supply (exceeds the carrying capacity) some individuals will starve or emigrate, thereby reducing the population. The population falls and remains below the carrying capacity until food is no longer limited. With adequate food resources, the population will begin to increase again, repeating the pattern. In some cases, the fluctuations are relatively small while other species may experience dramatic oscillations in their population.

Back to Top

What is a Community?

Any particular location supports populations of different species. Therefore, a community is defined as "all the different populations that live together in an area." (Odum 1997). The area comprising the ACE Basin encompasses many different communities. Communities can have unique boundaries, have varied composition of species, and be variable in time and space. A community may be defined as all the plants and animals (including humans) living on a particular barrier island. Alternatively, a community may also be described in a more specific sense, such as all the parasites living in or on a single fish such as a spotted seatrout.

Different communities frequently have similar characteristics. They are usually composed of both common and rare species. Some species, such as deer, are generalists that live in a wide variety of habitats or feed on a wide range of foods; others species are specialists such as the Red-cockaded woodpecker, which requires specific microhabitats or food sources. Some of these specialists are threatened by reductions of their required habitat. The Red-cockaded woodpecker, an endangered species once found in the ACE Basin, requires pine stands with a minimum age of 50-70 years. The loss of this habitat through timber harvesting has resulted in the extirpation of Red-cockaded woodpeckers from the ACE Basin. In contrast, the marsh hen is also a specialist, inhabiting only the *Spartina* marshes. But, due to the expanse of this habitat in the ACE basin, this species is very abundant there. National and state level restrictions on impacting *Spartina* wetlands protect this habitat and therefore protect the marsh hen.

External forces such as geomorphology (primarily affecting plant communities) and episodic events such as storms or fire may also shape the structure of communities. Low-lying areas are generally wet and support only those plant species that can tolerate wet conditions. Sandy soils with limited organic materials do not hold moisture well, and those habitats are dominated by communities of plants and animals that can withstand dry conditions. Intense storms such as hurricanes may decimate an Atlantic maritime forest dominated by hardwoods allowing faster growing, shade intolerant, pine trees to establish themselves and temporarily dominate the plant community.

In addition to external physical forces, a number of biological processes within a community (such as species interactions) help to establish and maintain its structure. Examples include territorial behavior, predator-prey interactions, inhibitory chemicals used by plants to slow the growth of other plant species, overstory shading that reduces the growth of shade intolerant species, and parasites and diseases. All these processes interact to control the abundance and diversity of the community of plants and animals in an area. Consider the example of Edisto Beach: humans have greatly altered geomorphic features and wetlands of the island. The structure of the community has changed considerably through the modifications that humans have made to make the island habitable for them. This may favor raccoons, egrets, and house cats at the expense of salamanders and bald eagles.

Back to Top

Energy and Trophic Levels

- Energy subsidies in Managed Systems

The energy supplied by the sun is the only source of truly renewable energy on the earth. Other sources of energy, such as fossil fuels, are not renewable. Nuclear energy, although potentially unlimited, has disadvantages related to its waste products. Hydroelectric energy is renewable, but is dependent on solar energy and weather patterns to replace the water that flows through the dam. Most of the sunlight falling on the earth is absorbed as thermal energy (Energy Dissipation of Solar Radiation as Percentage of Annual Input into the Biosphere **)** and this drives physical processes such as the hydrological cycle through evaporation and rainfall, and weather patterns through the heating of the air and land. Only about 1-5% of energy from the sun is stored by photosynthesis while the rest is radiated as thermal energy or heat (Odum 1997).

Energy flow through the biosphere (the thin biological layer at the earth's surface) begins with the conversion of the radiant energy of sunlight to chemical energy by organisms called autotrophs. These include all the species, such as plants, algae and some bacteria, that can convert solar energy to high-energy molecules through the process of photosynthesis. These species convert raw materials such as elemental nitrogen, carbon dioxide, water, and potassium into organic molecules, and in the process store energy in those molecules. The organic materials synthesized in this way are used by autotrophs to grow and survive. This conversion of raw materials and solar energy to organic materials is called primary production. Gross primary production is the total amount of raw materials converted by plants to organic molecules. A percentage of the gross primary production is used to maintain the plants themselves. Any extra production is called net primary production and it is used for growth and reproduction or it may be lost as dissolved organic materials.

Energy stored by primary producers is used by primary consumers which include herbivores and detritivores. Some herbivores include deer, rabbits, seed-eating birds, caterpillars, and carp which feed on living plant material. Detritivores are less conspicuous but no less important because they eat dead plant material and start the decomposition processes that reduce the organic material back to simpler, lower energy forms. From an energy storage and transfer point of view, these levels of primary producer, primary consumer, and secondary consumer are called trophic levels. Energy stored in high-energy organic molecules is transferred between these levels by herbivores grazing on plants and carnivores preying on herbivores. If it is hierarchical, from plant to herbivore to carnivore, this flow of materials is called a food chain. However, movement of materials from primary producers to consumers to decomposers typically follows many different paths resulting in a complex network called the food web as depicted in this figure from Odum (1997).

Energy Subsidies in Managed Systems

In a natural system that has been undisturbed by anthropogenic impacts, there is a constant flow of energy, in the form of organic materials, that starts with autotrophs using raw materials combined with solar energy to produce high-energy organic molecules, which are then transferred up the food chain. As plants and animals excrete wastes or die, decomposers break down these waste materials, extracting the remaining energy from the organic molecules and reducing the material back to raw elements. Almost all of the energy needed to create this flow of energy is provided by solar energy with small amounts coming from geothermal and chemical sources.

Humans have substantially changed the flow of energy in some systems by subsidizing the energy input (Odum 1997). In the course of history, two major changes in energy flow have allowed the human population to expand significantly. The first was during the agricultural revolution, which occurred approximately 8,000 years ago. The primary mechanisms of subsidizing energy flow through agriculture became the addition of fertilizers (energy rich organic material) and removal of competitors (energy removed by unwanted sources such as weeds and pests). The second change occurred with the industrial revolution, when advances in medicines increased human life expectancies and the use of fossil fuels increased the productivity of agriculture through mechanization.

The global economy is currently using more energy than is renewable over the long term and we are therefore heavily dependent on non-renewable fossil fuels and nuclear energy. Our technologically advanced societies are using more energy than can be replaced by renewable energy sources. Thus, energy use is currently subsidized by fossil fuels, a limited resource; and nuclear energy an unlimited resource that has a significant impact on the environment through the release and disposal of radioactive byproducts. Renewable energy sources such as hydroelectric power and solar power, although cleaner, have limitations as well as undesirable impacts on the environment.

Energy use at the local level of the ACE Basin is no exception. Millions of dollars in fuel, fertilizer, and pesticides are used to increase the production of agricultural products well beyond natural levels. When fossil fuels become expensive and scarce, how will the current production levels be maintained on ACE Basin farms? One of the problems faced by society is how to maintain current production levels as non-renewable resources such as fossil fuels become scarce. This issue is not restricted just to the agricultural community but will impact many of the ways that human society uses fossil fuels to subsidize ecosystem services.

Back to Top

Ecosystem Services

A Global Perspective

Ecosystem services are defined by Daily (1997) as “the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life." Humans benefit from the materials and processes provided by these services. Some of these materials such as seafood and lumber are clearly apparent while others are less conspicuous including waste assimilation, carbon cycling, storm buffering, and the hydrological cycle.

From a global perspective, ecosystems within the ACE Basin contribute to the maintenance of the atmosphere by removing carbon dioxide and producing oxygen, by transforming nitrogenous wastes into less toxic forms, and by trapping pollutants. Global ecosystem services (Ecosystem services and functions) are large-scale processes that remain stable over long periods of time, thereby allowing biological systems to develop. Loss of these ecosystem services would result in significant changes in the stability of the global ecosystem, affecting all life on earth. However, the scale and complexity of the global ecosystem make it exceedingly difficult to detect changes; to attribute causes for the change; and to stop, or reverse, the processes leading to the change.

ACE Basin Perspective

The ACE Basin ecosystem is an integrated network of habitats that exchange nutrients, decompose organic detritus, convert chemicals from organic and inorganic states, capture energy, provide food and shelter, detoxify pollutants, and provide economic opportunities. Some of these services, such as food production, are readily apparent and have a market value. In the ACE Basin, commercial fishing is an important means of food production. Likewise, both agriculture and forestry products are produced in the ACE Basin and have a market value. Less apparent services include biological and chemical processes, such as the transfer of energy through the food chain, that operate to produce the fish or agricultural products (Peterson and Lubchenco 1997; Odum 1997). These services are generally taken for granted, yet they may be severely impacted by land use and pollution.

As an example, estuarine ecosystems absorb certain anthropogenic wastes (such as nitrogen released from municipal waste-treatment plants and fertilizers applied to agricultural fields) as well as trap and detoxify pollutants. However, if these services are overloaded or the capacity of the estuary to process these nutrients is reduced through wetland loss, the "free" service provided by the estuary will have to be replaced by expensive technological substitute services such as more efficient and expensive waste treatment plants.

Another example involves the dunes and maritime forests of the ACE Basin which provide protection from storms. Dune lines serve to buffer coastal areas from high seas and water levels during episodic events such as strong storms and hurricanes. Human activities such as building on dunes, changing the movement of sand with groins or jetties, or removing large areas of maritime forest may compromise this protective buffer allowing increased erosion or greater property damage (Thieler and Bush 1991).

Back to Top

Wetlands as Contaminant Filters

Wetlands and estuaries trap many pollutants such as oil (PAHs), pesticides (DDT, Chlordane), and heavy metals (lead, copper) in their sediments. Some of these pollutants, such as PAHs, may then be further degraded by natural microbial activity to less toxic byproducts or to simple compounds such as carbon dioxide and water (Peterson and Lubchenco 1997). Pollutants that are not readily degraded (PAHs, chlorinated compounds, and metals) are often bound up with the fine particulates that make up the sediments and therefore are less likely to be absorbed by wildlife. Sediments may temporarily trap the pollutants, but biogenic and oxidative processes periodically facilitate the release of sediment-associated pollutants. Therefore, pollutants may cause long-term effects on biological resources of the ACE Basin. Although not yet identified as a problem in the ACE Basin, many highly urban areas on the east coast of the United States have exceeded the capability of these services, and are experiencing the undesirable effects of these contaminants being released into the environment and affecting wildlife as well as human populations. These effects are seen in changes in plant and animal populations, increases in fish mortality, reduced growth and deformities, and harmful algal blooms (SCDHEC 1998). (See related section: Phytoplankton: Algal Blooms.)

Some ecosystem services can be difficult to assign a monetary value. Ecologists and economists have made some recent progress in assigning dollar values to ecosystem (Value of biome types) operations or functions to elucidate the economic value of pertinent non-market goods (Colgon 1990). While these estimates are considered rough ones and are thought to underestimate any actual dollar value equivalent of aggregate services of the biome (Costanza et al. 1997), they make the value of these services comparable with more easily recognized services such as the value of commercial fisheries (Total value of commercial fishing in South Carolina.) or the ability of aquatic systems to recycle municipal waste.

NEXT SECTION: Phytoplankton

Authors

G. Riekerk, SCDNR Marine Resources Research Institute

E. Wenner, SCDNR Marine Resources Research Institute

References

Christensen, N. L. 1988. Succession and natural disturbance: Paradigms, problems, and preservation of natural ecosystems. *In*: J. K. Agee and D. R. Johnson (eds.). Ecosystem management for parks and wilderness. University of Washington Press, Seattle, WA.

Colgon, C. S. (ed.). 1990. Valuing coastal zone management. National Coastal Research Institute, Publication No. NCRI-T-90-005.

Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R.V. O'Neill, J. Paruelo, R. G. Raskin, P. Sutton, and M.

van den Belt. 1997. The value of the world's ecosystem services and natural capital. Nature 387:253-260.

Daily G. C. (ed.). 1997. Nature's services: Societal dependence on natural ecosystems. Island Press, Washington, DC.

Meffe G. K. and C. R. Carroll. 1994. Principles of conservation biology. Sinauer Associates Inc., Sunderland, MA.

Odum, E. P. 1997. Ecology: A bridge between science and society. Sinauer Associates Inc., Sunderland, MA.

Peterson, C. H. and J. Lubchenco, 1997. Marine ecosystem services. *In*: G. C. Daily (ed.). Nature's services. Island Press, Washington, DC.

South Carolina Department of Health and Environmental Control. 1998. The citizen's guide to the Charleston Harbor Project. South Carolina Department of Health and Environmental Control, Office of Coastal Resource Management, Charleston, SC.

Thieler, E. R. and D. M. Bush. 1991. Hurricanes Gilbert and Hugo send powerful messages for coastal development. Journal of Geological Education 39:291-299.

Phytoplankton

Introduction

Common marine phytoplankton

Phytoplankton are free-floating microscopic plants that are mostly unicellular and produce chemical energy from light. This process is called primary production. Phytoplankton have a critical role in primary production, nutrient cycling, and food webs and make up a significant proportion of the primary production in aquatic systems (Dawes 1998). In many coastal systems, primary production is almost entirely a function of the phytoplankton. Even in salt marsh estuaries, where vascular plant biomass can greatly exceed that of algae, phytoplankton can contribute substantially to overall primary production (Sandifer et al. 1980; Lewitus et al. 1998).

Primary productivity is “the rate at which solar energy is converted into chemical energy by photosynthetic and chemosynthetic organisms” (Dillon and Rodgers 1980), and is usually expressed as grams of carbon fixed per unit area per unit of time (Dawes 1998). Dardeau et al. (1992) reported that annual phytoplankton primary production in southeastern estuaries ranges from 67-375 grams of carbon per square meter per year (gC/m^2/year) while Verity et al. (1993) reported values of 600-700 gC/m^2/year for Wassaw Sound in Georgia. These primary productivity values are very high compared to other ecosystems. For example, the primary productivity of a rice field has been reported to be 4.0 gC/m^2/year (Dawes 1998).

Phytoplankton are classified as microalgae and include species from the following divisions: Cyanobacteria (blue-green algae), Chlorophyta (green algae), Prochlorophyta, Euglenophyta, Pyrrhophyta (dinoflagellates), Cryptophyta (cryptomonads), Chrysophyta, and Bacillariophyta (includes diatoms). Most phytoplankton are motile, however, movement in the water column is mostly through transport by currents (Dawes 1998; Sandifer et al. 1980). Phytoplankton are usually grouped according to cell size. Picoplankton are the smallest and are identified as phytoplankton <2 micrometers (µm) in diameter. Nanoplankton are intermediate sized microalgae and range in size from 2-20 µm. Microplankton are the largest phytoplankton and include those algae >20 µm in diameter.

Microplankton are made up mostly of diatoms and dinoflagellates. Nanoplankton are dominated by phytoplankton with flagellas (e.g. cryptophytes and chrysophytes, and prymnesiophytes). These plankters can account for 75% of the total primary productivity of a system (Dawes 1998). Picoplankton are mostly prokaryotes such as cyanobacteria and prochlorophytes as well as several eukaryotic alga species. These tiny phytoplankters can account for as much as 50% of the primary production in oceanic waters (Dawes 1998).

Dinoflagellate *Gymnodinium breve*

Phytoplankton must be in the photic zone to photosynthesize. They rely on many different adaptations to move into or remain there. Non-motile phytoplankton rely on physical factors (water viscosity, convection cells, and wind- induced rotations), morphological features (branching frustules, colony formation, and bladder- like or needles-like cell shape), and physiological adaptations (production of mucilage and accumulation of lighter ions with a reduction of heavier ions or compounds) to reduce sinking rates (Dawes 1998). Cyanobacteria contain gas vacuoles that act like flotation and motile species can swim toward light.

Phytoplankton are the food source for numerous other organisms, especially the zooplankton. Zooplankton grazers can significantly decrease phytoplankton density. For example, at a grazing rate of 20%, zooplankton can decrease phytoplankton populations by approximately 75% (Dawes 1998). As with other factors which affect phytoplankton production, the effect of grazers is seasonal. Because grazers decline in winter, there is a lag in the spring before grazers become effective in controlling the spring bloom. Phytoplankton growth and productivity are affected by several factors which are called limiting factors. These limiting factors include light, temperature, circulation, grazing, and nutrients (Dardeau et al. 1992).

Back to Top

Environmental Effects

Effect of Light

Photosynthesis is the process by which solar energy is converted to chemical energy. This process usually involves the production of carbohydrates from carbon dioxide and water with the release of oxygen as a byproduct. Phytoplankton contain several different types of pigments which aid in the photosynthetic process. These pigments include: chlorophylls *a* and *b* (green), carotenoids (yellow and orange) and phycobilins (red and blue). The different divisions of phytoplankton are based partly on the types of pigments found in their cells.

Phytoplankton experience the greatest productivity when they encounter their optimal light and nutrient conditions. With adequate nutrients, phytoplankton growth and productivity increases with increasing light levels until a certain light level is reached. At this point photosynthesis is at a maximum (P_{max}) and further photosynthesis is inhibited with increasing light levels. Phytoplankton can only photosynthesize in the photic zone, which is limited to the maximum depth to which light can penetrate the ocean. Nutrients are often depleted in the photic zone because of utilization by phytoplankton and other organisms. The optimal depth for maximum production is reached when the light limiting effects of vertical mixing are balanced out by the benefits of advection into nutrient-rich bottom waters (Yentsch 1981). Seasonal changes in the length of the day also influence phytoplankton production, especially in mid and high latitudes. Phytoplankton abundance and biomass greatly increase during the summer months in higher latitudes because of the increased amount of light.

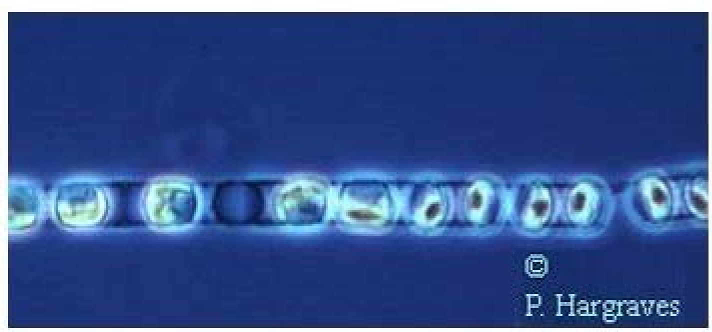
Effect of Temperature

Phytoplankton reproduction rates are closely linked to temperature. The maximum rate of cell division doubles for each 10°C increase in temperature. The upper limit of growth is therefore determined by temperature (Harris 1986). Several phytoplankton species (e.g. the diatom, *Skeletonema costatum*), however, increase assimilation rates of nutrients at lower temperatures and subsequently increase biomass (Goldman 1977). Coincidentally, *S. costatum* is often found in marine coastal waters during winter (Goldman 1977). The different responses to temperature exhibited by phytoplankton species can lead to a strong seasonal change in species composition and biomass.

Effect of Circulation

A pattern of stabilization-destabilization in circulation results in the highest rates of primary production in many estuarine, coastal, oceanic, or frontal environments. The stabilization period that occurs during slack tides or slow currents results in increased rates of photosynthesis and nutrient uptake. The destabilization period that occurs during flood or ebb tides or during fast current movement results in a replenishment of nutrients to the photic zone from more nutrient-rich underlying waters. During and following the destabilization period, photosynthesis is decreased by a shortage of light due to increased turbidity and mixing of the phytoplankton to deeper waters (Legendre 1981). Circulation patterns are vital in establishing the balance between light levels and nutrient availability necessary to maintain high primary productivity rates in marine systems.

Effect of Nutrients



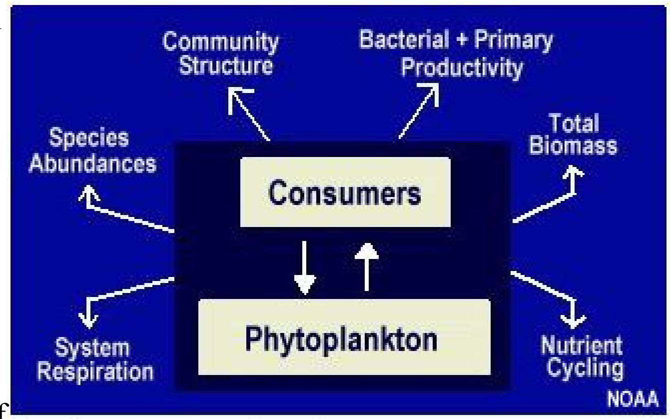
Diatom *(Skeletonema costatum)*

Although phytoplankton produce energy from carbon and water, they still require both inorganic (phosphorous, nitrogen, silicon, iron, etc.) and organic (vitamins) nutrients for growth. Vitamin concentrations are low in coastal waters but because vitamins have a high turnover rate and phytoplankton have low requirement levels for them, vitamins are not limiting to phytoplankton growth. Generally, phytoplankton growth is limited by inorganic nutrients. Four trace metals (zinc, copper, iron, and manganese) are considered to be important to phytoplankton. Of these four, iron and manganese are thought to be in low enough concentrations to limit growth (Dawes 1998).

Of the three other inorganic compounds (silicon, nitrogen, and phosphorous), nitrogenous compounds have the lowest concentrations in oceanic waters and are generally thought to limit phytoplankton growth in marine waters. Phosphate is the most biologically available form of phosphorous for most phytoplankton. This nutrient is found in low concentrations in marine systems, and in some cases, may be a significant limiting factor in phytoplankton growth. Finally, silicon, which is used in the cell structure of diatoms and silicoflagellates, usually has concentrations higher than nitrogen and phosphorous. During diatom blooms, however, the bioavailability of silicon may be severely lowered (Dawes 1998).

Eutrophication is an increase in the nutrient level in an aquatic system. As nutrient levels rise, growth of phytoplankton is no longer nutrient-limited and algal blooms occur. If the blooming algae produce toxic chemicals, fish kills and adverse human health effects can occur. If the algae don't produce toxins, the ecosystem can still be affected because phytoplankton respiration, zooplankton grazing, and bacterial decomposition can act to deplete dissolved oxygen to undesirable levels.

Phytoplankton composition changes with nutrient fluxes because individual taxa have different requirements (Tilman 1977; Kilham and Kilham 1984). Enclosure experiments have confirmed that nutrient enrichment alters the community composition of phytoplankton (Goldman and Stanley 1974; Sanders et al. 1987). Field studies report similar occurrences. In Moriches and Great South Bays (NY), for example, extremely dense populations of chlorophytes and cyanobacteria developed in waters fertilized by effluent from adjacent duck farms. These blooms coincided with collapse of the oyster fishery (Ryther 1954). Similar occurrences of dense concentrations of phytoflagellates in other eutrophic waters (e.g., Mahoney and McLaughlin 1977) imply that elevated nutrient concentrations alter phytoplankton community composition toward prevalence of smaller "less desirable" species (Smayda 1983; Verity 1998).



Enclosure experiment

However, dominance by flagellates is not exclusively predicated on nutrient loading. The availability of dissolved silicate may be equally or more important, because diatoms are dependent upon it while the vast majority of non-diatoms are not. Introduced by Schelske and Stoermer (1971, 1972), the hypothesis that silicate availability regulated phytoplankton community composition was formalized by Officer and Ryther (1980) and Ryther and Officer (1981). These studies describe two types of planktonic ecosystems, one dominated by diatoms, and another by flagellates and other small non-motile cells. They proposed that the diatom food web was associated with extensive fisheries (and therefore was preferable), while the flagellate food web was undesirable because it coincided with higher trophic levels which were not economically useful, or it was associated with hypoxia. While details are still being resolved, e.g. all diatoms are not apparently of equal value as food resources for zooplankton (Ianora et al. 1995) or necessarily better than equivalent-sized flagellates or ciliates (Verity and Paffenhšfer 1996), mesocosim studies support the relationship between silicate availability, diatoms, and fish (Doering et al. 1989). (Verity 1998).

Silicate concentrations in major southeastern rivers, in contrast to nitrogen, have been constant or declining during the past 25 years (Windom et al.

Fish kill

1993). If land use patterns result in nitrogen and phosphorus loading while silicate delivery to southeastern estuaries declines, diatom- dominated ecosystems may be replaced by flagellate-dominated ecosystems. This same pattern of changing phytoplankton community composition is also hypothesized to occur in the presence of pollutants (Greve and Parsons 1977), and was observed in mesocosim experiments with additions of trace metals (Cu, Hg) and hydrocarbons (Dunstan et al. 1975; Gray 1982). Thus, increased land use can be expected to produce three broad impacts: eutrophication, shifting nutrient ratios, and introduction of contaminants. These changes have been associated with shifts from diatom- to flagellate-dominated ecosystems. If such land use impacts occur in South Carolina and Georgia watersheds, a concurrent shift in ecosystems food chain dynamics may occur (Greve and Parsons 1977). Increasing occurrence and spread of novel phytoplankton blooms with nutrient loading and shifts in N:Si ratios may also occur (Smayda 1989). Blooms of toxic dinoflagellates that can cause major fish kills have already been reported in estuarine waters of North Carolina and Florida (Burkholder et al. 1992, 1995; Lewitus et al. 1995). Thus, phytoplankton community composition can both directly and indirectly affect ecosystem structure and its harvestable resources (Verity 1998).

Back to Top

Marine Phytoplankton

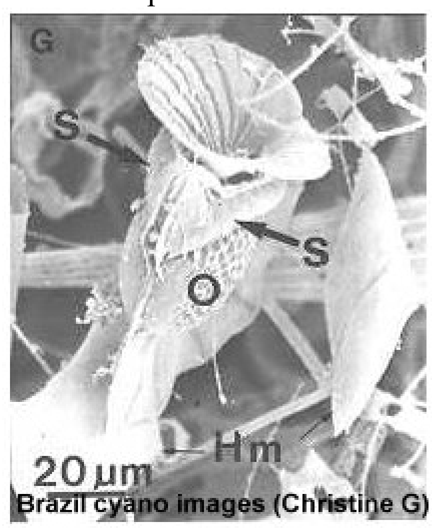
Few studies on marine phytoplankton have been conducted in the regions in or surrounding the ACE Basin study area. The National Oceanic and Atmospheric Administration’s (NOAA) Estuarine Eutrophication Survey assessed the status and trends of phytoplankton in twelve estuarine systems in Georgia and South Carolina (Verity 1998). This survey was based on qualitative responses from survey participants and are not always based on detailed data collection. Of the twelve estuaries examined, the Stono/North Edisto River system and the St. Helena Sound system are located within the ACE Basin study area (NOAA 1996). This study reported that the phytoplankton community for both estuaries was dominated by diatoms. Chlorophyll *a* concentrations, which is a measure of phytoplankton concentrations, were unknown in the Stono/North Edisto rivers, but in St. Helena Sound, they were reported to be < 5 microgram per liter (µg/L) for areas with salinity >0.5 parts per thousand (ppt) (NOAA 1996).

Although no other studies are known from the ACE Basin study area, studies in other regions of the southeast can be used to estimate the phytoplankton community in the ACE Basin region. Verity et al. (1993) examined the species composition and productivity of phytoplankton in Wassaw Sound,

Wassaw sound

Georgia. They reported that, during the summer, flagellated nanoplankton (2-4 µm) were the numerical dominants and diatoms dominated the biomass (Dominant phytoplankton in Wassaw Sound, GA). During the winter, the flagellated nanoplankton *Katodinium rotundatum* dominated both biomass and abundance. However, a diatom bloom developed each January during the three-year study. Verity et al. (1993) also reported that chlorophyll *a* concentrations ranged from 3.2-6.3 µg/L over the three-year study with the highest concentrations occurring inshore and during the summer.

Davis and Van Dolah (1992) examined the phytoplankton community in Charleston Harbor, South Carolina. This study identified 451 species of phytoplankton including 170 diatoms, 152 chlorophytes, 48 dinoflagellates, 36 cyanobacteria, 29 euglenophytes, 10 chrysophytes, and 6 cryptomonads in the harbor. They found that the diatom, *Skeletonema costatum*, along with three other diatoms, and one cyanobacterium were the dominant species (Phytoplankton species in Charleston Harbor). Davis and Van Dolah also reported that seasonal trends occurred in species composition and abundance. Diatoms dominated the spring and early fall periods while cyanobacteria and flagellates dominated the summer and winter periods. Highest phytoplankton abundances (~ 7,000 cell/ml) occurred in May-June with a smaller peak in abundance in February.



Synechococcus sp.

The importance of nano- and picoplankton to primary production in southeastern estuaries was emphasized by Lewitus et al. (1998), who examined the phytoplankton community of North Inlet, South Carolina. They found that picoplankton were the numerically dominant phytoplankton throughout the entire year, and that nanoflagellates contributed substantially to phytoplankton abundance and biomass during the summer bloom. The cyanobacteria *Synechococcus* spp. composed 95-100% of the phototrophic picoplankton. Other dominant species included the diatoms *Cylindrotheca closterium* (microplankton), *Nitzschia* spp. (nanoplankton), and *Thalassiosira* spp. (nanoplankton). Chlorophyll *a* concentrations were highest in July at 15 µg/L.

Back to Top

Freshwater Phytoplankton

Just like many other aquatic organisms, phytoplankton species distributions are controlled by salinity. So far, this discussion has centered on marine phytoplankton. Freshwater primary producers include members from the same divisions and are affected by the same limiting factors as marine phytoplankton (i.e. light, temperature, circulation, and nutrients). Primary producers in the static environment of freshwater lakes and ponds are mostly phytoplankton, however, in the more dynamic flowing water conditions of freshwater creeks and rivers, attached algae (i.e. periphyton) are the dominant organisms. To our knowledge, no studies exist which characterize freshwater phytoplankton or periphyton in the ACE Basin study area.

Grant (1974) found that diatoms were the dominant organisms in the upper reaches of the Cooper River-Tailrace Canal system in South Carolina. Molley et al. (1976) examined the freshwater riverine regions surrounding Ocala, Florida. They reported that centric diatoms (i.e. having surface markings radially arranged) were the dominant organisms with blue-green algae such as *Chroococcus* spp., *Microcystis* spp., *Spirulina* spp., and *Anabeana* spp. also abundant. Camburn et al. (1978) examined the benthic diatom community of Long Branch Creek, South Carolina. They reported 268 diatom taxa with *Eunotia* spp., *Achnanthes* spp., *Navicula* spp., *Pinnularia* spp., *Gomphonema* spp., and *Nitzschia* spp. being the numerical dominants.

Zingmark (1975) examined the phytoplankton community in freshwater ponds on Kiawah Island, South Carolina. He found that the cyanobacteria, *Oscillatoria* spp., made up approximately 50% of the cells counted. Other common phytoplankton species included *Crucigenia irregularis*, *Microcoleus* spp., *Anabaena* spp., *Anacystis cyanea*, *Tricodesmium* spp., and *Merismopedia* spp. In all, Zingmark reported 27 species as being common in these ponds (Phytoplankton in freshwater pond samples from Kiawah Island,SC). Goldstein and Manzi (1976) examined the freshwater phytoplankton in two ponds in South Carolina. This study identified 259 phytoplankton and periphyton species. Of these, 146 were Chlorophyta, 11 were Pyrrhophyta, 46 were Cyanobacteria, and 45 were Chyrsophyta.

Back to Top

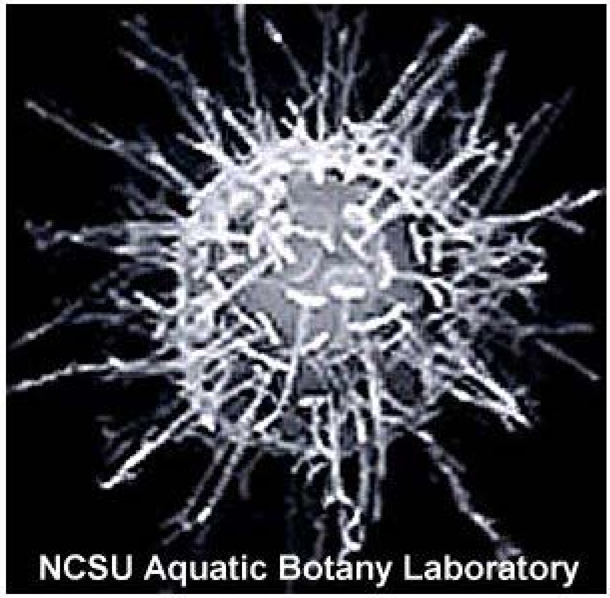
Harmful Algal Blooms

Most phytoplankton have the potential to bloom. Usually environmental (e.g. nutrient depletion) and biological (e.g. grazing) factors are sufficient to limit phytoplankton populations from attaining exceptionally high densities. If, however, these controlling factors are eliminated, blooming phytoplankton can have environmentally detrimental effects either by causing oxygen depletion or toxic poisoning. Oxygen depletion effects occur when respiration by blooming phytoplankton (usually non-toxic species) and by other organisms feeding on the phytoplankton decrease oxygen to low enough levels to cause animal mortalities. Toxic poisoning effects are caused by only a few dozen phytoplankton species and most of these are dinoflagellates, prymnesiophtyes, chloromonads, or diatoms.

The best known toxic algal blooms are those produced by dinoflagellates. Some of these blooms are called red tides because of the red or rust color of the water caused by high concentrations of phytoplankton cells. Some red tides are believed to begin with the germination of dormant cells that settled onto the seafloor during times of nutrient scarcity (Anderson 1994). When conditions improve these cells germinate and bloom. Toxic red tides are often grouped into the following categories: (1) those that kill primarily fish (e.g. *Gymnodinium* sp.); (2) those that kill invertebrates (e.g. *Gonyaulax* sp.); and (3) those that don’t kill but produce toxins that are sequestered by bivalves (e.g. *Protogonyaulax* sp.) or fish (e.g. *Gambierdiscus toxicus*).

Toxins can kill fish and invertebrates directly. For example, in the Gulf of Mexico, the dinoflagellate, *Gymnodinium breve*, causes massive fish kills by releasing neurotoxins into the gills of nearby fish causing asphyxiation (Anderson 1994). Algal toxins can also cause mortality as they are accumulated in the food web. For example, thousands of herring in the Bay of Fundy died after eating planktonic snails which had consumed the toxic dinoflagellate *Alexandrium* sp. Toxins bioaccumulated by bivalves can cause paralytic shellfish poisoning (PSP), diarrhetic shellfish poisoning (DSP), neurotoxic shellfish poisoning (NSP), or amnesic shellfish poisoning (ASP) when these contaminated bivalves are consumed by humans. Humans can develop ciguatera fish poisoning (CFP) from eating fish which have consumed the toxic dinoflagellate, *Gambierdiscus toxicus*.

Recently, a heterotrophic dinoflagellate, *Pfiesteria piscicida*, has been identified as the causative agent in numerous major fish kills in the southeastern United States (Burkholder et al. 1995). These fish kills occur when dormant benthic cysts of the dinoflagellate encounter chemical cues from nearby fish. The cysts release zoospores which produce an exotoxin that anaesthetizes the fish, causes shedding of the fish epidermis, and produces open ulcerative lesions. The dinoflagellates consume the fish epidermis. The fish eventually dies and the dinoflagellates once again become non-toxic (Burkholder et al. 1995). The presence of *Pfiesteria* or *Pfiesteria*-like species has been confirmed at selected, sudden-death fish-kill sites from Delaware to Alabama (Burkholder et al. 1995).



Pfiesteria **- a pathenogenic dinoflagellate**

Outbreaks of toxic algal blooms have been reported in many regions of the United States. They are, however, either unknown or thought to have no impacts on resources in any Georgia or South Carolina estuaries. It is generally thought that the rigorous vertical mixing imposed by high tidal amplitudes minimizes the potential development of blooms or high concentrations of the flagellated phytoplankton species generally associated with nuisance or toxic occurrences. In contrast, blooms of the toxic heterotrophic dinoflagellate *Pfiesteria* are reported to occur in North Carolina and Florida estuaries, where tidal amplitudes are considerably smaller (Verity 1998).

NEXT SECTION: Plants

Authors

L. Zimmerman, SCDNR Marine Resources Research Institute

References

Anderson, D. M. 1994. Red tides. Scientific American 271(2):62-68.

Burkholder, J. M., E. J. Noga, C. W. Hobbs, H. B. Glasgow, Jr., and S. A. Smith. 1992. New 'phantom' dinoflagellate is the causative agent of major estuarine fish kills. Nature 358:407-410.

Burkholder, J. M., H. B. Glasgow, Jr., and C. W. Hobbs. 1995. Fish kills linked to a toxic ambush-predator dinoflagellate: distribution and environmental conditions. Marine Ecology Progress Series 124:43-61.

Camburn, K. E., R. L. Lowe, and D. L. Stoneburner. 1978. The haptobenthic diatom flora of Longbranch Creek, South Carolina. Nova Hedwigia, Band 30:149-279.

Dardeau, M. R., R. F. Modein, W. W. Schroeder, and J. J. Stout. 1992. Estuaries. p. 615-744. *In*: C. T. Hackney, S. M. Adams, and W. H. Martin (eds.). Biodiversity of the southeastern United States: Aquatic communities. John Wiley and Sons Inc., New York, NY.

Davis, R. B. and R. F. Van Dolah (eds.). 1992. Characterization of the physical, chemical, and biological conditions and trends in three South Carolina estuaries 1970-1985. Vol. I. Charleston Harbor estuary. South Carolina Seagrant Consortium, Charleston, SC.

Dawes, C. J. 1998. Marine Botany. 2nd edition. John Wiley and Sons Inc., New York, NY.

Dillon, C. R. and J. H. Rodgers. 1980. Thermal effects on primary productivity of phytoplankton, periphyton, and macrophytes in Lake Keowee, SC. Water Resources Research Institute. Clemson University, Clemson, SC.

Doering, P. H., C. A. Oviatt, L. L. Beatty, V. F. Banzon, R. Rice, S. P. Kelly, B. K. Sullivan, and J. B. Frithsen. 1989. Structure and function in a model coastal ecosystem: Silicon, the benthos, and eutrophication. Marine Ecology Progress Series 52:287-299.

Dunstan, W. M., L. P. Atkinson, and J. Natoli. 1975. Stimulation and inhibition of phytoplankton growth by low molecular weight hydrocarbons. Marine Biology 31:305-310.

Goldman, J. C. and H. I. Stanley. 1974. Relative growth of different species of marine algal in wastewater-seawater mixtures. Marine Biology 28:17-25.

Goldman, J. C. 1977. Temperature effects on phytoplankton growth in continuous culture. Limnology and Oceanography 22:932-935.

Goldstein, A. K. and J. J. Manzi. 1976. Additions to the freshwater algae of South Carolina. Journal of the Elisha Mitchell Scientific Society 92:9-13.

Grant, R. R. Jr. 1974. Algae. p. 16-30. *In*: Cooper River survey 1973 for the E.I. Dupont de Nemours and Company. Academy of Natural Science, Philadelphia, PA.

Gray, J. S. 1982. Effects of pollutants on marine ecosystems. Netherlands Journal of Sea Research 16:424-443.

Greve, W. and T. R. Parsons. 1977. Photosynthesis and fish production: Hypothetical effects of climatic change and pollution. Helgolander Wissenschaftliche Meeresuntersuchungen 30:666-672.

Harris, G. P. 1986. Phytoplankton ecology: Structure, function, and fluctuation. Chapman and Hall, London, UK.

Ianora, A., S. A. Poulet, A. Miralto. 1995. A comparative study of the inhibitory effect of diatoms on the reproductive biology of the copepod *Temora stylifera*. Marine Biology 121:533-539.

Kilham, S. S. and P. Kilham. 1984. The importance of resource supply rates in determining phytoplankton community structure. *In*: D. G. Meyers and J. R. Strickler (eds.). Trophic Interactions Within Aquatic Ecosystems. Westview Press Inc., Boulder, CO.

Legendre, L. 1981. Hydrodynamic control of marine phytoplankton production: The paradox of stability. p. 191-207. *In*: J. C. J. Nihoul (ed.). Ecohydrodynamics. Elsevier Scientific Publishing, Amsterdam, Netherlands.

Lewitus, A. J., R. V. Jesien, T. M. Kana, J. M. Burkholder, H. B. Glasgow, and E. May. 1995. Discovery of the phantom dinoflagellate in Chesapeake Bay. Estuaries 18:373-378.

Lewitus, A. J., E. T. Koepfler, and J. T. Morris. 1998. Seasonal variation in the regulation of phytoplankton by nitrogen and grazing in a salt-marsh estuary. Limnology and Oceanography 43(4):636- 646.

Mahoney, J. B. and J. J. A. McLaughlin. 1977. The association of phytoflagellates in lower New York Bay with hypereutrophication. Journal of Experimental Marine Biology and Ecology 28:53-65.

Molley, M., J. Lennon, N. Drawas, and P. Herbst. 1976. Cross Florida Barge Canal restudy report: Benthic macroinvertebrate and plankton communities of the associated aquatic systems for the proposed Cross Florida Barge Canal. Environmental Research and Technology, Inc. Prepared for: Department of the Army, Corps of Engineers, Jacksonville, FL.

National Oceanic and Atmospheric Administration. 1996. Estuarine Eutrophication Survey. Vol. 1. South Atlantic Region. Office of Ocean Resources Conservation Assessment, Silver Spring, MD.

Officer, C. B. and J. H. Ryther. 1980. The possible importance of silicon in marine eutrophication. Marine Ecology Progress Series 3:83-91.

Ryther, J. H. 1954. The ecology of phytoplankton blooms in Moriches Bay and Great South Bay, Long Island, New York. Biological Bulletin 106:198-209.

Ryther, J. H. and C. B. Officer. 1981. Impact of nutrient enrichment on water uses. *In*: B. J. Neilson and L. E. Cronin (eds.). Estuaries and Nutrients. Humana Press, Clifton, NJ.

Sanders, J. G., S. J. Cibik, C. F. D'Elia, and W. R. Boynton. 1987. Nutrient enrichment studies in a coastal plain estuary: changes in phytoplankton species composition. Canadian Journal of Fisheries and Aquatic Sciences 44: 83-90.

Sandifer P. A., J. V. Miglarese, D. R. Calder, J. J. Manzi, and L. A. Barclay. 1980. Ecological characterization of the sea island coastal region of South Carolina and Georgia. Vol. III: Biological features of the characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-79/42.

Schelske, C. L. and E. F. Stoermer. 1971. Eutrophication, silica depletion, and predicted changes in algal quality in Lake Michigan. Science 173:423-424.

Schelske, C. L. and E. F. Stoermer. 1972. Phosphorus, silica and eutrophication in Lake Michigan. *In*: G. E. Likens (ed.). Nutrients and eutrophication. American Society of Limnology and Oceanography, Lawrence, KS.

Smayda, T. J. 1983. The phytoplankton of estuaries. *In*: B. H. Ketchum (ed.). Estuaries and enclosed seas. Elsevier, New York, NY.

Smayda, T. J. 1989. Primary production and the global epidemic of phytoplankton blooms in the sea: A linkage? *In*: E. M. Cosper, V. M. Bricelj, and E. J. Carpenter (eds.). Novel phytoplankton blooms. Coastal and Estuarine Studies No. 35. Springer, New York, NY.

Tilman, D. 1977. Resource competition between planktonic algae: An experimental and theoretical approach. Ecology 58:338-348.

Verity, P. G. 1998. Phytoplankton of the South Atlantic Bight. Draft report submitted to LUCES-South Carolina Seagrant Consortium. Skidaway Institute of Oceanography, Skidaway, GA.

Verity, P. G. and G. A. Paffenhšfer. 1996. On assessment of prey ingestion by copepods. Journal of Plankton Research 18:1767-1779.

Verity, P. G., J. A. Yoder, J. S. Bishop, J. R. Nelson, D. B. Craven, J. O. Blandon, C. Y. Robertson, and C. R. Tronzo. 1993. Composition, productivity, and nutrient chemistry of a coastal ocean planktonic food web. Continental Shelf Research 13:741-776.

Windom, H. L., J. O. Blanton, P. G. Verity, and R. Jahnke. 1993. Oceanographic response to environmental change in ocean processes: U.S. southeast continental shelf. A Summary of Research Conducted in the South Atlantic Bight Under the Auspices of the U.S. Department of Energy From 1977 to 1991. U.S. Department of Energy, Office of Scientific and Technical Information, Oak Ridge, TN.

Yentsch, C. S. 1981. Vertical mixing, a constraint to primary production: An extension of the concept of an optimal mixing zone. p. 67-78. *In*: J. C. J. Nihoul (ed.). Ecohydrodynamics. Elsevier Scientific Publishing, Amsterdam, Netherlands.

Zingmark, R. G. 1975. The phytoplankton of Kiawah Island. *In*: W. M. Campbell, J.M. Dean and W.D. Chamberlain (eds.). Environmental inventory of Kiawah Island. Prepared for Coastal Shores Inc. Environmental Research Center, Inc., Columbia, South Carolina.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Plants

Maritime dry grassland in a beach community

The 30 plant community types described in this section were identified and classified by The Nature Conservancy during botanical surveys of natural areas on 28 sites in the ACE Basin (see Plant community sites). Several of the 33 communities originally described in the 1993 publication by TNC (TNC 1993) have been reclassified, and the current nomenclature is listed in the cross reference table . In the ACE Basin, 3 of the 30 plant communities are on the barrier and barrier-like islands. Estuarine wetlands contain 4 plant communities, and 16 community types are in palustrine wetlands. The upland areas on the marsh islands and the mainland areas contain seven plant community types. The linked text sections provide general ecological information about the plant communities.

Maritime Communities
Estuarine Communities
Palustrine Communities
Upland Communities

For detailed, site-specific information on the occurrence and species composition of the plant communities at the sites, refer to the GIS data. Although the principal natural communities on survey sites were inventoried, the inventory may not reflect all communities present on a particular survey site. In addition, not all community types in the Basin were documented.

NEXT SECTION: Decomposers

Author

S. Upchurch, SCDNR Marine Resources Research Institute

M E N U

Introduction

Decomposition Process

Soil Formation

Decomposer Community

Decomposers and C, N and S cycling

Forest Ecosystems

Tidal Freshwater Marhes

Tidal Salt Marshes

Management Implications

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Decomposers

Introduction

Soil fungi

The decomposer community, though not readily visible by virtue of its small size, is an important component of the ACE Basin study area. The term decomposers is used to describe a guild of organisms (e.g., bacteria, fungi, crabs) that process organic constituents (e.g., plant material) to release carbon and other nutrients such as nitrogen (N) and phosphorus (P). This process creates a key link in transfer of energy and cycling of nutrients between various trophic groups in an ecosystem. This transfer of energy from one trophic group to another occurs via the consumption, death and decay of organisms. The breakdown of organic matter and conversion of organically bound nutrients into basic inorganic forms is called mineralization.

Decomposition Process

Decomposition of organic matter is chiefly regulated by three interacting factors: (1) the decomposer community; (2) the physicochemical environment and; (3) the quality of resource (see organic matter). In wetland sediments, the soil atmosphere, soil pH, temperature, redox potential and soil structure comprise the physicochemical environment. The redox potential is a measure of the probability of a substance to gain (to be reduced) or lose (to be oxidized) electrons. In addition, the quality of organic matter (estimated by the ratio of its carbon and nitrogen content or C:N ratio) largely determines the rate of carbon turnover and varies with the vegetation type.

The ACE Basin ecosystem comprises various types of sub-ecosystems differing in their biotic and physicochemical properties which control the activity and abundance of decomposers. For instance, the hydro-ecosystem (water columns) and the litho-ecosystem (adjoining marshes) of the ACE Basin study area form the two major environments for decomposition processes. In addition, both the water column and the adjoining wetlands can be further subdivided into fresh, brackish and salt water regions depending on the extent of sea water intrusion due to tidal forcing. Changes in salt concentration and associated parameters such as pH and redox potentials impact the functioning and abundance of decomposers. For example, the abundance of free bacteria decreases exponentially along the salinity gradient, as has been observed for the St. Lawrence estuary (Painchaud et al. 1996). Similarly, estuarine hydrodynamics additionally influence the distribution and function of the microbial community and the type of dominant vegetation that is a source of organic carbon for the decomposers.

In river-dominated tidal estuaries, such as the ACE Basin study area, an important source of carbon is the dissolved organic carbon (DOC) transported from upstream sites to the downstream marshes. This is of particular relevance to the ACE Basin because this ecosystem includes the Edisto River which is laden with dissolved and particulate organic matter; as a result, the Edisto River is often called a "blackwater " river. Inland waters are dominated by DOC from degradation of terrestrial and aquatic plants. In such waters, DOC can account for about 80% of the total organic carbon pool (DOC + particulate organic carbon attached to clay and sediment particles; Wetzel et al. 1995). The DOC leached from decomposing litter is a mixture of compounds of differing lability. For example, DOC may consist of simple sugars of high lability, organic compounds with intermediate lability and refractory compounds, such as humic acids, with low lability. During transport, more labile compounds of this heterogenous mixture are selectively degraded by microbiota, so that eventually only the refractory fraction of the original DOC reaches the estuaries. This refractory substance is subjected to increased residence time on reaching the estuary. Other abiotic factors such as hydrological conditions and salinity further transform DOC and contribute to the import of organic carbon aggregates and other nutrients to adjoining wetland surfaces.

Soil bacteria

The organic carbon source in wetlands and soils from other environments is chiefly derived from plant residues, and the quality of the organic substrate is determined by the dominant vegetation. Most plant matter consists of carbohydrates (made up of carbon, hydrogen and oxygen, e.g., sugars, hemicellulose and cellulose), proteins and lignin. Soluble sugars and other simple carbohydrates are energy rich organic compounds composed of carbon, hydrogen and oxygen produced during photosynthesis. Hemicellulose and cellulose are increasingly complex forms of carbohydrates; the former partially soluble and the latter inert. These plant constituents are broken down into less complex forms during decomposition by bacteria and fungi. Proteins are made of subunits called amino acids, which are nitrogen containing compounds. Proteins are degraded very rapidly as they are the most abundant nitrogen containing constituent (see the subsection on organic matter quality). Lignins are organic substances that, with cellulose, form the chief part of a woody tissue in plants. The lignin fraction of plant residue is the slowest to degrade and its decomposition is accomplished primarily by fungi (Paul and Clark 1996). In salt marsh sediments, however, bacterial assemblages are more efficient (relative to fungi) in degrading the lignocellulosic fraction of *Spartina alterniflora* (Benner et al 1984), which is the dominant vegetation in salt marshes in the southeastern USA and the ACE Basin study area.

Back to Top

Soil Formation

Decomposers play an important role in formation of soil organic matter by degrading energy rich organic compounds and, in the process, by generating more refractory materials such as humus. In addition, several species of epiphytic fungi are associated with various plant parts of *Spartina alterniflora*. Some of these species produce humic acid-like substances that could contribute substantial amounts (330 Kg/ha) to the annual input of humic substances in salt marshes (Filip and Alberts 1988, 1989, 1993). Such forms of organic matter are dark colored, complex organic material that are slow to degrade and are depleted in their oxygen and nitrogen content relative to the parent plant and animal organic material. These refractory materials are broadly classified into three main categories (humic acids, fulvic acids and humins) based on their chemical properties. It is rarely possible to separate microorganisms from the decaying plant material and sediments where most of the decomposition occurs. Hence, soil organic matter consists of these partially decayed plant residues, the microorganisms and the small fauna involved in decomposition, and the byproducts of decomposition. (See related section: Soils.)

Back to Top

Decomposer Community

- Microbes
- Bacteria
- Fungi
- Microfauna
- Mesofauna
- Macrofauna

Soils harbor an extremely high diversity of organisms. The decomposer community consists of four main categories of organisms: microbes, microfauna, mesofauna (litter transformers), and macrofauna (ecosystem engineers) (See Soil biomass).

Microbes

The driving force in most terrestrial ecosystems is microbial biomass, since abundance and speciation of microbes largely control the rates of turnover and mineralization of organic substrates. Soil microbes mainly consist of various types of bacteria, fungi and algae. Among these, bacteria and fungi include organisms that actively participate in organic matter decomposition. Algae are photosynthetic and do not contribute to the decomposition processes other than

Soil microbes

by acting as a source of organic carbon, therefore, they will not be discussed further.

Bacteria

Bacteria are generally 1 - 2 mm long and 0.5 - 1 mm in diameter. They are the most numerous organisms in soil with more than 104 species. These species differ from each other in their physiological make-up and adaptation. Depending on the source from which an organism derives its carbon and energy for growth, one can categorize these species into three major groups - the photolithotrophs, the chemolithotrophs and the chemoorganotrophs (heterotrophs). The first group consists of organisms that use light energy and derive their cell carbon from CO_2. The second group contains organisms that derive their energy from an inorganic chemical source (e.g., NH_4+, NO_2-, Fe_2+, S_2- etc.). The third group includes those bacteria that principally derive their cell carbon from organic substrates. The majority of known bacterial species fall under this third group and are commonly referred to as heterotrophs and constitute a major fraction of the decomposers. This means that bacteria occupy every trophic group in an ecosystem.

"Ecological Classification" of Bacteria

Differentiation of bacteria by trophic groups suggests that they are subjected to a wide variety of environmental conditions. Bacteria are usually associated with sediment particles, though some free-living bacteria are also known to occur in sediment pore water. Plant roots, and the immediate area around the plant roots, provide a prime habitat for soil microbes and bacterial abundance and species diversity usually decline with increasing distance from root surfaces (Bacteria) (Paul and Clark 1996). Some bacteria live in a symbiotic relationship with plant roots. Such symbionts (e.g., nitrogen fixing bacteria) provide important nutrients to plants by converting atmospheric N_2 gas into forms of nitrogen used by plants such as NH_4+. (See related section: Biogeochemistry: Nitrogen Cycling.) Soil structure, prevailing chemical conditions, and the presence of plant roots determines which types of bacteria occupy a particular zone. For example, the photolithotrophic bacteria occur in open environments' (since they use light as an energy source) and are exposed to the atmosphere. Such bacteria require oxygen for survival and are termed obligate aerobes. Similarly, other types of bacteria can survive in the presence or absence of oxygen and are called facultative anaerobes. Facultative anaerobes can tolerate occasional intrusions of oxygen rich air. Still other types of bacteria do not survive in presence of oxygen and are referred to as obligate anaerobes. This differentiation of bacteria based on the physical and chemical environment in which they live and function is probably the most important form of ecological classification. The ability to function in a specific environment naturally leads to a flow of organic matter from one zone to the other as these various groups perform different ecological functions.

Fungi

These organisms constitute the major component of soil biota in terms of biomass. Fungi are larger than bacteria and have morphologically distinct hyphae (tubes). The length of some fungal hypha ranges from 2 - 10 mm. In the sediment matrix, fungi are restricted to large spaces between soil aggregates. Functionally, fungi are heterotrophs and obligate aerobes. Some species of fungi occur in close association with plant roots . This association is beneficial to both plants and fungi. Fungi provide the plants with nutrients (absorbed from the surrounding soil matrix through their hyphae) and plants provide the fungi with organic substances needed for growth. Among the numerous functions of fungi in soils, the decomposition of organic matter is the most ecologically significant. Fungi degrade a wide range of organic matter from simple sugars and amino acids to more resistant polymers such as lignin and humic substances.

Microfauna

The term microfauna refers to organisms that are less than 100 mm in dimension. Protozoa and nematodes make up the bulk of this group. They are heterotrophic organisms requiring preformed organic carbon for growth. This organic carbon is mainly obtained from consumption of microbes and, to a lesser extent, fungi. Protozoa which feed on microbes and fungi are restricted to the top 10 - 20 cm (3.9 - 7.9 inches) of sediment profile where bacteria and fungi are abundant (Killham 1994). They also actively participate in decomposition processes by ingesting and processing fine organic particles in sediments. In addition, they also inhabit the guts of various larger organisms where they play a critical role in decomposition of cellulosic material. Since protozoa and nematodes are primary predators of microbes, they influence decomposition rates of organic matter by altering the abundance of bacteria and fungi. Thus, changes in an ecosystem that affect the abundance and activity of microfauna are likely to alter the overall decomposition rates of organic matter in that ecosystem (see Ecological consequences of alterations in trophic interactions).

Mesofauna

Litter transformers mainly include mesofauna and some large arthropods. This group of organisms is called litter transformers because of their role in the breakdown of organic matter. The impact of litter transformers on the soil organic matter dynamics is mediated through active digestion of fresh plant material by some and re-ingestion of partially digested material by others. Most often, mesofauna re-ingest their feces (and feces of other organisms) and assimilate the nutrients and other compounds released due to microbial activity. This also provides a carbon source in the form of bacterial biomass present in the feces. Partially digested organic matter in the fecal aggregates provide a good habitat for enhanced microbial activity, which further degrades the organic matter and releases important nutrients. Some species of earthworms and molluscs also belong to this group, as they fragment larger pieces of plant material and make them susceptible to further degradation.

Macrofauna

Arthropod in its burrow

Macrofauna include organisms with an average size above 2 mm (0.08 inches) and are classified as ecosystem engineers because they modify the soil structure by digging and creating specific structures for their movements and living activities (e.g., burrows, ray pits, galleries and chambers). In addition, their feeding activities result in the formation of casts and fecal pellets, which not only modify soil parameters such as porosity, aggregation, and bulk density, but also create an ideal environment for microbial activity. The mucous lining of burrows also stimulates bacterial growth by providing a labile carbon source, while the animal excrement provides the nitrogen source. This accounts for the higher rates of bacterial growth, activities, and biomass often observed in burrow walls of animals such as shrimps. Macrofauna also alter the rates of decomposition of organic matter by translocating surface sediments and plant litter to deeper layers or moving the deeper sediments to the surface. The intensity of bioturbation activities varies with location and the dominant macrofauna within and among ecosystems. For instance, in a salt marsh, the depth of bioturbation and the extent of overall modification of the soil structure due to fiddler crab activity is greater along the creek banks than at higher elevations. In a forest ecosystem, earthworms and termites have a profound impact on soil structure and turnover of organic matter.

Linkages between plant litter and groups of decomposers are complex and reciprocal in nature. The overall efficiency of the decomposition process depends on the nature of biotic interactions between soil microbes and soil fauna (see biotic interactions). Though soil microbes have the enzyme systems most appropriate for breaking down organic matter, their abundance and activity vary with the soil faunal dynamics at a higher trophic level and the variables that regulate them. Interactions can be broadly resolved at three levels: (1) microfood-webs, which involve nematodes, protozoa, and their predators (interaction between microbes and mesofauna); (2) litter- transforming systems, which involve mesofaunal and some macrofaunal interactions; (3) ecosystem engineering systems, which involve larger organisms that can significantly alter the environment. Altering trophic cascades ultimately influences the cycling of carbon and nutrients. It is important to understand that the role of ecosystem engineers and mesofauna is restricted to fragmentation of large organic material. Bacteria and fungi, on the other hand, represent the primary decomposers' because they possess the necessary enzymes to breakdown organic substrates into their constituent inorganic forms. Thus, changes in habitat conditions will dictate the species of bacteria and fungi that in turn, will influence the degradation pathway and the overall rates of carbon turnover. Although the above description of decomposer community is general, the interactions between ecosystem engineers, mesofauna and microbes hold true for various sub-ecosystems that are part of the ACE Basin study area. In the subsequent section, differences in bacterial and fungal community and their role in C, N and S cycling is highlighted for each of the various sub-ecosystems of the ACE Basin study area.

Back to Top

Decomposers and C, N and S Cycling

The biological elements' C, N, P and sulphur S, are the main building blocks of cellular tissue and are initially absorbed and stored in energy rich organic substances. Plants take up C as atmospheric carbon dioxide (CO2) gas, absorb nutrients and water from soil and use light energy to produce organic compounds which support their growth. The process of converting atmospheric CO2 into more complex forms of organic carbon by using light energy and water is termed photosynthesis. The breakdown of these organic carbon complexes yields energy for growth and is termed respiration. The product of aerobic respiration is CO2 and water. Not all organisms can produce complex organic carbon substances by using light or other sources of energy (organisms that use chemical energy to produce organic carbon substances are called chemoautotrophs). This means that "consumers" depend on primary producers for their supply of energy rich organic compounds to respire and grow.

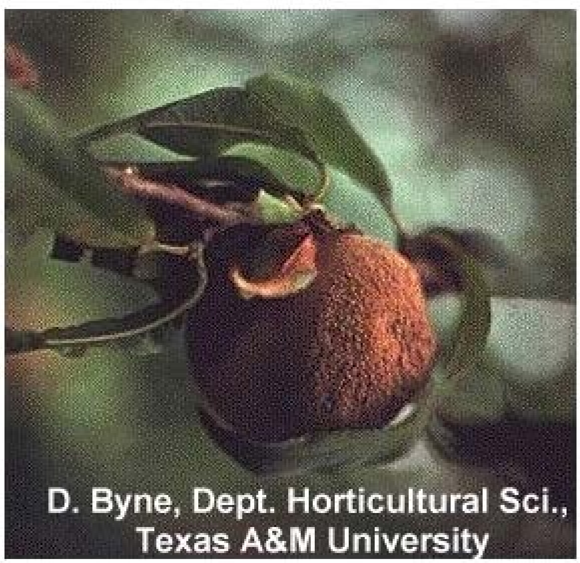
At the most fundamental level, respiration can be defined as any energy yielding biotic oxidation. This means that there could be several types of respiration in a given environment. This energy yielding oxidation involves transfer of electrons from an oxidized organic substrate to organic or inorganic molecules. These oxidation and reduction reactions are mediated by specific enzymes produced by the decomposers (especially by bacteria and fungi). Depending on the molecular recipient of the transferred electrons, these reactions can be broadly classified into three categories : (1) aerobic respiration- gaseous (molecular) oxygen is the electron acceptor; (2) anaerobic respiration- inorganic compound other than oxygen acts as the electron acceptor; (3) fermentation- an anaerobic process in which an organic compound is the electron acceptor. These three forms of respiration occur in different zones within the soil depending upon the qualitative redox potential decomposition and are mediated by specific microbial groups utilizing the appropriate electron acceptor. Here the product of one microbial group serves as substrate for the subsequent microbial group to convert organic molecules to methane, CO_2 and water. Hence, the rate of CO2 and methane evolution from sediments can be used as a proxy for rate of organic matter decomposition.

In the sediment matrix, once oxygen is depleted, a sequential reduction of various electron acceptors follows. The soil redox potential determines the acceptor that will be most energetically favorable at any given time. Similarly, differences in physicochemical characteristics between sub-ecosystems of the ACE Basin study area could alter the activity and speciation of dominant decomposers.

In the following paragraphs, the role of decomposers in C, N and S cycling is described for forests, tidal freshwater and saltwater marshes, which together comprise most of the landscape of the ACE ecosystem. Since, specific information about activity and distribution of decomposer communities in the ACE Basin study area is lacking, insightful parallels are drawn from studies conducted in other similar ecosystems. (See related section: Biogeochemistry.)

Back to Top

Forest Ecosystems



Brown rot fungi

The extensive watershed of the ACE ecosystem is represented by bay forests, bottomland hardwood, and upland forests. In the Edisto River Basin, more than 50% of the watershed is forested and is chiefly dominated by pine communities in the uplands (see Upland Community). A network of streams from these subsystems drains into the major rivers thus forming a continuum. In such ecosystems, the decomposition process begins with the introduction of organic matter (chiefly as plant litter) through mechanical and biotic activity. The soil organic carbon is rich in cellulose, hemicellulose and lignin, which form the main components of woody plant tissue. Typically, there is an initial flush of decomposition as plant residues enter the soil. This is due to decomposition of the most labile fractions of the organic matter. Subsequently, a much slower and steady breakdown of organic matter occurs as stable substances are formed after the initial flush. The breakdown of cellulose is mediated by microbes and the soil animals, which exposes greater surface area for microbial attack through comminution. Earthworms play an important role in this respect. The gut of an earthworm contains high levels of cellulase activity (partially contributed by gut microbes), which facilitates breakdown of this polymeric form of carbon. Depolymerization of cellulose is mainly achieved by specialized saprophytes, e.g., fungi such as brown rot fungi *(Basidiomycotina), Fusarium, Aspergillus, Trichoderma* and *Penicillium* species and by bacterial species such as *Bacillus, Pseudomonas* and *Clostridium*. Decomposition of cellulose represents the breakdown of high molecular weight compounds into low molecular weight compounds, which are readily utilized by microbes. Once the cellulosic and hemicellulosic components of the soil organic matter are degraded, the lignin fraction is attacked. The decomposition of lignin is carried out by Basidiomycotina fungi, which are collectively called white rots. These include fungi such as *Phanaerochaete chrysosporium* and *Coriolus versicolor*. Lignin degradation is inhibited by high levels of nitrogen in some white rot fungi (Killham 1994). This suggests a strong link between carbon and nitrogen cycles, the two elements that are the most important determinants of nutrient cycling in ecosystems.


Earthworms

The nitrogen cycle is tightly coupled to the carbon cycle as most nitrogen transformations in soil depend on the supply of carbon (Paul 1976). Though atmospheric deposition of nitrogen is important (particularly in polluted areas), the largest contribution of nitrogen input in terrestrial environments is from biological nitrogen fixation and nitrogen mineralization. While nitrogen fixation is carried out by various free living and plant associated microbes such as *Bacillus, Klebsiella, Rhizobium, Azotobacter, Beijerinkia, Azospirullum* and *Frankia* (actinomycetes), nitrogen mineralization involves participation by soil microbes and animals. The soil animals, in addition to accelerating the mineralization process by comminution, also mineralize nitrogen in their guts. The fecal matter produced is enriched in nitrogen and is a prime site for microbial mediated mineralization. For instance, small mammals such as voles play an important role in C and N mineralization by depositing fecal material, which facilitates dispersal of fungal spore and labile nutrient pools to micro sites of seedling establishment (Pastor et al. 1996). Anderson et al. (1985) show that, in temperate forest soils, mineralization of nitrogen by soil fauna is equal to or greater than that mediated by microbial decomposers. In moorland and acid forests, the faunal contribution to the decomposer community is mainly due to enchytraeid worms, springtails and mites. Earthworms and their interaction with soil microbes is of particular importance in nitrogen mineralization. For instance, in deciduous woodland soils the annual nitrogen flux through earthworms is several times the amount (30 - 70 kg ha-1) contained in the leaf fall (Killham 1994).

The loss of mineralized nitrogen in soils occurs via immobilization, nitrification and denitrification. The balance between mineralization and immobilization is controlled by the C:N ratio of the substrate and the C:N requirements of the decomposers (see relationship between decomposer and C:N ratio). Although the C:N ratio of decomposing litter determines whether or not nitrogen is mineralized, there are complexities in natural ecosystems that compound this relationship. For example, the soil organic matter is a heterogenous mixture of carbon derived from various plant types that differ in their C:N ratio or litter quality. In the ACE Basin study area *Quercus pinus* (swamp chestnut oak) and *Acer rubrum* (red maple), which are important components of swamp forest community, differ in their quality. Maple leaves form medium quality litter, but degrade faster than oak leaves, which contain less available nitrogen (Sinsabaugh and Moorhead 1997). As a result, in such ecosystems the effect of diversity in litter quality on microbial and faunal components of detritus food-web is complex. For instance, in mixed oak and maple litter, assemblages of fungivorous nematodes and mesofaunal were greater and lesser, respectively, than that expected based on litter made up of a single species (Wardle and

Lavelle 1997). The mineralized nitrogen (in the form of ammonium) is either taken up by plants and microbes or converted to nitrate (through nitrification process), which is further transformed into nitrous oxide and nitrogen gas by denitrifiers. These two processes are mainly carried out by microbes with no direct participation by larger decomposers. Since the higher trophic assemblages exert a top-down' control on the microbial community, natural and anthropogenically induced changes in soil fauna will alter the rates of nitrification and denitrification and that of overall mineralization. For example, Perison et al. (1997), while studying the relative impacts of harvest methods in the blackwater bottomland forests of the Edisto River estuary, found that the decomposition rates were higher in the harvested area. They attributed this to accelerated microbial activities as a result of higher soil temperatures. However, harvesting also resulted in a change in herpetofaunal species composition, though the indices of diversity were similar between the harvested and control plots. Higher ammonium and organic carbon concentrations in groundwater samples were attributed to increased decomposition rates. Similarly, deforestation in such river dominated ecosystems can lead to increased concentrations of ammonium and nitrate in drainage waters that are associated with eutrophication in streams and rivers.

Back to Top

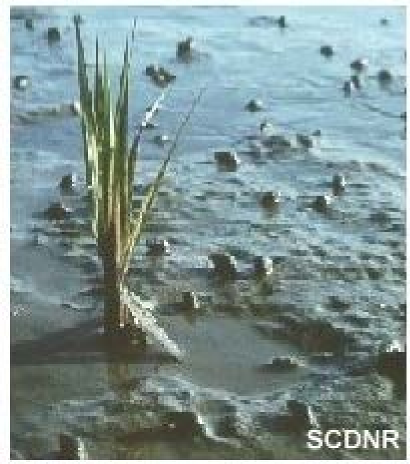
Tidal Freshwater Marshes

The decomposer community of tidal freshwater marshes and their interactions are complex (see Energy flow for tidal freshwater marsh). There are three major sources of energy in such systems. Tidal freshwater marshes are usually well flushed systems with reciprocal relationships with the adjoining river water. This means that the chemistry and biology of the surface water will influence the biogeochemistry in the wetland surface. This is particularly true for the ACE Basin study area where blackwater rivers (e.g., Edisto River, Combahee River) bring terrestrially derived organic carbon to the wetland surface. However, plant detritus and the associated microbial community form the most important sources of energy in freshwater marshes. The decomposer community typically consists of bacteria, fungi, and meiobenthic and macrobenthic communities. The meiobenthic community is primarily dominated by nematodes. Macrobenthos are composed of amphipods, oligochaete worms, freshwater snails and insect larvae. These benthic invertebrates can readily consume plant litter. The vascular plant community in the upper reaches of the Edisto River and the Ashepoo River is dominated by big cordgrass, cattail, sawgrass, wild rice, arrow-arum, and pickerelweed (See Palustrine Report). These plant types differ in their litter quality. For instance, the rate of decay of leaves of *Zizania aquatica, Pontederia cordata, Sagittaria latifolia* and *Nuphar luteum* varies, with *N. luteum* decaying the fastest. The broad-leaved perennials (such as *Pontederia cordata*, *Sagittaria latifolia* and *Numphar luteum*) generally have a low C:N ratio in their leaf tissues. Due to the higher nutritional quality of these plants, consumers prefer these over detritus of other low nutrition quality plants such as *Spartina*. The high marsh grasses, however, have low tissue nitrogen concentration and decay much more slowly.

Temperature and combined availability of oxygen and water in tidal freshwater wetlands provides optimum conditions for decomposition. These conditions also dictate pathway of organic carbon respiration and the type of microbial community that will dominate. Under aerobic conditions, oxygen is the major electron acceptor dominating aerobic respiration. Nitrate and manganese in zone II and Fe^{3+} in zone III dominate facultative anaerobic respiration. Under strict anaerobic conditions, zone IV and zone V are dominated by sulphate reduction and methane formation, respectively. It is imperative to realize that in any given ecosystem the byproduct of respiration (partially degraded organic matter) from one zone subsidizes the demand for utilizable organic carbon in the subsequent zones. In mineral-rich fresh, brackish and even salt water wetlands, iron reduction is an important pathway for organic matter decomposition (Sorensen 1982; Lovely 1991; Roden and Wetzel 1996). Furthermore, in freshwater wetlands (such as those in the upper reaches of the ACE Basin study area) where sulphate (a major component of sea water) is not present, methane formation is the dominant form of anaerobic respiration. This is consistent with the view that "thermodynamic considerations predict that in closed aqueous systems containing living organisms, after O2 is removed during oxidation of organic matter, biological reduction of alternative electron acceptors, NO_3-, MnO_2, $Fe(OH)_3$ and $SO_4$2-, should proceed in that order" (Ghiorse 1988).

Back to Top

Tidal Salt Marshes



Eastern Mudsnail (Ilyanassa obsoleta)

Tidal salt marshes are unique in that they are characteristic of both terrestrial and aquatic environments. The location of salt marshes in a river dominated continuum, such as those in the ACE Basin study area, makes them susceptible to nutrient and organic matter inputs from upstream marshes and facilitates their important role in subsidizing nutrient and organic carbon requirements of adjacent coastal open waters. In the Southeastern United States and in the ACE Basin study area, salt marshes are dominated by one plant species - *Spartina alterniflora* (see Estuarine Report). This dominant food source is of limited nutritional value. Despite the low nutritional value of the dominant organic carbon source and harsh environmental conditions (e.g., salt stress), salt marshes have a high diversity of consumers (see salt marsh food web). The benthic community in salt marshes is composed of various macrofauna, mesofauna and microbes. The macrofaunal community is dominated by various species of crabs (e.g., fiddler and blue crabs), gastropod molluscs (such as *Littorina irrorata*), polychaetes and amphipods. These are the primary foragers' of marsh vegetation, detritus and mesofauna. The mesofaunal community consists of protozoa, nematodes, copepods, annelids and rotifers. These organisms primarily feed on the microbial population, which chiefly consists of various species of bacteria and fungi. Recall that *Spartina alterniflora* supports a large number of epiphytic fungi, which not only contribute carbon and nutrients, but also participate in decomposition of standing biomass.

Approximately 90 % of the above ground productivity (from *Spartina* sp.) dies and decays on the marsh surface where energy is channeled through the detrital pathway. Though decay rates of salt marsh vegetation vary with location, there is evidence that macrofauna may increase the decomposition rates of the plant litter (Hemminga and Buth 1991). Additionally, in a microcosm study, the benthic macrofauna initially increased the release of CO_2, primarily by decomposing old and relatively refractory organic matter (Andersen and Kristensen 1992). Mesofauna also stimulate the decomposition of plant litter in salt marshes. For instance, a bacterivorous marine nematode (*Diplolaimelloides bruciei*) stimulated the decomposition of *Spartina anglica* leaves (Alkemade et al. 1992). During this study, presence of nematodes increased the CO_2 production of green decaying leaves by 20 - 25% while incorporating carbon in their biomass. The microbial community in a salt marsh is primarily responsible for decomposition and cycling of nutrients. As *Spartina alterniflora* (which has a high C:N ratio) decomposes, the detritus increases in protein content from 10 to 24% of ash free dry weight. This is mediated by the microbial community decomposing the *Spartina* litter. The increase in nutritional quality of the detritus not only facilitates accelerated decomposition but also enhances the food value for consumers. The microbial production in standing plant litter is strongly dominated by fungi, which can account for virtually all the nitrogen present during certain points in the standing decay period (Newell 1996). Though fungi are generally aerophilic, they play an important role in organic matter decomposition in anaerobic salt marsh sediments (Padgett and Celio 1990). This suggests that the root associated fungi are either microaerophilic or are capable of translocating sufficient oxygen through their hyphae into the oxygen deficient sediments (Padgett et al. 1989). The dominance and adaptations of fungi in salt marshes does not preclude the role of bacteria in these environments. Though fungi participate in the breakdown of the lignocellulosic fraction of salt marsh vegetation, bacterial mediated decomposition of this fraction of *Spartina alterniflora* litter is more efficient (Benner 1984). Salt marsh sediments support some of the highest rates of heterotrophic bacterial activity (Howarth 1993).

Fiddler crab

As in the case of freshwater marshes, the physicochemical environment and periodic tidal inundations dictate the dominant pathway for organic matter decomposition in salt marsh sediments. The tidal flushing saturates the marsh surface with sea water (rich in sulfate) and prevents diffusion of oxygen into sediments. In these anaerobic environments, bacterial mediated sulfate reduction is the dominant pathway for organic matter decomposition (See Table-3). The links between sulphur, carbon and nitrogen cycles are most obvious in a salt marsh. For instance, *Spartina alterniflora*, which is the source of organic carbon for sulphate reducers (e.g. various species of genus *Desulfovibrio*, *Desulfotomaculum*, and *Desulfobacter*), is primarily limited by nitrogen. In addition, *Spartina alterniflora* (and other marine organisms) synthesizes and stores an organic sulfur compound called dimethylsulfonium propionate (DMSP). This DMSP enters the sulfur cycle through microbial action where it is degraded into dimethyl sulfide (DMS) and acrylate. The latter is used as an energy source by bacteria. Acrylate utilizing bacteria support high rates of nitrogen fixation and denitrification in salt marsh sediments and play an insignificant role in brackish and freshwater sediments, as has been observed in the Cooper River estuary in South Carolina (de Souza and Yoch 1996). Furthermore, the products of sulfate reduction are hydrogen sulfide (H_2S) gas and other reactive sulfide (S_2-) species. These reactive species contribute to the reducing environment and influence the availability of nutrients, particularly phosphorus, by reacting with inorganic minerals such as iron. This phenomenon partially accounts for higher phosphorus availability in salt marshes than in freshwater wetlands.

Back to Top

Management Implications

The structure and function of decomposer communities in these environments have the potential to alter the dynamics of nutrient cycling through various feedback mechanisms between faunal and biogeochemical processes. The interrelatedness of various nutrient cycles means that changes in surface water quality within these ecosystems (with respect to any one nutrient) will impact other components of ecosystem functioning. From the perspective of ecosystem management, the tight coupling between surface water quality and the structure and function of decomposer communities facilitates their use as an efficient management tool for assessing ecosystem changes in response to anthropogenic perturbations. In the ACE Basin study area, sites with varying degrees of anthropogenic impact (e.g. Big Bay vs. St. Pierre) provide an excellent setting for such a study.

NEXT SECTION: Zooplankton

Author

P.V. Sundareshwar, University of South Carolina

References

Alkemade, R., A. Wielemaker, and M. A. Hemminga. 1992. Stimulation of decomposition of *Spartina anglica* leaves by the bacterivorous marine nematode *Diplolaimelloides bruciei* (Monohysteridae). Journal of Experimental Marine Biology and Ecology 159(2):267-278.

Andersen, F. O. and E. Kristensen. 1992. The importance of benthic macrofauna in decomposition of microalgae in a coastal marine sediment. Limnology and Oceanography 37(7):1392-1403.

Anderson, J. M., S. A. Huish, P. Ineson, M. A. Leonard, and P. R. Splatt. 1985. Faunal biomass: A key component of a general mode of nitrogen remineralization. *In* A. H. Fitter (ed.). Ecological interactions in soil - plants, microbes and animals. BES Special Publication 4. Blackwell, Oxford.

Benner, R., S. Y. Newell, and A. E. Maccubbin. 1984. Relative contribution of bacteria and fungi to rates of degradation of lignocellulosic detritus in salt marsh sediments. Applied Environmental Microbiology. 48:36-40.

de Souza, M. P. and D. C. Yoch. 1996. Differential metabolism of dimethyl-sulfoniopropionate and acrylate in saline and brackish intertidal sediments. Microbial Ecology 31:319-330.

Dunn, M. L. 1978. Breakdown of freshwater tidal marsh plants. MS Thesis. University of Virginia, Charlottesville, Virginia.

Filip, Z. and J. J. Alberts. 1988. The release of humic substances from *Spartina alterniflora* (Loisel.) into seawater as influenced by salt marsh indigenous microorganisms. The Science of the Total Environment 73:143-157.

Filip, Z. and J. J. Alberts. 1989. Humic substances isolated from *Spartina alterniflora* (Loisel.) following long-term decomposition in seawater. The Science of the Total Environment 83(3):273-285.

Filip, Z. and J. J Alberts. 1993. Formation of humi-like substances by fungi epiphytic on *Spartina alterniflora*. Estuaries 16(3A):385-390.

Gessner, T. V. 1977. Seasonal occurrence and distribution of fungi associated with *Spartina alterniflora* from a Rhode Island estuary. Mycologia 69:477-491.

Ghiorse, W. G. 1988. Reduction of manganese and iron, Chapter 6. pp 305-331 *In*: A. J. B. Zehnder (ed.). Biology of anaerobic microorganisms. Wiley, New York.

Heal, O. W., J. M. Anderson, and M. J. Swift. 1997. Plant litter quality and decomposition: an historical overview. *In*: G. Cadisch and K. E. Giller (eds.). Driven by nature: Plant litter quality and decomposition. CAB International, Champaign, IL.

Hemminga, M. A. and G. J. C. Buth. 1991. Decomposition in salt marsh ecosystems of the Southwest Netherlands: The effects of biotic and abiotic factors. Vegetatio 92(1):73-83.

Howarth, R. W. 1993. Microbial processes in salt marsh sediments. *In*: T. E. Ford (ed.). Aquatic microbiology: An ecological approach. Blackwell Scientific Publications, Boston, MA.

Killham, K. 1994. Soil Ecology. Cambridge University Press, Cambridge, UK.

Lavelle, P. 1997. Faunal activities and soil processes: Adaptive strategies that determine ecosystem function. Advances in Ecological Research 27:93-132.

Lovely, D. R. 1991. Dissimilatory Fe(III) and Mn(IV) reduction. Microbiological Reviews 55:259-287.

Mitsch, W. J. and J. G. Gosselink. 1993. Wetlands. Van Nostrand Reinhold, New York, NY.

Newell, S. Y. 1996. Established and potential impacts of eukaryotic mycelial decomposers in marine/terrestrial ecotones. Journal of Experimental Marine Biology and Ecology 200(1-2):187-206.

Odum, E. P. 1971. Fundamentals of Ecology. Saunders College Publishing, Philadelphia, PA.

Padgett, D. E., D. A. Celio, J. H. Heath, and C. T. Hackney. 1989. Growth of filamentous fungi in a surface-sealed woody substratum buried in salt marsh sediments. Estuaries 12(3):142-144.

Padgett, D. E. and D. A. Celio. 1990. A newly discovered role for aerobic fungi in anaerobic salt marsh sediments. Mycologia 82(6):791-794.

Painchaud, J., D. Lefaiver, J. C. Therriault, and L. Legendre. 1996. Bacterial dynamics in the upper St. Lawrence estuary. Limnology and Oceanography 41(8):1610-1618.

Pastor, J., B. Dewey, and D. P. Christian 1996. Carbon and nutrient mineralization and fungal spore composition of fecal pellets from voles in Minnesota. Ecography 19(1):52-61.

Paul, E. A. 1976. Nitrogen cycling in terrestrial ecosystems. p 225-243 *In*: J. O. Nriagu (ed.). Environmental biogeochemistry, Volume 1: Carbon, nitrogen, phosphorus, sulfur, and selenium cycles. Proceedings from the Second International Symposium on Environmental Biogeochemistry. Ann Arbor Science Publishers, Inc., Anne Arbor, Michigan.

Paul, E. A. and F. E. Clark. 1996. Soil microbiology and biochemistry. Academic Press, New

York, New York.

Perison, D., J. Phelps, C. Pavel, and R. Kellison. 1997. Effect of timber harvest in a South Carolina blackwater bottomland. Forestry and Ecological Management 90(2-3):171-185.

Reddy, K. R., T. C. Feijtel, and W. H. Patrick. 1986. Effect of soil redox conditions on microbial oxidation of organic matter. *In*: Y. Chen and Y. Avnimelech (eds.). The role of organic matter in modern agriculture. Martinus Nijhoff, Boston, MA.

Roden, E. E. and R. G. Wetzel. 1996. Organic carbon oxidation and suppression of methane production by microbial Fe(III) oxide reduction in vegetated and unvegetated freshwater wetlands sediments. Limnology and Oceanography 41(8):1733-1748.

Sinsabaugh, R. L. and D. L. Morehead. 1994. Resource allocation to extracellular enzyme production: a model for nitrogen and phosphorus control of liter decomposition. Soil Biology and Biochemistry 26: 1305-11.

Sorensen, J. 1982. Reduction of ferric iron in anaerobic, marine sediments and interaction with reduction of nitrate and sulfate. Applied Environmental Microbiology 43:319-324.

Wardle, D. and P. Lavelle. 1997. Linkages between soil biota, plant litter quality and decomposition. *In*: G. Cadisch and K. E. Giller (eds.). Driven by nature: Plant litter quality and decomposition. CAB International, University Press, Cambridge, UK.

Wetzel, R. G., G. Patrick, G. Hatcher, and T. S. Bianchi. 1995. Natural photolysis by ultraviolet irradiance of recalcitrant dissolved organic matter to simple substrates for rapid bacterial metabolism. Limnology and Oceanography 40:1369-1380.

M
E
N
U

Definition

Classification

Trophic Importance

Zooplankton Behavior

Freshwater Zooplankton

Estuarine Zooplankton

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Zooplankton

Definition

Organisms that live in aquatic environments face certain challenges that their terrestrial counterparts do not. One of the obvious differences is the motion of the fluid medium, which presents opportunities and drawbacks that are unique to animals and plants that live suspended in the water column. Among the benefits this lifestyle offers are enhanced dispersal of the population, which may be achieved at a relatively low energy cost, the resultant high gene flow among dispersed populations, and the ability to readily expand into new habitats.

Aquatic organisms with limited swimming ability relative to the strength of ambient currents are said to be planktonic. The term plankton is derived from the Greek word *planktos*, which means wandering or drifting. Organisms such as these, whose distributions are closely tied to the movement of the water mass in which they reside, are at risk of being transported away from conditions that are necessary for their survival.

Classification

Biologists typically classify plankton into three general categories based on their phylogeny: phytoplankton are microscopic algae and other photosynthetic organisms; zooplankton are animals, mainly invertebrates; and ichthyoplankton comprise the larval fish component of the plankton.

Zooplankters are classified based not only on their taxonomy, but frequently they are grouped according to their size Zooplankton size classification). Larger planktonic organisms (mesoplankton and above) are usually collected by towing finely woven conical plankton nets behind a vessel or streaming nets out from a fixed object in a swift current. The size of the openings in the netting material (mesh size)

Nets for sampling zooplankton

depends on the size-class of plankton being targeted. The smaller classes of plankton (microplankton and below) are generally collected by trapping water in bottles because nets fine enough to retain them clog rapidly when they are towed.

A third way of classifying zooplankters is based on the relative length of their planktonic life. Organisms that remain planktonic throughout the entire duration of their life cycle are referred to as holoplankters, and these are the permanent zooplanktonic residents of the water column. Other organisms, which spend only a portion of their lives as plankters, usually during the larval stages, are called meroplankters. Most of the common benthic invertebrates of coastal and estuarine waters have meroplanktonic larvae.

Back to Top

Trophic Importance

The estuarine zooplankton are of considerable trophic importance. Many copepods and other zooplankters, especially estuarine species, are omnivores that derive the majority of their nutrition by feeding on heterotrophic protists such as ciliates and dinoflagellates, although under some circumstances they may rely more heavily on microphytoplankton (Kleppel et al. 1998). In localities where macrophytes are abundant, such as salt marshes or seagrass beds, zooplankton standing stocks may obtain much of their nutrition by feeding on detritus (Roman et al. 1983). In estuaries, heterotrophic protists are an important component of the microzooplankton, since they provide a link between bacterial production and higher trophic levels (Heip et al. 1995). Their importance in the diets of many marine and freshwater zooplankton species was emphasized by Sanders and Wickham (1993), who noted that protists serve as a necessary link in the transfer of bacterial biomass to larger organisms.

Zooplankton density and volume specific biomass are usually greater in estuaries than in other aquatic habitats, reflecting the generally higher productivity of an estuarine environment. The species of fish and shellfish responsible for over 85 percent (by weight) of the commercial fisheries landings of the southeastern Atlantic states are estuarine or estuarine—dependent at some life stage (Burrell 1975a). For many of these species that depend on estuaries as spawning or nursery grounds (e.g., Atlantic croaker, Atlantic menhaden, seatrout, drum, blue crab, and white shrimp), an abundant zooplanktonic population is necessary. Recently, Allen et al. (1995) described how competition for zooplankton as food in a high salinity South Carolina estuary may be minimized by vertical and lateral partitioning and temporal shifts in dietary selectivity. Similar partitioning of zooplankton food sources, based upon prey size, has been documented for freshwater fish species such as the threadfin shad and blueback herring introduced to the Jocassee Reservoir in the 1970s (Davis and Foltz 1991).

Certain mesoplankters, particularly copepods and cladocerans, are essential as food for early fish larvae and for larger predacious zooplankters, which in turn are fed upon by late larval and postlarval fish and other organisms. In estuaries, macroplankters such as mysid shrimp and gammarid amphipods may be the most important food chain link in habitats bounded by extensive salt and brackish marshes, which themselves often are important fish nursery grounds (Ragotzkie 1959; Van Engel and Joseph 1968; University of Georgia Marine Institute 1971). In fresh water, most larval fish are zooplanktivores, frequently selecting small-bodied organisms like rotifers and copepods. Cladocerans, which are generally larger, are preferentially selected by older fish.

Back to Top

Zooplankton Behavior

Although the diverse assemblages of zooplankton in marine, estuarine and freshwater habitats are all subjected to the vagaries of the water in which they reside, they do not all respond similarly to the forces that cause the water to move. By using selective behavior in response to various physical cues, even planktonic organisms can exert some influence on the ultimate outcome of their transport (Epifanio 1988). Thus, by responding to salinity cues, some planktonic species may be distributed only within restricted zones in coastal waters, such as the low-salinity regions of estuaries, while others with may reside only in coastal waters and the high-salinity reaches near the estuary mouth.

Another important aspect of zooplankton behavior is the periodic vertical migration exhibited by many copepods (Steele and Henderson 1998). The diel (or daily) vertical migration (DVM) of many planktonic organisms may be influenced by the abundance of both food items and predators, as well as other environmental cues such as light, salinity, and temperature. In addition to locating food and avoiding predators, zooplankton may benefit from the changes in their bioenergetics that result from metabolic rates that differ on either side of the thermocline (McLaren 1963) in stratified waters. Avent et al. (1998) recently provided evidence that a common species of the estuarine copepod genus *Acartia* exhibits an endogenous vertical migration with a period that coincides with the semi-diurnal tide in San Francisco Bay Vertical migration .

Back to Top

Freshwater Zooplankton

Studies of the zooplankton of freshwater habitats in coastal regions of the southeastern states are limited, and virtually nothing has been published on the freshwater plankton of the ACE Basin. Sandifer et al. (1980) reviewed the literature describing the general characteristics of freshwater zooplankton in riverine, palustrine and lacustrine habitats of the coastal sea islands of the southeast United States. Among the early studies were those of Turner (1910), who described the copepod and cladoceran fauna of wetland habitats near Augusta, Georgia. The zooplankton of the temporary and permanent ponds and ditches sampled by Turner (1910) included 4 species of calanoid copepods, 10 cyclopoids, 1 harpacticoid, and 24 species of cladocerans. The copepod *Cyclops serulatus* and the cladoceran *Simocephalus serrulatus* were the most widely distributed taxa.

More recent research has described the species richness and population dynamics of zooplankton in another type of palustrine habitat, the Carolina bays of the Savannah River site of the U.S. Department of Energy. These geological features are shallow, poorly drained elliptical or oval depressions that number in the hundreds of thousands throughout the Atlantic coastal plain from New Jersey to Florida. Their distribution and ecological status in South Carolina was addressed by Bennett and Nelson (1991), who noted that 20 of these features are located in Colleton County; however their precise locations, and consequently their inclusion within the ACE Basin characterization area, was not described. Sharitz and Gibbons (1982) discussed the ecology of southeastern Carolina bays, but made no mention of their zooplankton.

Mahoney et al. (1990) reported that Carolina bays on the upper South Carolina coastal plain support exceptionally rich zooplankton communities, compared with temporary ponds elsewhere. These communities are generally dominated early in the wet season by crustacean taxa with long generation times, such as anostracans, conchostracans and calanoid copepods. In the 23 bays studied, seven species of the calanoid genus *Diaptomus* were common; none of which are typically found in nearby permanent waters. Another group of crustaceans, the cladocerans, were represented by 26 genera and at least 44 species, many of which showed considerable overlap between the fauna of the temporary bay ponds and permanent reservoir waters. Other major invertebrate taxa collected in the Carolina bays were cyclopoid and harpacticoid copepods; the crustacean orders Amphipoda, Isopoda, and Ostracoda; the insect orders Ephemeroptera, Odonata, Coleoptera, Trichoptera; the Dipteran families Ceratopogonidae, Chaoboridae, Chironomidae, and Culicidae; and oligochaetes, nematodes and aquatic mites.

The population dynamics of zooplankton in Rainbow Bay, one of the 23 Carolina bays mentioned above, were studied by Taylor and Mahoney (1990). They observed a temporal pattern in that Carolina bay pond that was typical of many others. The community was initially dominated by the copepods *Diaptomus stagnalis* and either *Acanthocyclops vernalis* or *Diacyclops haueri*, but later in the hydroperiod by cyclopoid copepods and cladocerans, including *Daphnia laevis* and *Simocephalus* spp. Experiments conducted on sediments from the dry pond bed suggested that the time of emergence from resting stages was a determinant of the initial succession of species in this temporary aquatic habitat. Predation by amphibian larvae (primarily salamanders) was not sufficient in this pond to limit the abundance of the predominant zooplankters; thus, population growth was limited for extended periods by insufficient food. (See related section: Geomorphology.)

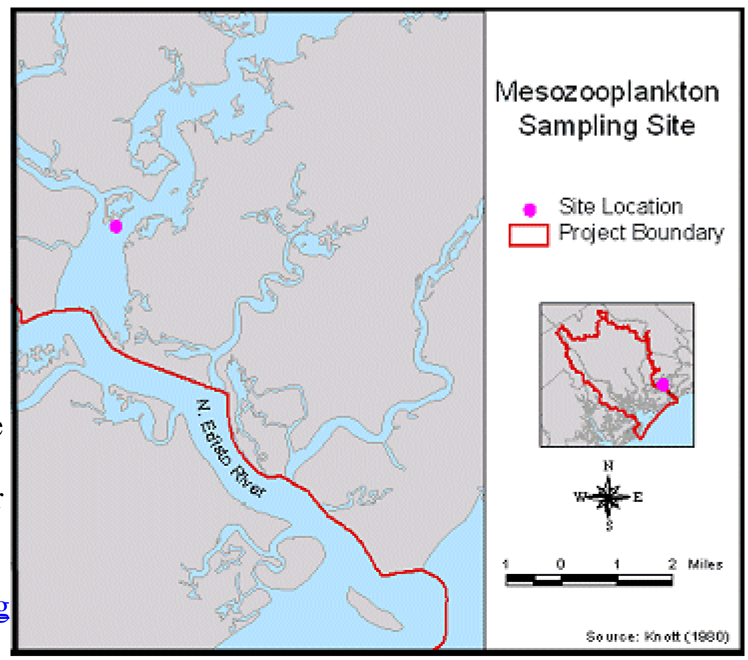
The zooplankton of lakes and rivers is generally dominated by the free-living non-photosynthetic protists, rotifers and microcrustaceans; however, the species composition of these groups may be quite different in lacustrine habitats than in riverine ones (Sandifer et al. 1980). Hudson (1975) described the zooplankton of Keowee Reservoir, a man-made lake in the South Carolina piedmont region. Of the 53 species of copepods and cladocerans identified from the reservoir, only about 15 were common in the plankton, while the remainder were littoral or benthic species. *Diaptomus mississippiensis*, *Mesocyclops edax*, and *Tropocyclops prasinus* were the most abundant copepods, while *Diaphanosoma branchyurum*, *Holopedium amazonicum*, *Daphnia ambigua*, and two species of *Bosmina* were the most abundant planktonic cladocerans. More recent research on the zooplankton of reservoirs in South Carolina focused on the spatial heterogeneity of the plankton communities (Betsill and Van den Avyle 1994) and the effects of thermal stresses caused by nuclear reactor cooling effluents (Taylor et al. 1993).

Riverine zooplankton of coastal South Carolina has not been intensively studied. Herlong and Mallin (1985) noted that the zooplankton below an impoundment on Black Creek, South Carolina, was augmented by the impoundment outfall, making it much denser than that upstream from the impoundment. Dames and Moore Associates (1975) sampled freshwater creeks and portions of the Cooper River, collecting 12 taxa of rotifers, 4 taxa of copepods, and 2 taxa of cladocerans. Rotifers and copepods together comprised nearly 90 percent or more of the total number of zooplankters at all six sample sites. The most abundant rotifers were *Polyarthra* sp. and *Keratella cochlearis*, while the only genus of copepod identified was *Diaptomus*. The cladocerans *Bosmia longirostris* and *Alonella* sp. were dominant within that taxon.

Back to Top

Estuarine Zooplankton

- Estuarine Mesozooplankton
- Estuarine Macrozooplankton



Estuarine Mesozooplankton

The abundance of mesozooplankton in the North Edisto River at Bluff Point, near the boundary of the ACE Basin Characterization Area, was described by Knott (1980). Surface samples collected weekly from May 1975 to May 1976 in the river and two adjacent upland saltwater impoundments yielded more than 146 unique taxa (Taxonomic listing of species). Considerable seasonal variation in total zooplankton abundance was noted in the river, as well as in the impoundments. In the river, monthly mean densities greater than 10,000 indiv./m^3 occurred from April through June, with a peak during April of 1976 (23,325 indiv./m^3). Although zooplankton abundances in the river remained above 6000 indiv./m^3 year round, this was not the case in the impoundments, where late fall/winter minimums of only a few hundred indiv/m^3 were observed. The significant winter decline in zooplankton abundance in the impoundments was attributed to decreased algal productivity during the colder months, coupled with the absence of a detrital food supply like that found throughout the year in the river (Knott 1980).

The calanoid copepod ***Acartia tonsa*** was by far the most abundant mesozooplankter in the Edisto River at Bluff Point. Its numerical dominance was even more pronounced in the nearby saltwater impoundments, where it was 1 to 2 orders of magnitude greater in abundance than any other species Taxonomic composition and abundance. In contrast to *A. tonsa*, the second most abundant species in the river, the harpacticoid copepod *Euterpina acutifrons*, did not successfully colonize the ponds. Rotifers and barnacle larvae (cirripedes) were among the remaining dominant species in samples from the river, along with the calanoids *Parvocalanus crassirostris*, *Pseudodiaptomus coronatus*, and copepod nauplii.

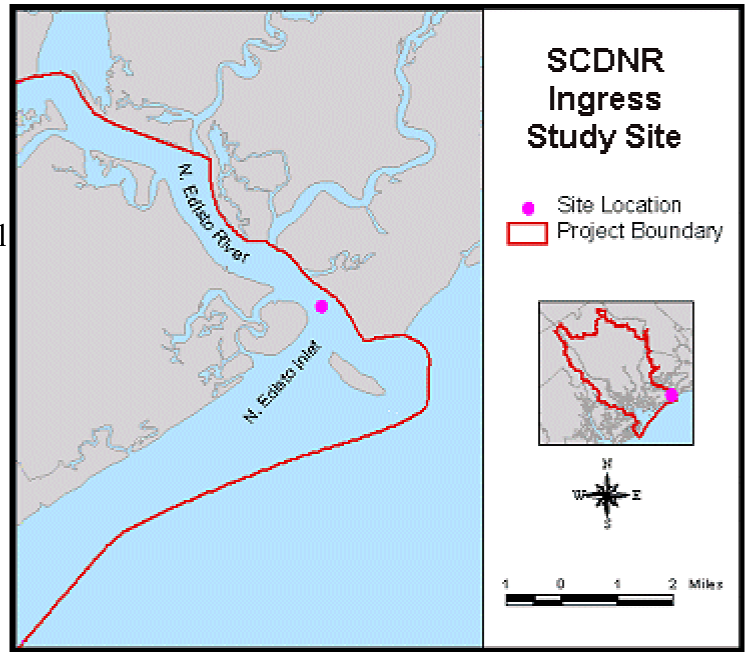
The total zooplankton abundance reported by Knott (1980) in the North Edisto River was similar to that described at North Inlet, South Carolina, by Lonsdale and Coull (1977), who used comparable methods and equipment to investigate composition and seasonality of mesozooplankton in that high salinity estuary. The overall mean abundance in the North Edisto (10,148 indiv./m^3) was only slightly greater than at North Inlet (9,257 indiv./m^3). Similarity between the species composition of these two locations was also high, with a 67 percent coincidence among the 12 dominant mesoplanktonic taxa collected at each site. Furthermore, similarity between the mesozooplankton of these two sites with that described qualitatively by Burrell (1975b) from the Wando River, South Carolina, suggests that estuarine waters of the ACE Basin are likely to support a comparable community. Although the literature contains scant reference to studies of estuarine zooplankton of the ACE Basin itself, one might expect it to resemble that which typically inhabits many southeastern and Gulf coast estuaries, based on the similarities between estuarine zooplankton in the North Edisto River and elsewhere in South Carolina and that described from North Carolina (Mallin 1991), Georgia (Stickney and Knowles 1975), the Florida Gulf coast and Keys (Grice 1960), and the Gulf of Mexico (Buskey 1993).

The relative contribution of meroplanktonic organisms to total zooplankton abundance was uniformly low (3 to 21 percent) in the North Edisto River. The predominant meroplanktonic taxa were gastropod veligers (which peaked in spring), barnacle larvae (which peaked in winter/early spring), and decapod crustacean larvae (which peaked in spring and summer). Although a variety of decapod crustacean larvae were collected (at least 20 species), they contributed relatively few numbers to the total mesoplankton community (Taxonomic listing of species). Many of the planktonic larvae of decapods are macroplanktonic, and they may not have been efficiently captured by the 30 centimeter (12 inch) diameter net with 147 mm mesh deployed by Knott (1980). Samples collected in North Inlet, South Carolina, by Lonsdale and Coull (1977), using a nearly identical plankton net, also contained relatively few meroplanktonic larvae (25 percent by number), suggesting a sampling bias against some of the larger crustacean larvae that might be able to avoid capture by these small fine-meshed nets.

Copepods were predominant among the mesozooplankton of the North Edisto River, both in terms of species richness (63 different species) and abundance (78 percent in the river; 95 to 98 percent in the ponds)(Knott 1980). The copepods comprised 24 truly planktonic species in the orders Calanoida and Cyclopoida and a rich representation of the Harpacticoida (39 species), all but three of which were typically benthic organisms that were suspended at the shallow river station by tidal turbulence.

Estuarine Macrozooplankton

Early studies of macrozooplankton in South Carolina targeted the larval stages of commercially important crustaceans. Fisheries researchers conducted periodic plankton sampling in the Wando, Cooper and Ashley Rivers near Charleston, South Carolina, and in the Santee River to the north, using nets designed to capture macroplankton (Bears Bluff Laboratories, Inc. 1964). In addition to larval crustaceans, two taxa were among the numerically dominant organisms at most stations: copepods (which were not quantitatively represented because of the coarse mesh nets) and the medusa stage (jellyfish) of undifferentiated species of coelenterates. Burrell (1975b) also found coelenterate medusae to be seasonally abundant in the Wando River, including *Blackfordia virginica* and *Nemopsis bachei*, along with the comb jelly *Mnemiopsis*. Hester (1976) and Calder and Hester (1978) described a rich planktonic coelenterate fauna in South Carolina estuaries.



White shrimp and blue crab are two decapod crustaceans with significant commercial value in South Carolina. (See related section: [Commercial Fisheries](#).) Both of these species have a life history that includes offshore larval development and an estuarine nursery habitat. Much is known about the use of South Carolina saltmarsh nursery habitats by these two species (Boylan and Wenner 1993; Mense and Wenner 1989; Wenner and Beatty 1993), but less is understood of the links between their offshore and estuarine life history stages. Consequently, recent studies (1993-94) in the ACE Basin Characterization Area by SCDNR focused on the way in which coastal oceanographic and meteorological processes influence the movement of planktonic postlarvae of these two species from the inner continental shelf through the North Edisto Inlet, to their estuarine nursery grounds. Postlarvae of both species are macrozooplankton that are potentially influenced by strong tidal forces, wind stress, bottom friction, and buoyancy fluxes. The **SCDNR Ingress studies** in the North Edisto Inlet were designed to explain some of the ways in which postlarval decapod distributions (both spatial and temporal) are related to the physical processes of transport. These specifically address ways in which periodic phenomena such as tides and daily or lunar cycles, and less predictable ones such as wind-generated currents, interact to influence the transport of planktonic larvae of these two species through the inlet and into the estuary.

Studies by other researchers working in the North Inlet estuary of South Carolina provide additional insight into the composition and dynamics of a macroplanktonic community that is likely to closely resemble that in the ACE Basin. Tidal, day-night, and day-to-day patterns of macrozooplanktonic abundance were described by Houser and Allen (1996), who observed large pulses of crab and shrimp larvae originating from nocturnal hatching events in the upper reaches of a tidal creek. The most abundant organisms in their 6-month series of daily samples were fish larvae (primarily the goby *Gobiosoma*), larval and postlarval decapod crustaceans (including the snapping shrimps *Alpheus* spp., the fiddler crabs *Uca* spp., the grass shrimps *Palaemonetes* spp., and the commercially valuable shrimps *Penaeus* spp.), juvenile bivalves, the holoplanktonic chaetognaths (arrow worms), gammarid amphipods and hydromedusae. Further seaward in Town Creek, near the inlet of the same estuary, Moore and Reis (1983) observed a similar macrozooplanktonic community dominated by the mysid crustacean *Neomysis americanus*. At that locality they also noted greater numbers of the holoplanktonic decapod crustaceans *Acetes americanus* and *Lucifer faxoni*, which are more typical residents of shallow coastal oceanic environments and high salinity inlets. Further documentation of such tidal incursions of coastal macrozooplankton into this estuary was provided by Costello and Stancyk (1983), who described the mechanism by which the macroplanktonic appendicularian *Oikopleura dioica* enters the North Inlet from the ocean.

NEXT SECTION: Benthic Invertebrates

Author

D. Knott, SCDNR Marine Resources Research Institute

References

Allen, D. M., W. S. Johnson, and V. Ogburn-Matthews. 1995. Trophic relationships and seasonal utilization of salt-marsh creeks by zooplanktivorous fishes. Environmental Biology of Fishes 42(1):37-50.

Avent, S. R., S. M. Bollens, and S. P. Troia. 1998. Diel vertical migration in zooplankton: experimental investigations using video-microscopy and plankton mini-towers. *In* American Geophysical Union (ed). 1998 Ocean Sciences Meeting, 9-13 February 1998, San Diego, CA. American Geophysical Union, Washington, DC.

Bears Bluff Laboratories, Inc. 1964. Biological studies of Charleston Harbor, S.C. and the Santee River. Submitted to the USFWS, contract no. 14-16-0004-1024.

Bennett, S. H. and J. B. Nelson. 1991. Distribution and status of Carolina bays in South Carolina. Nongame and Heritage Trust Section, South Carolina Wildlife and Marine Resources Department.

Betsill, R. K. and M. J. Van den Avyle. 1994. Spatial heterogeneity of reservoir zooplankton: a matter of timing? Hydrobiologia 277(1):63-70.

Blanton, J. O., F. E. Werner, A. Kapolnai, B. O. Blanton, D. Knott, and E. L. Wenner. 1998. Wind-generated transport of ficticious passive larvae into shallow tidal estuaries. Fisheries Oceanography 8 (suppl. 2):210-223.

Bowman, T. E. 1971. The distribution of calanoid copepods off the southeastern United States between Cape Hatteras and southern Florida. Smithsonian Contributions to Zoology 96.

Boylan, J. M. and E. L. Wenner. 1993. Settlement of brachyuran megalopae in a South Carolina estuary. Marine Ecology Progress Series 97:237-246.

Brownlee, D. C. and F. Jacobs. 1987. Mesozooplankton and microzooplankton in the Chesapeake Bay. *In* S.K. Majumdar, L.W. Hall Jr., and H.M. Austin (eds). Contaminant Problems and Management of Living Chesapeake Bay Resources. Pennsylvania Academy of Science, Easton, PA.

Burrell, V. G., Jr. 1975a. The relationship of proposed offshore nuclear power plants to marine fisheries of the South Atlantic region of the United States. *In* Institute of Electrical and Electronic Engineers (eds). Proceedings of the Ocean '75 Conference, San Diego, CA. Institute of Electrical and Electronic Engineers, New York, NY.

Burrell, V. G., Jr. 1975b. A preliminary list of the most common species of zooplankton found in the Wando River, August 1972-August 1974. Unpublished data from the South Carolina Department of Natural Resources, Charleston, SC. Summarized in Sandifer et al. 1980.

Buskey, E. J. 1993. Annual pattern of micro- and mesozooplankton abundance and biomass in a subtropical estuary. Journal of Plankton Research 15(8):907-924.

Calder, D. R. and B. S. Hester. 1978. Phylum Cnidaria *In* An annotated checklist of the biota of the coastal zone of South Carolina, Zingmark,R. G. (ed.) University of South Carolina Press, Columbia, SC.

Costello, J. and S. E. Stancyk. 1983. Tidal influence upon appendicularian abundance in North Inlet estuary, South Carolina. Journal of Plankton Research 5(2):263-277.

Daborn, G. R. and M. Brylinsky. 1981. Zooplankton diversity and species associations in the inner Bay of Fundy. Estuaries 4(3):253.

Dames and Moore Associates. 1975. Environmental assessment report on a proposed chemical plant, Berkeley County, South Carolina. Prepared for Amoco Chemicals Corporation. Park Ridge, IL.

Davis, B. M. and J. W. Foltz. 1991. Food of blueback herring and threadfin shad in Jocassee Reservoir, South Carolina. Transactions of the American Fisheries Society 120(5):605-613.

DeLancey, L. B., J. E. Jenkins, and J. D. Whitaker. 1994. Results of long-term, seasonal sampling for *Penaeus* postlarvae at Breach Inlet, South Carolina. Fishery Bulletin 92:633-640.

Durbin, A. G. and E. G. Durbin. 1981. Standing stock and estimated production rates of phytoplankton and zooplankton in Narragansett Bay, Rhode Island. Estuaries 4(1):24-41.

Epifanio, C. E. 1988. Transport of invertebrate larvae between estuaries and the continental shelf. American Fisheries Society Symposium 3:104-114.

Fulton, R. S. III. 1983. Interactive effects of temperature and predation on an estuarine zooplankton community. Journal of Experimental Marine Biology and Ecology 72:67-81.

Fulton, R. S. III. 1984. Predation, production and the organization of an estuarine copepod community. Journal of Plankton Research 6(3):399-415.

Grice, G. D. 1960. Calanoid and cyclopoid copepods collected from the Florida Gulf coast and Florida Keys in 1954 and 1955. Bulletin of Marine Science 10:217-226.

Grice, G. D. and N. H. Marcus. 1981. Dormant eggs of marine copepods. Oceanography and Marine Biology: An Annual Review 19:125-140.

Heip, C. H. R., N. K. Goosen, P. M. J. Herman, J. Kromkamp, J. J. Middelburg, and K. Soetaert. 1995. Production and consumption of biological particles in temperate tidal estuaries. Oceanography and Marine Biology: An Annual Review 33:1-149.

Herlong, D. D. and M. A. Mallin. 1985. The benthos-plankton relationship upstream and downstream of a blackwater impoundment. Journal of Freshwater Ecology 3(1):47-59.

Hester, B. S. 1976. Distribution and seasonality of hydromedusae in South Carolina estuaries. Masters of Science Thesis, College of Charleston, Charleston, SC.

Hopkins, T. L. 1977. Zooplankton distribution in surface waters of Tampa Bay, Florida. Bulletin of Marine Science 27(3):467-478.

Houser, D. S. and D. M. Allen. 1996. Zooplankton dynamics in an intertidal salt-marsh basin. Estuaries 19(3):659-673.

Hudson, P. L. 1975. 1975 annual report: southeastern reservoir investigation. United States Fish and Wildlife Service. Clemson, SC.

Kleppel, G. S., C. A. Burkart, L. Houchin, and C. Tomas. 1998. Egg production in the copepod *Acartia tonsa* in Florida Bay during summer. The roles of food environment and diet. Estuaries 21(2):328-339.

Knott, D. M. 1980. The zooplankton of the North Edisto River and two artificial saltwater impoundments. Masters of Science Thesis, College of Charleston, Charleston, SC.

Knott, D., J. Amft, C. Barans, J. Blanton, B. Stender, P. Verity, E. Wenner, and F. Werner. (in preparation, 1998). The influence of wind forcing on the ingress of blue crab megalopae into a South Carolina coastal inlet.

Lonsdale, D. J. and B. C. Coull. 1977. Composition and seasonality of zooplankton of North Inlet, South Carolina. Chesapeake Science 18(3):272-283.

Mahoney, D. L., M. A. Mort, and B. E. Taylor. 1990. Species richness of calanoid copepods, cladocerans and other branchiopods in Carolina Bay temporary ponds. American Midlands Naturalist 123(2):244-258.

Mallin, M. A. 1991. Zooplankton abundance and community structure in a mesohaline North Carolina estuary. Estuaries 14(4):481-488.

McLaren, I. A. 1963. Effects of temperature on growth of zooplankton and the adaptive value of vertical migration. Journal of the Fisheries Research Board of Canada 26:199-220.

Mense, D. J. and E. L. Wenner. 1989. Distribution and abundance of early life history stages of the blue crab, *Callinectes sapidus*, in tidal marsh creeks near Charleston, SC. Estuaries 12(3):157-168.

Moore, R. H. and R. R. Reis. 1983. Analysis of spatial and temporal variations in biomass and community structure of motile organisms in Town Creek, a South Carolina tidal pass. Contributions in Marine Science 26:111-125.

Omori, M. and T. Ikeda. 1984. Methods in Marine Zooplankton Ecology. John Wiley & Sons. New York,NY.

Ragotzkie, R. A. 1959. Plankton productivity in estuarine waters of Georgia. Publications of the Institute of Marine Science, University of Texas 6:146-158.

Roman, M. R., M. R. Reeve, and J. L. Froggatt. 1983. Carbon production and export from Biscayne Bay, Florida. Vol. I: Temporal patterns in primary production, seston and zooplankton. Estuarine, Coastal and Shelf Science 17:45-59.

Sanders, R. W. and S. A. Wickham. 1993. Planktonic protozoa and metazoa: predation, food quality and population control. Marine Microbial Food Webs 7(2):197-223.

Sandifer, P. A., J. V. Miglarese, D. R. Calder, J. J. Manzi, and L. A. Barclay. 1980. Ecological characterization of the Sea Island coastal region of South Carolina and Georgia. Vol. III: Biological features of the characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C. FWS/OBS-79/42.

Sharitz, R. R. and J. W. Gibbons. 1982. The ecology of southeastern shrub bogs (Pocosins) and Carolina bays: a community profile. United States Fish and Wildlife Service, Division of Biological Services, Washington, DC. FWS/OBS-82/04.

Steele, J. H. and E. W. Henderson. 1998. Vertical migration of copepods. Journal of Plankton Research 20(4):787-799.

Stickney, R. R. and S. C. Knowles. 1975. Summer zooplankton distribution in a Georgia estuary. Marine Biology 33:147-154.

Taylor, B. E. and D. L. Mahoney. 1990. Zooplankton in Rainbow Bay, a Carolina bay pond: population dynamics in a temporary habitat. Freshwater Biology 24:597-612.

Taylor, B. E., A. E. DeBiase, and D. L. Mahoney. 1993. Development of the zooplankton assemblage in a new cooling reservoir. Archiv fur Hydrobiologie 128(2):129-148.

Turner, C. H. 1910. Ecological notes on the cladocera and copepoda of Augusta, Georgia, with description of new or little known species. Transactions of the Academy of Sciences of St. Louis 19(10):151-176.

University of Georgia Marine Institute. 1971. Notes on the natural history and invertebrate fauna of the upper north Newport River *In* An ecological survey of the north and south Newport Rivers and adjacent waters with respect to possible effects of treated kraft mill effluent. Final Report to the Georgia Water Quality Control Board. UGA #D2422-122.

Van Engel, W. A. and E. B. Joseph. 1968. The characterization of coastal and estuarine fish nursery grounds as natural communities. U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries.

Wenner, E. L. and H. R. Beatty. 1993. Utilization of shallow estuarine habitats in South Carolina, U.S.A., by postlarval and juvenile stages of *Penaeus* spp. (Decapoda: Penaeidae). Journal of Crustacean Biology 13(2):280-295.

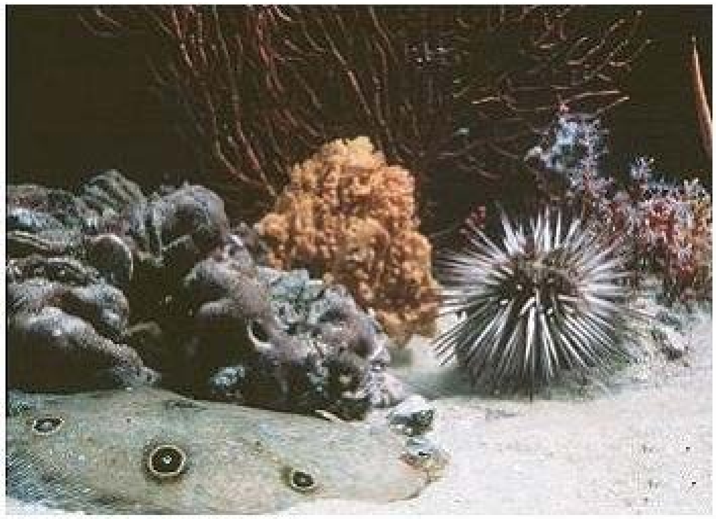
Wenner, E., D. Knott, J. Blanton, C. Barans, and J. Amft. 1998. Roles of tidal and wind-generated currents in transporting white shrimp (*Penaeus setiferus*) postlarvae through a South Carolina (USA) inlet. Journal of Plankton Research 20(12):2333-2356.

Introduction
Meiofauna
Macrofauna
Summary
References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Benthic Invertebrates

Introduction

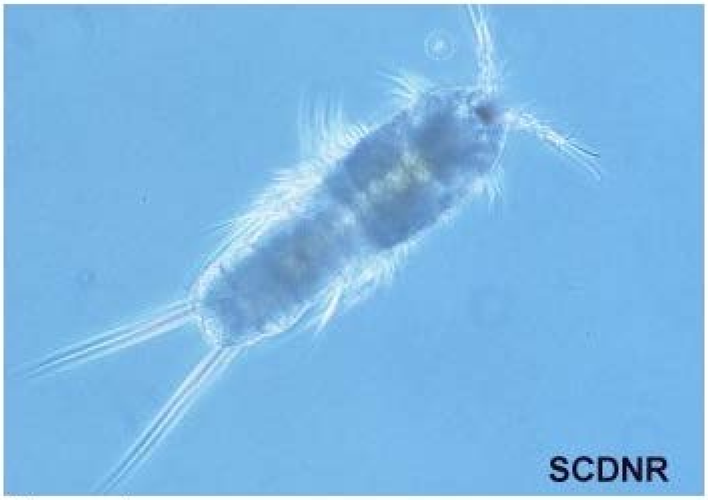

Benthic community

Benthic invertebrate communities are generally separated into two major size classes. The meiofauna are organisms (metazoans plus foraminiferans) that typically range from 63 to 500 mm in size, and the macrofauna are all of the larger organisms greater than 500 mm in size. Both groups include species that are considered to be either epifauna because they reside primarily on the surface of the sediments and other substrata, or infauna because they burrow or live beneath the surface of the sediment-water interface. A brief description of both the meiofaunal and macrofaunal assemblages from estuarine and freshwater areas of the ACE Basin or other similar habitats is provided in the following sections.

Meiofauna

Meiofaunal assemblages are generally most abundant in the upper few centimeters of fine muddy sediments. In some cases, more than 90% of the organisms can be found in the top centimeter of these sediments (Kennish 1986). In subtidal habitats of South Carolina, Coull and Bell (1979) found that 70% of all of the estuarine meiofauna they studied were present in the upper two centimeters and 95% were found in the top seven centimeters of the sediments. Although some meiofaunal organisms can be found in deeper sediments, they are primarily limited to the burrows created by larger macrofaunal species.

Studies of meiofaunal communities and their distribution patterns in both the estuarine and freshwater portions of the ACE Basin drainage system are lacking, but a substantial amount of research has been conducted on this faunal group in North Inlet, a small high salinity estuary located in the northern portion of South Carolina. The dominant meiofaunal taxa found in shallow creek and vegetated marsh habitats of that inlet were nematodes and copepods (Coull et al. 1977, Bell et al. 1978). Other taxa commonly found at lower densities include some species of polychaetes, ostracods, oligochaetes, turbellarians, bivalves and other miscellaneous taxa (Bell 1982, Bell and Woodin 1984, Kennish 1986). Several of these species may include life stages that are meiofaunal in size only as juveniles, whereas other species remain as meiofauna throughout their entire life cycle.



Copepod

In shallow water salt marsh and tidal creek habitats of the North Inlet estuary, Coull et al. (1979) documented clear distribution patterns among the meiobenthic copepod species sampled. Species that were primarily restricted to subtidal habitats included *Halectinosoma winonae* and *Pseudobradya pulchella*, both of which are considered to be epibenthic species. *Nannopus palustris* occurred only on the mudflats and low marsh and is well adapted to low dissolved oxygen environments. Species found in the intertidal zone of the salt marsh flats included *Diarthrodes aegideus*, which was abundant only during the winter and spring months, *Pseudostenhelia wellsi* and *Robertsonia propinqua*, which were limited to the lower marsh zone, and *Nitocra lacustris* and *Schizopera knabeni*, which were limited to the high marsh flats. Species found across the entire subtidal-intertidal gradient included *Microarthridium littorale*, *Halicyclops coulli*, and *Enhydrosoma propinquum* (Coull et al. 1979).

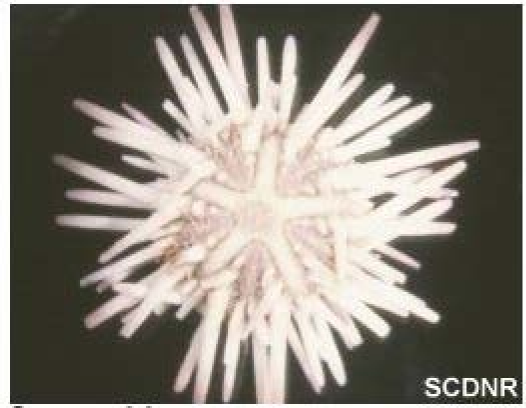
Long-term studies of shallow water meiofaunal assemblages at North Inlet have documented substantial seasonal and annual variability in the abundance, and to a lesser extent, the composition of the meiofauna (Coull and Bell 1979, Coull and Dudley 1985). Meiofaunal assemblages at a subtidal muddy station were dominated by nematodes throughout most of a 63-month study period, with greatest densities observed during the spring and summer months (Coull and Bell 1979). Copepod assemblages at North Inlet also showed distinct seasonal changes at a muddy site, but seasonal effects were less pronounced at a sandy station.

Data on deeper-water meiofaunal assemblages in southeastern estuaries are lacking, but those assemblages are likely to include many of the same subtidal and widely distributed species noted above. Data are also lacking on freshwater meiofaunal assemblages in South Carolina. In other freshwater systems, the smaller taxa that are typically considered to be meiofaunal in size include nematodes, rotifers, gastrotrichs and tardigrades (Hynes 1970).

Meiofaunal organisms play an important role in the estuarine food web complex since they consume bacteria, other microfauna and flora, and detritus, and they are, in turn, consumed by many larger macrofaunal invertebrates and juvenile finfish (Stickney et al. 1975, Bell and Coull 1978, Alheit and Scheibel 1982, Kennish 1986, Smith and Coull 1987, Coull 1990). Their densities can be quite high (2.6 x 107 individuals/m^2) and standing crop dry weight biomass can average about 1-2 g/m^2 (Coull and Bell 1979). This, combined with their short life cycle and high turnover rates in the sediments, make the meiofauna an extremely important contributor to the total carbon production of estuarine bottom habitats.

Back to Top

Macrofauna



Sea urchin

- Sub-tidal Estuarine
- Tidal Creeks
- Marsh Flats
- Sand Beaches
- Riverine Areas

Sub-Tidal Estuarine

Studies of the benthic macrofauna in the ACE Basin have been more extensive than for the meiofauna, although sampling has largely been limited to subtidal estuarine habitats and non-tidal freshwater habitats. With respect to the estuarine habitats of the ACE Basin, Calder and Boothe (1977a, 1977b) and Calder et al. (1977) sampled 11 stations in the vicinity of the NERR on a quarterly basis during 1974 and 1975 to characterize both the epifaunal and infaunal assemblages as part of a larger Estuarine Survey Program conducted by the South Carolina Wildlife and Marine Resources Department (See map of Estuarine Benthic Sampling Stations). Van Dolah et al. (1979, 1984) sampled at nine additional sites in the North Edisto and Dawhoo Rivers during 1977 and 1978 to evaluate the effects of dredging and open-water spoil disposal in that area. Both of these studies utilized an oyster dredge (0.8 m mouth width) to qualitatively assess the larger epibenthic organisms, and bottom grabs (0.1 - 0.13 m^2) to quantitatively sample the infauna. Other studies that have assessed the estuarine benthic infauna include Van Dolah et al. (1991) and Hyland et al. (1996, 1998). In the study by Van Dolah et al. (1991), grab samples were collected at two locations in St. Helena Sound to evaluate the effects of shrimp trawling on these communities. In the studies by Hyland et al. (1996, 1998) grab samples were collected at five locations in the ACE basin system during 1994 and 1995 as part of the Estuarine Monitoring and Assessment Program (EMAP) for estuaries of the southeastern United States. The linked tables provides a listing of all epifaunal taxa that were collected at three or more of the sites sampled by Calder and Boothe (1977a, 1977b) and a listing of the dominant infauna collected from the 26 stations sampled in all of the studies noted above.

White shrimp *Penaeus setiferus*

A diverse array of epifaunal species was found at most of the estuarine stations sampled in the ACE. Species present at more than 70% of the stations sampled by Calder and Boothe (1977a) and Van Dolah et al. (1979) included the arthropods *Callinectes sapidus, Balanus improvisus, Penaeus setiferus*; the chordate *Mogula manhattensis*; several cnidarians (*Ectopleura dumortieri, Obelia bidentata, Clytia kincaidi*), several bryozoans (*Aeverrillia setigera, Anguinell palmata, Membranipora tenuis, Amathia distans, Bowerbankia gracilis*, and *Electra monostachys*) and the polychaete *Sabellaria vulgaris*, which was attached to shell fragments and other hard surfaces in the samples. Of the 23 stations sampled, 15 had more than 30 species present in the oyster dredge sample and only 3 stations had fewer than 5 species. Review the table of epifauna . Stations in the North Edisto River, and at Rock

Creek had the greatest diversity of species. The North Edisto River had high and relatively stable salinities throughout the areas studied by Calder and Boothe (1977a) and Van Dolah et al. (1979), and several of the sites had shell or hard bottom substrata. These environmental characteristics are conducive to the growth of sessile epifauna which, in turn, provide attractive habitat for many motile species.

Stations in the South Edisto River showed a much greater variation in salinity than the North Edisto (Calder and Boothe 1977b, Calder et al. 1977). They found the highest diversity of epifaunal organisms in the polyhaline and euhaline sections of the river and lowest species diversity at the oligohaline sites. Review the Venice System of salinity classification for information on salinity ranges. The reduced presence of many of the cnidarians, bryozoans and other invertebrate taxa that can not osmoregulate would be expected in low salinity environments.

Subtidal infaunal communities were also quite diverse at the stations sampled by Calder and Boothe (1977b), Calder et al. (1977), Van Dolah et al. (1984, 1991), and Hyland et al. (1996, 1998), with only six of the 26 sites having fewer than 10 species per grab, and only seven of the sites having fewer than 500 animals/m^2. Review the table of infauna . An average of 20 species were found at the sites sampled by these investigators, with the average infaunal density equal to 2,430 individuals/m^2.

Species diversity of the benthic infaunal assemblages collected from the 26 stations, as measured by the H' index developed by Shannon and Weaver (1949), ranged from 0.8 to 4.4, with the average value of all the stations equal to 2.8. This average is close to the mean H' values observed for infaunal assemblages at “undegraded” sites (2.8-3.0) that were sampled throughout the southeastern region by EMAP during 1994 and 1995 (Hyland et al. 1996, 1998). Seven of the stations had H' values that were near or below average H' values noted for “degraded” stations (1.7-1.8) in the EMAP program. Sediment contaminants were measured at three of those sites (CP94076, CP94077 and CP95156, but only one of the sites (*CP95156*) had elevated levels of total DDT, DDD, arsenic, chromium and nickel that could account for the low diversity values observed. This station also had a very low benthic index score (1.0), which is indicative of a severely degraded benthos (Hyland et al. 1998, Van Dolah et al. 1999). The other two sites had no elevated contaminant levels and they were located in relatively pristine areas in St. Pierre Creek and the North Edisto River. Thus, the low diversity values observed at those sites must be attributable to other unknown factors. The remaining four stations with low average diversity values were all located in areas that were disturbed by either dredging or disposal operations during the study conducted by (Van Dolah et al. 1984).

Although a large number of species was collected at the 26 stations sampled for the infauna, only 10 species were found at more than five of these stations. They included the polychaetes *Paraprionospio pinnata, Sabellaria vulgaris, Streblospio benedicti, Nereis succinea*, and *Heteromastus filiformis*; the amphipods *Ampelisca vadorum, Batea catharinensis, Melita nitida,* and *Paracaprella tenuis*; and the bivalve *Mulinia lateralis*. A few species were found at only one or a few sites, but were very abundant (> 1000 individuals/m^2). These included the polychaetes *Sphaerosyllis perkinsi, Tharyx killariensis, Pista palmata* and *Parapionosyllis longicirrata*. Other taxa that were commonly found at many of the sites, often a high abundances, that were not identified to the genus or species level included oligochaetes, nemerteans, and actinarians. Both sediment characteristics and salinity conditions appear to be the primary environmental factors influencing the distribution of the infaunal species, as well as some of the epifaunal taxa that were collected by grab. Stations with sandy sediments generally had a relatively high abundance of amphipods, as well as syllid polychaetes, particularly in the more saline environments. Some of the dominant amphipods collected (e.g., *M. nitida, P. tenuis, B. catharinensi,* and *Ericthonius brasiliensis*) and many of the syllid polychaetes are commonly associated with the sediment surface and tend to have life habits that are more epifaunal than infaunal. At sites with predominantly muddy sediments and at many of the sites with mixtures of sand and mud, polychaetes tended to be the predominant taxa along with oligochaetes and the bivalve *Mulinia lateralis*. Some stations with mixtures of mud and sand also had high abundances of other bivalves, such as *Nucula proxima* and *Tellina texana*.

Stations with relatively low salinities frequently had a lower mean number of species per grab and lower faunal densities than many of the more saline sites sampled. This pattern was not consistent, however, since some of the stations in polyhaline and euhaline locations also had relatively low numbers of species and faunal abundance. Data on salinity patterns were lacking for many of the benthic infaunal stations sampled. Thus, the effects of salinity on the distribution of these species is not well documented by the studies conducted in the ACE Basin area. Other studies have documented clear effects of salinity on infaunal distribution patterns in southeastern estuaries and other regions (e.g. Boesch 1977, Van Dolah et al. 1990, Hyland et al. 1998).

Tidal Creeks

Studies of the benthic macrofauna inhabiting shallow-water tidal creeks and estuarine marsh flats are lacking for the ACE Basin study area, but there are data from other studies of these habitats in South Carolina estuaries. The most recent study involved an evaluation of macrobenthos in tidal creeks around the Charleston Harbor area (Lerberg 1997). In that study, Lerberg found that oligochaetes and polychaetes comprised greater than 95% of the fauna from unvegetated intertidal surfaces. Nine taxa accounted for approximately 90% of the specimens collected. These included the oligochaetes *Monopylephorus* cf. *rubroniveus, Tubificoides heterochaetus, T. brownae* and the polychaetes *Streblospio benedicti, Heteromastus filiformis, Laeonereis culveri, Capitella capitata, Tharyx* cf. *acutus,* and *Neanthes succinea*. Each of these species demonstrated a complex distributional pattern that was related to environmental conditions with respect to salinity, dissolved oxygen conditions and sediment characteristics (Lerberg 1997). There were also clear patterns in the “upstream” versus “downstream” portions of the creek sections studied and these patterns varied between creeks draining forested versus developed upland watersheds. In forested creeks, faunal densities were significantly higher in the upper-most reaches, particularly with respect to *M.* cf. *rubroniveus* and *C. capitata*. In contrast, the abundance of some polychaetes, such as *S. benedicti* and *H. filiformis*, were higher in the lower reaches of developed creeks. Dominant species in euhaline forested creeks included *T. acutus*, *S. benedicti*, and *H. filiformis*, whereas the oligochaetes *M. rubroniveus* and *T. heterochaetus* and the polychaete *C. capitata* were dominants in the polyhaline and/or mesohaline forested creeks. Some of these species (e.g. s. benedicti, H. filiformis and T. acutus) were much less abundant in creeks with developed uplands. In contrast, the polychaete *L. culveri* was much more abundant in the lower salinity developed creeks than in the forested creeks. Creeks exposed to hypoxic conditions had higher abundances of the oligochaete *M.* cf. *rubroniveus*, whereas *L. culveri* and *H. filiformis* tended to be more abundant and common in creeks with higher dissolved oxygen conditions.

Grass shrimp ***(Palaemonetes vulgaris)***

Most of the dominant taxa noted above obtained their highest abundances in sediments with a mixture of mud (20-80% silts and clays) and sand (Lerberg 1997).

In a study of a tidal creek near Cat Island, South Carolina (Georgetown County), Wenner and Beatty (1988) also found that oligochaetes and polychaetes were the most abundant taxa, although they also observed relatively high densities of mollusks, amphipods and decapods in their samples. Species collected from their study site included the mollusks *Macoma balthica, Tellina* sp., *Mulinia lateralis*; the polychaetes *Scolecolepides viridis, Laeonereis culveri, Polydora* sp. *Heteromastus filiformis, Glycera americana*, and *Sabellaria vulgaris*; the decapods *Palaemonetes vulgaris, P. pugio, Rhithropanopeus harissii*, and the amphipods *Melita nitida* and *Corophium lacustre*. Oligochaetes and nemerteans were not identified to lower taxonomic levels.

Marsh Flats

Amphipod ***(Gammarus palustris)***

Although no studies of the benthic macrofauna have been conducted in vegetated marsh flats of the ACE Basin, or in the impounded wetlands of this system, these fauna have been evaluated as part of other studies conducted elsewhere in South Carolina . These include a comparison of wetland impoundments and adjacent open marsh habitats in South Carolina by Wenner and Beatty (1988) and evaluation of the effects of pipeline construction on the vegetation and macrofauna of salt marshes in the Charleston Harbor area by Knott et al. (1997). Wenner and Beatty (1988) found that mollusks, polychaetes, oligochaetes and insects were the numerically dominant taxa in vegetated flats of impounded marsh, which contained *Ruppia maritima, Spartina alterniflora,* and *Scirpus robustus* as the dominant vegetation. These taxa were also abundant in the open marsh flats which had *S. alterniflora* as the dominant vegetation. Amphipods and decapods were more abundant in the open marsh flats than in the impounded marsh areas. Species which were abundant and largely restricted to the open marsh flats included the amphipods *Gammarus palustris, Orchestia uhleri*, the polychaete *Manayunkia* sp., the tanaid *Hargeria rapax*, and ceratopogonid insects. Other taxa that were found in lower abundance on the open marsh flats included the mollusk *Gukensia demissa*, the fiddler crab *Uca pugnax,* and the amphipod *Dulichiella appendiculata*. *Gukensia* and *Uca* were not well sampled with the gear used by Wenner and Beatty, and were therefore rare in their samples.

The study of invertebrate macrofaunal assemblages by Knott et al. (1997) in marsh flats of the Charleston Harbor estuary focused on species that were retained in pit traps or could be counted in quadrats, rather than on many of the smaller epibenthic and infaunal species, such as the amphipods and polychaetes. Major taxa collected from their pit traps included the fiddler crab *Uca pugnax*, the snails Hydrobiidae (undet.) and *Ilyanassa obsoleta*, as well as oligochaetes, ostracods and the tanaid *Hargeria rapax*. Although not collected in their pit traps, the snail *Littorina irrorata*, the mussel *Gukensia demissa*, and other *Uca* spp. were also common on the vegetated flats. All of the taxa collected in the studies by Wenner and Beatty (1988) and Knott et al. (1997) are common to marshes throughout South Carolina, and should be representative of the species that would be found in the ACE Basin system.

Sand Beaches

Sand beaches along the barrier islands of the ACE Basin represent another significant habitat that has not been sampled with respect to benthic invertebrates. However, several studies of other South Carolina beaches provide information on the fauna that are likely to be present. Three of the most recent studies completed in the southern half of the state involved assessments of the macroinfauna at Folly Beach and Kiawah Island, which are located just to the north of the ACE Basin, and Fripp and Hilton Head Island, which are located just south of the Basin (Van Dolah et al. 1992, 1994, Levisen and Van Dolah 1996). All of these studies were completed as part of monitoring studies to evaluate the effects of beach nourishment or beach scraping operations.

Mole crab *(Emerita talpoida)*

Dominant infaunal species collected from the lower intertidal zone (mean sea level [MSL]to mean low water[MLW]) were similar among the three studies cited above, although there were seasonal and spatial differences in the abundance of each species. Species that were most abundant at MSL in one or more of the three studies included bivalve *Donax variabilis*, the haustoriid amphipods *Neohaustorius schmitzi, Parahaustorius longimerus, Protohaustorius deichmannae, Haustoirius canadensis*, and *Acanthohaustorius millsi*, and the polychaete *Scolelepis squamata*. Most of these species were also the dominant taxa at MLW, where the bivalve *Mulinia lateralis* and the polychaete *Paraonis fulgens* were also found in relatively high abundances. Fauna dominant in the surf zone (within 15 m of MLW) included *P. deichmannae*, *A. millsi, D. variabilis, M. lateralis, S. squamata, S. texana,* and *P. fulgens*. Total faunal densities species number per core sample were lowest at MSL, greater at MLW and greatest in the subtidal surf zone area. Although densities of each species varied seasonally, most were present throughout all of the seasons sampled in these studies. Larger macrofauna, such as the ghost crab, *Ocypode quadrata*, the mole crab *Emerita talpoida*, and the burrowing ghost shrimp *Callianassa* spp., were not sampled well in these studies due to the small core size used, but they are known to be abundant on South Carolina beaches (Ruppert and Fox 1988). Many of the smaller invertebrate species found in the beach sands are an important food source for a variety of birds. In the lower intertidal zone, these invertebrates are also fed on by many fish species which are present during high tide.

Riverine Areas

The South Carolina Department of Health and Environmental Control (DHEC) has conducted most of the macrobenthic sampling known to have occurred in the freshwater, riverine portions of the ACE Basin. The fauna collected at their stations (Freshwater Benthic Sampling Stations) are typical of the fauna found in soft sediments (mud, sand) of freshwater streams in other areas (Hynes 1970). The dominant taxa observed at the DHEC sites include insects (represented by several taxonomic orders), amphipods (primarily *Crangonyx* sp., *Gammarus* sp. and *Hyallela azteca*), the isopod *Asellus* sp., crayfish (Cambaridae undet.) and oligochaetes. In general, insect taxa form a much greater component of the invertebrate taxa found in freshwater habitats compared to estuarine. One large pelecypod that was not abundant at the stations sampled by DHEC, but which has been found in many freshwater systems of South Carolina is the Asian clam *Corbicula manilensis* (Sandifer et al. 1980).

Only one station in the ACE Basin system was located in the tidal freshwater portion of the study area, and this station had oligohaline salinities on several sampling dates. The dominant taxa found at that site (upper S. Edisto River station) included the amphipods *Lepidactylus dytiscus*, *Gammarus fasciatus*, *Parapleustes aestuarius*, and other Gammaridae (undet.); the polychaete *Scolecolepides viridis*, the isopod *Chiridotea* sp, and insects (Ceratopogonidae undet.).

In freshwater areas with harder substrates, other taxa can often be found, including sessile sponges, hydrozoans, bryozoans, flatworms, other amphipod and isopod species, and many species of insect larvae (Hynes 1970). One relatively large invertebrate that is commonly found in many of the freshwater rivers and streams of South Carolina is the crayfish. Wishart and Loyacano (1974) documented 24 species of crayfish in South Carolina. Crayfish found in the ACE Basin were not present in densities considered high enough to support a commercial fishery. Most of the freshwater taxa are stenohaline and their distributions do not extend very far into estuarine habitats.

Back to Top

Summary

In general, there are many factors that play an important role in regulating the distribution and abundance of the meiofaunal and macrofaunal communities described above. Since these biota represent an important food source for many other larger taxa, predation effects are often a major regulating factor. Competition, both among individuals within a species as well as among species, can also play a major role in limiting faunal abundances and distribution. These factors, when combined with the effects of various physicochemical factors such as salinity, temperature, dissolved oxygen, sediment grain size, depth of the redox (reducing) layer within the sediments, and distribution along the intertidal-subtidal depth gradient in estuarine environments, result in very complex spatial and temporal patterns in the structure of these assemblages. Readers interested in learning more about the effects of various biotic and physicochemical factors on both meiofauna and macrofaunal assemblages should review general texts on freshwater and estuarine ecology, such as those published by Hynes (1970), Kennish (1986), Mann and Lazier (1991), Ruttner (1971), Valiela (1995), and Levinton (1995). Those interested in learning more about the life habits and distribution of the dominant macrofauna in South Carolina estuaries should review general guides to marine and estuarine life, such as the text by Ruppert and Fox (1988).

NEXT SECTION: Insects

Author

R. Van Dolah, SCDNR Marine Resources Research Institute

References

Alheit, J. and W. Scheibel. 1982. Benthic harpacticoids as a food source for fish. Marine Biology 70:141-147.

Bell, S. S. 1982. Notes and discussion on the population biology and meiofaunal characteristics of *Manayunkia aestuarina* (Polychaeta: Sabellidae: Fabrincinae) from a South Carolina salt marsh. Estuarine, Coastal and Shelf Sciences 14:215-221.

Bell, S. S. and B. C. Coull. 1978. Field evidence that shrimp predation regulates meiofauna. Oecologia 35:141-148.

Bell, S. S. and S. A. Woodin. 1984. Community unity: Experimental evidence for meiofauna and macrofauna. Journal of Marine Research 42:605-632.

Bell, S. S., M. C. Watzin, and B. C. Coull. 1978. Biogenic structure and its effect on the spatial heterogeneity of meiofauna in a salt marsh. 1978. Journal of Experimental Marine Biology and Ecology 35:99-107.

Boesch, D. F. 1977. A new look at the zonation of benthos along the estuarine gradient. p. 245-266. *In*: B. C. Coull (ed.). Ecology of Marine Benthos. University of South Carolina Press, Columbia, SC.

Calder, D. R. and B. B. Boothe, Jr. 1977a. Some subtidal epifaunal assemblages in South Carolina estuaries. South Carolina Marine Resources Center Data Report No. 4. South Carolina Wildlife and Marine Resources Department, Charleston, SC.

Calder, D. R. and B. B. Boothe, Jr. 1977b. Data from some subtidal quantitative benthic samples taken in estuaries of South Carolina. South Carolina Marine Resources Center Data Report No. 3. South Carolina Wildlife and Marine Resources Department, Charleston, SC.

Calder, D. R., B. B. Boothe, Jr., and M. S. Maclin. 1977. A preliminary report on estuarine macrobenthos of the Edisto and Santee River Systems, South Carolina. South Carolina Marine Resources Center Technical Report No. 22. South Carolina Wildlife and Marine Resources Department, Charleston, SC.

Coull, B. C. 1990. Are members of the meiofauna food for higher trophic levels? Transactions of the American Microscopical Society 109(3):233-246.

Coull, B. C. and B. W. Dudley. 1985. Dynamics of meiobenthic copepod populations: a long-term study (1973-1983). Marine Ecology Progress Series 23 (3):219-229.

Coull, B. C. and S. S. Bell. 1979. Perspectives of marine meiofaunal ecology. *In*: R. J. Livingston (ed.). Ecological processes in coastal marine systems. Plenum Press, New York, NY.

Coull, B. C., S. S. Bell, A. M. Savory, and B. W. Dudley. 1979. Zonation of meiobenthic copepods in a southeastern United States marsh. Estuarine and Coastal Marine Science 9:181-188.

Hyland, J. L., L. Balthis, C. T. Hackney, G. McRae, A. H. Ringwood, T. R. Snoots, R. F. Van Dolah, and T. L. Wade. 1998. Environmental quality of estuaries of the Carolinian Province: 1995. Annual statistical summary for the 1995 EMAP-Estuaries Demonstration Project in the Carolinian Province. NOAA Technical Memorandum NOS ORCA 123. NOAA/NOS, Office of Ocean Resources Conservation and Assessment, Silver Spring, MD.

Hyland, J. L., T. J. Herrlinger, T. R. Snoots, A. H. Ringwood, R. F. Van Dolah, C. T. Hackney, G. A. Nelson, J. S. Rosen, and S. A. Kokkinakis. 1996. Environmental quality of estuaries of the Carolinian Province: 1994. Annual statistical summary for the 1994 EMAP-Estuaries Demonstration Project in the Carolinian Province. NOAA Technical Memorandum NOS ORCA 97. NOAA/NOS, Office of Ocean Resources Conservation and Assessment, Silver Spring, MD.

Hynes, H. B. N. 1970. The ecology of running waters. University of Toronto Press, Toronto, ON, Canada.

Kennish, M. 1986. Ecology of estuaries. Volume II. Biological aspects. CRC Press, Boca Raton, FL.

Knott, D. M., E. L. Wenner, and P. H. Wendt. 1997. Effects of pipeline construction on the vegetation and macrofauna of two South Carolina, USA salt marshes. Wetlands 17:65-81.

Lerberg, S. B. 1997. Effects of watershed development on macrobenthic communities in tidal creeks of the Charleston Harbor area. M.S. Thesis. University of Charleston, Charleston, SC.

Levinton, J. S. 1995. Marine biology: Function, biodiversity, ecology. Oxford University Press, New York, New York.

Levisen, M. V. and R. F. Van Dolah. 1996. Environmental evaluation of the Kiawah Island beach scraping project. Final Report to the Town of Kiawah Island, Kiawah Island, SC. South Carolina Department of Natural Resources, Charleston, SC.

Mann, K. H. and J. R. N. Lazier. 1991. Dynamics of marine ecosystems. Blackwell Scientific Publications, Boston, MA and Oxford University Press, New York, NY.

Ruppert, E. E. and R. S. Fox. 1988. Seashore animals of the southeast. University of South Carolina Press, Columbia, SC.

Ruttner, F. 1971. Fundamentals of limnology. University of Toronto Press, Toronto, ON, Canada.

Sandifer P. A., J. V. Miglarese, D. R. Calder, J. J. Manzi, and L. A. Barclay. 1980. Ecological characterization of the sea island coastal region of South Carolina and Georgia. Vol. III: Biological features of the characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-79/42.

Shannon, C. E. and W. Weaver. 1949. The mathematical theory of communication. University of Illinois Press, Urbana, IL.

Smith, D. L. and B. C. Coull. 1987. Juvenile spot (Pices) and grass shrimp predation on meiobenthos in muddy and sandy substrata. Journal of Experimental Marine Biology and Ecology 105:123-136.

Stickney, R. R., G. L. Taylor, and D. B. White. 1975. Food habits of five species of young southeastern United States estuarine Sciaenidae. Chesapeake Science 16:104-114.

Valiela, I. 1995. Marine ecological processes. 2nd Edition. Springer-Verlag, New York, NY.

Van Dolah, R. F., D. R. Calder, and D. M. Knott. 1984. Effects of dredging and open water disposal on benthic macroinvertebrates in a South Carolina estuary. Estuaries 7:28-37.

Van Dolah, R. F., D. R. Calder, F. W. Stapor, Jr., R. H. Dunlap, and C. R. Richter. 1979. Atlantic Intracoastal Waterway environmental studies at Sewee Bay and North Edisto River. South Carolina Marine Resources Center Technical Report No. 39. South Carolina Wildlife and Marine Resources Department, Charleston, SC.

Van Dolah, R. F., P. H. Wendt, E. L. Wenner (eds.). 1990. A physical and ecological characterization of the Charleston Harbor estuarine system. Final Report submitted to the South Carolina Coastal Council. South Carolina Wildlife and Marine Resources Department, Charleston, SC.

Van Dolah, R. F., P. H. Wendt, and M. V. Levisen. 1991. A study of the effects of shrimp trawling on benthic communities in two South Carolina sounds. Fisheries Research 12:139-156.

Van Dolah, R. F., P. H. Wendt, R. M. Martore, M. V. Levisen, and W. Roumillat. 1992. A physical and biological monitoring study of the Hilton Head beach nourishment project. Final Report submitted to the town of Hilton Head Island and the South Carolina Coastal Council. South Carolina Wildlife and Marine Resources Department, Charleston, SC.

Van Dolah, R. F., R. M. Martore, A. E. Lynch, M. V. Levisen, P. H. Wendt, D. J. Whitaker, and W. D. Anderson. 1994. Environmental evaluation of the Folly Beach nourishment project. Final Report. U.S. Army Corps of Engineers, Charleston District and Marine Resources Division, South Carolina Department of Natural Resources, Charleston, SC.

Van Dolah, R. F., J. L. Hyland, A. F. Holland, J. S. Rosen, and T. R. Snoots. 1999. A benthic index of biological integrity for assessing habitat quality in estuaries of the Southeastern United States. Marine Environmental Research 48: 269-83.

Wenner, E. L. and H. R. Beatty. 1988. Macrobenthic communities from wetland impoundments and adjacent open marsh habitats in South Carolina. Estuaries 11: 29-44.

Wishart, M. A. and H. A. Loyacano. 1974. A survey of edible crawfish for the coastal plain of South Carolina. Completion Report for the Coastal Plains Regional Commission. Department of Entomology and Economic Zoology. Clemson University, Clemson, SC.

M
E
N
U

Introduction

Example Habitat: Salt Marsh

Example Taxon: Butterflies

Total Numbers of Insect Species

Conservation Measures

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Insects

Introduction

Because of their diversity and abundance, insects play major roles in the functioning of terrestrial and freshwater ecosystems. Insects influence the nutrient and energy flow of ecosystems in many ways, but perhaps most importantly as decomposers (see related chapter: Decomposers). No source of decaying organic material goes unused by insects, and their action is often necessary before other groups of decomposers can take advantage of the material. In both terrestrial and freshwater aquatic ecosystems, insect decomposers are crucial to the breakdown of plant material (both leaf litter and woody material), dead animals and waste material. Insecticide-treated leaf litter has a significantly slower rate of decomposition than untreated litter (Weary and Merriam 1978), and bag-exclusion experiments also indicate the importance of insect decomposition (Wiegert 1974). The decomposition of carrion is also slowed when insects are excluded (Payne 1965). Probably the most dramatic example of the importance of insect decomposition comes from dung feeders. After cows were imported to Australia, it was discovered that the native dung beetles would not utilize the moist cow dung, having evolved with much drier kangaroo dung. These unused dung pads remained in fields for months before breaking down. Eventually the accumulation of dung was extreme (calculated at 6 million pads per 30/minutes; Waterhouse 1991). The problem was solved by importing several species of African dung beetles which prefer the moister dung.

Velvetbean caterpillar - a common agricultural pest

Much of the diversity of insects and plants in terrestrial ecosystems can be attributed to the extensive interactions between these two groups, both through herbivory (Ehrlich and Raven 1964) and pollination (Kevan and Baker 1983). Insects are the major herbivores in most terrestrial ecosystems, accounting for up to 80% of the total plant consumption in the system (Price 1997). Insects are less efficient than vertebrates at assimilating plant material but more efficient at converting assimilated material into body tissue (Wiegert and Evans 1967; Slansky and Scriber 1985). At the Savannah River Site, Odum and others (1962) calculated that sparrows contribute 3.6 kcal/m^2 to the energy flow of the ecosystem, mice 6.7 kcal/m^2, and Orthoptera (grasshoppers, katydids and crickets) 25.6 kcal/m^2. Because of the cost of maintaining a warm body in birds and mammals, the actual production by Orthoptera was 100 times greater than that of sparrows and 33 times greater than that of mice. This indicates that insects (here only one group of herbivorous insects) consume more energy in the system than vertebrates and make more available to the secondary consumer levels. They are extremely important to the functioning of the community. Wiegert and Evans (1967) and Golley and Gentry (1964) found similar results in Michigan and South Carolina old fields.

Insects are also important as predators and parasitoids in ecosystems. In many cases, these predators and parasitoids may be the major factor controlling herbivorous insect populations (Dempster 1983). At least indirect evidence for such control comes from our extensive use of predators and parasitoids in biological control efforts. We do know that insects serve as prey items for a large array of invertebrates and vertebrates. Major groups of fishes, amphibians, reptiles, birds and mammals all use insects as the mainstay of their diet (Thompson 1984). Insects are such a rich food resource that these groups have often divided the insect prey items into specialized guilds, for example foliage gleaners and bark drillers (Willson 1974).

Despite the many important ways that insects influence ecosystem structure and function, we know relatively little about the insect faunas of most southeastern U. S. habitats, including those in the ACE Basin study area. For most groups of insects in most habitats, a great deal remains to be learned about how they influence the structure and functioning of that ecosystem. With those limitations in mind, this section will examine one habitat (salt marsh) and one group of insects (butterflies), which will serve as examples indicating the relative diversity and specialization of insects in the ACE Basin study area. To help in extrapolation to other, less well-known insect groups, estimates of the total number of insect taxa as well as of the number of insect species in various taxa have been generated for the ACE Basin study area.

Back to Top

Example Habitat: Salt Marsh

Of all habitats characteristic of the ACE Basin study area, the most is known about the community of insects found in salt marshes (Davis 1978; Davis and Gray 1966; Foster and Treherne 1976; Marples 1966; Teal 1962). Davis and Gray (1966) extensively sampled North Carolina salt marshes and recorded seasonal occurrence and abundance of insects. They showed that the most abundant insects in the salt marsh are the Diptera (true flies) and Homoptera (hoppers), each with only a few common species represented. The next most abundant orders of insects are Coleoptera (beetles), Orthoptera (grasshoppers, katydids and crickets), Lepidoptera (butterflies and moths), Hemiptera (true bugs), Hymenoptera (bees, wasps and ants), and Odonata (dragonflies and damselflies), respectively, as well as smaller numbers of other orders. Vernberg and Sansbury (1972) found similar results in Port Royal Sound, South Carolina, and these same dominants are likely abundant throughout salt marshes in the ACE Basin study area.

Despite what seems like a wide range of insect orders and species in the salt marsh habitat, the relative diversity in this habitat is perhaps the lowest of any in the ACE Basin study area. Although insects have been wildly successful in all terrestrial and freshwater habitats, few have been able to invade habitats characterized by high salinities or tidal influences (Merrit and Cummins 1996), both of which are typical of salt marshes. Although many explanations have been proposed for this phenomenon, no consensus has been reached. Two common explanations include inability to deal with the high osmoregulatory stress and competition with other invertebrates. Merrit and Cummins (1996) hypothesize that insects have not advanced past brackish areas because almost all aquatic insects are immatures, but the associated adults are largely terrestrial and are unable to live in the open ocean.

Blue dasher *Pachydiplax longipennis*

Salt marsh insects exhibit the typical range of insect lifestyles, including herbivores, detritivores, predators, parasitoids, and parasites. Salt marsh herbivores have been shown to play a significant role in nutrient cycling within the marsh, consuming 5-10% of the annual *Spartina* production (Kraeuter and Wolf 1974; Smalley 1960; Teal 1962). These herbivores include several common piercing species plant bugs - Homoptera (e.g. *Prokelisia*); chewing species of grasshoppers, katydids and crickets - Orthoptera (e.g. *Orchelimum fidicinium*); butterflies and moths - Lepidoptera (e.g. *Panoquina* spp.); leaf beetles - Coleoptera (Chrysomelidae); ants - Hymenoptera (Formicidae); and several fly species that consume fluids secreted by plants - Diptera (e.g. *Chaetopsis* spp.). Detritivores include flies (Ephydridae, Canacidae, Dolichopodidae) and springtails - Collembola (*Anurida*). Predators include dragonflies - Odonata (e.g. *Pachydiplax*, *Erythemis*), robber flies (Asilidae), assassin bugs (Reduviidae), marsh flies (Sciomyzidae), and beetles (Melyridae). Parasitoids consist of several families of Hymenoptera, including Ichneumonidae, Braconidae, Chalcidoidea, Scelionidae, and Dryinidae. Major parasites are mosquitoes (Culicidae), no-see-ums (Ceratopogonidae), and greenheaded and deer flies (Tabanidae). In the ACE Basin study area these insect parasites have a significant impact on humans because they act as disease vectors as well as annoyances, and a great deal of effort is spent controlling populations (Todd 1996). The most commonly used mosquito control in the ACE Basin study area is Altosid® larvicide, an insect growth regulator which prevents development to adult. It is sometimes mixed with Bti (*Bacillus thuringiensis israelensis*), a bacterium effective at killing mosquito larvae.

Overall, salt marsh habitat has a relatively low diversity of insects despite their high abundance. Davis and Gray (1966) sampled approximately 400 species from several North Carolina salt marshes, and Davis (1978) listed 358 species (without Lepidoptera) presumed to be found in South Carolina salt marshes.

Back to Top

Example Taxon: Butterflies

Probably the best studied taxa of insects in the ACE Basin study area and elsewhere are the butterflies and skippers (Papilionoidea and Hesperioidea). Several lists of butterflies known from coastal South Carolina have been compiled (Gatrelle 1975; McCord undated; Sharpe 1914; Wallace 1987). Approximately 125 butterfly and skipper species are probably found in the ACE Basin study area as either residents or migrants (Species habitats). This species count was compiled from the sources above as well as collection records and known distributions as documented in Opler and Krizek (1984) and Opler and Malikul (1998). By examining the habitats of these species, a comparison can be made between the relative numbers of generalized vs. specialized species, and a determination can be made about which habitats harbor more specialists and which habitats are most critical in maintaining current butterfly species diversity.

South Carolina's climate supports an interesting mix of butterfly species. Resident species include a combination of primarily subtropical species, several geographically widespread species, and many species more narrowly restricted to the southern or coastal states. Subtropical residents include the Gulf Fritillary (*Agraulis vanillae*), the Cloudless Sulphur (*Phoebis sennae*), and the Long-tailed Skipper (*Urbanus proteus*). Widespread species include the Viceroy (*Limenitis archippus*), Red-spotted Purple (*Limenitis arthemis*), Red Admiral (*Vanessa atalanta*), Monarch (*Danaus plexippus*), and Tiger Swallowtail *(Papilio glaucus*). Southern and coastal species include the Yehl Skipper (*Poanes yehl*), Aaron's Skipper (*Poanes aaroni*), Salt Marsh Skipper (*Panoquina panoquin*), Southern Skipperling (*Copaeodes minima*), Carolina Roadside Skipper (*Amblyscirtes carolina*), Eastern Pygmy Blue (*Brephidium isophthalma*), Carolina Satyr (*Hermeuptychia sosybius*), and Palamedes Swallowtail (*Papilio palamedes*). Seasonal migrants are also a significant element in the South Carolina fauna, and they include the Zebra (*Heliconius charitonius*), Peacock (*Anartia jatrophe*), Queen (*Danaus gilippus*), Dogface (*Colias cesonia*), and Mourning Cloak (*Nymphalis antiopa*).

Habitat associations as published in Opler and Krizek (1984) and Opler and Malikul (1998), as well as field experience, were used to define butterfly species as generalists or specialists . Species restricted to one or few very similar mature, native habitats are classified as specialists (33% of all species), while those found in a variety of native and/or disturbed habitats are classified as generalists (67% of all species). Host plant restriction was not used as a criterion for specialization in order to emphasize those habitats that seem to be most important in maintaining butterfly diversity. A restricted host plant range or other restricted resources would, of course, also have an impact on the distribution and abundance of species. Thus, most decisions to classify a species as specialist or generalist could be made easily. Therefore, this designation of specialist species is somewhat conservative. Many of the species counted as generalist are not found everywhere, but are at least found in a variety of habitat types or are common in areas with high levels of human impact.

A large number of species are generalists in either open or wooded habitats. Many of these are species characteristic of disturbed or weedy habitats, including the whites (*Pieris* spp.), sulphurs (*Colias* spp.), Black Swallowtail (*Papilio polyxenes*), Eastern Tailed Blue (*Everes comyntas*), and Fiery Skipper (*Hylephila phyleus*). The remainder prefer wooded habitats but not a particular forest type. These include the Tiger Swallowtail (*Papilio glaucus*), Red-spotted Purple (*Limenitis arthemis astyanax*), Comma (*Polygonia comma*), Question Mark (*Polygonia interrogationis*), and Carolina Satyr (*Hermeuptychia sosybius*).

Of the 125 butterfly and skipper species in the ACE Basin study area, 41 are classified here as habitat specialists. Of these, 27 are restricted to some sort of wooded habitat and 12 to open habitats, and 2 have mixed preferences. The most commonly represented habitats are swamps (10 species), pinewoods (7 species), brackish or freshwater marshes (5 species), salt marsh (4 species), and moist woods (3 species). Overall, 24 species prefer wet or moist habitats and 17 prefer dry habitats. Of those 24 species preferring wet or moist habitats, 19 species inhabit true wetlands, with standing water during a significant part of the year. This indicates that no one habitat type is significantly more important than another in butterfly conservation, but wetlands and pinewoods are the most common specialized habitats.

Many of the specialized species appear to be habitat-restricted because of their habitat-restricted host plants. For example, several of the swamp-restricted species (*Enodia creola*, *Amblyscirtes carolina*, and *Amblyscirtes reversa*) use cane (*Arundinaria*) as their larval host; Salt Marsh Skippers (*Panoquina panoquin*) use *Spartina* as their larval host; and the Eastern Pygmy Blue (*Brephidium isophthalma*) uses glasswort (*Salicornia*) as its larval host. Other host-restricted species use plants that are not as habitat-restricted. For example, Monarchs (*Danaus plexippus*) use milkweed species, many sulphurs (Coliadinae) use legumes, and many blues (Polyommatinae) use a variety of flowers and fruits.

Species typical of the five most commonly represented specialized habitats include the Creole Pearly Eye (*Enodia creola*), Duke's Skipper (*Euphyes dukesi*), Yehl Skipper (*Poanes yehl*), and Carolina Roadside Skipper (*Amblyscirtes carolina*) for swamps; Pine Elfin (*Callophrys niphon*), Georgia Satyr (*Neonympha areolata*), and Dusky Roadside Skipper (*Amblyscirtes alternata*) for pinewoods; Broad-winged Skipper (*Poanes viator*), Twin-spotted Skipper (*Euphyes bimacula*) and Dion Skipper (*Euphyes dion*) for freshwater marshes; Aaron's Skipper (*Poanes aaroni*), Salt Marsh Skipper (*Panoquina panoquin*), and Eastern Pygmy Blue (*Brephidium isophthalma*) for salt marshes; and Zebra Swallowtail (*Eurytides marcellus*), Harvester (*Feniseca tarquinius*), and Clouded Skipper (*Lerema accius*) for moist woods. Overall, of the 41 specialist species, 21 are skippers (Hesperiidae), and 11 are blues, hairstreaks, and their relatives (Lycaenidae). The remainder are from other families.

These numbers indicate that loss of some specialized habitats, particularly wetlands, could result in the disproportionate loss of species from two families of butterflies and skippers. For at least these insect groups, the numbers emphasize the importance of swamps, freshwater marshes and salt water marshes for maintaining species diversity.

Back to Top

Total Numbers of Insect Species

American cockroach

Whereas butterfly occurrences and distributions are relatively well known, at least on a regional scale, other insect taxa are less well known or not studied at all. Those that have received some attention are the Lepidoptera other than butterflies (Wallace 1987), aquatic insects (Brigham and others 1982), Odonata (Dunkle 1989, 1990), coastal zone species (Davis 1978), and beetles (Kirk 1970).

Based on known and likely distributions, the ACE Basin study area should have 30 orders of insects (out of the 31 recognized in Borror and others 1989), only lacking the Grylloblattaria, which are known only from beyond the treeline in the mountains and arctic. Of those probably occurring in the area, collection records exist for all but three, those being Protura, a group of small and easily overlooked soil organisms; Zoraptera, rare insects found primarily in decaying logs and saw dust; and Embiidina, a group known as the web-spinners which should be at the northern limit of its range in South Carolina (Scholtens, B. 1999, College of Charleston, pers. comm.).

Estimates of total species are much less certain and are made by extrapolating from the few, relatively well-known groups mentioned above. Wallace (1987) catalogued species of Lepidoptera collected at the Wedge Plantation on the South Carolina coast just south of Georgetown. This collection is probably the most comprehensive of any coastal plain collection for a complete order of insects. The 1,167 species known from this locality still severely underrepresents many of the families of small moths, which would push the total significantly higher. The number of mayflies (Ephemeroptera - 56), stoneflies (Plecoptera - 28) and caddisflies (Trichoptera - 117) species occurring in the coastal region was estimated using Brigham and others (1982). Dunkle (1989, 1990), working with Florida odonate species, provides an estimate of 104 species of dragonflies and damselflies (Odonata) likely along the South Carolina coast. These estimates for aquatic groups are probably close to the actual numbers, but most collections are from outside the ACE Basin study area. Kirk (1970) records 808 beetle species collected in the southern coastal plain, and while this is a good first tabulation, it no doubt severely underestimates the total number in the region because it is highly unlikely that beetles are significantly outnumbered by Lepidoptera.

Caddisfly

By using these tabulations and comparing species totals to numbers surveyed in other areas, it is possible to estimate how many species might be expected in the ACE Basin region. These estimates should be considered preliminary because so few groups have been surveyed, and for those that have, there are either relatively few collections, or survey work was done outside the ACE Basin study area. Most totals for particular orders of insects are comparable to those from the Mt. Desert region (Procter 1946) or from North Carolina (Wray 1967) (Total Species). The total number of species in the former survey was 6,367 and in the latter 12,520. The total number of species in the ACE Basin study area is probably somewhat higher than that from Mt. Desert, but lower than that for the state of North Carolina. A conservative estimate for the ACE Basin study area would be 8,000-10,000 species.

If a more precise estimate is to be made, a concerted effort is needed to sample select groups of insects over a range of habitats. Likely selections among taxonomic groups would be the Lepidoptera (at least the butterflies), the Odonata, and perhaps the beetles, because all have significant previous background data. The butterflies, dragonflies, and damselflies, in particular, are large and obvious enough to be surveyed in a single field season, and they occur in all major habitats in the ACE Basin study area.

Back to Top

Conservation Measures

Since no group of insects in any ACE Basin habitat has received significant attention, it is difficult to make knowledgeable decisions about how best to maintain insect diversity in the region. However, there is consensus in the field of insect conservation that the most important factor in maintaining diversity is maintaining appropriate habitat (Gaston and others 1993; Pullin 1995). In this regard the ACE Basin study area is fortunate because large areas of habitat are already set aside as protected lands. Additional conserved areas could be advantageous in maintaining insect diversity, but decisions about which habitats are most important will have to await more complete information on occurrence and distribution of insects in the region.

NEXT SECTION: Decapod Crustaceans

Author

B. Scholtens, College of Charleston

References

Borror, D.J., C.A. Triplehorn, and N.F. Johnson. 1989. An introduction to the study of insects, 6th ed. Saunders College Publishing, Fort Worth, TX.

Brigham, A.R., W.U. Brigham, and A. Gnilka (eds.). 1982. Aquatic insects and oligochaetes of North and South Carolina. Midwest Aquatic Enterprises, Mahomet, IL.

Davis, L.V. 1978. Class Insecta. p. 186-220. *In*: R. G. Zingmark (ed.). An annotated checklist of the biota of the coastal zone of South Carolina. University of South Carolina Press, Columbia, SC.

Davis, L.V. and I.E. Gray. 1966. Zonal and seasonal distribution of insects in North Carolina salt marshes. Ecological Monograph 36:275-295.

Dempster, J.P. 1983. The natural control of populations of butterflies and moths. Biological Review 58:461-481.

Dunkle, S.W. 1989. Dragonflies of the Florida peninsula, Bermuda, and the Bahamas. Scientific Publishers, Gainesville, FL.

Dunkle, S.W. 1990. Damselflies of Florida, Bermuda and the Bahamas. Scientific Publishers, Gainesville, FL.

Ehrlich, P.R. and P.H. Raven. 1964. Butterflies and plants: A study in co-evolution. Evolution 18:586-608.

Foster, W.A. and J.E. Treherne. 1976. Insects of marine salt marshes: Problems and adaptations. p. 5-42 *In*: L. Cheng (ed.). Marine insects. American Elsevier Publishing Company, New York, NY.

Gaston, K.J., T.R. New and M.J. Samways (eds.). 1993. Perspectives on insect conservation. Intercept Ltd., Andover, MA.

Gatrelle, R.R. 1975. The Hesperioidea of the south coastal area of South Carolina. Journal of the Lepidopterists' Society 29:56-59.

Golley, F.B. and J.B. Gentry. 1964. Bioenergetics of the southern harvester ant, *Pogonomyrmex badius*. Ecology 45:217-225.

Kevan, P.G. and H.G. Baker. 1983. Insects as flower visitors and pollinators. Annual Review of Entomology 28:407-453.

Kirk, V.M. 1970. A list of beetles of South Carolina. Part 2: Mountain, piedmont, and southern coastal plain. Technical Bulletin 1038, SC Agricultural Experimental Station, Clemson, SC.

Kraeuter, J.N. and P.L. Wolf. 1974. The relationships of marine macroinvertebrates to salt marsh plants. p. 449-462. *In*: R.J. Reimold and W.H. Queen (eds.). Ecology of Halophytes. Academic Press, New York, NY.

Marples, T.G. 1966. A radionuclide tracer study of arthropod food chains in a *Spartina* salt marsh ecosystem. Ecology 47:270-277.

McCord, J.W. undated. Butterflies of the ACE Basin - Poco Sabo Plantation. unpublished report.

Merrit, R.W. and K.W. Cummins. 1996. An introduction to the aquatic insects of North America, 3rd ed. Kendall/Hunt Publishing Company, Dubuque, IA.

Odum, E.P., C.E. Connell, and L.B. Davenport. 1962. Population energy flow of three primary consumer components of old-field ecosystems. Ecology 43:88-96.

Opler, P.A. and G.O. Krizek. 1984. Butterflies east of the Great Plains. The Johns Hopkins University Press, Baltimore, MD.

Opler, P.A. and V. Malikul. 1998. A field guide to eastern butterflies. Houghton Mifflin Company, Boston, MA.

Payne, J.A. 1965. A summer carrion study of the baby pig *Sus scrofa* L. Ecology 46:592-602.

Price, P.W. 1997. Insect ecology, 3rd Ed. John Wiley and Sons, New York, NY.

Procter, W. 1946. Biological survey of the Mt. Desert Region. Part VII: The insect fauna. Wistar Institute Press, Philadelphia, PA.

Pullin, A.S. (ed.). 1995. Ecology and conservation of butterflies. Chapman and Hall, London, U.K.

Sharpe, J. 1914. Preliminary list of butterflies of the vicinity of Charleston. Bulletin of the Charleston Museum of Natural History 10:33-35,41-43.

Slansky, F. and J.M. Scriber. 1985. Food consumption and utilization. p. 87-163. *In*: G.A. Kerkut and L.I. Gilbert (eds.). Comprehensive insect physiology, biochemistry and pharmacology. Vol. 4. Pergamon Press, Oxford, U.K.

Smalley, A.E. 1960. Energy flow of a salt marsh grasshopper population. Ecology 41:785-790.

Teal, J.M. 1962. Energy flow in the salt marsh ecosystem of Georgia. Ecology 43:614-624.

Thompson, J.N. 1984. Insect diversity and the trophic structure of communities. p. 591-606. *In*: C.B. Huffaker and R.L. Rabb (eds.). Ecological entomology. John Wiley and Sons, New York, NY.

Todd, K.V. 1996. The 35th annual report of the Charleston County mosquito abatement program. Charleston County Mosquito Abatement Program, North Charleston, SC.

Vernberg. F.J. and C.E. Sansbury. 1972. Studies on salt marsh invertebrates of Port Royal Sound. *In*: South Carolina Water Resources Commission (ed.). Port Royal Sound environmental study. South Carolina Water Resources Commission, Columbia, SC.

Wallace, F.L. 1987. A check list of the Richard B. Dominick moth and butterfly collection. International Center for Public Health Research, University of South Carolina, Columbia, SC.

Waterhouse, D.F. 1991. Insects and humans in Australia. p. 221-235. *In*: I.D. Naumann (ed.). The insects of Australia: A textbook for students and research workers. Cornell University Press, Ithaca, NY.

Weary, G.C. and H.G. Merriam. 1978. Litter decomposition in a red maple woodlot under natural conditions and under insecticide treatment. Ecology 59:180-184.

Wiegert, R.G. 1974. Litterbag studies of microarthropod populations in three South Carolina old fields. Ecology 55:94-102.

Wiegert, R.G. and F.C. Evans. 1967. Investigations of secondary productivity in grasslands. p. 499-518. *In*: K. Petrusewicz (ed.). Secondary productivity in terrestrial ecosystems. Institute of Ecology, Polish Academy of Sciences, Warsaw, Poland.

Willson, M.F. 1974. Avian community organization and habitat structure. Ecology 55:1017-1029.

Wray, D.L. 1967. Insects of North Carolina, 3rd supplement. North Carolina Department of Agriculture, Division of Entomology, Raleigh, NC.

M
E
N
U

Introduction

Nearshore Coastal

Subtidal and Estuarine

Salt Marsh

Oyster Reefs

Impoundments

Tidal Freshwater

Conclusion

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Decapod Crustaceans

Introduction

The order Decapoda consists of shrimps, crayfishes, lobsters, and crabs. The members of this group have ten legs and are distinguished from other crustaceans by a well-developed carapace that covers the head and thorax. The decapod crustaceans of the ACE Basin study area are ecologically, recreationally and commercially important. Species such as blue crab and penaeid shrimp are important to commercial and recreational fisheries, while others such as grass shrimp are important to the trophodynamics of the estuary (Welsh 1975).

It appears that decapod crustaceans play a critical role in metabolizing and controlling the flow of energy in estuarine ecosystems. Decapods are preyed upon by a variety of predators from alligators to fishes. Depending on its intensity, predation is a factor in controlling population density, as well as structuring species assemblages within a habitat. Decapods are also important predators themselves, consuming phytoplankton, benthic algae, and macrobenthos (Coull and Bell 1983). Decapod particulate feeders consume detritus derived from *Spartina* and feces, thereby making detritus available to several different trophic levels and processing particles in such a way that substrate is enhanced for accelerated growth by diatoms and bacteria (Field 1983). While there is some information on the role of specific decapod species in aquatic systems, our understanding of decapod crustacean populations and communities is limited. As more information is collected on life histories, demography, and species interactions, a better understanding of the role of decapods in ecosystems will emerge.

White shrimp *(Penaeus setiferus)*

The ACE Basin study area estuarine system is similar to other systems throughout the state in that it supports a diverse assemblage of decapods and provides both a seasonal habitat for adults and juveniles and a permanent year-round habitat for resident species. Subtidal and intertidal estuarine habitats provide a refuge from predation and a source of food for many decapods. These habitats are exploited by year-round residents such as grass shrimp (*Palaemonetes* sp.), or seasonally abundant species such as blue crab, *Callinectes sapidus*, and the penaeid shrimps, white shrimp *Penaeus setiferus* (recently changed to *Litopenaeus* *setiferus*), brown shrimp *Penaeus aztecus* (recently changed to *Farfantepenaeus aztecus*), and pink shrimp *Penaeus duorarum* (recently changed to *Farfantepenaeus duorarum*) (Kneib 1984; Weinstein 1979). Although decapod species are conspicuous inhabitants of the ACE Basin study area and many are economically important, few comprehensive studies of the decapod community have been done in that region. No information is available on the decapod community from shallow marsh, oyster reefs, or impoundments in the ACE Basin study area; however, information on decapods from these habitats is available for other coastal areas of South Carolina. Most of the information on decapod species assemblages has come from trawl surveys of the rivers in and near the ACE Basin study area. These data are the most comprehensive to date for assessing spatial and temporal changes in species composition, diversity, and biomass.

Back to Top

Nearshore Coastal

The coastal zone, defined by Struhsaker (1969) as extending from the sounds and estuaries out to depths of 18 m (59 feet), is characterized by low relief sand and mud bottom among which is interspersed "Alive-bottom" reefs. These reefs are distinguished from the surrounding sand biotope by supporting a diverse assemblage of sessile invertebrates as well as numerous motile species which are inhabitants of the complex microhabitats of the reefs. The decapod community from the nearshore coastal zone, outside the geographic boundaries of the ACE Basin study area, was described in several papers. Wenner and Read (1981, 1982) described decapod crustacean assemblages from open shelf and live bottom habitats between Cape Fear, North Carolina and Cape Canaveral, Florida. They collected 184 species from 38 families. The inner shelf assemblage contained few species with high abundance. The inner shelf deca pod community at depths of 4-20 m (13 - 66 ft) was further described by Wenner and Wenner (1988). They collected 60 species of decapods, many of which occur in trawl samples from the ACE Basin study area. *Trachypenaeus constrictus*, the hardhead shrimp; *Callinectes similis*, the lesser blue crab; the portunid crabs, *Portunus gibbesii, P. spinimanus, Ovalipes stephensoni* and *O. ocellatus*; and the white (*Penaeus setiferus*) and brown (*Penaeus aztecus*) shrimps were the most abundant decapods encountered. The coastal assemblage appears to be composed of physiologically adaptable species which are not stressed by variable salinity due to large amounts of river runoff or seasonal changes in bottom temperature. Several of these nearshore species, such as the blue crab, lesser blue crab, portunids (*Portunus* spp. and *Ovalipes* spp.), white and brown shrimp, hardhead shrimp, and rock crab (*Cancer irroratus*) have been encountered in trawl tows in the ACE Basin study area (Decapod trawl survey).

Sampling of decapod crustaceans in nearshore areas is continuing as part of the Southeast Area Monitoring and Assessment Program (SEAMAP) EXIT. The SEAMAP trawl survey covers the coastal zone between Cape Hatteras, North Carolina and Cape Canaveral, Florida. Multi-legged cruises are

Trawling activities in the ACE Basin

conducted in spring, summer and fall during which stations from 24 inner strata, delineated by the 4-10 m (13-33 ft) depth contours, are sampled. Ten outer strata off South Carolina, Georgia and Florida at depths of 10-19 m (33-62 ft) are also sampled in spring, while seven outer strata off North Carolina were sampled in fall. As many as 50 decapod species have been collected since the survey began in 1989. Catches have consistently been dominated by white and brown shrimp, the portunid crabs *Portunus gibbesii* and *Ovalipes stephensoni*, and the lesser blue crab *Callinectes similis* (J. Boylan. 1999. SCDNR. pers. comm.).

Back to Top

Subtidal and Estuarine

Decapod crustaceans are an important component of estuarine subtidal rivers and tidal creeks in the ACE Basin study area. The first comprehensive trawl survey describing fluctuations in the distribution and abundance of decapod crustaceans in the ACE Basin study area was conducted from 1973-1975 (Wenner et al. 1991). A total of 38 species were collected from eight stations in the North Edisto River, while 30 species were taken from four stations in the South Edisto. Mesh size, net dimensions and towing speed influence trawl catches. The small size of the trawl used in the ACE surveys makes them highly selective for juvenile stages. The dominant decapod species in terms of abundance and biomass were white shrimp (*Penaeus setiferus*), brown shrimp (*Penaeus aztecus*), blue crab (*Callinectes sapidus*) and sea bob (*Xiphopenaeus kroyeri*). These species together comprised almost 94% by number and > 97% by weight of the total decapod catch. As indicated for finfish assemblages, the decapod assemblages consisted of transient species, stenohaline marine species, and estuarine endemics. (See related section: Fish .) The faunal diversity was controlled primarily by salinity in the South Edisto River, while the North Edisto lacked a distinct halocline and had a fairly uniform distribution of species among stations. In the South Edisto, the estuarine endemic species were separated spatially from euryhaline marine transients and stenohaline marine species.

More recently, a routine monitoring of decapod crustaceans was begun in 1995 as part of a long-term survey of the three major rivers in the ACE Basin (See NERR trawl stations). This monthly trawl survey in the ACE Basin National estuarine Research Reserve (NERR) has collected a total of 43,319 individuals representing 28 species (Decapod trawl survey). Greater number of species (26) was collected in the South Edisto, while 23 species were collected from the Ashepoo River and 17 were taken from the Combahee River (Species by river). This difference probably reflects influence of the strong salinity gradient in the South Edisto which encourages invasion by stenohaline marine species from the coastal zone. Within all rivers, stations in the lower part yielded the most species. Station E001 in the South Edisto was especially diverse with 22 decapod species. The stations that were characterized as mesohaline, based on salinity conditions at the Ashepoo , the Combahee , and the South Edisto trawl stations over the sampling period, generally yielded more individuals than other stations. Fewest individuals were collected at station E019 in the South Edisto which has the lowest salinity of any stations sampled . As noted by Wenner et al. (1991), it appears that many estuarine endemic forms were spatially separated from the euryhaline transients and the stenohaline marine species. The overlap in distribution of the transient and stenohaline decapods contributed to increased species richness at stations nearest the mouth. 0

The white shrimp *Penaeus setiferus*, the brown shrimp *Penaeus aztecus*, and the blue crab *Callinectes sapidus* were the numerically dominant species for all three rivers. These three species constituted >90% of the total number of individuals collected. *Penaeus* setiferus and *C. sapidus*, respectively, were the top-ranked species in terms of weight.

Seasonal changes in abundance are common for many decapods. Wenner et al. (1991) noted that the numerically-dominant decapod crustaceans in the North and South Edisto displayed similar patterns of seasonal abundance in both rivers. Recent trawl surveys in the ACE Basin NERR indicated that *Penaeus setiferus* was most abundant in summer and fall. Abundance was fairly consistent among stations in the Combahee and Ashepoo, although fewest white shrimp occurred at stations furthest upriver. In the South Edisto, stations E001 and E019 yielded the greatest abundance. .

Panaeid shrimp post-larvae

Temporal and spatial abundance patterns of white shrimp are related to life history of the species and the size at which white shrimp are vulnerable to the trawl gear. White shrimp are recruited migrate) as postlarvae to the estuaries and sounds of the ACE Basin study area in late spring and early summer, grow rapidly to juvenile and subadult stages in estuarine nursery areas, and emigrate to coastal waters in fall (See related subsection: Zooplankton: Macrozooplankton). Postlarvae seek habitats in shallow tidal creeks with muddy/sand substrate and plentiful organic debris. Juveniles prefer oligohaline and mesohaline areas but may be found along the entire estuarine salinity gradient (Wenner and Beatty 1993). During mild winters, white shrimp can overwinter in deep, high salinity areas but their survival is dependent on temperature minima being >6EC (Farmer et al. 1978).

Brown shrimp *Penaeus aztecus* are highly seasonal in the ACE Basin study area with peak catches occurring in June or July. Brown shrimp were collected at every station in the trawl survey of the ACE NERR, but very few were collected at station E019 located furthest upriver in the South Edisto (See NERR trawl stations).

Abundance patterns of brown shrimp are closely related to its life history in the southeastern United States. Brown shrimp generally recruit to South Carolina estuaries as early as February, with peak ingress of postlarvae occurring in March-April (Wenner et al. 1990). Postlarvae and juveniles are associated with shallow vegetated habitats over a wide range of salinities (Wenner and Beatty 1993). Brown shrimp grow rapidly until late summer when much of the population moves from estuaries to offshore areas causing a rapid decline in abundance within the estuaries. Emigration usually occurs in July and August in the Carolinas, with a corresponding peak recruitment to the coastal shrimp fishery (South Atlantic Fisheries Management Council 1981).

The blue crab *Callinectes sapidus* occurred during every season and at every station sampled, indicating its general ubiquity within the ACE Basin study area estuarine areas (60-70% of all trawls in the three rivers captured this species). Greatest densities of juveniles and subadults occurred in fall and winter, although this varied depending upon station and river.

Blue crab are recruited as megalopae to estuaries of South Carolina in late summer and early fall (Mense and Wenner 1989; Boylan and Wenner 1993). Following settlement and molting to the first crab stage, blue crab occupy a variety of estuarine habitats including tidal creeks, marsh rivulets and oyster shell banks. Juveniles and subadults occupy the mid to upper reaches of estuaries. Spring and winter peaks in juvenile blue crabs have been reported for coastal South Carolina. Mense and Wenner (1989) found that the greatest abundance of juveniles occurred during January and September in the Charleston Harbor system. This winter cohort of juveniles most likely results from a late summer spawn of larvae, Wenner et al. (1990) hypothesized that the increased abundance of juvenile blue crabs in early winter may reflect increased utilization of estuarine nursery areas from which predators have emigrated due to decreasing water temperature.

Back to Top

Salt Marsh

Fiddler crab ***(Uca pugnax)***

Salt marshes provide habitat for several decapod species in coastal South Carolina. Rapid fluctuations in water quality variables such as salinity, temperature, and dissolved oxygen restrict the number of decapods that occur in the salt marsh. In spite of these harsh conditions, marshes are highly productive in terms of organic matter. The protection afforded by marsh grass stem structure and the abundant food supply of salt marshes make them important nursery habitats for larval and juvenile stages of decapod species such as blue crab, white shrimp, and grass shrimp. Subadult stages move into intertidal marshes along the creek edge on incoming tides and penetrate the interior marshes during flood tide (Kneib and Wagner 1994). Resident species such as fiddler crabs (*Uca* spp.) burrow preferentially in sediments with intermediate densities of *Spartina* root mats (Bertness and Miller 1984) ## . Fiddler crabs and grass shrimp are important prey of piscine, avian, an d mammalian marsh inhabitants.

Although no specific information is available on the decapod community from shallow marsh habitats in the ACE Basin study area, decapod crustaceans common to salt marshes of the nearby Port Royal Sound were studied by Vernberg and Sansbury (1972). A total of eight decapod species was collected from five marsh sites. The fiddler crab, *Uca pugnax,* was most common in their samples, although *U. pugilator* was frequently collected near high tide in sandy substrates. The mud crabs, *Panopeus herbstii* and *Eurypanopeus depressus,* were common around areas where oyster shell occurred. Other species common at their marsh sites included *Sesarma reticulatum* and *S. cinereum*. Knott et al. (1997) sampled salt marshes near Charleston, South Carolina and found that grass shrimp *Palaemonetes pugio* dominated collections from the marsh surface. Other dominant species were white shrimp and the mud fiddler crab, *Uca pugnax*.

Back to Top

Oyster Reefs

Oyster reef at low tide

Oyster reefs are a major habitat in the intertidal zone of the ACE Basin study area and harbor numerous decapod species. These reefs provide the only intertidal three-dimensional structural relief in an otherwise unvegetated, soft-bottom, benthic habitat Klemanowicz (1985) sampled motile and non-colonial invertebrates from oyster reefs in the Coosaw River and found that the mud crabs, *Eurypanopeus depressus* and *Panopeus herbstii,* were the dominant decapods. More recently, Wenner et al. (1996) provided a list of decapod and fish species associated with intertidal oyster reefs in the vicinity of Charleston Harbor. Several decapod species such as the mud crabs, *Panopeus herbstii* and *Eurypanopeus depressus,* and the stone crab, *Menippe mercenaria,* occupy the many crevices found on intertidal oyster reefs. The association of *E. depressus* with oyster reefs in intertidal area s enables this species to avoid dessication as well as potential predators (Grant and McDonald 1979). Thus, oyster reefs provide a refuge from predation and also harbor smaller invertebrates upon which many decapods feed. In turn, decapods on these reefs are prey for finfish species such as oyster toadfish, sheephead and blennies that inhabit the reefs at flood tide. Other decapod species move on and off the reefs with the tide. These include grass shrimp (*Palaemonetes* spp.), blue crab and penaeid shrimp.

Back to Top

Impoundments

Impoundments are a man-made alteration to wetlands that can affect the community structure of

Aerial view of former rice field impoundment

organisms that inhabit them. Impounding wetlands produces changes in vegetation that may affect the relationship between the natural distribution of salt-marsh plant communities and associated animal populations. Because tidal flooding expands the surface area of the marsh and its utilization by natant macrofauna, predator-prey interactions, competition, disturbance, and physical stresses may be intensified in impoundments that are subject to prolonged flooding. Despite the potential consequences on macroinvertebrate populations, little information exists on community assemblages from South Carolina. The most comprehensive treatment of the decapod community from coastal wetland impoundments was provided by Wenner et al. (1986) for the Santee delta. The most abundant species in impoundments were grass shrimp (*Palaemonetes pugio* and *P. vulgaris*), white shrimp (*Litopenaeus setiferus*), brown shrimp (*Penaeus aztecus*), pink shrimp (*F. duorarum*) and blue crab (*Callinectes sapidus*). These species were also dominant in trawl collections from an adjacent tidal creek. Abundance and biomass of these dominant species declined in summer and early fall, likely due to stressful water quality conditions occurring in impoundments. Overall, the faunal assemblages in the impoundments were distinct from those in the adjacent creek which was attributed to sampling bias as well as real differences in the habitats themselves.

The degree to which decapod species are able to inhabit impounded areas depends on the timing of recruitment and the water exchange schedules of the impoundment management strategy (Olmi 1986). Planktonic decapod crustaceans occurred in estuarine impoundments of the Santee Delta from May to November. Penaeid shrimp postlarvae recruiting to impoundments were brown shrimp, pink shrimp, white shrimp, and hardhead shrimp (*Trachypenaeus constrictus*). Megalopae of the blue crab recruited to impoundments from July through November. As the decapod species grew within the impoundments, the water-control structures probably acted as barriers to their emigration. Blue crab and penaeid shrimp had restricted access to the creek during periods when they would normally emigrate to offshore areas. Greater abundance of mature female blue crab within impoundments during months when spawning migrations to high-salinity waters occur suggested that crabs were retained within impoundments. Su b-adult white and brown shrimp were collected in the impoundments during fall, the season when emigration to nearshore coastal areas occurs (Wenner 1986).

Back to Top

Tidal Freshwater

The decapod community in freshwater portions of the ACE Basin study area has not been

Tidal freshwater marsh

scientifically investigated, in spite of the importance of tidal freshwater wetlands as transition zones between salt-brackish marshes and non-tidal freshwater areas. Consequently, many decapods that occur in oligohaline zones of estuaries may also occur in freshwater areas of the ACE. There has been some information on community composition and nursery function of low-salinity wetland habitats along the US Atlantic coast. Odum et al. (1984) reviewed the community composition and nursery function of low-salinity marshes and noted that clear differences exist in the invertebrate communities of tidal freshwater marshes versus salt marshes. It has been hypothesized that few crustacean species inhabit freshwater marshes because of physiological difficulties that result from inhabiting low salinity areas. Species impoverishment of tidal freshwater marshes has also been attributed to general lack of habitat diversity (Odum 1988). Recent studies in tidal freshwater wetlands of Virginia indicated that invertebrate species composition of marsh surface residents was similar in tidal freshwater and salt marshes, despite physicochemical differences in the habitats. Many of the shrimp and crabs occurring in freshwater marshes have well-developed osmoregulatory capabilities and are not stressed by low and often variable salinities that occur in oligohaline conditions (Moore 1992). Rozas and Hackney (1983, 1984) documented the importance of oligohaline marshes as nursery areas for grass shrimp and blue crab. Freshwater shrimp of the genus *Macrobrachium* and the mud crab, *Rhithropanopeus harrisii*, occurred but were rare in their collections.

Back to Top

Conclusion

Given the baseline information collected on decapod crustaceans from the ACE Basin study area, it appears that this system is similar to others that have been studied throughout the state in that it supports a diverse assemblage of decapods and provides both seasonal habitats for adults and juveniles and permanent year-round habitats for resident species. Given differences in life history, sizes and behaviors of decapod crustaceans, further efforts to understand their community structure in the ACE Basin study area should focus on shallow marsh and freshwater areas where there is a paucity of information. A state-wide monitoring program being initiated in 1999 by the South Carolina Department of Natural Resources may provide some additional data to compare the communities in the ACE Basin study area with other areas in the state.

NEXT SECTION: Fish

Author

E. Wenner, SCDNR Marine Resources Research Institute

References

Bertness, M. D. and T. Miller. 1984. The distribution and dynamics of *Uca pugnax* (Smith) burrows in a New England salt marsh. Journal of Experimental Marine Biology and Ecology 83:211-237.

Boylan, J. M. and E. L. Wenner. 1993. Settlement of brachyuran megalopae in a South Carolina, USA, estuary. Marine Ecology - Progress Series 97:237-246.

Coull, B. C. and S. S. Bell. 1983. Biotic assemblages: Populations and communities. p. 283-319. *In*: F. J. Vernberg and W. B. Vernberg (eds.). The biology of Crustacea. Vol. 7: Behavior and ecology. Academic Press, New York, NY.

Farmer, C. H. III, J. D. Whitaker, and N. L. Chipley. 1978. Pilot study to determine the overwintering patterns of white shrimp. SC Marine Resources Division.

Field, J. G. 1983. Flow patterns of energy and matter. p. 758-785. *In*: O. Kinne (ed.). Marine Ecology. Vol. V: Ocean Management, Part 2: Ecosystems and Organic Resources. John Wiley and Sons, New York, NY.

Grant, J. and J. McDonald. 1979. Dessication tolerance of *Eurypanopeus depressus* (Smith) (Decapoda: Xanthidae) and the exploitation of microhabitat. Estuaries 2(3):172-177.

Klemanowicz, K. J. 1985. Effects of a mechanical oyster harvester on macrofaunal community structure. M.S. Thesis. College of Charleston, Charleston, SC.

Kneib, R. T. 1984. Patterns of invertebrate distribution and abundance in the intertidal salt marsh: Causes and questions. Estuaries 7:392-412.

Kneib, R. T. and S. L. Wagner. 1994. Nekton use of vegetated marsh habitat at different stages of tidal inundation. Marine Ecology Progress Series 106:227-238.

Knott, D. M., E. L. Wenner, and P. H. Wendt. 1997. Effects of pipeline construction on the vegetation and macrofauna of two South Carolina, USA salt marshes. Wetlands 17(1):65-81.

Mense, D. J. and E. L. Wenner. 1989. Distribution and abundance of early life history stages of the blue crab, *Callinectes sapidus*, in tidal marsh creeks near Charleston, SC. Estuaries 12(3):157-168.

Moore, R. H. 1992. Low-salinity backbays and lagoons. p. 541-614. In: C. T. Hackney, S. M. Adams, and W. H. Martin (eds.). Biodiversity of the Southeastern United States: Aquatic communities. John Wiley and Sons Inc., New York, NY.

Odum, W. E., T. J. Smith III, J. K. Hoover, and C. C. McIvor. 1984. Ecology of tidal freshwater marshes of the United States east coast: A community profile. Biological Service Program, Fish and Wildlife Service.

Odum, W. E. 1988. Comparative ecology of tidal freshwater and salt marshes. Annual Review of Ecological Systems 19:147-176.

Olmi, E. J. III. 1986. Recruitment patterns of selected decapod crustaceans. p. 303-360. *In*:

M. R. DeVoe and D. S. Baughman (eds.). South Carolina Coastal Wetland Impoundments: Ecological Characterization, Management, Status and Use. Vol. II: Technical Synthesis. Publication No. SL-SG-TR-82-2. South Carolina Sea Grant Consortium, Charleston, SC.

Rozas, L.P. and C. Hackney 1983. The importance of oligohaline estuarine wetland habitats to fisheries resources. Wetlands 3:77-89.

Rozas, L.P. and C. Hanckney 1984. Use of oligohaline marshes by fishes and macrofaunal crustaceans in North Carolina. Estuaries 7:213-224.

South Atlantic Fishery Management Council. 1981. Profile of the penaeid shrimp fishery in the South Atlantic. Charleston, SC.

Struhsaker, P. 1969. Demersal fish resources: Composition, distribution and commercial potential of the continental shelf stocks off southeastern United States. Fishery Industrial Research Report No. 4. Bureau of Commercial Fisheries, U.S. Fish and Wildlife Service, Washington, DC.

Vernberg. F.J. and C.E. Sansbury. 1972. Studies on salt marsh invertebrates of Port Royal Sound. *In*: South Carolina Water Resources Commission (ed.). Port Royal Sound environmental study. South Carolina Water Resources Commission, Columbia, SC.

Weinstein, M. P. 1979. Shallow marsh habitats as primary nurseries for fishes and shellfish, Cape Fear River, North Carolina. Fishery Bulletin 77:339-358.

Wenner, E. L. 1986. Decapod crustacean community. p. 361-406. *In*: M. R. DeVoe and D. S. Baughman (eds.). South Carolina Coastal Wetland Impoundments: Ecological Characterization, Management, Status and Use. Vol. II: Technical Synthesis. Publication No. SL-SG-TR-82-2. South Carolina Sea Grant Consortium, Charleston, SC.

Wenner, E. L. and H. R. Beatty. 1993. Utilization of shallow estuarine habitats in South Carolina, USA, by postlarval and juvenile stages of *Penaeus* spp. (Decapoda: Penaeidae). Journal of Crustacean Biology 13:280-295.

Wenner, E. L. and T. H. Read. 1981. Distribution and assemblages of decapod crustaceans from the continental shelf of the South Atlantic Bight: 1977-79 MARMAP investigations. SC Marine Resources Center Technical Report No. 49.

Wenner, E. L. and T. H. Read. 1982. Seasonal composition and abundance of decapod crustacean assemblages from the South Atlantic Bight, USA. Bulletin of Marine Science 32(1):181-206.

Wenner, E. L. and C. A. Wenner. 1988. Seasonal composition and abundance of decapod and stomatopod crustaceans form coastal habitats, southeastern United States. Fishery Bulletin 87:155-176.

Wenner, E. L., J. Archambault, and J. Boylan. 1990. Recruitment of fishes and decapod crustaceans into nursery habitats. *In*: R. Van Dolah, P. H. Wendt, and E. L. Wenner (eds.). A physical and ecological characterization of the Charleston Harbor estuarine system. Final Report to SC Coastal Council.

Wenner, E. L. , W. P. Coon III, P. A. Sandifer, and M. H. Shealy, Jr. 1991. A comparison of species composition and abundance of decapod crustaceans and fishes from the North and South Edisto Rivers in South Carolina. South Carolina Marine Resources Division Technical Report No. 78.

Wenner, E., H. R. Beatty, and L. Coen. 1996. A method for quantitatively sampling nekton on intertidal oyster reefs. Journal of Shellfish Research 15(3):769-775.

Welsh, B. L. 1975. The role of grass shrimp, *Palaemonetes pugio*, in a tidal marsh ecosystem. Ecology 56:513-530.

MENU

Introduction

Freshwater Fish

Anadromous Fish

Estuarine Fish

Coastal Marine Fish

Fish Habitat

Conclusion

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Fish

Introduction

The fish communities of the ACE Basin study area consist of diverse assemblages of freshwater, estuarine and coastal marine species. Species assemblages are generally associated with physical characteristics in the aquatic ecosystem, such as salinity, vegetation and bottom substrate. Many of the fish species that characterize these communities move in response to environmental cues. Their reaction to cues may also change with growth and development so that few species mature in the area in which they were spawned. Thus, occurrence within a habitat or salinity regime may change with life history stage or season, making a static description of the fish community difficult to obtain.

American eel

Freshwater fishes occupy the uppermost portions of rivers in the ACE Basin study area, occurring from the tidal freshwater zone into nontidal freshwater areas. The physical process of tidal flushing enables mixing of some estuarine species with freshwater species tolerant of brackish water, thereby creating a dynamic and diverse community. Above the influence of the tide in the blackwater areas of rivers, true freshwater resident species, who cannot tolerate intrusion of salt water, occur along with anadromous species who migrate from oceanic to freshwater areas to spawn. The catadromous American eel (*Anguilla rostrata*), which travels from freshwater to the ocean for spawning, may also inhabit tidal and nontidal freshwater areas.

Estuarine fishes typically are euryhaline, inhabiting waters with salinities of 0-30 ‰. Given their ability to withstand broad changes in salinity, estuarine fishes are widespread in the ACE Basin study area. Based on salinity regime, it is possible to delineate four broad salinity zones within the estuary : oligohaline (0.5-5 ‰), mesohaline (5-18 ‰), polyhaline (18-30 ‰) and euhaline (> 30 ‰). These zones may be characterized by fish assemblages that vary, depending on season and age.

Coastal marine fishes spend much of their lives in coastal or oceanic waters where salinity exceeds 30 ‰. Spawning generally occurs offshore with eggs, larvae or early juveniles depending on tidal and wind-driven currents for transport to estuarine nursery areas. Many of the coastal marine fishes migrate into estuarine waters, depending upon seasonal changes in water temperature.

Back to Top

Freshwater Fish Community

Blackwater Stream

Numerous surveys have been conducted over the years to determine fish composition in the upstream portions of the ACE Basin study area. Freshwater communities were described by Anderson (1964) and Bayless (1968) while anadromous species were studied by Wade (1971, 1972) and White (1969, 1970). Surveys of freshwater streams that were three miles or longer in length were conducted between 1974 and 1981 by the South Carolina Department of Natural Resources (SCDNR) to determine species composition (Marcy and O'Brien-White 1995). In recent years, research emphasis has been placed on characterizing the status of the fisheries resources and the structure and composition of the fish community in the Edisto River (Thomason et al. 1993) which is one of the most significant "blackwater streams" of the southeastern coastal plain (Marcy and O'Brien-White 1995). Rotenone and electrofishing are the most common survey methods used, although creel surveys are conducted annually to assess angler harvest. Rotenone is a chemical that interferes with oxygen uptake causing fish to move to the water surface. Potassium permanganate is used to detoxify rotenone below the sampling site. Electrofishing involves introduction of a pulsed direct current to the water that stuns the fish, causing it to swim erratically at the surface, thereby enabling capture. To date, 87 species from 25 families have been identified from the freshwater portion of the Edisto River Basin from all sampling efforts since 1964 (Species Count).

Sampling of riverine habitats using quarterly electrofishing and annual rotenone application resulted in the collection of 68 species of fish from seven portions of the Edisto River: the north fork above the City of Orangeburg (NF-A); the north fork below Orangeburg (NF-B); the south fork (SF); and the Edisto River main stem (MS) above the freshwater-saltwater line (Electrofishing sites) (Tomason et al. 1993). Three segments (NS-A, SF and MS) were further subdivided so that seven stream reaches were sampled in the survey (Electrofishing sample sites). Electrofishing sites were established in each stream reach while rotenone sampling was done on the major river segments. The species assemblage was diverse with the Cyprinidae (minnows and carps), Ictaluridae (bullheads and madtoms), Centrarchidae (sunfishes) and Percidae (darters) families containing the most species. Several euryhaline species, such as the sea lamprey (*Petromyzon marinus*), summer flounder (*Paralichthys dentatus*), southern flounder (*P. lethostigma*), spotfin mojarras (*Eucinostomus argenteus*), and striped mullet (*Mugil cephalus*), occurred in sampling of the lower reaches and occasionally the upper reaches of the Edisto River. Numerically dominant taxa in electrofishing samples were the carps, minnows, and sunfishes (Electrofish). These same taxa, with the addition of bullhead catfishes, were also numerically dominant in rotenone sampling (River Sampling). Bullheads, suckers, and sunfishes were the dominant fish groups, by weight, in rotenone collections and accounted for 79 to 91 % of total fish biomass at the stream reaches sampled. In contrast, bullheads were rarely collected by electrofishing and never exceeded 2% of the biomass. Spotted sucker (*Minytrema melanops*) contributed the most biomass in both the rotenone and electrofishing collections. Other dominant species by weight in rotenone and electrofishing collections were the bowfin (*Amia calva*), flat bullhead (*Ameiurus platycephalus*), largemouth bass (*Micropterus salmoides*), common carp (*Cyprinus carpio*), longnose gar (*Lepisosteus osseus*), and American eel (*Anguilla rostrata*). Redbreast sunfish (*Lepomis auritus*), which is an important recreational species, contributed 6 % of the total biomass. (See related section: Recreational Fisheries.)

The standing crop of fish, a measure of number or weight per unit area, in segments of the Edisto River sampled by rotenone was highly variable between years and sampling locations. Highest standing crop was 164 kg/ha (146 lbs/acre) at the south fork, while lowest was 43 kg/ha (38 lbs/acre) at the North Fork below Orangeburg.

Surveys (Tomason et al 1993, Marcy and O'Brien-White 1995) indicate that the Edisto is characterized by a diverse freshwater fish community. However, the fact that diversity is high but production is low, especially at the segment below Orangeburg, suggests that there may be impacts on the macroinvertebrate food base in the system. Most species in the freshwater fish community utilize the shallow, palustrine emergent wetlands as foraging areas. Plankton, crustaceans, aquatic insects and small fishes are preferred prey.

Clearcutting hardwood timber, heavy crop irrigation, and industrial/residential development which occur in the Edisto watershed can impact populations of biotic macroinvertebrate and fish communities in the ACE Basin study area. Cutting of bottomland hardwoods eliminates leaves and woody debris which are an important primary food source. Loss of canopy cover allows solar radiation to raise water temperature to high levels, especially in summer. Erosion and siltation resulting from logging operations can also have detrimental effects on water quality.

Agricultural land on Donnelley Wildlife Management Area

Irrigation systems occur extensively in the Edisto watershed. These systems draw water from feeder streams which can be rapidly depleted during droughts. This results in loss of habitat and drastic water level reductions in the river. The natural flood cycle of the river can also affect the fish community since floods make additional habitat available for spawning and larval/juvenile stages. Thus, discharge history and duration of drought periods are important considerations when assessing fish production in the rivers of the ACE Basin study area

(Thomason et al. 1993).

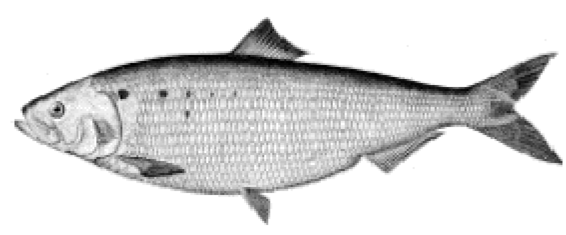
Water levels are also reduced by industries located in the watershed. Addition of effluents and thermal impacts may be a source of water quality degradation. Residential development can contribute to habitat degradation by removing it and introducing pollutants.

The introduction of the non-endemic flathead catfish to the Edisto River has had a profound effect on the resident fish community. The flathead catfish was introduced to South Carolina waters in 1964 by the SC Wildlife and Marine Resources Department (SCWMRD currently SCDNR). The catfish was stocked into Lake Marion and Clarks Hill Lake to control the gizzard shad population and to add an additional sportfish to the Santee-Cooper Lake Systems. Through a SCWMRD comprehensive study of the Edisto River from 1988-1992, it was determined that flathead catfish had found their way into the Edisto River (Thomason et al. 1993). This introduction of flathead catfish into the Edisto River raised concerns about possible impacts on redbreast sunfish and other native fishes. An SCDNR study conducted from 1996-1997 sampled areas from both the main branch and the forks of the Edisto River to assess the flathead catfish population (Allen 1997). This study determined that flathead catfish are evenly distributed throughout the mainstem of the Edisto River but have not yet colonized either fork in significant densities. The study also reported that the abundance of the native bullhead catfish is dramatically reduced in areas where flatheads are abundant. Populations of the sportfish, redbreasted sunfish, have also been depleted by the presence of flathead catfish in the Edisto River. As the number of flathead catfish increases, certain native species appear to decline in abundance. This can lead to a significant alteration of the fish community in the Edisto River and possibly other areas of the ACE Basin.

Back to Top

Anadromous Fish Community

- Striped Bass
- Sturgeon
- Shad



American shad *Alosa sapidissima*

Anadromous fish species reported in the ACE Basin study area include the American shad (*Alosa sapidissima*); hickory shad (*Alosa mediocris*); blueback herring (*Alosa aestivalis*); striped bass (*Morone saxatilis*); Atlantic sturgeon (*Acipenser oxyrhynchus*); and shortnose sturgeon (*Acipenser brevirostrum*), an endangered species (White 1969 1970, Curtis 1970). All of these species, except shortnose sturgeon, are transients that travel from the coastal marine environment, through estuaries, to riverine areas during spawning migrations. Juveniles of anadromous species utilize estuaries as nursery grounds, but most of their lives are spent in coastal marine waters. American shad, striped bass, and Atlantic sturgeon are the only anadromous species to ascend the Ashepoo River (White 1970). Shad reportedly ascend the Ashepoo to the vicinity of Walterboro (Walburg and Nichols 1967), although a decrease in stream size may impair movement in the area above the SC Highway 64 bridge (Ashepoo River). Neither striped bass nor Atlantic sturgeon were reported to be abundant in the Ashepoo (White 1970). Among anadromous fishes in the Edisto River, American shad was the dominant species (White 1969). Shad were reported to ascend the north fork no further than

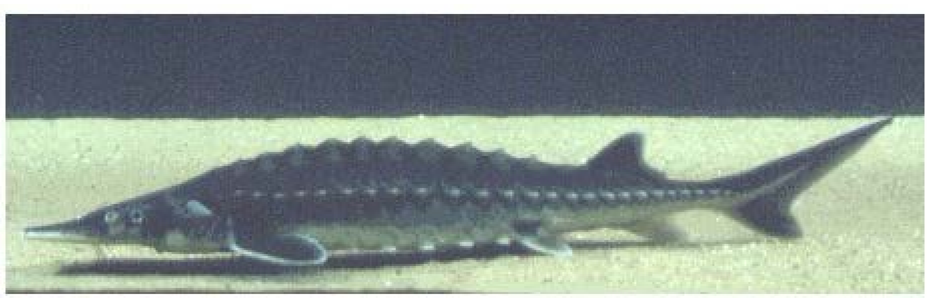
US Highway 301 near Orangeburg, and they ascended the south fork no further than Highway 321 near Denmark. Atlantic sturgeon, hickory shad, and striped bass were not abundant in the Edisto. Blueback herring were limited in their distribution in the River, and were not collected further upstream than near the US Highway 17 bridge at Jacksonboro (Edisto map ) (White 1969). In the Combahee River, striped bass and American shad were the only anadromous species reported by Curtis (1970).

Striped Bass

Striped bass *(Morone saxatilis)*

South of North Carolina, striped bass adults are not highly migratory and generally remain in the vicinity of their natal streams. Rulifson et al. (1982) noted that striped bass occur in all three rivers of the ACE Basin study area and that native stocks are believed to be endemic to each river system. Recent tagging and genetic studies have confirmed that striped bass generally remain in their river of birth and, therefore, the populations within each river have the potential to acquire distinct local genetic adaptations. These adaptations equip the local population with genetic traits that are specific to a particular habitat and can increase the long-term fitness of the population. The possibility of genetically distinct populations of striped bass in the rivers of the ACE Basin study area has lead the SCDNR to adapt strict controls on hatchery management strategies. In addition, the SCDNR has recommended a decrease in the daily harvest on ACE Basin striped bass to no more than two fish, 26 inches or greater in length (SCDNR News 1998). Striped bass spawning areas are usually within 60 km (37 miles) of the coast and can occur in tidally-influenced freshwater areas. Spawning locations in the ACE Basin study area include the Combahee River between US 17 and 17-A bridges (See Striped bass spawn ) (South Atlantic Fishery Management Council 1998). Little is known about the distribution and movements of juveniles. They prefer clean sandy substrates but have been found over soft mud, gravel and rock bottoms. Juveniles occupy nursery areas downstream which may include tidal fresh and estuarine waters (South Atlantic Fishery Management Council 1998).

Sturgeon



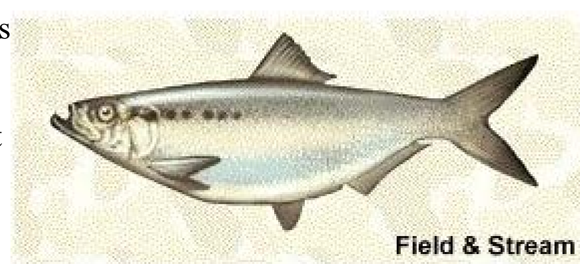
Shortnose sturgeon *(Acipenser brevirostrum)*

Atlantic sturgeon historically were the target of a significant commercial fishery along the East Coast. Stocks are now depressed throughout the range, with a moratorium on possession of the species in state waters (South Atlantic Fishery Management Council 1998). Based on the documented presence of either age 0 or age 1 juveniles and mature fish in spawning condition from 1993 to the present, populations of Atlantic sturgeon are thought to exist in the rivers of the ACE Basin study area. Atlantic sturgeon nursery areas in the Edisto River are broad, downstream reaches that are tidally influenced and have hard sand or shale substrates (South Atlantic Fishery Management Council 1998). Young sturgeon may spend several years in freshwater before migrating to sea. Historically, migration of Atlantic sturgeon occurred upstream as far as Stokes Bridge on the Edisto River and may have continued 100 miles or more upstream (Stokes Bridge). The Edisto River was historically identified as providing excellent habitat for sturgeon due to its water clarity and profusion of aquatic plants, crustaceans and molluscs. In 1998, the Sturgeon Project of the SCDNR observed Atlantic sturgeon as far upstream as the convergence of the north and south forks of the Edisto River (Bill Post, SCDNR, pers. comm.).

Shortnose sturgeon is a federally-listed endangered species that has been reported from the Ashepoo, Edisto, and Combahee Rivers. The species historically formed the basis of a valuable commercial fishery. Shortnose sturgeon spend most of the year in estuaries but ascend to freshwater portions of rivers to spawn in spring. They require large rivers unobstructed by dams or in which dams are located above their preferred spawning areas. Preferred spawning habitat is in flooded hardwood swamps along the inland portions of rivers. Adults typically occur in areas with little or no current. Juveniles occur at the saltwater/freshwater interface in most rivers, and the species is seldom found in shallow water. The shortnose sturgeon prefers lower salinity areas than Atlantic sturgeon; and where the two species co-occur, shortnose sturgeon are found in waters < 3 ‰ (South Atlantic Fishery Management Council 1998).

Shad

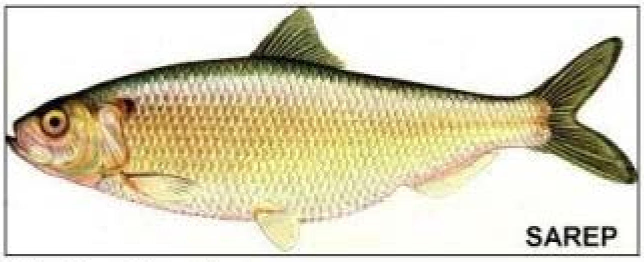
The American shad is an abundant anadromous species in the ACE Basin study area, although population declines have been noted in recent years. The shad stocks of the Edisto River have been reported to be in general decline when compared to other river systems in South Carolina and to its historical populations levels (McCord and Ulrich, unpublished report). Spawning occurs in inland portions of coastal rivers, generally in shallow areas dominated by sand or gravel and current velocities of 30.5 to 91.4 cm/sec (12 to 36 inches/sec) (South Atlantic Fishery Management Council 1998). American shad are believed to enter their natal streams to spawn. Most shad die after spawning, although repeat spawners have been documented. Juvenile shad are euryhaline and can use both fresh and saline estuarine nursery areas. Juveniles leave the estuary when water temperature drops below 15.5 C. They then migrate north to the Gulf of Maine in summer and travel south to waters off the mid-Atlantic states the following winter.



Hickory shad

Hickory shad have been reported from all rivers of the ACE Basin study area but information on location of major spawning sites is sparse. Studies in North Carolina and Georgia suggest that the species may prefer tributary streams and flooded back swamps, rather than spawning in the main river channel. The distribution and migration route of hickory shad once they move to oceanic waters is not well known. Occurrence of individuals along the coast of New England in summer suggests that they may migrate in a pattern similar to American shad (South Atlantic Fishery Management Council 1998).

Blueback herring is the most abundant



Blueback herring

anadromous species in South Carolina and occurs in all three major rivers of the ACE Basin study area. It is an important prey species for striped bass, weakfish and blue fish, forming a vital link between zooplankton, which it consumes, and top predators. The species requires coastal rivers and associated palustrine forested and aquatic wetland habitats, downstream estuaries, and the oceanic environment for completion of its life cycle (South Atlantic Fishery Management Council 1998). Blueback herring prefer spawning sites with fast currents, although they frequently occur in flooded back swamps and spawn among aquatic vegetation. Larvae prefer upstream areas with salinity <12 ‰, and juveniles will begin a downstream migration in fall. Little is known of their movements once emigration to the sea occurs. Blueback herring are highly tolerant of salinity changes, and can move from freshwater to saltwater with no harmful effects.

Back to Top

Estuarine Fish Community

Estuarine portions of the ACE Basin study area and adjacent rivers have been sampled over the past 30 years. Survey trawling was conducted by the Bears Bluff Laboratory on Wadmalaw Island during the 1960s that encompassed the area from Price Inlet to Calibogue Sound. Trawling in the North and South Edisto Rivers was also conducted as part of a statewide survey of South Carolina's estuaries from 1973 to 1977 (Wenner et al. 1991). In 1993, a long-term trawl survey was initiated to determine species composition of fishes and decapod crustaceans along the salinity gradient of the three major rivers in the ACE Basin study area (E. Wenner et al., unpublished). Species composition in the South Edisto River was determined during 1987-88 using rotenone sampling. Trammel nets were used during 1994-1997 to sample shallow water habitats of the major rivers in the Basin (C. Wenner et al. unpublished). Little information is available on the fish community that inhabits the marsh surface or estuarine impoundments in the ACE Basin study area. Miglarese and Sandifer (1982) presented a list of fish species that occur in impoundments on nearby Wadmalaw Island. The most comprehensive treatment of fishes from these shallow estuarine habitats, however, was provided by Wenner et al. (1986) from a study in the Santee delta.

Back to Top

Coastal Marine Fish Community

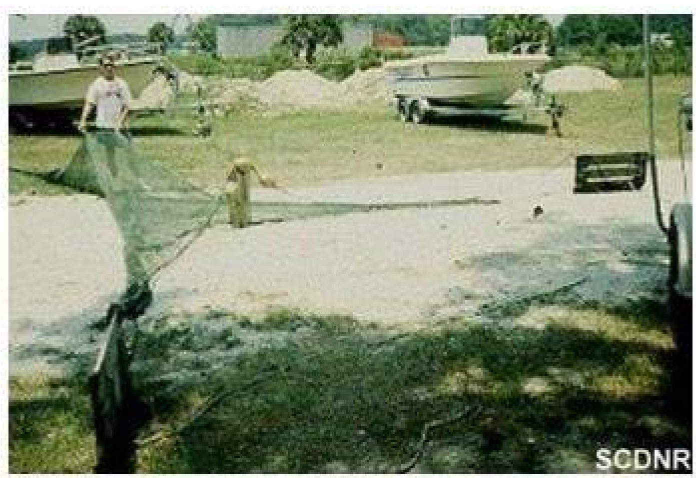
The coastal habitat off South Carolina ranges from the beaches seaward 15 to 25 km (9 to 15 miles) where depths are about 9 to 18 m (30 to 59 feet) (Beatty and Boylan 1997). The sea bottom of the coastal habitat is mostly homogeneous consisting of a sand, mud and shell mixture. Rock bottom areas, often called "live bottom" because of attached benthic invertebrates and algae, are patchily distributed in the coastal habitat. Fishes which occur in the coastal zone consist of year-round residents and migrant species who are in transit to or from spawning grounds or are using the coastal zone as spawning grounds (Wenner and Sedberry 1989, Beatty and Boylan 1997).

Species composition, abundance and biomass has been investigated in the coastal zone of the South Atlantic Bight from Cape Hatteras, North Carolina to Cape Canaveral, Florida. Fishes from the surf zone at Folly Beach, South Carolina were documented by Anderson et al. (1977) and Delancey (1984). Both studies collected species typical of the sandy beach nearshore habitat with bay anchovy (*Anchoa mitchilli*), Gulf whiting (*Menticirrhus littoralis*), white mullet (*Mugil curema*), pompano (*Trachinotus carolinus*), and Atlantic silverside (*Menidia menidia*) being numerically dominant. Wenner and Sedberry (1989) found that members of the sciaenid (drum) family made up 56% of the abundance and 66% of the biomass in their trawl collections between Cape Fear, North Carolina and the St. John's River, Florida. Spot (*Leiostomus xanthurus*) and Atlantic croaker (*Micropogonias undulatus*) were the two most abundant species collected, dominating catches during all seasons. Atlantic menhaden (*Brevoortia tyrannus*) were also abundant, but only in winter and spring. Spot, croaker and southern kingfish (*Menticirrhus americanus*) were important contributors to total finfish biomass. Overall, seven of the top 25 species by numbers and weight were members of the sciaenid family, a pattern that was consistent among seasons. Patterns of biomass, abundance, and community structure were found to reflect the seasonal migration patterns of the dominant species, as well as recruitment of juveniles to the coastal inshore nursery area (Wenner and Sedberry 1989).

An ongoing survey of fishes in the nearshore coastal zone by the Southeast Area Monitoring and Assessment Program (SEAMAP) program indicates numerical dominance by a number of species that occur within the estuaries of the ACE Basin during part of their life cycle. SEAMAP is a state-federal cooperative program that trawls in depth strata of 15-30 ft. and 30- 60 ft. from Cape Hatteras, N.C. to Cape Canaveral, FL (See map of Seamap stations). Since 1989, collections have been largely dominated by spot and Atlantic croaker, two of the common estuarine transient species found in trawl surveys of the ACE Basin study area (SEAMAP trawl data). Other species of numerical importance have been the Atlantic bumper (*Chloroscombrus chrysurus*), the striped anchovy (*Anchoa hepsetus*), the star drum (*Stellifer lanceolatus*), scup (*Stenotomus* spp.) and pinfish (*Lagodon rhomboides*). The fish community from the coastal zone appears to be dominated by sciaenid fishes, many of whom utilize estuaries for some part of their life cycle.

Back to Top

Fish Habitat



Otter trawl net

Subtidal Habitats

Regular surveys of the estuarine subtidal fish community in the ACE Basin study area have been conducted for many years. Most studies of the community ecology and life history of fishes from subtidal estuarine habitats has been based on sampling with otter trawl. The relatively small, fine mesh bottom trawls used in estuarine studies are generally biased toward capture of small fish. Early surveys that included the ACE Basin study area were conducted by Bears Bluff Laboratories from 1953-1964 (Bears

Bluff Laboratories, Inc. 1964, 1965). Additional estuarine surveys by bottom trawl were conducted in the channels of the North and South Edisto Rivers during 1973-1975 (Shealy 1974, Shealy et al. 1975, Wenner et al. 1991). These surveys collected 80 species of fish from the North Edisto and 65 species from the South Edisto River. The North and South Edisto Rivers were found to be dominated by sciaenids (star drum *Stellifer lanceolatus*, Atlantic croaker *Micropogonias undulatus*, spot *Leiostomus xanthurus*, and weakfish *Cynoscion regalis*). The bay anchovy (*Anchoa mitchilli*), white catfish (*Ictalurus catus*), Atlantic bumper (*Chloroscombrus chrysurus*), Atlantic menhaden (*Brevoortia tyrannus*), hogchoker (*Trinectes maculatus*), and spotted hake (*Urophycis regia*) were also common (Wenner et al. 1991). These ten species accounted for >90% of the total number of individuals and >70% of the total fish biomass in both rivers. *Stellifer lanceolatus* was the most abundant species collected.

The North and South Edisto rivers differ in salinity structure and community composition. The North Edisto is a relatively high salinity homiohaline river with limited freshwater input. Because there is no distinct halocline, many of the same species occurred at all the stations sampled. The species assemblages of the North Edisto were composed of stenohaline marine species, such as the hake (*Urophycis floridana*), the goby (*Gobiesox strumosus*), and the black sea bass (*Centropristis striata*), which were seasonal in their occurrence; and euryhaline transients, such as star drum, spot, croaker, menhaden and weakfish, which were abundant but temporary inhabitants of the estuary as adults. Estuarine endemic species were not abundant or frequently collected. The occurrence of hard substrate and attached epifaunal invertebrates near the mouth of the North Edisto enhanced diversity of the fish community. Estuarine fishes often concentrate in areas where hard substrates support colonization by sessile invertebrates and associated prey organisms.

In contrast to the North Edisto, the faunal composition of the South Edisto River is controlled by salinity. There is a distinct salinity gradient in the South Edisto, and a change in faunal composition was noticeable between the limnetic up-estuary areas and the meso-euhaline areas of the river. In terms of species assemblages, the estuarine endemic species such as longnose gar (*Lepisosteus osseus*), white catfish (*Ictalurus catus*), and channel catfish (*Ictalurus punctatus*) were spatially separated from the euryhaline marine transients and the stenohaline marine species (Wenner et al. 1991). The poikilohaline nature of the South Edisto and its rather uniform sandy substrate increases the likelihood that assemblages are structured according to salinity.

In an effort to more fully understand the estuarine fish community of the ACE Basin study area, a long-term trawl survey of the three rivers was begun in 1993. Data from this continuing survey by staff of the ACE National Estuarine Research Reserve are presented here to assess temporal and spatial changes in species composition, diversity and biomass in the rivers.

Current ACE Basin study area surveys are performed monthly with a 20 ft. semi-balloon otter trawl at four fixed locations within each of the three major rivers (NERR trawl stations). The sites in the South Edisto are the same locations that were sampled during an intensive survey of that river from 1973-1975 (Wenner et al. 1991). These stations and those within the other rivers represent a gradient in salinity from polyhaline conditions near the mouth to oligohaline /limnetic conditions furthest upriver.

As of December 1997, a total of 54,714 individuals and 80 species of fish were collected by the survey (Trawl fish rank). The greatest number of species was recorded from the Ashepoo (68) and Edisto (67) Rivers, respectively, while the Combahee (49) yielded the fewest species. Within each river, the greatest number of species was recorded from stations nearest the mouth. These results are similar to those reported by Wenner et al. (1991) who noted that the occurrence of euryhaline transients and stenohaline species increased species richness in high salinity areas of South Carolina estuaries. With the exception of the Combahee, more individuals were collected at stations in the mesohaline region of the river than at the station nearest the mouth (Trawl Summary).

Salinity and temperature varied among stations and by season, with lowest salinities and water temperatures in January-February and highest salinities and temperatures in summer. Marked differences between salinities at trawl stations occurred primarily in the South Edisto (South Edisto Trawl). Station E001, at the mouth of the estuary, had the highest mean salinity (23.6 ‰) while the most upstream station (E019) had the lowest (0.6 ‰). Similarly, in the Ashepoo, station A001 had the highest mean salinity (20.9 ‰) and station A011 the lowest (6.2 ‰); however, there was considerable overlap in extremes of salinity at all stations in the Ashepoo (Ashepoo Trawl). The Combahee had mesohaline salinities at stations C001, C005 and C008. Station C013, furthest upriver, had the lowest average salinity (8.9 ‰) (Combahee Trawl).

The numerically dominant finfish species for all three rivers were star drum, Atlantic croaker , and bay anchovy. These species constituted >68% of the total number of individuals collected. Atlantic croaker, black cheek tonguefish (*Symphurus plagiusa*), southern flounder (*Paralichthys lethostigma*), and star drum were the top-ranked species in terms of weight. Atlantic croaker was the numerical dominant in the Ashepoo while star drum was dominant in the Combahee and South Edisto Rivers (Trawl species by river).

Seasonal changes in abundance, dominance and species diversity have been previously noted for the South Edisto by Wenner et al. (1991). In the current ACE Basin trawl survey, Atlantic croaker dominated collections in winter and spring, while star drum were numerically dominant in summer and fall. These results were similar to those reported by Wenner et al. (1991) for the South Edisto River.

Examination of the abundance of dominant finfish species revealed seasonal changes and spatial variation within each river. Star drum were most abundant at stations characterized as having mesohaline salinities (Star drum abundance). Stardrum were not present at station E019 in the South Edisto which experienced low salinities for much of the year. Although star drum were present in the ACE Basin study area throughout the year, they were most abundant from July through December. The size extremes of star drum collected by trawl indicates that young-of-the-year as well as one-year old fish are present in the system; however, average size of star drum (57 mm or 2.2 inches) suggests that the rivers are dominated by juveniles. Wenner et al. (1991) noted that star drum (< 80 mm or 3.1 inches) were present in the Edisto River throughout the year, with apparent recruitment of the smallest individuals (60-70 mm or 2.4-2.8 inches modal length) occurring during fall in the South Edisto.

Atlantic croaker were collected at all stations sampled but were generally most abundant in the mid-to-lower reaches of the rivers (Croaker abundance) . Although Atlantic croaker were collected year-round in the ACE Basin study area, abundance was greatest during March-July. Small Atlantic croaker (<40 mm or 1.6 inches) were reported by Wenner et al. (1991) to migrate to the South Edisto during fall and winter. Young-of-the-year croaker remain in estuaries throughout the summer, after which migration to the nearshore coastal zone occurs. The average size (57 mm or 2.2 inches) of croaker from trawl collections in the ACE Basin study area suggests that juveniles are utilizing the rivers as a nursery ground. The larger fish (110-190 mm or 4.3 to 7.5 inches) collected were most likely one-year-olds. Wenner et al. (1991) noted that yearlings are present in low numbers in the South Edisto and occur at stations nearest the mouth.

The bay anchovy occurred throughout the rivers of the ACE Basin study area but was most abundant at stations in the meso- polyhaline salinity range. Fewest bay anchovy were collected at the stations located furthest upriver (Anchovy abundance). Bay anchovy were present year-round, although highest catches occurred during November-December. The average size of bay anchovy (52 mm or 2.0 inches) suggests that young-of-the-year recruits dominate in the ACE Basin study area. Wenner et al. (1991) noted that peak spawning occurs during summer and that smaller fishes occur primarily during summer and fall.

The estuarine fish community as determined from trawl collections in the rivers of the ACE Basin study area appears to be dominated most of the year by star drum, Atlantic croaker, and bay anchovy. These species not only showed temporal regularity but were the most abundant species collected. Wenner et al. (1991) noted that stability of species composition and dominance hierarchy enable communities to rebound from short-term stresses. Although some competition for food undoubtedly occurs, preferences for different salinity regimes, substrates and bathymetric zones are adaptive means to reduce competition from co-occurring species.

Shallow Water Habitats

Salt marsh habitat

Shallow water estuarine habitats are extremely important in the life history of fishes. The shallow tidal creeks with their oyster bars, mud flats, intertidal rivulets, and marsh are the principal nursery area for fishes in the ACE Basin study area. These areas are where larvae of many fish species grow into juveniles before moving into deeper subtidal habitats in the estuary (Wenner, undated A). The high productivity of coastal marshes contributes to abundant food resources for finfish (Shenker and Dean 1979, Boesch and Turner 1984). The annual die-off of *Spartina* provides a rich source of organic material that is broken down by fungi and bacteria. The resulting detritus is consumed by small fishes and benthic invertebrates. These organisms, in turn, are consumed by larger predators who move into shallow habitats with the rising tide. Many fish species move onto the marsh surface to feed while others move to edges of the marsh and fringing oyster reefs to ambush prey (Wenner, undated). The shallow-water marsh and oyster reef habitats also serve as a refuge from predation by providing spatially complex habitat which predators have difficulty penetrating (Boesch and Turner 1984, Knott et al. 1996).(See related section: Decomposers: Tidal Salt Marshes.)

Tidal Creeks

Tidal creeks are a major feature of estuaries in the ACE Basin study area. Variable in size and water depth, they provide primary nursery habitat for larvae and juveniles of many fish species. At high tide when predators can access these creeks, juvenile fishes take advantage of the protection

Tidal creek

afforded by the marsh. As the tide ebbs and predators are forced to leave the shallow creeks, juveniles move off the marsh surface and concentrate in the creeks where their abundances can be quite high (Wenner, undated A).

In South Carolina estuaries, numerous studies have documented the utilization of saltmarsh creeks by larval and juveniles fish (Cain and Dean 1976, Shenker and Dean 1979, Bozeman and Dean 1980). Few published studies of shallow water finfish communities have been conducted in the ACE Basin study area. Shallow water creek habitats in the ACE Basin study area have been sampled by staff of the Inshore Recreational Finfish Section of the SCDNR Marine Resources Research Institute. Rotenone sampling was conducted monthly during 1987-1988 in a small tidal creek off St. Pierre Creek in the South Edisto River. Trammel nets were deployed monthly at stations in the South Edisto, Ashepoo and Combahee Rivers and at sites in Two Sister/Rock Creek from 1994-1997 (Trammel sites). Both methods provide an effective way to sample shallow habitats and to capture fast-moving as well as demersal species.

Rotenone sampling at St. Pierre Creek yielded a total of 39 taxa and 46,726 individuals. Over 75% of the total number collected consisted of spot (*Leiostomus xanthurus*) and menhaden (*Brevoortia tyrannus*) (Creek Rotenone). Dominant species by weight were the mullet (*Mugil cephalus*), silver perch (*Bairdiella chrysoura*), menhaden and spot.

Water temperature and salinity at the St. Pierre Creek site varied seasonally (St. Pierre temperature and salinity). Highest salinities occurred during summer. Faunal composition at the rotenone station also changed with season. Spring and summer collections yielded the most species while the greatest number of individuals was collected in spring and winter (Creek rotenone by season). Seasonal changes in community composition largely reflect seasonality in spawning and recruitment, both of which appear to be correlated with water temperature (Hoffman 1991). Spot accounted for over 88% of all individuals collected in winter and 37.8% of those collected in spring. Spot are one of the most abundant estuarine transient species and all life stages are found in estuaries (Beckman and Dean 1984). Studies in South Carolina indicate that spawning occurs offshore from late November to mid-February, after which they recruit to estuaries. Hoffman (1991) noted a peak in spot recruitment in January with a decline in abundance by April based on rotenone collections in shallow marsh habitats of Charleston Harbor. In addition to spot, menhaden dominated spring collections by constituting 47% of the total number of individuals. The abundance of this species in shallow marshes is a consequence of their need for low to moderate salinity habitats as juveniles (Hoffman 1991). The recruitment period for menhaden to South Carolina estuaries is between February and May (Bozeman and Dean 1980, Hoffman 1991).

Summer collections were dominated by the Atlantic silverside (*Menidia menidia*) (31%) and the mummichog (*Fundulus heteroclitus*) (21%). Atlantic silversides also accounted for 84% of the total number of individuals collected in fall. Hoffman (1991) found that silversides were common in summer and fall, with primary recruitment of young-of-the-year occurring from April to June and a second wave of recruitment occurring in October. The mummichog (*Fundulus heteroclitus*) is a common inhabitant of tidal creeks and can withstand extreme conditions. Hoffman (1991) found that the greatest abundance of mummichogs occurred in July in the Charleston Harbor system.

Trammel netting for finfish

Monthly trammel net collections in the ACE Basin study area from 1994-1997 resulted in capture of 10,728 individuals among 53 species (Trammel fish lengths). The number of species and individuals varied among rivers with the greatest number occurring at the Two Sisters site and fewest occurring in the Combahee (Trammel summary). Seasonal differences in number of species and individuals appeared to be related to water temperature, with greatest richness and abundance occurring during spring, summer and fall (Trammel by season). Water temperature was highest (>30° C) in July and August, while lowest temperatures generally occurred in January-February. Salinities generally ranged from >20 to <35 ‰ at all sites except the Combahee which experienced the lowest salinity with values seldom above 25 ‰ (Trammel temperature and salinity).

The spotted seatrout (*Cynoscion nebulosus*), striped mullet (*Mugil cephalus*), spot (*Leiostomus xanthurus*), hardhead catfish (*Ariopsis felis*), red drum (*Sciaenops ocellatus*), and southern flounder (*Paralichthys lethostigma*) were the most abundant species collected in tidal creeks and together constituted over 80% of the total number of individuals. Fall and winter catches were numerically dominated by spot and spotted seatrout, respectively, while hardhead catfish dominated catches in spring and summer.

Examination of the distribution of recreationally important species caught by trammel net revealed spatial and temporal patterns. Spotted seatrout were collected in every month at each of the sites; however, abundance was greatest at Two Sisters Creek in November-December (Mean abundance of seatrout in trammel net collection). Wenner (1997) found spotted seatrout to occur infrequently in trammel net collections from the North Edisto during winter and found catches to be highest in October. The tidal creeks are used as a nursery ground for young juveniles which occur in abundance in early fall. The abundance of juveniles declines as water temperatures cool so that few are caught in shallow water areas during the coldest months. During this period, seatrout move into the deeper water of the channels of the main rivers and their largest tributaries (Wenner and Archambault, undated).

Striped mullet were most abundant at the Two Sisters/Rock Creek site where they occurred year- round (Mean abundance of mullet in trammel net collection). Abundance was lowest during the colder months (January-March). Spawning is reported to occur between

November and January off the coast of Georgia (Anderson 1958) suggesting that fishes occurring in the ACE Basin study area during January are mostly young-of-the-year.

Spot were most abundant during the warmer months. Abundance increased in April and reached a peak in the ACE Basin shallow marsh areas during fall (Mean abundance of spot in trammel net collection). Along the southeastern US, spot have an extended spawning period with recruitment of larvae from winter to early spring. The primary nursery habitat for newly recruited spot is the shallow marshes where they first become abundant in April (Wenner et al. 1998). As indicated by trammel net collections, spot continue to utilize shallow estuarine waters of the ACE Basin study area well into the fall.

Red drum were found throughout the year in the ACE Basin tidal creeks but appeared to be most abundant in summer and fall, especially at Two Sisters/Rock Creek (Mean abundance of drum in trammel net collection). According to Wenner (not dated B), red drum juveniles move into tidal creeks in August and continue to enter the shallow nursery habitats through October. With the onset of cold weather and a decline in water temperature, juveniles depart the shallow creeks and most occur in the deeper water areas of the rivers during winter.

Southern flounder were especially abundant in trammel net collections from March-October (Mean abundance of flounder in trammel net collection).. Very few individuals were collected in winter. This estuarine transient species has been reported to utilize South Carolina estuaries throughout the year (Wenner et al. 1990), with January to April being the main recruitment period for young-of-the-year.

Marsh Surface

Salt marsh at high tide

The ACE Basin study area has broad expanses of salt marsh that, when flooded by tide, provide an important habitat for numerous fishes. Because structure and function of a salt marsh are influenced by tide, salinity, nutrients and temperature which can change rapidly over a period of hours, it is a stressful environment. Yet, saltmarsh habitats are among the most productive ecosystems on earth, providing a significant source of energy to the estuary and nearshore waters.

In South Carolina, the low marsh is intertidal and flooded twice daily at high tide. During spring tides which occur on the new and full moon, tidal amplitude increases, more of the marsh surface is flooded and water depth over the marsh increases (Wenner, undated A). Utilization of the low and high marsh by estuarine fishes thus varies with the tide and lunar phase.

Fishes which are found on the marsh surface include resident species such as killifish and gobies which seek refuge from predators among emergent vegetation. These fishes feed on small worms and crustaceans on the marsh during flood tide. They may remain on the marsh when the tide recedes, occupying water-filled depressions and potholes in order to avoid large predatory fish that are found in tidal creeks adjacent to the intertidal marsh. Jackson (1990) found that the killifishes, such as mummichogs, were the most successful at exploiting the high marsh habitat near Charleston, SC. The mummichog (*Fundulus* *heteroclitus*) ascend onto the high marsh with the rising tide to feed (Weisberg et al. 1981) and lay eggs (Kneib 1986).

Creek at low tide

Most fishes associated with the marsh surface are larval or juvenile stages of seasonal transients. Early life stages of spot were numerically dominant in samples of the marsh surface near Charleston (Jackson 1990). The flooded marsh may be a settling site for spot making the transition from pelagic larvae to demersal juveniles (Hettler 1989). Red drum is another sciaenid that can be found on the marsh surface, mostly actively feeding and using the marsh as a nursery area to avoid predators. Drum utilize the marsh surface during every season but feed most actively on the marsh from spring through fall (Wenner, undated B). Other species such as silver perch, southern founder, spotted sea trout and striped mullet take advantage of intertidal rivulets, which are gullies in the marsh surface, to gain access to vegetated areas on the more elevated portion of the marsh (Wenner, undated A). Movement via rivulets to the marsh surface appears to reduce predation on small fishes by excluding large predators from these shallow intertidal gullies and by enabling quick access to protective vegetation.

Impoundments

Impounded marshes which occur in the ACE Basin study area have been documented to provide habitat for larval and juvenile fishes (McGovern 1986, Wenner et al. 1986, McGovern and Wenner 1990). In a study of seasonal recruitment of fishes into impounded and non-impounded marshes near Georgetown, South Carolina, a total of 53,230 larval and juvenile fishes among 64 species was collected (McGovern and Wenner 1990). At times when flow rate through the water control structures was reduced, seasonal changes in species diversity were observed in the tidal creek but not the impoundments. Reduced water flow into impoundments resulted in reduced numbers or total absence of species such as spot, summer flounder, southern flounder, red drum, and spotted seatrout from impoundments, even though these species were abundant in the adjacent tidal creek. Impoundment collections were dominated by ladyfish (*Elops saurus*), inland silverside (*Menidia beryllina*), and striped mullet (*Mugil cephalus*). Reduction in abundance of estuarine transients in impoundments was attributed to lack of tidal exchange between impoundments and the creek during times when their seasonal abundance was high in the creek. Wenner et al. (1986) summarized the annual cycle of fishes in the impoundments as follows:

> **Spring** flooding of impoundments results in recruitment from the tidal creek of a core group of species (mosquitofish *Gambusia affinis*, inland silverside *M. beryllina*, striped mullet *M. cephalus*, naked goby *G. bosci*, sheepshead minnow *C. variegatus*, mummichog *F. heteroclitus*, sailfin molly *P. latipinna*, and rainwater killifish *L. parva*) as larvae or juveniles. Taxa in the Sciaenidae, Engraulidae, Sparidae, and Clupeidae are also recruited during flooding.

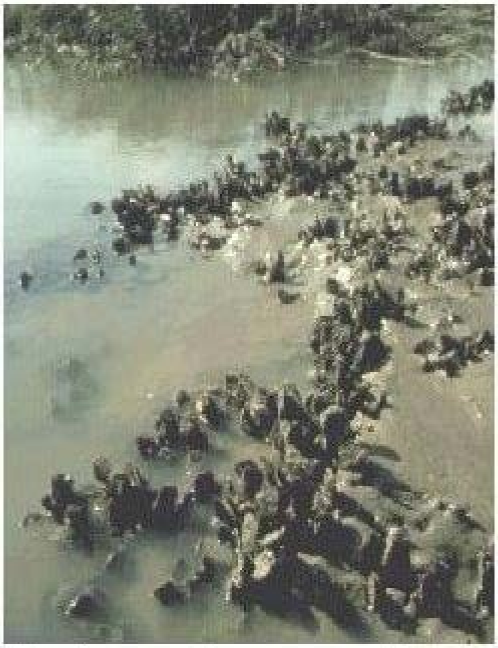
> **Summer** tidal exchange between the creek and impoundments results in ingress of lady fish (*Elops saurus*), tarpon (*Megalops atlanticus*), silver perch (*Bairdiella chrysoura*), and weakfish (*Cynoscion regalis*). As the water levels in the ponds rise,

the amount of tidal circulation decreases, thereby reducing larval recruitment from the creek.

Late summer reduction in tidal exchange, increased temperatures and low dissolved oxygen in the impoundments resulted in high mortality of estuarine transient species recruited earlier.

Fall and winter reductions in water level concentrate fishes in the perimeter ditches. Bird predation increases and temperature minima can stress species trapped in impoundments. The number of species decreases to minimum levels.

Oyster Reefs



Eastern oyster community *(Crassostrea virginica)*

In addition to tidal creek and marsh habitats, intertidal oyster reefs provide food and protection for numerous fish and macroinvertebrate species (Wenner et al. 1996). Fishes such as bay anchovy (*Anchoa mitchilli*), silversides (*Menidia* spp.), and killifishes (*Fundulus* spp.) are attracted to oyster reefs because of their complex three-dimensional structure. The reefs are also utilized by large predators such as spotted seatrout (*Cynoscion nebulosus*), red drum (*Sciaenops ocellatus*), summer flounder (*Paralichthys dentatus*) and sheepshead (*Archosargus probatocephaluss*). Juveniles of gag grouper (*Mycteroperca microlepis*) and snapper (*Lutjanus* spp.) were reported from oyster reefs in high salinity areas (Crabtree and Dean 1982). Gag grouper and sheepshead use the numerous spaces and crevices among the shells to hide from predators while feeding on benthic prey associated with the reef. Although there have been no investigations of the fish community associated with oyster reefs in the ACE Basin study area, many of the species reported by Wenner et al. (1996) for the Charleston area likely occur on these reef habitats in the ACE Basin study area as well (Oyster abundance). Of the 24 fish species collected, the bay anchovy, naked goby (*Gobiosoma bosci*), silverside, and spotfin mojarra (*Eucinostomus argenteus*) were the most abundant species. While these were the most numerous species found on the reef, there were many other species that utilize the reef and are important components of the fish community.

Back to Top

Conclusion

The extensive aquatic habitats of the ACE Basin study area that are used for spawning, nursery and foraging areas support and maintain many fish populations (Beasley et al. 1996). Limited development in the ACE Basin study area contributes to the health of fish populations by decreasing impacts on water quality, hydrology and vegetation. Because of dependence by fishes on the tidal wetlands in the ACE Basin as a source of food and protection from predators, it is essential that these areas remain intact. Disturbance of habitat will impact the community dynamics, resulting in decreased utilization by species and, in some cases, avoidance of the area. Habitats at risk from land-based impacts included oyster reefs, mudflats, and emergent tidal marshes. Direct destruction as well as degradation of water quality or hydrologic modifications can also affect habitat quality (South Atlantic Fishery Management Council 1998). In the ACE Basin study area, the major sources of land- based impacts include agriculture, silviculture, and residential or commercial development.

In areas where development, agriculture, and forestry occur, runoff can contribute pollutants that negatively impact fishes. The effect of increased volumes of chemical pollutants to surface waters is often insidious and can result in changes in community composition as well as declines in abundance of certain species over time. The effects may occur at rudimentary levels of trophic and ecological associations in key habitats (South Atlantic Fishery Management Council 1998, Scott et al. 1997). Improved management of existing habitats as well as restoration of impacted areas holds promise for maintaining integrity of fish communities. The integrity of vegetative buffers is an important aspect of habitat management in the ACE Basin study area because these buffer zones filter run-off of sediments and pollutants. In freshwater areas, riparian buffers also provide habitat for spawning and nursery function. Techniques that clean up, restore or create productive nursery habitat hold promise in assuring persistence of fish communities in the ACE Basin study area and southeast region.

Although habitat alteration is thought to have a substantial effect on fisheries production, it is difficult to quantify the relationship. Turner and Boesch (1987) showed that losses of shrimp stocks resulted from wetland losses, while increasing stocks occurred with increases in wetland acreage. It is likely that fish stocks would follow a similar trend. As the linkage between anthropogenic impacts and declining fish abundance, health and quality becomes clearer, the implications of increased population growth in areas surrounding the ACE Basin study area raise concerns. Because the southeast coastal zone is one of the nation's fastest growing regions, it is especially critical that monitoring of fishes that are dependent on rivers and estuaries for their survival continue. It is also important that effects at the population and community level be linked to physical and hydrologic alterations as well as water quality modifications.

NEXT SECTION: Herpetofauna

Author

E. Wenner, SCDNR Marine Resources Research Institute

References

Allen, D. E. 1997. Flathead catfish investigations in the Edisto River. Fisheries Investigations in Lakes and Streams - Freshwater Fisheries District VI. Job Progress Report, Project No. F-63-2-6.

Anderson, W. D., Jr. 1964. Fishes of some South Carolina coastal plain streams. Quarterly Journal of Florida Academy of Science 27(1):53.

Anderson, W. D., J. K. Dias, D. M. Cupka, and N. A. Chamberlain. 1977. The macrofauna of the surf zone off Folly Beach, South Carolina. U.S. Department of Commerce, NOAA Technical Report NMFS SSRF-704.

Anderson, W. W. 1958. Larval development, growth, and spawning of striped mullet (*Mugil cephalus*) along the south Atlantic coast of the United States. Fishery Bulletin 58:501-519.

Bayless, J. D. 1968. Survey and classification of the Edisto River and tributaries, South Carolina. SC. Wildlife and Marine Resources Department Report, Columbia, SC.

Bears Bluff Laboratories. 1964. Biological studies of Charleston Harbor, SC., and the Santee River. Submitted to U.S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife Contract No. 14- 16-0004-1024. Bears Bluff Laboratories, Wadmalaw Island, SC.

Bears Bluff Laboratories. 1965. Biological studies of Price Inlet area from Charleston Harbor to Bulls Bay, SC. Bears Bluff Laboratories, Wadmalaw Island, SC.

Beasley, B. R., W. D. Marshall, A. H. Miglarese, J. D. Scurry, C. Vanden Houten. 1996. Managing resources for a sustainable future: The Edisto River Basin project report. South Carolina Department of Natural Resources, Water Resources Division. Report 12.

Beatty, H. R. and J. M. Boylan. 1997. Results of the southeast area monitoring and assessment program-South Atlantic (SEAMAP-SA) nearshore, day/night trawl sampling in the coastal habitat of the South Atlantic Bight during 1987 and 1988. Atlantic States Marine Fisheries Commission Special Report 65.

Beckman, D. W. and J. M. Dean. 1984. The age and growth of young-of-the-year spot *Leiostomus xanthurus* (Lacepede) in South Carolina. Estuaries 7(4B):487-496.

Boesch, D. F. and R. E. Turner. 1984. Dependence of fishery species on salt marshes: the role of food and refuge. Estuaries 7(4):460-468.

Bozeman, E. L., Jr. and J. M. Dean. 1980. The abundance of estuarine larval and juvenile fish in a South Carolina intertidal creek. Estuaries 3(2):89-97.

Cain, R. L. and J. M. Dean. 1976. The annual occurrence, abundance, and diversity of fishes in a South Carolina intertidal creek. Marine Biology 36:369-379.

Crabtree, R. E. and J. M. Dean. 1982. The structure of two South Carolina estuarine tide pool fish assemblages. Estuaries 5(2):2-9.

Curtis, T. S. 1970. Anadromous fish survey of the Combahee River watershed. Project AFS2-4. South Carolina Wildlife Resources Department, Columbia, SC.

Delancey, L. B. 1984. An ecological study of the surf zone at Folly Beach, South Carolina. M.S. Thesis. College of Charleston, Charleston, SC.

Hettler, W. F., Jr. 1989. Nekton use of regularly-flooded saltmarsh cordgrass habitat in North Carolina, USA. Marine Ecology - Progress Series 56:111-118.

Hoffman, W. F. 1991. Temporal and spatial distribution of ichthyofauna inhabiting the shallow marsh habitat of the Charleston Harbor Estuary. M.S. Thesis. College of Charleston, Charleston, SC.

Jackson, C. D. 1990. Recruitment of fish larvae to shallow estuarine habitats along a salinity gradient. M.S. Thesis, College of Charleston, Charleston, SC.

Kneib, R. T. 1986. Size-specific patterns in the reproductive cycle of the killifish, *Fundulus heteroclitus*, (Pisces: Fundulidae) from Sapelo Island, Georgia. Copeia 2:342-351.

Knott, D. M., E. L. Wenner, and P. H. Wendt. 1996. Effects of pipeline construction on the vegetation and macrofauna of two South Carolina, USA salt marshes. Wetlands 17(1):65-81.

Marcy, B. C. Jr. and S.K. O'Brien-White (eds.). 1995. Fishes of the Edisto River Basin, South Carolina. Edisto River Basin Project Report 6, SC Department of Natural Resources, Water Resources Division, Columbia, SC.

McGovern, J. C. 1986. Seasonal recruitment of larval and juvenile fishes into impounded and non-impounded marshes. M.S. Thesis. College of Charleston, Charleston, SC.

McGovern, J. C. and C. A. Wenner. 1990. Seasonal recruitment of larval and juvenile fishes into impounded and non-impounded marshes. Wetlands 10(2):203-221.

Miglarese, J. V. and P. A. Sandifer. 1982. An ecological characterization of South Carolina wetland impoundments. SC Marine Resources Center Technical Report No. 51.

Rulifson, R. G., M. T. Huish, and R. W. Thoesen. 1982. Anadromous fish in the Southeastern United States and recommendations for development of a management plan. U.S. Fish and Wildlife Service, Fishery Resources, Region 4, Atlanta, GA.

SCDNR News 1998. News Release #98-168.

Scott, G. I., M. H. Fulton, J. Kucklick, T. Siewicki, T. Shearer, F. Holland, T. Chandler, and D. Porter. 1997. Chemical contaminants in the South Atlantic Bight: A myriad of contaminants - which ones count? p. 36-37. *In*: G. S. Kleppel and M. R. DeVoe (eds.). The South Atlantic Bight Land Use - Coastal Ecosystem Study (LU-CES). Report of a planning workshop. University of Georgia Sea Grant Program and South Carolina Sea Grant Program. Charleston, SC.

Shealy, M. H. Jr. 1974. Bottom trawl data from South Carolina estuarine survey cruises, 1973. SC Marine Resources Center Data Report No. 1.

Shealy, M. H. Jr., J. V. Miglarese, and E. B. Joseph. 1975. Bottom fishes of South Carolina estuaries: Relative abundance, seasonal distribution and length-frequency relationships. SC Marine Resources Center Technical Report No. 6.

Shenker, J. M. and J. M. Dean. 1979. The utilization of an intertidal salt marsh creek by larval and juvenile fishes: abundance, diversity, and temporal variation. Estuaries 2(3):154-163.

South Atlantic Fishery Management Council. 1998. Habitat plan for the South Atlantic Region: Essential fish habitat requirements for fishery management plans of the South Atlantic Fishery Management Council. Public Hearing Draft.

Thomason, C. S., D. E. Allen, and J. S. Crane. 1993. A fisheries study of the Edisto River. Wallop-Breaux Projects F-30 and F-32. SC Wildlife and Marine Resources Department, Columbia, SC.

Turner, R. E. and D. F. Boesch. 1987. Aquatic animal production and wetland relationships: Insights gleaned following wetland loss or gain. *In*: D. D. Hook et al. (eds.). The ecology and management of wetlands. Vol. 1: Ecology of wetlands. Timber Press, Portland, OR.

Wade, C. W. 1971. Commercial anadromous fishery, Edisto River, South Carolina. Annual Progress Report Project AFC-4-1. SC Wildlife and Marine Resources Department, Division of Game and Freshwater Fisheries, Columbia, SC.

Wade, C. W. 1972. Commercial anadromous fishery, Edisto River, South Carolina. Annual Progress Report, SC Wildlife and Marine Resources Department, Division of Game Freshwater Fisheries, Columbia, SC.

Walburg, C.H. and P.R. Nichols. 1967. Biology and management of the American shad and status of the fisheries, Atlantic coast of the United States, 1960. Special Scientific Report - Fisheries No. 550. U.S. Department of Interior, Fish and Wildlife Service, Washington, DC.

Weisberg, S. B., R. Whalen, and V. A. Lotrich. 1981. Tidal and diurnal influence on food consumption of a salt marsh killifish *Fundulus heteroclitus*. Marine Biology 61:243-246.

Wenner, C. A. 1997. Fishes in the shallows of the Charleston Harbor estuarine system as determined from stratified random trammel net collections. Final report to Charleston Harbor Project. SC Department of Natural Resources.

Wenner, C. A. Not dated A. The importance of the estuarine shallows. Charleston Harbor Project Publication, Grant #NA77OZ0124. Charleston, SC.

Wenner, C. A. Not dated B. Red drum: Natural history and fishing techniques in South Carolina. Educational Report No. 17. Marine Resources Division, SC Department of Natural Resources, Charleston, SC.

Wenner, C. A. and J. Archambault. Not dated. Spotted seatrout: Natural history and fishing techniques in South Carolina. Educational Report No. 18. Marine Resources Division, SC Department of Natural Resources, Charleston, SC.

Wenner, C. A., J. C. McGovern, R. Martore, H. R. Beatty, and W. A.Roumillat. 1986. Ichthyofauna. p. 415-526. *In*: M. R. DeVoe and D. S. Baughman (eds.). South Carolina coastal wetland impoundments: Ecological characterization, management, status and use. Vol. II: Technical Synthesis. Publication No. SL-SG-TR-82-2. South Carolina Sea Grant Consortium, Charleston, SC.

Wenner, C. A., W. A. Roumillat, J. E. Moran Jr., M. B. Maddox, L. B. Daniel III, and J. W. Smith. 1990. Investigations on the life history and population dynamics of marine recreational fishes in South Carolina: Part 1. South Carolina Wildlife and Marine Resources Department, Charleston, SC.

Wenner, C.A. and G.R. Sedberry. 1989. Species composition, distribution, and relative abundance of fishes in the coastal habitat off the southeastern United States. National Oceanic and Atmospheric Administration Technical Report NMFS 79. Prepared by South Carolina Wildlife and Marine Resources Department, Marine Resources Division, Charleston, SC.

Wenner, C. A., C. Walton, M. Brouwer, and E. L. Wenner. 1998. Age, growth and reproductive biology of selected species taken incidentally to the penaeid shrimp trawl fishery along the southeastern coast of the U.S. MARFIN Final Report, Grant No. NA57FF0297. SC Department of Natural Resources, Charleston, SC.

Wenner, E., H. R. Beatty, and L. Coen. 1996. A method for quantitatively sampling nekton on intertidal oyster reefs. Journal of Shellfish Research 15(3):769-775.

Wenner, E. L., W. P. Coon III, P. A. Sandifer, and M.H. Shealy, Jr. 1991. A comparison of species composition and abundance of decapod crustaceans and fishes from the North and South Edisto Rivers in South Carolina. South Carolina Marine Resources Division Technical

Report No. 78.

White, M. G. 1969. Anadromous fish survey of the Edisto and Coosawhatchie rivers--South Carolina. Job Completion Report Project AFS-2-2. SC Wildlife and Marine Resources Department, Columbia, SC.

White, M. G. 1970. Anadromous fish survey of the Savannah and Ashepoo rivers. Job Completion Report Project AFS-2-3. SC Wildlife and Marine Resources Department, Columbia, SC.

MENU

Introduction

Herpetofaunal Surveys

Herpetofauna as Indicators of Change

Herpetofauna by Habitat

Coastal Marine Habitats

Estuarine Open Water and Marsh Habitats

Riverine System - Open Freshwater

Freshwater Lakes

Wetlands

Upland Ecosystems

Summary

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Herpetofauna

Introduction

Eastern cottonmouth
(Agkistrodon piscivorus)

The warm, humid climate of coastal South Carolina supports extensive reptile and amphibian communities that are active throughout the year. The composition of herpetofaunal communities is primarily controlled by water regimes, the amount of salt in the water, and the structure of the vegetative community (Sandifer et al. 1980). (Number of Reptile Species by Habitat Type.) For example, some species are dependent on permanent sources of water such as rivers and ponds and some are relatively independent of standing water and do well in arid conditions such as dunes (Gibbons and Coker 1978). Other species, such as the marine turtles, do very well in highly saline conditions, while others would die rapidly if exposed to saltwater (Sandifer et al. 1980). Those species that are mobile, are tolerant of a wide range of conditions, and can establish populations easily are found in a wide variety of habitats. Species such as the American alligator, the cottonmouth, and the southern toad are examples of species that inhabit a wide range of areas and are important members of the herpetofaunal community in many of the ACE Basin habitats. Other species, such as salamanders or certain treefrogs, may have a restricted range of habitats because they cannot withstand exposure to saltwater, are very sensitive to dry conditions, or require ephemeral wetland habitats.

Herpetofaunal Surveys

The primary sources of information on herpetofaunal communities come from herpetological surveys. Species are captured, identified, and counted utilizing a variety of methods such as pitfall traps, drift fences, cover boards, and visual counts, as well as hand collection. There are few studies targeted on the herpetofauna of the ACE Basin, so most of the information presented here is from surveys conducted in habitats similar to those that occur in the ACE. Surveys of coastal South Carolina were conducted by a number of individuals over the last 150 years. These surveys provide lists of species and often indicate whether the species was abundant or rare, but because of the difficulty of quantitative sampling, few estimates of abundance or density were made. Some of the more recent surveys are included below.

Author/Date	Area Surveyed
Poer 1967	Isle of Palms
Conant 1975	Southeastern United States
Gibbons 1978	Coastal South Carolina
Gibbons and Coker 1978	Coastal South Carolina
Harrison 1978	Kiawah and Isle of Palms
Martof et al. 1980	Carolinas and Virginia
Gibbons and Harrison 1981	Kiawah and Isle of Palms
Conant and Collins 1998	Central and Southeastern United States

Approximately 110 species of herpetofauna have been documented or are expected to occur in the ACE Basin. Of these, there are 36 species of snakes, 18 species of turtles, 12 species of lizards including 1 introduced species, 20 species of frogs, 4 species of toads, 19 species of salamanders, newts and other amphibians, and 1 alligator species. The historic range of the gopher tortoise (*Gopherus polyphemus*) may have extended to the ACE Basin but has not been documented. Its current range does not include the ACE Basin (Conant and Collins 1998). These species range from abundant to rare in their respective habitats. The island glass lizard (*Ophisaurus compressus*), restricted to salt marsh (Bennett pers. comm.) and sandy habitats on barrier islands and mainland areas (Sandifer et al. 1980), is on the South Carolina list of endangered species .

Reptiles and amphibians play an important role as predators that serve to control the populations of various prey species, such as other reptiles and birds, and small mammals such as squirrels, rats, and mice. They are also important as prey species for birds, mammals, and other reptiles and amphibians and can make up most of the vertebrate biomass in some habitats (Burton and Likens 1975). Because of their habitat requirements, especially for the amphibians, changes in the diversity of the reptile community may indicate changes in the habitats that they are dependent on and therefore may serve as indicators of environmental change or degradation.

Back to Top

Herpetofauna as Indicators of Change

Reptiles and especially amphibians have been used as indicators of change in habitats (Pechmann et al. 1991; Blaustein et al. 1994; Fontenot et al. 1996). Their reliance on moist areas, a limited home range, and the relatively long life spans of some species make them

Southern black racer
(Coluber constrictor priapus)

sensitive to changes in the hydroperiod of their habitats. Natural changes in moisture, such as wet or dry weather periods, can have significant effects on populations of certain species (Blaustein et al. 1994; Phelps and Lancia 1995; Gibbons et al. 1997).

The current concern specific to a perceived global decline in amphibian populations is based on a few long-term studies and a large number of short-term studies (Blaustein et al. 1994). Two interpretations have been suggested by Blaustein et al. (1994). The first is that the decline in amphibian populations is real and is potentially a result of anthropogenic impacts at local and global levels. Changes such as wetland filling or draining, urbanization, and clear-cutting can significantly change the moisture regime, resulting in changes to the herpetofaunal community (Pechmann et al. 1991; Phelps and Lancia 1995). A shift towards a drier environment would tend to reduce the number of wetland-dependent species such as amphibians and increase the number of species able to withstand dry conditions, such as some lizards and snakes. Reptiles and amphibians are dependent on particular conditions, and changes in those conditions affect the species at both the individual and the population level. Habitat fragmentation may increase the likelihood of particular populations becoming extinct. In pre-fragmented habitats, if a local population went extinct, recruitment from other populations would often re-establish a new population. Habitat fragmentation, combined with the limited dispersal ability of many amphibians, may slow or eliminate this emigration to the point where the habitat may not be re-colonized.

The second suggestion by Blaustein et al. (1994) is a function of the life history of amphibians and the number of long-term studies. Amphibian populations are often dependent on ephemeral water sources. During wet years, breeding and recruitment may be very successful, while during dry years it may not occur at all. For amphibians that can live for many years (10-25 years in some cases), a few years of low recruitment can reduce the population significantly. However, if conditions improve, the population numbers can quickly return to high levels. Adults of many species can, in extremely dry conditions, remain dormant for months or years until conditions improve. This combination of life history characteristics results in large year-to-year or multiyear variations in the populations. This variability is difficult to measure using short-term studies or anecdotal information, and therefore it may be difficult to distinguish between natural variability and long-term declines.

Back to Top

Herpetofauna by Habitat

Eastern tiger salamander
(Ambystoma tigrinum tigrinum)

In the following text, reptile and amphibian communities are discussed by broad habitat categories. These categories are primarily based on Cowardin et al. (1979) and include marine, estuarine, riverine, lacustrine, and palustrine communities. The lacustrine and palustrine communities are subdivided into two to five sub-categories. The upland areas not covered by Cowardin are separated into pine forests, isolated freshwater wetlands such as Carolina bays, and hardwood forests. Although somewhat simplistic, many reptiles have relatively wide habitat requirements and generally fit within these broad designations. Classification of plant communities within both the wetland and upland areas is based on The Nature Conservancy's plant community nomenclature and is discussed in the Plant Community section. However, these habitat descriptions are human constructs, and many reptiles and amphibians may be found in a variety of habitats. Therefore, the reader should not consider the following lists as definitive but rather as a guide to the potential species within the habitats.

Because of the diversity of reptile and amphibian species, they are further broken down into taxonomic groups. Reptiles and amphibians can be separated into groups that include the crocodilians, snakes, lizards, turtles, and the amphibian groups of frogs, toads (anurans), and salamanders. Most of these groups can be found in all the habitats in the ACE Basin, although species composition will vary among habitats

Habitats and Hydrology

American alligator
(Alligator mississippiensis)

Because vegetative communities and herpetofauna are dependent on water conditions, many herpetofaunal communities are associated with particular plant communities and hydrologic conditions. The dry conditions associated with the dune and maritime shrub thicket communities will have species that are resistant to dessication. These same species may also be found in upland pine forests, also considered a dry habitat. Species found in maritime forests on barrier islands may also be found in inland maritime forests. However, species that cannot survive exposure to estuarine conditions may not colonize barrier island maritime forests but can be found in inland maritime forests (Gibbons and Coker 1978).

An additional difficulty is the mixture of habitat types (freshwater wetland, upland forest, estuarine tidal creek) in close proximity to one another. Because of this, species generally found in a given habitat may also be found in adjacent habitats.

The gradation of habitat types between the open waters of the river and lake and the freshwater swamps and forested wetlands is primarily a function of increasing structure (emergent grasses, shrubs, trees, etc) as the habitat changes from open water to forested wetland. Some reptiles and amphibians, such as the alligator, water snakes in the Genus *Nerodia*, the cottonmouth, the Florida cooter, and the yellowbelly slider, are ubiquitous throughout these environments. The differences in the reptile and amphibian communities lie more in the distribution and abundance of more specialized species. Population abundance for reptiles and amphibians is difficult to measure, and estimates do not exist for the ACE Basin.

Back to Top

Coastal Marine Habitats

Loggerhead sea turtle ***(Caretta caretta)***

- ACE Basin Barrier Island Habitats
- Maritime Dune and Shrub Habitats
- Barrier Island Maritime Forest

Reptiles occurring in the coastal marine habitat, those areas just seaward of the ACE Basin, include the green, Kemps Ridley, loggerhead, hawksbill, and the occasional leatherback. Most of these are considered transients in South Carolina waters. The loggerhead is the only species that is regularly seen in the estuarine portions of the ACE Basin, also nests on the beaches of the barrier islands. Loggerhead turtle species feed on a variety of crustaceans and mollusks. Kemp's ridley turtles also occur in estuarine waters but their smaller size means. The primary anthropogenic impacts to these species in the ACE Basin are loss of nesting habitat from development of barrier island beaches (loggerhead turtles only) and impacts by commercial trawlers. Because nesting loggerhead turtles use South Carolina beaches, management practices are in place to protect nests and hatchlings from natural predation and human interference. (See related section: Threatened and Endangered Species: Loggerhead Sea Turtle.)

ACE Basin Barrier Island Habitats

The barrier islands of South Carolina contain a wide variety of habitat types ranging from coastal dunes, with little to no freshwater, to wetland areas in upland forests. (See related sections: Geomorphology; Plants.)

Maritime Dune and Shrub Habitats

The coastal dune, maritime dry grassland, and maritime dune shrub thicket plant communities found on Edisto Beach, Otter Island, Deveaux bank, and Hunting Island are generally dry, desert-like environments. These habitats are characterized by sandy, dry soils, exposure to wind and salt spray, and direct sun. Only those reptiles and amphibians that can withstand these dry conditions, such as the six-lined race runner, can be regularly found here (Reptiles of Dune and Maritime Habitats). Other species such as the island glass lizard (state species of concern), eastern glass lizard, eastern coachwhip, and eastern diamondback rattlesnake are seen occasionally (Gibbons and Harrison 1981). The eastern spadefoot toad and the southern toad can also withstand dry conditions and may be found in these dry habitats. The diamondback terrapin may use these areas for nesting but does not spend extensive amounts of time in these habitats, preferring the estuarine tidal creeks and marshes. Although not documented in the ACE Basin, the Texas horned lizard has become established on a few coastal barrier islands and could potentially colonize barrier islands in the ACE Basin.

Barrier Island Maritime Forest

Green anole
(Anolis carolinensis)

On barrier islands such as Edisto Beach, Otter Island, Pine Island, and Hunting Island, maritime forest communities can be found. The diversity of reptile species that inhabit the maritime forest habitat is higher than dry dune and shrub environments (Gibbons and Coker 1978; Sandifer et al. 1980). This is due to the presence of moist habitats, intermittent or permanent water sources, and cover in the form of leaf litter, vegetation, and rotting logs that provide a variety of microhabitats for herpetofauna to utilize. Species common to these barrier island forests are green treefrogs, Carolina anole, ground skinks, broadhead skinks, rat snakes, and eastern diamondback rattlesnakes. Other less frequently found species include squirrel treefrogs, southern leopard frogs, rough green snakes, southeastern crowned snakes, and cottonmouth snakes. Those islands with permanent fresh water may have additional species including the American alligator, chicken turtle, and yellow bellied slider (Gibbons and Harrison 1981; Gibbons 1978).

Species Diversity on Barrier Islands

In general, a wide diversity of habitats means that a large number of species will utilize them. However, when compared to adjacent mainland areas, barrier islands may have lower abundance and diversity of species (Gibbons and Coker 1978). This is a result of some of the mainland species being unable to successfully traverse the harsh salt marsh habitats that lie between the mainland and barrier islands. Only those species able to swim or raft over on floating materials and to withstand the saline waters will successfully emigrate to the islands. In addition, while some barrier islands have permanent fresh water areas, most do not. Therefore, species that are able to cross to the island but require permanent freshwater may not survive the occasional droughts, further reducing the species diversity on island habitats. This may account for the relative paucity of turtles, such as the eastern chicken turtle, yellow bellied sliders, eastern mud turtle, and snapping turtle, that are abundant on the mainland but less common on barrier islands. Gibbons and Coker (1978) have demonstrated a positive correlation between area of forested habitat on barrier islands and the number of species on the island. While lower than adjacent mainland areas, species diversity increases as the area of the forest increases on barrier islands.

In addition to forested area, the age of the island may have an effect on species diversity. Barrier islands in the ACE Basin formed during the Holocene, approximately 6-12,000 years ago. Islands of Pleistocene age, such as Cumberland Island, Georgia, are older and have had a longer time for species to colonize them. These older islands show a richer diversity of reptile species (Sandifer et al. 1980). (See related section: Geomorphology.)

Back to Top

Estuarine Open Water and Marsh Habitats

Marbled salamander
(Ambystoma opacum)

Because of the difficult conditions found in open water estuarine and salt marsh habitats, there are few species that utilize these habitats. The Carolina diamondback terrapin is the only species that is a resident. They are found in the tidal creeks of the salt marsh where they live and feed. They lay eggs in nests just above the high-tide line, often on the edges of marsh islands.

The loggerhead is principally a marine species but is also frequently seen in the rivers, generally feeding on crustaceans, jellyfish, and fishes. They are seasonal transients, moving south during the winter to find warmer waters. Alligators are known to feed in estuarine waters and may spend time in waters that are between 10 and 20 parts per thousand, but rarely stay in these areas for long periods. (See related section: Species Gallery.)

Other species can occasionally be found, but these species are generally passing through and are not residents of these habitats. The amphibians (salamanders, newts, frogs, and toads) are the only class of vertebrates that have not adapted to saline environments. These species are generally dependent on moist areas where they absorb and lose water through their skin. In saline waters, these species rapidly dehydrate and die (Sandifer et al. 1980).

Similar to open water estuarine areas, estuarine impoundments are generally saline and have a limited number of herpetofauna. Diamondback terrapins, alligators, and occasionally cottonmouths are found. It is in oligohaline habitats, where the salinity is below 5 parts per thousand (ppt), that the diversity of species begins to increase (Sandifer et al. 1980).

Back to Top

Riverine System - Open Fresh Water

Fresh water ecosystems are defined by Cowardin et al. (1979) to be those systems where the average salinity is less that 0.5 ppt. As one moves up the rivers of the ACE Basin into the multitude of palustrine habitats, the salinity decreases. In these freshwater, open riverine habitats, the number of species of reptiles and amphibians increases from the numbers in estuarine areas (Reptiles found in Riverine Habitats). In the mainstem rivers, with relatively deep areas and strong currents, only those species that can swim against the current are found. These species include a number of snakes such as the cottonmouth, redbelly water snake, banded water snake, and brown water snake, as well as others. The American alligator and a number of turtles including the Florida cooter, snapping turtle, river cooter, spiny softshell, and yellowbelly slider are found in riverine systems. (See related section: Plants: Palustrine Communities.)

Back to Top

Freshwater Lakes

Similar to riverine areas, the deepwater portions of lakes (the limnetic region) support a limited number of species (Reptiles found in Open-Water Lake Habitats . This is in part because there is limited structure (submerged and emergent vegetation, dead branches, etc.) to provide cover from predators or to attract those species that serve as prey. The animals that utilize these areas are generally more mobile and include the American alligator, Florida cooter, Florida softshell, snapping turtle, yellowbelly slider, and the stinkpot turtle. Snakes such as the cottonmouth, redbelly water snake, and banded water snake can be found occasionally in the open water of lakes.

Stinkpot
(Sternotherus odoratus)

As one approaches the edge of a lake (the littoral region), the number of potential species changes from approximately 14 to more than 30 (Reptiles Potentially Found in Lake Edge Habitats). The additional species in littoral habitats is a function of additional structure. Increased habitat complexity adds refuge from predators, locations for basking, and prey items also seeking refuge. The proximity of these edge habitats or ecotones to both the river and to the swamps and upland areas may result in higher species diversity than in the adjacent habitats (see Ecosystem Processes: Ecotonal Habitat). Understandably, all the species found in open water spend some of their time in the littoral region of a lake. In addition to these species, there are potentially six species of salamanders, newts, and sirens, and eleven species of frogs. Four additional species of snakes and three turtles are found in littoral habitats.

Back to Top

Wetlands

- Tidal Emergent Wetlands and Impoundments

Green treefrog
(Hyla cinerea)

- Tidal Forested Wetlands
- Non-Tidal Forested Wetlands

Tidal Emergent Wetlands and Impoundments

The quiet waters and low salinities of the primarily freshwater tidal wetlands and impoundments historically used for rice culture are excellent habitat for a number of turtles, snakes, frogs, and alligators (Reptiles found in Freshwater Wetlands). Many of the species found in the adjacent riverine system can also be found in tidal marshes and impoundments. This habitat is similar to the littoral zone of lakes and supports many of the same species. The habitat is dominated by Ranid frogs such as the southern leopard frog, pig frog, bullfrog, and pickerel frog. With the increased structure, an increasing number of smaller frogs is potentially present including the southern cricket frog, green treefrog, and squirrel treefrog. Snake species include the cottonmouth, banded water snake, redbelly water snake, and brown water snakes. Other snake species found in areas with increased structure include the glossy crawfish snake and the black swamp snake. Salamanders found in these habitats include the greater siren and the two-toed amphiuma. Lizards are not as abundant, but the Carolina anole can be found among emergent plants. In drier areas, the five lined skink and the broadhead skink may be found. Turtles that frequent the quiet waters and haul-out areas include the chicken turtle, snapping turtle, Florida cooter, yellowbelly slider, Florida softshell, and stinkpot.

These habitats are prime areas for the American alligator. With dikes and banks to bask and nest on, and a wide variety of birds, small mammals, fish, and amphibians on which to prey, this top predator is an abundant species. Protected from human harvest by its inclusion in the endangered species act, the alligator has been given a chance to return to a relatively high abundance. Unlike other species, alligator populations are not severely limited by loss of habitat but are limited by human harvest. Elimination of unregulated harvest has allowed the species to recover to the point that limited harvests are allowed in some states. (See related section: Hunting.)

Tidal Forested Wetlands

Tidal forested wetlands contain a wide variety of microhabitats that support a diverse community of herpetofauna (Reptiles found in Tidal Forested Wetlands). The complexity of this habitat, a combination of permanent forested wetlands, swamps, and small ponds, results in a variety of habitats and more than 30 species within those habitats.

Southern leopard frog
(Rana utrucularia)

Amphibians are well represented in permanently flooded habitats such as tidal emergent and forested wetlands. The low current velocities combined with the high number of prey items (crustaceans, fish, insects, other amphibians and reptiles) make this an ideal habitat. The anurans (frogs and toads) are the most abundant group in these habitats. These species utilize the floating and emergent vegetation growing in these areas as refuge and foraging areas. Treefrog species include the southern cricket frog and the upland chorus frog. Ranid frogs, such as the river frog and the southern leopard frog, are common inhabitants of tidal swamps. The number of species of salamanders begins to increase in these more protected stillwater habitats. More open-water species such as the two-toed amphiuma and the greater siren can be found, as well as additional species not found in open water. These include the Mabee's salamander, southern dusky salamander, dwarf salamander, and the South Carolina slimy salamander. Toads are not well represented, as they tend to prefer slightly drier habitats such as intermittently flooded wetlands and upland areas. However, the eastern narrowmouth toad can be found in these habitats.

Eastern mud turtle
(Kinosternon subrubrum subrubrum)

Turtles are also an abundant group, with approximately seven species potentially occurring in tidal forested habitats. Species that do not haul out to bask in the sun, such as the snapping turtle, Florida softshell, and eastern mud turtle, can be found in shallow water areas. Florida cooters and yellow bellied sliders are also abundant in tidal forested habitats. These species can often be seen basking on logs and banks. These turtles have developed this behavior in order to increase their metabolism. Basking in sunlight increases their body temperature, and this in turn increases their metabolism and helps them to digest their food (Sandifer et al. 1980).

Snakes that are common to tidal and non-tidal forested wetlands include the cottonmouth, copperhead, banded water snake, red bellied and brown water snakes, and rough green snakes. These species feed primarily on a variety of fishes, frogs, invertebrates, and other amphibians. These snakes, in addition to basking turtles, are often the most visually apparent reptiles because of their active lifestyles. Alligators are common residents in both tidal and non-tidal coastal wetlands.

Non-tidal Forested Wetlands

Southern copperhead
(Agkistrodon contortrix contortrix)

Tidal influences in the mainstem of the rivers of the ACE Basin extend beyond the project area. However, as one moves from the mainstem into tidal swamps and forested wetlands, the effects of the tide are reduced or nonexistent. Snuggedy Swamp, south of Walterboro, has minimal influences well into the swamp away from the Edisto River. While the herpetofauna of non-tidal forested wetlands are similar to those of tidal forested wetlands, some species are not found as regularly. These semi-permanently flooded habitats generally do not support reptiles and amphibians that require permanent water sources, such as the greater siren, two-toed amphiuma, and snapping turtle. Non-tidal forested wetlands may go through periods of low water levels, restricting the number of species that are dependent on permanent water sources. Aquatic species begin to be replaced by more semiaquatic species.

A few species are found in non-tidal wetlands that are not found frequently in tidal wetlands. These include the carpenter frog, little grass frog, the many-lined salamander, the three-lined salamander, and the oak toad. Some lizards and snakes that are more frequent in non-tidal than in tidal forested wetlands because of the drier conditions are the eastern and slender glass lizards, black swamp snake, timber rattlesnake, and the southeastern crowned snake. The latter is a fossorial species, inhabiting moist areas under fallen logs and leaf-litter.

As the habitat becomes drier, with shorter periods when standing water is available, the species comprising the herpetofaunal community shift towards those species that are more resistant to dessication. Frogs and salamanders, although not particularly resistant to dessication, utilize wet microhabitats such as leaf litter, rotten logs, and small springs and seeps that occur in forested wetlands. These species include upland chorus frog, southern cricket frog, dwarf salamander, Mabee's salamander, spotted salamander, and the South Carolina slimy salamander.

Back to Top

Upland Ecosystems

- Upland Isolated Wetlands
- Upland Pine Flatwoods
- Upland Hardwood Forests

The diversity of habitats in upland hardwood and pine flatwood communities can result in a wide variety of herpetofauna. The hydroperiod of these habitats can range from temporarily or seasonally flooded during periods of heavy rain to very dry after periods of drought. Many of the species present in upland habitats that are dependent on moist conditions utilize microhabitats of rotting logs, springs and seeps, and perched wetland areas such as Carolina Bays and pocosins, as well as other moist locations within the upland community. Some of these species are very dependent on the intermittent ponds and pools that form during wet periods. In years of drought, these species may not be able to mate and spawn because the temporary pools do not form. The species that occur in upland habitats in the ACE Basin are, therefore, dependent on the history of rain in the previous months. Bullfrogs may be common during wet periods, while lizards and pine woods treefrogs may be more common during dry periods.

Upland Isolated Wetlands

Eastern diamondback rattlesnake
(Crotalus adamanteus)

Some upland areas include isolated wetlands such as Carolina Bays and other pocosins. These wetlands serve as "islands" of moisture surrounded by dry areas and attract those species that need moist areas (Reptiles Found in Upland Isolated Wetlands). Where present, these isolated wetlands tend to concentrate wetland-dependent species and increase the diversity of the herpetofauna inhabiting the area. For this reason, pine flatwood communities where isolated wetlands occur may be one of the more herpetologically diverse communities because of the combination of the species associated with upland dry habitats and species associated with isolated wetlands (Bennett 1998 pers. comm.).

The herpetofauna community in isolated wetlands can be significantly different from that in similar habitat of non-tidal freshwater wetlands. They both have relatively shallow, still waters with extensive structure in the form of trees, shrubs, fallen logs, and leaf litter. The differences lie in the hydrologically disconnected nature of isolated wetlands. Species that are completely dependent on water have difficulty crossing the dry uplands to reach the isolated wetland and therefore are not common in these habitats. The primary method of dispersal for these species is during very wet years when upland areas are flooded.

Isolated wetlands have a diverse amphibian community, in part because of the limited numbers of fish associated with these wetlands. Fish are a primary predator of amphibian eggs, and isolated and/or ephemeral wetlands are often not colonized by fish. In addition, isolated wetlands may dry up seasonally or during dry years, so only species that can withstand these conditions can survive long term. During especially dry years, some of the sirens and amphiumas may burrow into the mud and seal themselves up in a protective cocoon to wait for another wet period. Other species lay eggs that remain dormant until the pond fills again.

Upland Pine Flatwoods

The mostly dry habitat of the upland pine flatwood community goes through regular seasonal as well as multiyear dry stages. Herpetofauna in these areas must be able to withstand long periods with little moisture. Snakes, with their armored scales, tend to be more resistant to such conditions and tend to dominate these upland communities. The dominant species include the corn snake, eastern diamondback rattlesnake, black racer, eastern garter snake, and pine snake. The pine woods treefrog is found in these habitats. Lizards found in these dry habitats include the broadhead skink, six lined racerunner, slender glass lizard, mimic glass lizard, ground skink, and eastern fence lizard. The only salamander endemic to this habitat is the flatwoods salamander, which is usually associated with the few wetter areas such as isolated wetlands.

Upland Hardwood Forests

Squirrel tree frog
(Hyla squirella)

The diversity of the herpetofaunal community in upland hardwoods is similar to that of the pine flatwoods. However, the species that inhabit upland hardwoods can be quite different. The habitat tends not to be as dry as pine flatwoods and supports additional species of salamanders, including the spotted salamander, marbled salamander, and the mole salamander, as well as others. The copperhead and cottonmouth snakes are present in this habitat. Other snakes such as the black racer, timber rattlesnake, and smooth earth snake are present in hardwood forest habitats but uncommon in pine flatwoods. A number of treefrogs are present, including Cope's gray treefrog, the green treefrog, the barking treefrog, and the squirrel treefrog. The southern toad, eastern narrowmouth toad, and eastern spadefoot toad are also present. Unless there are closely associated wetlands, the eastern box turtle is the only turtle species present. As with the pine flatwoods habitat, if isolated wetlands occur in a hardwood forest, the species diversity can be much higher than would otherwise be indicated.

Back to Top

Summary

The reptiles and amphibians of the ACE Basin are an important component of the biodiversity and energy flow of the ecosystems within it. While some species can be found in a wide variety of habitats, others have very specific habitat requirements. Changes to these habitats through deforestation, clearing for agriculture or suburban uses, and draining or rerouting water bodies can have significant impacts on the health of reptile and amphibian populations. The amphibians, in particular, are especially sensitive to habitat and hydroperiod changes, whether natural or anthropogenic.

NEXT SECTION: Birds

Authors

G. Riekerk, SCDNR Marine Resources Research Institute

W. Rhodes, SCDNR Wildlife and Freshwater Fisheries

References

Bennett, S. 1998. Personal Communication. SC Department of Natural Resources, Columbia, SC.

Blaustein, A.R., D.B. Wake, and W.P. Sousa. 1994. Amphibian declines: judging stability, persistence, and susceptibility of populations to local and global extinctions. Conservation Biology 8(1):60-71.

Burton, T.M. and G.E. Likens. 1975. Salamander populations and biomass in the Hubbard Brook experimental forest, New Hampshire. Copeia 3:541-546.

Conant, R. 1975. A field guide to reptiles and amphibians of eastern and central North America. Houghton Mifflin Company, Boston, MA.

Conant, R. and J.T. Collins. 1998. A field guide to reptiles and amphibians of eastern and central North America. Third Edition. Houghton Mifflin Co., New York, NY.

Cowardin, L.M., V. Carter, F.C. Golet, E.T. Laroe. 1979. Classification of wetlands and deepwater habitats of the United States. FWS/OBS-79/31. U.S. Department of Interior, Fish and Wildlife Service, Office of Biological Services. Washington, D.C.

Fontenot, L.W., G. Pittman-Noblet, S.G. Platt, and J.M.A. Akins. 1996. A survey of herpetofauna inhabiting polychlorinated biphenyl contaminated and reference watersheds in Pickens County, South Carolina. Journal of the Elisha Mitchell Scientific Society 112(1):20-30.

Gibbons, J.W. 1978. Reptiles. pp 270-276. *In* Zingmark, R.G. (ed.) An annotated checklist of the biota of the coastal zone of South Carolina. University of South Carolina Press, Columbia SC.

Gibbons, J.W., V.J Burke, J.E. Lovich, R.D. Semlitsch, T.D. Tuberville, J.R. Bodie, J.L. Greene, P.H. Niewiarowski, H.H. Whiteman, D.E. Scott, et al.. 1997. Perceptions of species abundance, distribution, and diversity: Lessons from four decades of sampling on a government-managed reserve. Environmental Management 21(2):259-268.

Gibbons, J.W. and J.W. Coker. 1978. Herpetofaunal colonizations patterns of Atlantic coast barrier islands. American Midlands Naturalist 99(1):212-233.

Gibbons, J.W. and J.R. Harrison. 1981. Reptiles and amphibians of Kiawah and Capers Islands, South Carolina. Brimleyana 5:145-162.

Harrison, J.R. 1978. Herpetofauna. pp 260-269. *In* Zingmark, R.G. (ed.) An annotated checklist of the biota of the coastal zone of South Carolina. University of South Carolina Press, Columbia, SC.

Martof, B.S., W.M. Palmer, J.R. Bailey, and J.R. Harrison III. 1980. Amphibians and reptiles of the Carolinas and Virginia. University of North Carolina Press. Chapel Hill, North Carolina.

Pechmann, J.H.K., D.E. Scott, R.D. Semlitsch, J.P Caldwell, L.J. Vitt, and J.W. Gibbons. 1991. Declining amphibian populations: the problem of separating human impacts from natural fluctuations. Science 253:892-895.

Phelps, J.P. and R.A. Lancia. 1995. Effects of a clearcut on the herpetofauna of a South Carolina bottomland swamp. Brimleyana 22:31-45.

Poer, L.D. Jr. 1967. A herpetological survey of the Isle of Palms, a South Carolina coastal island. Masters of Science Thesis. University of South Carolina, Columbia,SC.

Sandifer P.A., J.V. Miglarese, D.R. Calder, J.J. Manzi, and L.A. Barclay. 1980. Ecological characterization of the Sea Island coastal region of South Carolina and Georgia, Vol. III: Biological features of the characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C., FWS/OBS-79/42.

Introduction
Coastal Marine Habitats
Estuarine Ecosystems
Wetland Ecosystems
Riverine Ecosystems
Old Fields
Pine Forests
Conservation Issues
References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Birds

Introduction

Barn swallow *(Hirundo rustico)*

All birds share the following characteristics: (1) tetrapods with feathers; (2) forelimbs modified to form wings; (3) respiration through lungs; (4) endothermic; (5) internal fertilization; (6) shelled amniotic eggs; and (7) acute vision (Campbell 1993). Birds fill a wide range of ecological roles. Nectar-eating species such as hummingbirds, herbivorous species such as ducks which feed on aquatic vegetation, and granivorous species such as doves and buntings all depend on plant matter for a substantial portion of their diet. These species represent primary consumers in the food web. Insectivorous species such as swallows and warblers, and shorebird species such as plovers and sandpipers that feed on crustaceans and molluscs represent the next higher trophic level. Omnivorous species such as grackles and crows eat a combination of plant and animal matter which represent multiple trophic levels. Raptor species such as hawks, eagles, and owls represent the highest bird trophic level. These birds feed on mammals, reptiles, and amphibians as well as other birds and are considered top predators. Scavengers such as vultures and gulls play an important role in removal of dead animal matter and nutrient recycling.

The ACE Basin study area has an extremely rich bird life. Over half of the species of birds that occur in North America inhabit the 320,000 hectares (790,000 acres) of the ACE Basin study area. Several bird surveys have been conducted in the ACE Basin study area. The South Carolina Department of Natural Resources (SCDNR) Wildlife and Freshwater Fisheries division has conducted colonial waterbird surveys since 1969. This program uses both ground and aerial surveys to determine the number of various birds species that nest in colonies in the ACE Basin study area. Nesting colonies can be found in a variety of habitats including upland forests, forested wetlands, beaches, and bird keys (Colonial waterbird nest locations). The South Carolina Center for Birds of Prey EXIT has conducted the South Carolina Coastal Hawk Migration Survey since 1995. This survey focuses on the hawk species that migrate into coastal South Carolina during the winter. The ACE Basin survey site is located three miles inland on Edisto Island in estuarine marsh habitat surrounded by forested wetlands, croplands, and upland forests. The United States

Geological Survey (USGS) has conducted the Breeding Bird Survey (BBS) in the ACE Basin study area at a site near Walterboro since 1970. This is a large-scale roadside survey of North American birds with the objective of estimating population change for songbirds. The Walterboro route of this survey travels through upland forests, forested wetlands, and old- field habitats (Breeding bird survey route). The Audubon Society has coordinated the Christmas Bird Count (CBC) in the ACE Basin study area since 1990. Groups of volunteers work together to identify and count all birds possible within a 24-km (15-mile) circle. The survey site is centered at Brickyard Launching Bridge, Bennetts Point Road and includes both freshwater and estuarine non-forested wetlands, forested wetlands, upland forests and old- field habitats (Christmas bird survey). The SCDNR has compiled an ACE Basin Bird Checklist that lists all the birds inhabiting the area along with their residency and abundance status.

There are about 8,600 species of birds in the world divided into 28 orders. Of these, approximately 280 species of birds in 17 orders occur in the ACE Basin study area. Many of these birds migrate in tremendous numbers to South Carolina from northern breeding grounds to spend their winters or to rest before continuing their migration to more southern areas. Because birds can fly, the barriers that restrict travel for many animals are easily avoided by birds. Therefore, birds are rarely restricted to one environment and are often found in a variety of habitats (Potter et al. 1980). However, birds frequently exhibit a preference of one habitat over others and this habitat preference affects distribution and abundance. The avifauna of different habitats in the ACE Basin study area will be discussed below. This discussion is based mainly on information obtained from Sandifer et al. (1980) and Potter et al. (1980).

Back to Top

Coastal Marine Habitats

- Marine Subtidal Waters
- Beaches
- Bird Keys
- Dunes
- Maritime Shrub
- Maritime Forest

Double-crested cormorant *(Phalacrocorax auritus)*

Marine Subtidal Waters

An estimated thirty species of birds utilize the marine subtidal habitat as feeding grounds. Eight of these species are common year-round residents and seven are common in winter (Bird habitat). Five species that utilize this habitat (e.g. shearwaters, phalarope, gannet, and petrel) are mainly pelagic and are seen only rarely near shore. The concentration of fish and invertebrates by the Gulf Stream provide ample prey for these birds. The majority of birds in this habitat are piscivorous and catch fish by aerially diving (e.g. terns, gannets); surface diving (e.g. loons, cormorants); or surface skimming (skimmers, gull-billed terns). Two species (e.g. Wilson's petrel and northern phalarope) feed on nearshore zooplankton while diving ducks consume benthic organisms (Sandifer et al. 1980). The brown pelican and the double-crested cormorant are probably the most common permanent resident species that feed in subtidal habitats of the ACE Basin study area. Double-crested cormorants dive from the surface to feed on small fish and can often be seen swimming with just their head and neck above water. These birds feed in subtidal waters but are most likely to nest in stunted cypress trees along heavily forested lake shores (Potter et al. 1980).

Beaches

Peregrine falcon
(Falco peregrinus)

An estimated forty-four avian species can be found on the intertidal beaches of the ACE Basin study area. Twenty-three of these are common year-round residents of the beaches. The avifauna community of beaches can be divided into three broad categories: (1) marine species such as brown pelicans, royal terns, and black skimmers which feed on fish and use the beaches only for resting or breeding; (2) macrobenthic predator species such as sanderlings, American oystercatchers, plovers, and sandpipers which hunt in the sand for annelids, crustaceans, and mollusks; and (3) beach scavengers such as gulls, crows, boat-tailed grackles, and vultures which feed mostly on dead animal matter that litters the beaches (Sandifer et al. 1980).

Although most species of birds found on beaches are not limited to this environment, there are a few species (e.g. sanderlings, red knots, piping plovers, and Wilson's plover) which almost exclusively inhabit beaches. Sanderlings are small shorebirds that forage for mollusks, worms, and crustaceans in the surf zone. These birds are common year-round residents of the ACE Basin study area but breed in the Arctic (Sandifer et al. 1980). Brown pelicans are one of the most common marine seabirds seen on the beach. This species breeds on bird keys and feeds on fish by plunging from the air into the ocean. Both the black and turkey vulture can be seen on ACE Basin beaches. These birds hunt for carrion in a variety of habitats but nesting occurs most often in woodlands or swamps. Black vultures mostly hunt by sight over open habitat while turkey vultures are most often forest hunters and therefore depend on smell to locate prey. Both species are common year-round residents and are important ecologically because of their consumption of dead animal matter. The peregrine falcon is a winter predator in this habitat and is regularly seen in the ACE Basin study area during the fall migration in October. This species is endangered due to pesticide exposure, but numbers in the ACE Basin study area are steadily increasing as the bird recovers. Peregrine falcons are frequently seen perched low on remote barrier island beaches where they feed on shorebirds (Murphy, pers. comm.).

Bird Keys

Bird keys and banks are small isolated islands that usually occur in tidal inlets and broad bays. They are very dynamic habitats because they are susceptible to over wash by storm action and spring tides and because they tend to migrate in response to inlet morphology (Sandifer et al. 1980). Bird keys are used by a number of colonial birds for breeding because they provide protection from terrestrial predators such as raccoons. Historically, several bird keys in the ACE Basin study area were utilized by colonial waterbirds. However, recent anthropogenic alterations in channel flows have destroyed these keys (i.e. Egg Bank Island at the mouth of Harbor River). Currently, the only bird key in the ACE Basin study area on which birds nest is Deveaux Bank at the mouth of the North Edisto River.

Laughing gull *(Larus atricilla)*

Twelve species of birds are estimated to currently nest on Deveaux Bank. Forty-two percent of all colonial waterbird nests identified in the ACE Basin study area since 1969 were found to occur on Deveaux Bank (Colonial waterbird nesting sites). Royal terns, brown pelicans, laughing gull, sandwich terns, and black skimmers are the dominant nesting species on bird keys (Colonial waterbirds. Colonial birds that breed on bird keys exhibit distinct habitat preferences. Brown pelicans prefer higher grounds where there is sufficient vegetation for nest construction. The number of brown pelican nests on Deveaux Bank has decreased since the 1970s (Pelican abundance) probably because of erosion of Deveaux Bank over the past 20 years. Prior to the 1970s, pelican populations declined because of DDT but since the ban on DDT in 1972, pelican populations have been on the rise and in 1985 they were delisted as an endangered species on the Atlantic coast. Royal tern nests are nothing more than depressions in the sand; if the nest is destroyed, a new nest is built and new eggs are laid. Royal tern colonies are the largest colonies on Deveaux Bank with thousands of nests often present during one breeding season (Royal tern abundance). Sandwich terns also occur in large numbers and nest in mixed colonies with royal terns. Laughing gulls establish their colonies on the fringes of brown pelican and royal tern colonies in order to exploit the food source provided by pelican and tern eggs and young. Since 1975, laughing gull nests have been recorded in the ACE Basin study area only at Deveaux Bank. Both black skimmers and gull billed terns nest in unvegetated areas of Deveaux Bank above the mean high tide mark.

Dunes

The maritime dune habitat is a harsh environment with many stressful physical attributes (e.g. blowing sand, high summer temperature, limited freshwater and sparse vegetation). Sea oats are the dominant plants and the abundance of seeds are food for the many granivorous birds which inhabit the dunes. Seeds make up the bulk of the diet for eleven of these species of birds including doves, blackbirds, sparrows, and cardinals. The Savannah sparrow is a common winter resident that feeds on dune plant matter. This species consumes more insects than other sparrows but the majority of the diet consists of grass and weed seeds. Insectivores (e.g. nighthawk, swallows, chimney swift, and warblers) are the next largest trophic group. The common nighthawk is a common summer resident which nests directly on the sand dunes and in many other open areas. These birds eat a variety of insects including flying ants, mosquitos, beetles, and gnats. The fish crow is the dominant scavenger and the great horned owl is the most abundant raptor. Large numbers of great horned owls have been observed hunting over sandy beaches for rodents and waterfowl (Sprunt and Chamberlain 1970).

Shorebirds such as terns, plovers, and sandpipers use the dunes for resting, feeding, and nesting. The least tern uses the dune habitat for breeding habitat with nesting occurring in the fore dune area. The least tern has declined in numbers over the years because of anthropogenic disturbance of beach habitats and is now listed as a state threatened species. This species has adapted to the changing environment by establishing nesting colonies on rooftops. Large shopping centers with gravel rooftops can support a surprising number of least tern nests. However, gravel rooftops have recently been replaced by rubber rooftops which are less expensive. Only K-mart still maintains the gravelled rooftops which can be used as nesting sites by the least tern (Murphy pers. comm.).

Maritime Shrub

Moving inland from the dune community, is the maritime shrub community which offers fewer habitats to bird species than does the nearby maritime forest. The lack of an understory and the low plant density provide little food for granivorous and herbivorous species. Many species in this habitat are omnivorous either year round (mockingbird and grackles) or seasonally (tree swallows). Most species in the shrub community consume insects (e.g. kingbird, yellow-throat, and sparrow hawk). The majority of species in this habitat are residents of the adjacent dune or maritime forests and utilize the shrub community only as feeding or nesting grounds. Two species, tree swallow and yellow-rumped warbler, are closely associated with this habitat because during cold weather when insects are scarce they consume wax myrtle berries. Also, the ground dove nests in wax myrtle and is, therefore, dependant on this habitat. Ground doves are granivores and consume a wide variety of seeds. This species is currently a state-threatened species along with the least tern, glossy ibis, and Wilson's plover. A top predator in this habitat is the sharp-shinned hawk which is a fairly common winter resident. This raptor inhabits woodlands and ventures into the shrub community to hunt for small birds, insects, and small mammals.

Maritime Forests

Painted bunting ***(Passerina ciris)***

Maritime forests provide more diverse habitats than the beach, dunes, or shrub habitats, therefore, they contain a more diverse avian community. The dense vegetation and low canopy height of undisturbed maritime forests, however, act to decrease habitat types compared to inland forests. Therefore, avian species diversity is usually lower than that in inland forests (Sandifer et al 1980). Of the 280 birds found in the ACE Basin study area, almost one- third (87) can be found in the maritime forests . Many of the birds in the maritime forests are passerine birds including flycatchers, swallows, crows, nuthatches, wrens, kinglets, thrushes, vireos, warblers, sparrows, blackbirds, grackles, and finches. Insects make up all or part of the diet of most passerine birds with grains and fruits also important. Warblers, swallows, vireos, and flycatchers feed almost exclusively on insects, while sparrows, buntings, and finches feed mainly on vegetarian matter such as fruits, seeds, and grains (Sprunt and Chamberland 1970). The yellow-rumped warbler, or myrtle warbler, is the most common winter warbler in the ACE Basin study area. This species consumes many small insects along with the fruits of various plants (e.g. waxmyrtle and bayberry). The painted bunting is probably the most visually spectacular bird found in this habitat. This species is a common summer resident that builds its nest in bushes, trees, or Spanish moss and raises up to three broods a year. Turkey and black vultures are both common year-round scavengers in maritime forests. Top year-round predators in the maritime forests include three species of owls (screech owl, barred owl, and great horned owl) and two species of hawks (red-tailed and red-shouldered). The red-shouldered hawk occupies the ecotone between wetlands and forests and frequently feeds in wetland forests (Murphy pers. comm.). This species nests high in large trees near dense woodlands and feeds mostly on frogs and snakes.

Back to Top

Estuarine Ecosystems

Lesser scaup *(Aimophila aestivalis)*

The estuarine subtidal habitat is an open water system used mainly by birds for resting and feeding. All of the birds found in this habitat are water birds which feed on fish, benthos, carrion, or insects. Three species of gulls (laughing, herring, and ring-billed) are considered common year-round residents of the ACE Basin study area. Herring and ring-billed gulls are abundant in winter but rare in other seasons and laughing gulls are abundant in summer but rare in winter. All three species eat a variety of food items and are important in the consumption of dead animal matter. Terns, cormorants, and brown pelicans inhabit open water areas to feed on fish. The double-crested cormorant is a common year-round resident that doesn't breed in South Carolina. Other water birds such as the lesser scaup, ring-necked duck and ruddy duck feed on aquatic vegetation. The lesser scaup is a common winter resident that breeds in Canada. It eats the seeds of water lilies, pondweed, water milfoil, and widgeon grass along with mollusks, crustaceans, and insects. The osprey is the only bird of prey to utilize this habitat where it feeds on its primary prey, fish. Ospreys can be seen year-round but are rare in December and January.

The intertidal salt marshes provide habitat for a variety of avian species. Eighty-seven species of birds utilize salt marshes for feeding or breeding. Thirty-two of these are common year-round residents while an additional thirteen are common winter residents. Wading birds such as herons and egrets use this habitat for feeding on their primary prey which includes mummichogs, mullet, menhaden, and penaeid shrimp. Other birds such as rails, swallows, wrens, and blackbirds use the smooth cordgrass as feeding and nesting grounds. The clapper rail is a strict inhabitant of ACE Basin salt marshes. This species feeds, roosts, nests, and raises its young on the *Spartina* marsh (Sandifer et al. 1980). The clapper rail feeds on crabs, minnows, shrimp, and marsh insects and, in turn, is an important food item for a variety of mammalian and avian predators.

Two sparrows, the sharp-tailed and the seaside, also rely heavily on salt marshes. The sharp- tailed sparrow is a common winter resident while the seaside is a year-round resident that nests on the marsh surface where *Juncus* and *Spartina* are the dominant plants (Bent 1968). Both species consume mostly animal

Northern harrier *(Nyctanassa violacea)* also know as a marsh hawk

matter including insects, crustaceans, and marine worms. The insectivorous long-billed marsh wren is another dominant species of the salt marsh. This species is found only in estuarine and freshwater wetlands and its eggs and young are heavily preyed upon by salt marsh mammals such as raccoons, marsh rice rats, and minks. Four raptors are found in estuarine emergent wetlands. Of these, the northern harrier or marsh hawk is probably the most important. This raptor is a common winter resident that is most abundant during migrations. Marsh hawks prey upon rodents and small birds that inhabit the marsh.

The abundance of fish and invertebrates in intertidal flats provides excellent feeding opportunities for many avian species. Fifty-five species of birds are estimated to occur in this habitat and over half of these are common year-round residents in the ACE Basin study area. Almost all of the species found here are wading birds or shorebirds including herons, egrets, ibises, gulls, plovers, sandpipers, and terns. The boat-tailed grackle and fish crow are the only non-aquatic species found regularly on intertidal flats. Both species feed on small fish and invertebrates.

Eight species of herons and egrets utilize the intertidal flats as feeding grounds with the great egret, snowy egret, and tricolored (Louisiana) heron being the most abundant. Many of the shorebirds feed extensively in this habitat but breed in others (e.g. beaches or bird keys). Migrations into and out of the intertidal flats can greatly affect abundances of some shorebirds in this habitat. Abundances of herring gulls, ring-billed ducks and American oystercatchers increase in the winter as northern birds migrate south. Other species such as the semipalmated plover, ruddy turnstone, and least sandpiper decline in abundance during the summer as they leave to breed in other habitats.

The American oystercatcher is possibly the most notable bird in this habitat. Although it breeds on beaches, this bird feeds exclusively on the flats. Oystercatchers feeds mainly on mollusks including oysters and clams. Upon finding a gaping oyster the bird plunges its beak between the shells to cut the adductor muscle. This causes the shell to fall open and the oyster is easily obtained. Oystercatchers were hunted to near extinction in the early 1900's (Sandifer et al. 1980) but today the species is considered a common year-round resident. Although this bird is now common, the number of nests observed in the ACE Basin study area is low (Oystercatcher abundance) because of anthropogenic disturbance of its nesting habitats.

Back to Top

Wetland Ecosystems

- Impoundments
- Non-Forested Wetlands
- Palustrine Forests

Impoundments

Impoundments are estuarine or freshwater wetlands which have been diked to create managed bodies of water. Most impoundments in the ACE Basin study area are managed for waterfowl and are characterized by brackish or freshwater vegetation. The waterfowl in impoundments consists of geese (Canada geese); puddle ducks (e.g. mallards, teals, gadwalls, wigeons, and shovelers); and diving ducks (e.g. ring-necked ducks, buffleheads, mergansers, and ruddy ducks). Puddle ducks are the most abundant group of waterfowl. These species preferentially feed on wild rice, spikerush, pondweeds, smartweeds, bulrushes, and wigeon grasses and, therefore, many impoundments are managed for these plant species (see Harvest management of waterfowl). The Christmas Bird Count (CBC) found that the green-winged teal and the American wigeon (i.e. baldpate) were among the five most abundant species of birds found within the survey area (Christmas bird count). About 75% of the survey area is non-forested wetlands that contain numerous impoundments.

Rails, coots, and gallinules are also commonly found in impoundments. The king rail inhabits freshwater impoundments while the clapper rail is restricted to estuarine impoundments. Virginia rails, sora rails, American coots and the common gallinules (i.e. common moorhen) inhabit both estuarine and freshwater impoundments where they feed on snails, insects, fish, and aquatic plants. Herons, egrets, and ibises also utilize impoundments for feeding. The CBC found the white ibis to be the most abundant wading bird in the survey area with the great egret, glossy ibis, and great blue heron also abundant (Christmas bird count).

Other shorebirds that are common in impoundments include yellowlegs, plovers, dowitchers, sandpipers and avocets. The American avocet is a rare winter inhabitant of the ACE Basin study area. This species feeds by sweeping its long bill through shallow water and consuming the aquatic insects and marsh plant seeds that it stirs up (National Geographic Society 1987; Potter et al. 1980). The bald eagle and osprey, although uncommon, both use this habitat as hunting grounds.

Non-Forested Wetlands

The avifauna of palustrine non-forested wetlands contains many of the same species that occur in impoundments and estuarine emergent wetlands. The transitional zone from brackish to freshwater contains a high diversity of vegetation for food and habitat. Ninety-two of the 177 avian species in the ACE Basin study area are estimated to occur within non-forested wetlands. Twenty-one of these species are considered common year-round residents while an additional 25 are common winter residents (Bird habitat). The CBC found that the common grackle and the red-winged blackbird were the most abundant species within the survey area. These birds are both omnivores, but there is a seasonal shift from a diet of mostly insects in the spring and summer to mostly seeds and grains in fall and winter (Bent 1965).

Non-forested wetlands provide nesting grounds for a variety of birds including gallinules, wrens, swallows, red-winged blackbirds, and king rails. The tree swallow is probably the most abundant swallow during the winter while the purple martin is the most abundant summer resident. The purple martin nests in hollow trees and bird houses and forages for insects over open areas such as ponds, rivers, and marshes (Bent 1963a). Other birds such as herons, egrets, and ibises use freshwater wetlands as feeding grounds. Great egrets are a common sight in ACE Basin wetlands. This wading bird nests in mixed species colonies in tall trees near or over water.

Waterfowl are abundant in this habitat because the freshwater vegetation is often preferred over salt marsh vegetation for food. Most waterfowl species such as mallards, teals, gadwalls, and pintails are winter residents and, in general, are present in the ACE Basin study area from September to May. The ring-necked duck is especially abundant here during the winter because of its preference for the seeds of freshwater plants such as waterlilies and watershields.

Several insectivores including the common yellowthroat, marsh wren, barn swallow, and purple martin are common in palustrine wetlands while granivorous species include the swamp, song, and Savannah sparrows. Numerous raptor species are found in non-forested wetlands. Ten of the thirteen hawk species identified by the South Carolina Coastal Hawk Migration Survey inhabit non-forested wetlands (Hawk migration). Both the red-tailed and red-shouldered hawks are common year-round residents and marsh hawks and sparrow hawks are the most common winter residents.


Southern bald eagle

Bald eagles are the top predators here, although these birds nest in trees and use the wetlands only for hunting. In 1977, there were only 13 occupied bald eagle breeding areas known to remain in all of South Carolina. Six of the 13 were in the ACE Basin. This remnant population allowed for the recovery of the eagle population to occur far more rapidly then in adjacent states where no nesting eagles remained (Bald eagle nests). The ACE Basin provides high quality nesting habitat with abundant prey, large trees for nesting and protection from disturbance at nest and foraging sites.

Typically, an eagle's diet is composed of 80% fish, 10% birds, 5% mammals and 5% carrion. The presence of abundant bird prey such as coots, moorhens and ducks, however, results in a greater percentage consumption of birds in the diet. This may have mitigated some of the effects of pesticides, with fish prey more heavily contaminated then birds. The extensive acreage of managed marsh impoundments that occur in the ACE Basin study area and elsewhere in the state, may explain why South Carolina maintained a remnant eagle nesting population.

During the 1998 nesting season, 30 of the 129 occupied breeding areas in South Carolina were in the ACE Basin (Bald eagle nests). While the percentage of nests in the ACE Basin has declined as eagle nesting has repopulated statewide, it still remains one of the high density centers for nesting. Nesting occurs during the winter with the peak of egg laying the last week in December. Winter nesting is adaptive as water clarity is maximum, wintering bird prey are available and shad and herring runs coincide with the maximum energy demands of the chicks in the nest.

Bald eagles can be seen during any month of the year, but are most abundant during the winter. They reach their lowest density during July and August because many birds move north after the nesting season.

Palustrine Forests

Forested wetlands in the ACE Basin study area provide avifauna a wide variety of habitat types. The occurrence of wet and dry tree species and both grassland as well as closed canopy sites contribute to a high diversity of birds (Sandifer et al. 1980). An estimated 132 species of birds can be found in forested wetlands; the highest diversity of any environment in the ACE Basin study area. Of these 132 species, 34 are common year-round residents and 23 are common winter residents. Common year-round residents include omnivores such as the American crow, common grackle, and red-winged blackbird; herbivores such as wood ducks and mourning doves; insectivores such as Carolina wrens, white-eyed vireos, and common yellowthroats; scavengers such as black and turkey vultures; and raptors such as bald eagles, barred owls, red-shouldered hawks, and red- tailed hawks. Common winter residents include American goldfinches, robins, cedar waxwings, dark-eyed juncos, eastern phoebes, hooded mergansers, lesser scaups, song sparrows, and ruby- crowned kinglets.

Wood stork ***(Mycteria americana)***

Palustrine forests are important nesting grounds for wading birds such as herons, ibises, and egrets. White ibises which are the second most abundant colonial nesting bird in the ACE Basin study area, nest almost exclusively in wooded swamp habitats (Wading bird nesting habitat). Cattle egrets and great egrets also nest in wooded swamps with 71% and 41%, respectively, of the nests occurring in this habitat. In the ACE Basin study area, wood storks also nest exclusively in wooded swamps. These birds are federally endangered and, until 1981, no eggs or young had been reported in South Carolina. Nesting populations of wood storks have steadily increased since 1981 and in 1997, 653 wood stork nests were identified in the ACE Basin study area (Wood stork abundance).

Ten species of birds are closely associated with forested wetlands. Most of these species are warblers which feed on the large number of insects that occur in this habitat. Seven of these species, the blue-winged warbler, golden-winged warbler, Tennessee warbler, Swainson's warbler, black-throated warbler, gray-cheeked thrush, Louisiana waterthrush, and worm-eating warbler, are rare or uncommon but can be found in forested wetlands of the ACE Basin study area (Bird habitat). The Breeding Bird Survey (BBS) which includes forested wetland habitats identified Swainson's warbler in 1977, 1993, and 1995. The BBS also found the Kentucky warbler, which is considered a fairly common summer resident of the ACE Basin study area, to be present every year from 1991 to 1996.

Back to Top

Riverine Ecosystems

The riverine system as discussed here is limited to the open water areas of rivers and does not include adjacent wetland areas. The avifauna of the riverine systems of the ACE Basin study area is made up of species that occur in other habitats and use the rivers for feeding or resting (Sandifer et al. 1980). Species found here forage in the rivers for aquatic plants or animals. Grebes and wading birds hunt for fish either by diving (grebes) or by fishing from shore (wading birds). Shorebirds such as sandpipers and plovers also fish from shore in the rivers for crustaceans, mollusks, fish, and aquatic insects while gulls and terns forage on the rivers for similar prey.

About eleven species of ducks use the river to forage for aquatic vegetation such as pondweeds, wigeon grass, wild rice, eelgrass, and marsh grass. The wood duck is a dominant year-round resident in riverine systems. This species nests on or near water in the natural cavities of dead or live trees (Potter et al. 1980) and young hatch in April or May. Both year-round residents and wintering residents of wood ducks can be found in the ACE Basin study area. Insectivores such as swifts and swallows hunt over the rivers for aquatic insects. The chimney swift is a voracious insectivore which feeds over rivers. This small, dull-colored bird often gathers in large numbers and spends most, if not all, of its day on the wing catching beetles, flies, and ants (Bent 1964; Sprunt and Chamberlain 1970).

Osprey *(Pandion haliaetus)*

The osprey is the only bird of prey to utilize this habitat extensively. Ospreys can be seen during all months of the year, but are in low numbers during December and January. The osprey not only hunts in the riverine waters for fish but it also commonly nests on dead snags, channel markers, and power line poles in rivers. The osprey is almost exclusively a fish eating species and, like the bald eagle, suffered a dramatic population decline in numbers as a result of pesticide contamination. By the mid 1970's, it is estimated that the statewide population had declined to 300 nesting pairs. Currently this population has recovered to more than 1,000 nesting pairs. Populations within the ACE Basin continue to increase with nesting concentrated on the Combahee River. Unlike the Charleston Harbor population of ospreys, the birds nesting in the ACE Basin only occasionally build nests on manmade objects. The ACE Basin study area serves as a control that can be used to evaluate the effects of development on the osprey population (Murphy pers. comm.).

Back to Top

Old Fields

Old field habitats consist of croplands, fields, and pastures along with their adjacent edge communities in which secondary succession is just beginning. Diversity and densities of birds tend to be low in newly abandoned farmlands and to increase as succession proceeds. The edge community supports a high diversity and density of avifauna. The combination of open grasslands, transitional shrubs, and trees provides ideal habitat for many species by providing access to feeding grounds, nearby escape cover, and prime nesting habitat.

Red-tailed hawk *(Buteo jamaicensis)*

Seventy-four birds are estimated to occur in old-field habitats of the ACE Basin study area. Of these, 20 are common year-round residents, 14 are common winter residents, and seven are common summer residents. Many of the birds (e.g. cardinals, mockingbirds, mourning doves, buntings, and sparrows) that occur here fulfill part or all of their dietary needs from the seeds, grains, and fruits that are plentiful in these fields. Others (e.g. Carolina wren, common yellowthroat, brown thrasher, and eastern meadowlark) consume the insects that are feeding in this habitat. Because many old-field birds consume vast numbers of insects, they are extremely beneficial to farmers in insect control. Omnivores common in this habitat include American crow, red-winged blackbirds, and common grackle. The Breeding Bird Survey and the Christmas Bird Count, which both traverse areas containing old field habitats, found that these species were quite abundant.

Eight birds of prey are found in this habitat. Seven of the eleven species of migratory hawks identified on Edisto Island by the South Carolina Coastal Hawk Migration Survey inhabit old-field communities (Hawk migration). The red-tailed hawk is probably the dominant raptor in this habitat. This large broad-winged hawk feeds primarily by the perch and wait method of hunting. Food consists primarily of small mammals. Because of the extensive time this species spends perching, it is conspicuous on the landscape and is frequently blamed for the depredations of other species of predators. This is the largest and most common of the broad-winged (Buteo) hawks found in the ACE Basin study area (Murphy pers. comm.).

Back to Top

Pine Forests

The avian fauna in pine forests of the ACE Basin study area is less diverse than many other habitats. Coastal plain pine forests don’t develop dense understories because of frequent fires as well as poor soil conditions. The lack of a dense understory combined with the low habitat variability in monotypic pine canopy results in a low species diversity. Fifty-two species of birds are estimated to occur in pine forests and almost half are considered common year-round residents. Insect-eaters, generalists, and seed-eaters are represented by warblers, bobwhites, and the brown-headed nuthatch, respectively.

Four species of warblers can be found in pine forests and the pine warbler is most commonly associated with this habitat. Pine warblers build their nests in pine trees and forage for grasshoppers, locusts, moths, beetles, flies, and other insects. The brown-headed nuthatch is a seed-eating species that is most common in pine forests. This species builds its nests in cavities of decaying trees and lines the nest with the sheaths of pine seeds. The nuthatch consumes mostly pine seeds along with some insects (Sprunt and Chamberlain 1970). The bobwhite quail is an omnivore that is abundant in pine forests. Bobwhites are a popular game bird in the ACE Basin study area and are hunted extensively (See related subsection: Hunting: Bobwhite Quail.) This species builds its nest in areas where vegetation is dense and provides abundant cover. Bobwhites eat a myriad of foods including seeds, insects, fruits, leaves, spiders, crustaceans, and tubers (Bent 1963b).

Woodpeckers are also abundant in this habitat, with the red-bellied being most abundant. The Breeding Bird Survey found the red-bellied woodpecker (Woodpecker abundance) was the most abundant woodpecker species in upland areas. Seven birds of prey can be found in pine forests. The screech-owl, which often builds its nest in woodpecker holes, is a dominant owl species in this habitat (Sandifer et al 1980). Both red-shouldered and red-tailed hawks were found to occur in the upland areas surrounding Walterboro.

Pine-Hardwood Upland Forests

Pine-hardwood forests in the ACE Basin study area have more bird species than the other upland communities. These forests have extensive subcanopy and understory growth that is not found in either pine forests or in old-field communities (see the Plants: Upland Community). The addition of the subcanopy and understory vegetation greatly augments the habitat types available and, therefore, more birds can be found here (Sandifer et al 1980). As with many other forested habitats, insectivores are common in mixed upland forests. Along with warblers and woodpeckers, the Carolina wren, tufted titmouse and white-eyed vireo are abundant (Insectivores). The Carolina wren is the state bird of South Carolina and is found in a variety of habitats. This species will nest almost anywhere a suitable nook or cavity is available including natural cavities, birdhouses, and mailboxes. Carolina wrens feed on a variety of insects and are, therefore, beneficial to farmers. Common granivores in this habitat include the mourning dove and the American goldfinch. Both of these species subsist almost entirely on seeds. The mourning dove is an important game species and is a year-round resident of the ACE Basin study area. The American goldfinch is a winter resident that consumes the seeds of sweetgum trees as a major part of its diet (Martin et al. 1951). The same species of raptors occur in mixed forests as in the pine forests. Dominant scavengers are the black and turkey vultures while the great-horned owl is the top predator (Sandifer et al 1980).

Back to Top

Conservation Issues

Indiscriminate hunting for plumage or sport around the 1900's had devastating effects on many species of birds. The great egret, the snowy egret, and least tern were hunted almost to extinction for their plumage while birds such as the wild turkey and wood duck were over-exploited by sport hunting. Conservation efforts that began in the 1800's have resulted in the protection of many of these

Eastern wild turkey
(Meleagris gallopavo silvestris)

exploited birds. The Endangered Species Act of 1973 was established to protect species that are in danger of becoming extinct. All migratory birds are now protected by federal law as are nonmigratory hawks and owls. These birds can not be killed legally except during regulated hunting season on specific species (Potter et al. 1980).

Unregulated pesticide use has also resulted in population declines of bird species. DDT, which was used in the United States prior to 1972, was particularly harmful because it was applied for a wide variety of purposes and its toxicity persists long after application. Ospreys, wading birds, and bald eagles are among the species of birds that were affected by pesticides such as DDT. These birds are generally higher level predators that are feeding on organisms that have bioaccumulated harmful pesticides. As these birds bioaccumulate pesticides, both lethal and sublethal effects can result. Birds can die from lethal effects or from weakness associated with the pesticides which causes increased susceptibility to disease or predators. One of the most common sublethal effects associated with pesticide use is thinning of eggshells. Thin eggshells are more likely to break, thereby killing the young. Obviously, when the young die, the population declines greatly. Through more strict regulations on pesticide use, bald eagles, pelicans, and ospreys, as well as many other bird species are slowly recovering.

The most serious conservation issue for birds of the ACE Basin study area is habitat destruction. Although much of the ACE Basin study area is protected from development, there are still concerns. The conversion of upland communities into pine plantations and croplands has limited habitat diversity resulting in a subsequent decline in species diversity. Development of the beach communities has decreased the nesting habitat available to shorebirds. Redivergence of river channels has destroyed several bird keys that are important to colonial waterbirds. Habitat destruction in other regions can significantly affect species in the ACE Basin study area. As discussed above, many birds are migratory and use the ACE Basin study area only for a part of the year. For example, songbirds such as the summer tanager migrate from their summer breeding grounds (which includes the ACE Basin study area) to Latin America for the winter. As nesting habitat (i.e. forests) in the ACE Basin study area and winter habitats in Latin America are converted to other land uses songbird populations decline. Recent declines in songbird population have been noted both nationally and in the ACE Basin.

To ensure the health of the avifauna, conservation groups must continue to strive to protect species from harm due to over-hunting, environmental pollution, and habitat loss. Careful control of hunting and pesticide use can protect species to a degree, but habitats must be preserved. Because every species has different needs, the effect of development on each species found in a habitat must be examined to ensure the continued existence of the population.

NEXT SECTION: Mammals

Author

L. Zimmerman, SCDNR Marine Resources Research Institute

References

Bent, A. C. 1963a. Life histories of North American flycatchers. Dover Publishing Inc., New York, NY.

Bent, A. C. 1963b. Life histories of North American gallinaceous birds. Dover Publishing Inc., New York, NY.

Bent, A. C. 1964. Life histories of North American cuckoos, goatsuckers, hummingbirds and their allies. 2 Parts. Dover Publishing Inc., New York, NY.

Bent, A. C. 1965. Life histories of North American blackbirds, orioles, tanagers and allies. Dover Publishing Inc., New York, NY.

Bent, A. C. 1968. Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies. Smithsonian Institution Press, Washington, DC.

Campbell, N. A. 1993. Biology. 3rd Edition. Benjamin/Cumming Publishing Company Inc., Redwood City, CA.

Martin, A. C., H. S. Zim, and A. L. Nelson. 1951. American wildlife and plants: A guide to wildlife food habits. Dover Publishing Inc., New York, NY.

Murphy, T. undated personal communication. South Carolina Department of Natural Resources, Wildlife and Freshwater Fisheries Division.

National Geographic Society. 1987. Field guide to birds of North America. Second edition. National Geographic Society, Washington, DC.

Potter, E. F., J. F. Parnell, and R. P. Teulings. 1980. Birds of the Carolinas. University of North Carolina Press, Chapel Hill, NC.

Sandifer, P. A., J. V. Miglarese, D. R. Calder, J. J. Manzi, and L. A. Barclay. 1980. Ecological characterization of the sea island coastal region of South Carolina and Georgia. Vol. III: Biological features of the characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-79/42.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Mammals

Introduction

Mammals are often considered to be the most advanced form of life on earth (Golley 1966). All mammals have the following characteristics in common: (1) possess four limbs; (2) young are nourished from mammary glands of the female; (3) have respiratory system with diaphragm to ventilate lungs; (4) can maintain body temperature independent of external temperature; (5) most bear live young; and (5) possess hair (Campbell 1993).

White tailed deer
(Odocolleus virginianus)

Mammals fill a wide range of ecological roles within an ecosystem. Herbivores such as rabbits and deer are the primary consumers which feed on plant material and are prey to numerous omnivores and carnivores. Omnivores such as moles, shrews, opossums, and bears feed on a wide variety of plant and animal matter and can function as both predator and prey in an ecosystem. Carnivores such as raccoons, dolphins, and bobcats feed on other animals and can be essential in the population control of other mammals. Predators preferentially prey upon old, weak, or diseased animals, which helps maintain the health of the prey population. The abundance and availability of prey, likewise, control predator populations because when prey are scarce predator populations decline.

There are approximately 4,500 species of mammals separated into 14 orders (Campbell 1993). Forty-seven species of mammals, in nine orders, are estimated to occur in the ACE Basin study area (See mammal species list). The orders of mammals in the ACE Basin study area include marsupials, insectivores, bats, rabbits, rodents, carnivores, manatees, dolphins, and hooved mammals. Many mammals are widely distributed and can be found in a variety of habitats; however, they often tend to exhibit a preference for a specific habitat. Different habitats within the Basin will contain unique mammalian faunal communities, which will be discussed below. Few data exist on densities of mammalian species in the ACE Basin study area; therefore, occurrence rather than numerical abundance will be presented here.

Back to Top

Coastal Habitats

- Coastal Waters
- Dune Communities
- Maritime Forests

Coastal Waters

A number of mammals have adapted to an exclusively aquatic life. These include dolphins, whales, and manatees. A number of dolphins and whales can be found in waters offshore of the ACE Basin study area. These include the saddleback, Risso, Atlantic spotted, and striped dolphins, as well as the short-finned pilot, killer, goose-beaked, sperm, dwarf sperm, and pygmy whales. These species are almost exclusively oceanic species and are encountered only very rarely in the near-shore coastal regions. Two species of marine mammals are residents in the coastal waters of the ACE Basin study area, the bottlenose dolphin and the West Indian manatee (See mammal habitat).

The bottlenosed dolphin is widely distributed throughout the world's oceans and is a year-round resident in the ACE Basin study area. In a particular area, dolphins are either migratory or permanent year-round residents. For example, in Bull Creek, South Carolina, near Hilton Head, 67 bottlenose dolphins have been identified, and 22 of these are residents (Petricig 1993). Groups of bottlenose dolphins, called pods, can be seen regularly in the waterways of the ACE Basin study area. Pods are commonly made up of 6-8 individuals. Dolphins feed on various species of fish, shrimp, crabs, and squid. Females reach sexual maturity at 7-10 years of age, breeding is seasonal with most activity in the spring, gestation lasts 12 months, and the young continue to nurse for up to 24 months although they begin eating fish at 6-7 months (S. Murphy, 1998, pers. comm.).

West Indian manatee
(Trichechus manatus)

The West Indian manatee occurs along the coast of Florida, Georgia, and South Carolina. Manatees often undertake extensive north-south seasonal migrations. Manatees are herbivores that feed opportunistically on a wide variety of submerged, floating, and emergent vegetation. Shallow grass beds with ready access to deep channels are preferred feeding areas in coastal and riverine habitats. In the ACE Basin study area, manatees feed on smooth cordgrass during high tide. Females reach sexual maturity at age five, breeding occurs year round but is most common from March through November, gestation is probably 12-14 months, and calves remain with their mother for 1-2 years. Manatees are slow moving animals, and consequently, mortality due to collision with boats and ships is high. Also, manatees can become entangled in or ingest various debris (e.g. monofilament line, plastic bags, and fish hooks) that can lead to injury or death (S. Murphy, 1998, pers. comm.).

Dune Communities

Raccoon *(Procyon lotor)*

The sand dunes and maritime dune shrub community along the coast of the ACE Basin study area are extremely harsh environments, and few mammalian species are adapted to subsist here (Sandifer et al. 1980). In general, only those species which can adapt to survive in any habitat are found in the dune communities (Mammal Habitat). Several of these species, such as the house mouse and raccoon, are generalist feeders which consume a wide variety of plant and animal matter. Pelton (1975) found the house mouse to be the dominant mammal in the sand dunes of Kiawah Island, South Carolina. Andre (1981) found that the marsh rice rat was the only small mammal trapped in the sand dunes of Bulls Island, Charleston County. Other small mammals which can be found on the dunes include the eastern mole, which can exist anywhere moist soils occur, and the cottontail and marsh rabbits. The marsh rabbit is the more abundant of the two rabbit species in the dune habitats. All of these small mammals provide important prey items for birds of prey which hunt extensively over the dunes.

White-tailed deer, opossums, and raccoons are probably the only large mammals found on sand dunes. These mammals come out onto the dunes to graze (deer) or to hunt (raccoons and opossums). White-tailed deer are a ubiquitous mammal species that can be found in every habitat in the ACE Basin study area, including the dune community. Deer are highly adaptable to different habitats but benefit from transitional zones that combine fields, croplands, and young forests. Raccoons are the principal carnivore on the dunes. This species eats a wide variety of plants and animal matter, and, on the dunes, they can be a serious threat to sea turtle eggs. (See related subsection: Herpetofauna: Coastal Marine Habitats.) Raccoons are very adaptable and can be found in almost any habitat. A furbearer survey conducted in the ACE Basin study area by the Wildlife and Freshwater Fisheries division (WFF) of the South Carolina Department of Natural Resources (SCDNR) found that raccoons occurred at all the sites studied.

Maritime Forests

Maritime forests of the barrier islands in the ACE Basin study area, such as Edisto Island, contain a more diverse mammalian community than the dune communities which often border them mammal habitat . However, this community is generally more impoverished than the mainland forested communities (Sandifer et al. 1980). The maritime forest provides ample food and shelter to the mammals which live there (See related section Plants: Maritime Community).

All five insectivore species of the ACE Basin study area probably occur in maritime forests. These mammals are important predators in this habitat. Shrews and moles are voracious insect eaters and are beneficial to humans in insect control. Shrews live on the surface under cover of grasses, leaves, logs, or rocks, while moles build extensive tunnels in the soil and spend most of their time underground (Webster et al. 1985). The short-tailed shrew, least shrew, and eastern moles were found in the maritime forest of Kiawah Island, South Carolina (Pelton 1975).

Seminole bat *(Lasiurus seminolus)*

Bats are another important predator in the maritime forests of the ACE Basin study area. All 11 species of bats that are found in the ACE Basin study area consume insects and are also beneficial to man in insect control. Most bats roost in trees and leave their roosts at dusk to forage over open fields or permanent water. The dominant bats in the maritime forests are probably Seminole bats, red bats, big-brown bats, and evening bats. The Seminole bat prefers to roost in pine trees, while the red bat prefers hardwoods (M. Strayer Bunch, 1998, pers. comm.).

Although both the cottontail and marsh rabbits utilize the maritime forests only rarely, numerous rodent species can be found in this habitat. Both gray and fox squirrels can be found in maritime forests on barrier islands. These species feed on the mast of coniferous or hardwood trees. Gray squirrels prefer large tracts of mature forests of oak, hickory, and beech mixed with other hardwoods and conifers. Trees are used not only for the mast they produce but also as nesting sites (Webster et al. 1985). Fox squirrels are larger than gray squirrels and prefer to inhabit longleaf pine and pine-oak forests (Webster et al. 1985; Whitney 1998). The fox squirrel dens in hollow tree trunks and, therefore, mature trees are important to this species (Webster et al. 1985). Other rodents that probably inhabit the maritime forests include the cotton mouse, cotton rat, eastern woodrat, and marsh rice rat. Andre (1981) trapped both the rice rat and the cotton mouse in the maritime forests of Bulls Island, South Carolina, and Pelton (1975) found that the cotton mouse, cotton rat, and eastern woodrat were the dominant rodents in the maritime forests of Kiawah Island, South Carolina.

Of the larger omnivorous or carnivorous mammals, the raccoon, opossum, and bobcat are probably the most abundant in the maritime forests (Pelton 1975). The bobcat is usually found in heavily forested areas and preys upon rodents and rabbits. This species can also be found traveling through or foraging near impoundments. The SCDNR Wildlife and Freshwater Fisheries Furbearer Survey found bobcats in non-forested wetlands bordered by forests on Bear Island in the ACE Basin study area. The bobcat's pelt is valuable, and harvest of the bobcat is allowed statewide. The cat is not endangered, but harvest is heavily monitored (Baker and Carmichael 1996).

Feral pigs and white-tailed deer are also abundant in maritime forests. Pelton (1975) noted that both of these species were found in many different habitats on Kiawah Island including dunes, marshes, woodlands, and old fields.

Back to Top

Estuarine Ecosystems

Like the dune community, the salt marsh habitats of the ACE Basin study area have a low diversity of mammals (Mammal Habitat). However, several species of mammals are specifically adapted to this habitat. The marsh rabbit is often abundant in the brackish marshes of coastal zones. It feeds upon a variety of marsh plants including cat brier, centella, marsh pennywort, and cattails (see Plants: Estuarine Community). This rabbit is prey for owls, hawks, foxes, alligators, and snakes. The marsh rice rat is also adapted to the salt marsh habitat (Webster et al. 1985). Andre (1981) found that the rice rat was the dominant small mammal in the salt marsh of Bulls Island, South Carolina.

Marsh rabbit
(Sylvilagus palustris)

River otters are a dominant carnivore in the salt marsh habitat. They feed on a variety of aquatic animals including fish, crustaceans, turtles, and waterfowl (Baker and Carmichael 1996). River otters prefer clear waters free of human disturbance. Impacts of industrial and urban wastes on the fish and crustaceans that otters feed on has decreased populations in some areas, as has loss of suitable habitat. In South Carolina, otter populations have remained stable (Baker and Carmichael 1996).

Back to Top

Palustrine Ecosystem

The palustrine ecosystem is the most diverse habitat in the ACE Basin study area (see Plants: Palustrine Community). The ecosystem contains freshwater rivers, marshes, meadows, swamps, hardwood forests, mixed forests, and pine forests. Because it is so diverse, the palustrine ecosystem is likely to provide suitable habitat for every mammal found in the ACE Basin study area (Mammal Habitat). Some species, such as the opossum, eastern mole, golden mouse, house mouse, cottontail rabbit, raccoon, long-tailed weasel, and white-tailed deer are ubiquitous and are found in many different palustrine habitats. Other species exhibit specific habitat preferences.

Southeastern shrews prefer damp fields or floodplains while short-tailed shrews seek the shelter of leaf litter in forested areas (Webster et al. 1985; Mengak et al. 1987). Bats utilize the palustrine forests and swamps just as they do the maritime forests. Many bats roost in man-made structures and, wherever there are abandoned buildings or mines in the ACE Basin study area, bats such as the free-tailed or big-brown are probably present. The palustrine forests are also home to rodents such as the gray squirrel, fox squirrel, eastern woodrat, and cotton rats. Weakley (1981) found that all of these species were common in woodlands on Mary's Island, South Carolina.

Palustrine forests are also inhabited by gray foxes and, to a lesser extent, black bears. Gray foxes are considered woodland inhabitants, although a mixture of woodlands and fields may be beneficial (Baker and Carmichael 1996).

Gray fox ***(Urocyon cinereoargenteus)***

Foxes feed on rats, mice, and rabbits, as well as some plant material and carrion. The SCDNR Wildlife and Freshwater Fisheries Furbearer Survey found that gray foxes occurred in both upland and wetland forests but did not occur in non-forested wetlands. Gray fox pelts are considered valuable, and commercial harvest of this species in South Carolina is second only to the raccoon (see Hunting: Gray Fox).

Freshwater marshes and swamps in the palustrine ecosystem are the preferred habitat of several mammals. Many species of bats forage for food in the open water regions of swamps, and both the marsh rabbit and the cotton mouse preferentially inhabit these wet areas. The star-nosed mole builds subterranean and surface tunnels in moist soils, where it spends most of its life. Like other insectivores it consumes insects and, in turn, is consumed by raptors, skunks, minks, and snakes. This small mammal is beneficial in insect control and soil aeration; however, it has been listed as an endangered species by the South Carolina Heritage Trust.

The beaver also occupies swamps in freshwater wetlands. Beavers are herbivores that eat leaves, twigs, and bark. They build dams in streams and ponds, which often flood surrounding lands. The resulting wetlands are used for feeding and nesting by not only the beaver but also many other animals (Webster et al. 1985). In the past, beaver pelts were so valuable that the species was extirpated from South Carolina and had to be reintroduced in 1940. Demand for beaver pelts has diminished in recent years, and populations in the ACE Basin study area are probably stable (Baker and Carmichael 1996).

Minks are an important carnivore in swamps as well as marshes (Weakley 1981; Clark et al. 1985; Baker and Carmichael 1996). They consume a variety of prey, but fish seem to be most important (Baker and Carmichael 1996). Minks are generally nocturnal and live in dens under tree roots, bridge crossings, rock piles, and along stream beds (Webster et al. 1985; Baker and Carmichael 1996). Historically, minks were exploited heavily for their pelts; however, most minks harvested today are farm-raised. As with the otters, the greatest threat to mink populations currently is loss of habitat and pesticide contamination (Baker and Carmichael 1996).

Back to Top

Upland Ecosystems

The upland ecosystem in the ACE Basin study area contains fewer unique habitats than palustrine ecosystems (see Plants: Upland Community) and, therefore, a less diverse mammalian community (Mammal Habitat). Two species of mammals are probably more common in the uplands than in the palustrine ecosystem. The old field mouse has its highest abundance in sandhill habitats which occur in the uplands of the ACE Basin study area (Webster et al. 1985). The striped skunk is generally associated with uplands and is seldom seen in wetland environments (Webster et al. 1985). The striped skunk occupies a wide variety of habitats from forests to cultivated fields and suburban neighborhoods. Skunks are nocturnal and feed on many kinds of plants and animals. Skunks release a noxious musk to discourage predators. However, great horned owls, which along with bobcats are the primary predator of skunks, do not appear to be affected by this deterrent.

Eastern cottontail rabbit
(Sylvilagus floridanus)

Much of the upland areas in the ACE Basin study area have been converted to agricultural fields (see Resource Use: Agriculture). Regions which contain agricultural or cleared fields interspersed with woodlands provide suitable habitat for a number of mammalian species. Species which inhabit the interspersed cropland/woodland areas include cottontail rabbits, cotton rat, Norway rat, oldfield mouse, eastern harvest mouse, coyote, red fox, and white-tailed deer. For small herbivorous mammals such as cottontail rabbits, this habitat provides sites for foraging as well as sufficient cover for protection against predators (Webster et al. 1985). Cottontail rabbits consume numerous types of plant material, but herbaceous plants provide the bulk of the food. This species is an important prey for such predators as foxes, bobcats, raptors, and snakes (Webster et al. 1985). "Edge" species such as cottontail rabbits depend heavily on the protection of transition plant species such as hedges and thickets. The current agricultural practice of plowing and planting fields up to the forest edge has dramatically reduced the amount of suitable habitat for rabbits as well as other "edge" species (Lucas 1991).

Coyotes and red foxes utilize the agricultural fields to hunt the small mammals which forage there. Both species feed on rabbits, mice, birds, insects, carrion, and even some fruits and berries. Neither the coyote nor red fox are native to South Carolina. Coyotes were first seen in the Northwest section of the state and are expanding towards the southeast. Red foxes are common in South Carolina, but habitat competition with coyotes is expected to decrease their numbers.

Another habitat common to the uplands is pine forests and pine plantations. These forested areas contain a mammalian community that is similar to that found in palustrine forests. A few species such as the fox squirrel and Seminole bats would have higher abundances here than in the palustrine forests because of their preference for feeding on or roosting in pine trees.

Back to Top

Current Status of Mammals

Man is the greatest threat to the mammalian fauna of

Black bear *(Ursus americanus)*

the ACE Basin study area. Loss of habitat, hunting, and environmental pollution all affect the mammalian community. For example, both the red and gray wolf were common in South Carolina during early American history. However, both were exterminated by over-hunting during colonial times. The mountain lion is also believed to be extirpated in South Carolina due to hunting by poachers and those unaware that it is an endangered species. West Indian manatees are in danger of becoming extinct because of anthropogenic impacts on the population (e.g. collision with boats, entrapment in flood gates or navigational locks, and red tide outbreaks). The West Indian manatee is the only mammalian species in the ACE Basin study area that is listed as federally endangered. The black bear, bottle-nose dolphin, and a subspecies of white-tailed deer found on Hunting Island are listed as species of Special Concern by the South Carolina Heritage Trust and are documented by Heritage Trust as occurring in the ACE Basin study area. A number of other species listed as threatened, endangered, or species of special concern most likely occur in the ACE Basin study area but have not been documented by Heritage Trust (See list of endangered mammals).

Loss of habitat is probably the most significant threat to mammals. Conversion of forested lands to agricultural fields or pine plantations produces monocultures which support substantially fewer species (Meffe and Carroll 1994). Increased urbanization in the ACE Basin study area will decrease the amount of large undisturbed tracts of land, which can affect large mammalian species such as the mountain lion and black bear. As with the wolves and mountain lion, black bear were once abundant in South Carolina (Webster et al. 1985). However, a vast decrease in the amount of undisturbed habitat has all but eliminated them from the ACE Basin study area and only transients are now encountered (Breck Carmichael, SCDNR Wildlife and Freshwater Fisheries, per. comm.).

To preserve the mammalian fauna in the ACE Basin study area, large tracts of undisturbed land that have an interspersion of many different habitat types such as wetlands, meadows, and forests must be protected. This diverse ecosystem can, in turn, support a diverse mammalian community.

NEXT SECTION: Threatened and Endangered Species

Author

L. Zimmerman, SCDNR Marine Resources Research Institute

References

Andre, J. B. 1981. Habitat use and relative abundance of the small mammals of a South Carolina barrier island. Brimleyana 5:129-134.

Baker, O.E. III and D.B. Carmichael, Jr. 1996. South Carolina's Furbearers. Department of Natural Resources, Division of Wildlife and Freshwater Fisheries.

Campbell, N.A. 1993. Biology. 3rd Edition. Benjamin/Cumming Publishing Company, Inc. Redwood City, CA.

Clark, M.K., D.S. Lee, and J.B. Funderburg Jr. 1985. The mammal fauna of Carolina Bays, Pocosins, and associated communities in North Carolina: an overview. Brimleyana 11:1-38.

Golley, F.B. 1966. South Carolina Mammals. The Charleston Museum, Charleston, SC.

Lucas, G. 1991. Fleet foot. South Carolina Wildlife 38(6):6-10.

Meffe, G.K. and C. R. Carroll. 1994. Principles of Conservation Biology. Sinauer Associates, Inc., Sunderland, MA.

Mengak, M.T., D.C Guynn Jr., J.K. Edwards, D.L. Sanders, and S.M. Miller. 1987. Abundance and distribution of shrews in western South Carolina. Brimleyana 13:63-66.

Murphy, S. 1998 personal communication. South Carolina Department of Natural Resources, Wildlife and Freshwater Fisheries Division. Charleston, South Carolina.

Pelton, M.R. 1975. Mammalogy. *In:* W.M. Campbell, J.M. Dean, and W.D. Chamberlain (eds). Environmental inventory of Kiawah Island. Report prepared for Coastal Shores Inc. Environmental Research Center Inc., Columbia, SC.

Petricig, R. 1993. Population and behavioral patterns of bottlenose dolphins in Bull Creek, South Carolina. *In* Wang, K., P. Payne, and V. Thayer (eds.) Coastal Stock(s) of Atlantic Bottlenose Dolphin: Status Review and Management. Proceedings and Recommendations from a Workshop held in Beaufort, North Carolina, 13-14 September 1993. National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Silver Spring, MD.

Sandifer P.A., J.V. Miglarese, D.R. Calder, J.J. Manzi, L.A. Barclay. 1980. Ecological characterization of the Sea Island coastal region of South Carolina and Georgia, Vol. III: Biological features of the characterization area. United States Fish and Wildlife Service, Office of Biological Services, Washington, D.C., FWS/OBS-79/42.

Strayer Bunch, M. 1998 personal communication. South Carolina Department of Natural Resources, Wildlife and Freshwater Fisheries Division. Clemson, South Carolina.

Webster, W.D., J.F. Parnell, and W.C. Biggs Jr. 1985. Mammals of the Carolinas, Virginia, and Maryland. University of North Carolina Press, Chapel Hill, NC.

Weakley, A.S. 1981. Natural features inventory and management recommendations for Mary's Island Plantation, Colleton County, South Carolina. Ph.D. Dissertation. Duke University, Durham, NC.

Whitney, M. 1998. 1996 Fox squirrel sighting survey report. Department of Natural Resources, Division of Wildlife and Freshwater Fisheries.

Threatened and Endangered Species

Introduction

Least tern *(Sterna albifrons)*
A state threatened species

One of the more obvious resource management concerns is regionally and nationally endangered and threatened species (Forsythe and Ezell 1976, Sandifer et al. 1980, USFWS 1998). While the low pollution levels, limited urbanization, and relatively high habitat diversity contribute to the importance of the ACE Basin as a refuge for endangered species, future unchecked and environmentally unfriendly development may reduce the ability of the area to support endangered species. Why are so many species becoming either locally or completely extinct? This is primarily a result of loss of habitat, over-harvesting, and the introduction of exotic species (Clegg et al. 1995). In the United States over the last 300 years, human activity changed terrestrial habitats from primarily forested to agricultural and urban uses. The loss of large areas of undisturbed habitats, in combination with over-harvesting, has either driven species to extinction or narrowed their range to central or core areas. Some species are more vulnerable to local or complete extinction because of characteristics of the organisms' biology. For example, the behavior and biology of the Florida panther and black bear necessitates that they occupy large areas of undisturbed forest. The loss of large contiguous areas has reduced the range and populations of these two species considerably (Hoage 1985).

The following definitions were taken from the Endangered Species Act of 1973. An endangered species is defined as "...any species which is in danger of extinction throughout all or a significant portion of its range." A threatened species is defined as "...any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

The State of South Carolina recognizes both of these designations through its own legislation and mandates established in the mid-1970s. Other species are considered of regional or local concern if their populations are threatened in South Carolina but not necessarily threatened throughout their entire range. (See related section: SC State Laws: Non-game and Endangered Species Conservation Act.)

The ESA and Ecosystem Management

The Endangered Species Act should not be considered a front-line management tool; rather, it should be considered a final defense against the permanent loss of a species or habitat (Clegg et al. 1995). The first lines of defense should involve integrated management of ecosystems at a broad level that includes local planning, zoning, local and state efforts to protect wildlife and habitats, and conservation easements, as well as others. If management at these levels fails and a population falls to levels that are considered threatened or endangered, the ESA and its management tools would be used to slow the loss of the species by protecting critical habitats and implementing recovery plans. Implementation of the ESA by itself will not stop the extinction of a species; that requires the cooperation of many agencies to implement a recovery plan that may lead to the recovery of the species.

In the ACE Basin, initiatives were implemented over the last decade or two that resulted in large tracts of land being permanently protected from significant development. These efforts are part of the reason for the health of the wildlife populations in the ACE Basin, including endangered species such as the woodstork, bald eagle, and peregrine falcon. The last two have been proposed for delisting, but no action has been taken to date.

Symptoms of an Impacted Population

It is often difficult to assess when a given population or species is threatened or endangered. One of the primary methods is observation of a decrease in the range of the species (USFWS 1985). A decrease in the geographic range of a species occurs as a species goes from relatively high population numbers towards extinction. The decline in population levels may be a result of over harvest, such as occurred with the American alligator, or as a result of decreased habitat, as has occurred with the red-cockaded woodpecker. As the population continues to decrease in size, individuals are found only in core regions of their original range. These core areas can be considered as vital habitat for the species, and reduction of those habitats may seriously impact the species.

As an example, during the 1800s -1900s, animals such as the Florida panther and black bear, which require a large home range, found it increasingly difficult to co-exist with a rapidly expanding human population (Clegg et al. 1995). Their large body size and position high up the food chain requires a broad area in which to find food to survive. As the size of these habitats was reduced by agriculture and other human-induced changes, these species found it increasingly difficult to find undisturbed critical habitats. In addition, Florida panther and black bear were hunted extensively, which further reduced their populations. By comparison, deer, which are a relatively large mammal, have been able to adapt to the changing environment by utilizing agricultural fields and suburban habitats to find the food and shelter they need. Historically, unrestricted hunting was the greatest threat facing deer populations. With restrictions and other management practices, these populations are no longer under serious threat and may be considered by some to be a nuisance species. (See related section: Hunting.)

Biological Basis for Species Extinctions

Changing habitats, as well as the inability of a species to adapt to those changes, is one of the primary reasons for the extinction of a species. Over evolutionary time, millions of species have evolved and become extinct as major changes have occurred at global and regional levels. Of concern to managers today is not that species become extinct, but rather the greatly increased rate of extinction, which is well above estimated natural rates (Clegg et al. 1995).

The extinction of species is dependent on a number of factors related to the biology and behavior of a species as well as their exploitation by humans (hunting, commercial harvest). Long lifetimes and narrow habitat requirements are the primary characteristics that can lead to a species becoming threatened or endangered. Other characteristics include the stability of their required habitats over time, the position of the species within the food chain, and biological factors such as body size and reproduction rates.

The East Coast of North America has been relatively stable for millions of years, allowing for the development of complex animal communities that were dependent on expansive areas of undisturbed forest, plains, and wetlands, and long periods of stable conditions. As these habitats were changed, initially by native Americans, and then even more rapidly by European settlers, those species dependent on extensive areas of forest dwindled in numbers. As these habitats were converted from their natural form to those utilized by humans (forest to field or suburban development), the community of species dependent on the original habitat changed.

Another aspect of the biology of a species that may make it vulnerable to extinction is its reproductive behavior. Animals that live for a long time, have only a few offspring per year, have long gestations periods, and have long periods in which the parents care for the young are called "k"-selected species. Examples are manatees, sharks, dolphins, sea turtles, and humans. Species that live for a short time, produce many young, and do not care for their young are "r"-selected species. Examples are mosquitoes, white shrimp, and anchovies. Because of their inability to reproduce rapidly, "k"-selected species tend to be more sensitive to change and are, therefore, less able to adapt to a rapidly changing environment. (Humans are a notable exception.)

Federal and State Responsibilities

The Federal Endangered Species Act (ESA) of 1973, as amended, (16 U.S.C. 1531 et seq.) was instituted to provide protection for species on the brink of extinction and to emphasize the loss of species through habitat modification and commercial activities. The State of South Carolina followed in 1974 with a companion ESA to protect endangered and threatened species in South Carolina. Also included were species that were not necessarily close to being listed as a federally threatened or endangered species but were likely to be lost from the state. These species are listed as species of regional or local concern.

Sign posted to protect loggerhead turtle nesting area

The Secretaries of Interior and Commerce, working primarily through the US Fish and Wildlife Service and the National Marine Fisheries Service, are the primary governmental organizations charged with the determination of federally threatened or endangered species. Five factors are considered when determining if a species is threatened, and these are based on the best scientific and commercial data available, as well as whether the species is currently being managed by other international governments. These factors include present or threatened destruction, modification, or curtailment of a species habitat or range; overutilization for commercial, recreational, scientific, or educational purposes; disease or predation; the inadequacy of existing regulatory mechanisms; and other natural or manmade factors affecting its continued existence (National Oceanic and Atmospheric Administration 1996).

Each species to be included, removed, or considered for change in status goes through a review process that includes a scientific review of available information and data, a period for public comment, and documentation in the Federal Register. The Federal Register can be accessed on the Web. The Secretary determines what regulations and conservation practices are necessary to provide for the conservation of the species and its critical habitat. For many species, recovery plans are required to develop a set of criteria for delisting and a list of tasks required to achieve these goals. These recovery plans are then implemented by all branches of government responsible for the protection of natural resources, as well as private companies, non-governmental organizations, and private individuals which monitor these populations to document changes in abundance and to evaluate the effectiveness of management activities (National Oceanic and Atmospheric Administration 1996).

Species listed as endangered or threatened by the federal government are automatically listed at the same classification by the State of South Carolina. In some cases, the state may have data to indicate that the species needs extra protection and may list a federally threatened species as a state endangered species, increasing the level of protection for the species in South Carolina. The South Carolina Department of Natural Resources, Heritage Trust section, has several committees that review the status of species of concern and make recommendations to their advisory board. In cases deemed appropriate, the advisory board may increase a species from a species of concern to threatened, or from threatened to endangered.

Endangered and Threatened Species in the ACE Basin

•American Alligator	•Bald Eagle	•Least Tern	•Canby's Dropwort
•Loggerhead Sea Turtle	•Peregrine Falcon	•Red-cockaded Woodpecker	
•Shortnose Sturgeon	•Wood Stork	•Other Endangered Species	

There are currently nine federally endangered and six threatened species of plants and animals that are found in ACE Basin habitats at some point during the year (See endangered species). Five of these species (Atlantic loggerhead turtle, southern bald eagle, wood stork, shortnose sturgeon, and peregrine falcon) occur regularly in the ACE Basin, while others are seen seasonally (manatee) or are suspected to be in the ACE Basin but have not been extensively surveyed (pondberry, island glass lizard). These species either are permanent residents that may be found year round or are seasonally dependent on the habitats in the ACE Basin for some portion of their life cycle. The Florida subspecies of the West Indian manatee passes through the ACE Basin area during exploratory movements (sometime as far north as the Chesapeake) and may reside seasonally during the summer months. There is only one plant species (Canby's dropwart) listed as a federally endangered species known to exist in the ACE Basin, although the pondberry is suspected to be present. Approximately 30 additional species are designated by the State of South Carolina as threatened, endangered, or species of concern. (See Interactive Map of Endangered Species).

American Alligator

American alligator
(Alligator mississippiensis)

Wetlands in the ACE Basin provide diverse habitats important to the American alligator. Overall, alligator populations within the tri-river system have been increasing. In an intensive study of alligator nesting ecology in coastal South Carolina, Wilkinson (1983) characterized the ACE Basin as one of the most important nesting regions in the state. Marsh impoundments are their preferred nesting habitat. Estuarine impoundments provide abundant and diverse food resources, varied water depths (optimum foraging habitat for all age classes of alligators), and excellent nesting sites on internal remnant dikes and berms of functional embankments (Wilkinson 1983). Since freshwater or low salinity wetlands (< 12 ppt) are preferred by nesting alligators, most reproductive activity occurs within impoundments. In response to extended protected status, South Carolina's alligator populations have increased significantly, and the species currently is officially considered as "threatened." The alligator's present status allows for a controlled harvest that South Carolina Wildlife and Marine Resources Division, now the SC Department of Natural Resources, Marine Resources Division, initiated in 1988 through exclusive removal of "nuisance" alligators by authorized agents. This program is designed to minimize troublesome alligator-human encounters typically associated with expanding urban communities. Bear Island Wildlife Management Area serves as the headquarters for alligator hide storage and sale for animals removed through this program. (See related section: Protected Lands.)

Bald Eagle

Bald eagle on the nest

The ACE Basin supports 23.3 percent of South Carolina's nesting bald eagles, making it the most important southern bald eagle nesting region in the state. There were 30 occupied nesting territories in 1998 (T. Murphy, 1998, pers. comm.). Presence of suitable nest trees and short distances to abundant prey in rivers and impoundments have been cited as the most important potential factors for eagle nest siting (Murphy and Coker 1978, Bryon et al. 1996). Within the ACE Basin, impoundments interspersed among isolated islands that support large pine forests/trees provide excellent eagle nesting habitat. The isolated location of the basin and the availability of food in rivers and impoundments enhance successful eagle nesting. Typical food remains found in eagle nests suggest that they prey heavily on common moorhens and occasionally on coots and catfish (Murphy and Coker 1978). The lack of industrial pollutants may also contribute to eagle reproductive success in the ACE Basin.

Canby's Dropwort

Canby's dropwort

Canby's dropwort is the only plant species occurring in the ACE Basin that is listed as a federally endangered species. Only one population of Canby's dropwort exists in the ACE Basin, and only 25 populations exist in the Coastal Plain of the East Coast of the United States between Delaware and Georgia (USFWS 1990). This genus is not found anywhere else in the world. Canby's dropwort can be found in wetland habitats such as pond cypress savannas, cypress pond/pine sloughs, wet pine savannas, and Carolina bays. The plant requires open, shallowly flooded areas. This species is sensitive to water levels, so long periods of drought or heavy rain can significantly impact populations. During a drought in Colleton County during 1984 and 1985, only 5 of 500 plants in the population survived (Rayner 1988). Efforts to artificially propagate this species have not been very successful (USFWS 1990). Primary threats to this species are natural events, such as drought, and anthropogenic impacts, such as draining wetlands.

Least Tern

The state threatened least tern is the smallest of the terns that occur in coastal waters of the ACE Basin and feed on beaches and shallow mud flats. Easily confused with gulls, terns have lighter bodies than gulls and a forked tail compared to the square tail of gulls. With the greater disturbance associated with human encroachment (development and recreation), undisturbed nesting areas on traditional island nesting sites have become critically limited. The majority of least terns now nest on gravel-covered rooftops of larger buildings. This habitat provides little disturbance from people and animals and protection from predators such as raccoons, but it comes with other hazards such as tar, flooding, and excessive heat. This manmade habitat has begun to be threatened because of alternatives to gravel rooftops being used in new buildings and replacement rooftops (Murphy, 1998, pers. comm.).

Loggerhead Sea Turtle

Loggerhead sea turtle ***(Caretta caretta)***

The loggerhead sea turtle is a regular inhabitant of the ACE Basin. Adult and benthic immature loggerheads use estuarine and nearshore waters for feeding, and adult females use the beaches of the ACE Basin for nesting. Hatchling loggerheads leave nesting beaches and begin a pelagic existence. Juvenile or pelagic immature loggerheads from the east coast of the United States are thought to be associated with convergence zones at the edges of oceanic currents in the North Atlantic gyre (Turtle Expert Working Group 1998). They remain in these zones until reaching approximately 10-12 years of age when they recruit to coastal areas at a size of 40-60 centimeters or 16-24 inches (straight carapace length). Benthic immatures remain in coastal areas for an additional 10-15 years before beginning reproductive migrations.

The population estimate of nesting females is approximately 14,000, based on aerial and ground surveys (Loggerhead/Green Turtle Recovery Team 1991, Hopkins, pers comm). In the United States, this species ranges from New Jersey to the Gulf of Mexico, with the highest nesting densities occurring in North Carolina, South Carolina, Georgia, and Florida.

The primary anthropogenic threat to loggerhead turtles is commercial fishing (incidental catch) (Turtle Expert Working Group 1998). This threat has been reduced in recent years by the requirement for Turtle Excluder Devices (TEDs) to be installed in shrimp nets but still contributes significantly to overall mortality (Crowder et al. 1995; Turtle Expert Working Group 1998). Additional impacts are to beachfront nesting habitats by development, beach use, and hardened structures. Some of these impacts include groins and seawalls that impede access to nesting habitat or force turtles to lay eggs in areas that are flooded by the tide. On undeveloped beaches, hatchlings crawling out of the nest at night are attracted to the water by the natural illumination of the ocean. On developed beaches, the lights in buildings tend to attract the juveniles towards higher ground and away from the ocean, resulting in increased mortality. Masking or turning off lights during the nesting season is one method to reduce this type of mortality. Additional anthropogenic threats to turtles are beach renourishment, dredging, and marine pollution (Turtle Expert Working Group 1998).

Peregrine Falcon

Although the peregrine falcon has experienced dramatic declines in the past, the species continues to be regularly reported in South Carolina during migration periods and in winter. During annual migration, several hundred peregrines are believed to pass through the ACE Basin, with individuals regularly using beaches and associated estuarine habitat throughout the winter. Migrating peregrines are believed to feed extensively on migratory shore and passerine bird species, while wintering falcons feed heavily on red-winged blackbirds. The recovery of the peregrine falcon has been attributed to a combination of being listed as an endangered species, which produced the protection and management provided by the Endangered Species Act (ESA), and the banning of the use of DDT, thereby reducing the loss of eggs during nesting (USFWS 1987).

Red-cockaded Woodpecker

The red-cockaded woodpecker (RCW) is one of the more extensively studied endangered species. Although this species is still widespread throughout the Southeastern United States, the number of groups has decreased. This decrease is primarily attributed to changes in type and age of the pine tree species used for nesting (USFWS 1985). Currently, RCW's are not known to nest in the ACE Basin area (Duncan, 1998, pers. comm.). Red-cockaded woodpeckers live in small family groups of two to four individuals composed of a mated pair and up to one or two young males that help with nesting. A cavity tree cluster, formerly called a colony, is a group of nesting families and can range in size from 1 to 30 nests in an area (Jackson 1994). Each cavity tree cluster usually can be contained in a circle with a diameter less than 850 meters (2800 ft). Their preferred selection of pine trees, primarily longleaf, that are older than 70 years is the primary reason for their endangered status. Older trees are more susceptible to a fungus that affects the heartwood of pine trees, making it easier for RCW's to build nesting cavities. Most of the southeastern forests, including the ACE Basin, have been completely cleared once or twice since European settlement. It is only since the establishment of government reserves, parks, and other protected areas since the late 1900s and early twentieth century that harvest has been limited and older trees have been allowed to remain standing. Standard timber crop rotations are about 30 years, which does not allow timber stands to reach an age at which RCW's can utilize them as nesting trees. Westvaco and Georgia-Pacific, the largest timber companies working in the ACE Basin, have management plans that incorporate protection of habitats utilized by RCW's to minimize the loss of additional suitable habitat (J. Grobowski, 1998, pers. comm.).

Shortnose Sturgeon

Little is known concerning the abundance and ecology of the shortnose sturgeon in the ACE Basin except that the species has been documented in the South Edisto River and, although not currently confirmed, has historically inhabited the Combahee and Ashepoo Rivers. A marl hole above Givhans Ferry, located outside the study area on the South Edisto River, was believed to be an important spawning area for the closely-related Atlantic sturgeon (Sandifer et al. 1980). The three-river system contributes to the Basin's importance as habitat for sturgeon because of the excellent water quality and lack of dams that limit migration.

Shortnose sturgeon range from Saint John River in Canada to Indian River, Florida

(Dadswell et al. 1984). The slow growth rate and the 3-7 year period from birth to maturity make this population sensitive to threats such as incidental catch in commercial species. Little is known about their spawning habitats, but like the Atlantic sturgeon, they may spawn in the upper reaches of the rivers. Loss of access to these habitats through dam construction may contribute to their decline. The US Fish and Wildlife Service is currently working on a recovery plan for the shortnose sturgeon.

Wood Stork

Wood stork ***(Mycteria americana)***

The wood stork is one of the most spectacular wading birds occurring within the ACE Basin and represents the only true stork regularly found in the United States. Population estimates in the United States range from 5,500 to 6,500 pairs (USFWS 1996). Wood stork nesting activity was first documented in the ACE Basin in 1981 when 11 pairs nested. Since then, nesting activity has increased dramatically; an estimated (minimum of) 1,289 storks were fledged in 1990, from 536 nests in three rookery sites (T. Murphy, 1998, unpublished data). By 1995, wood storks were nesting in six different colonies. Two of these colonies are in the ACE Basin, and two are just outside the boundaries of the Basin.

In addition to supporting breeding populations of storks, the ACE Basin provides important foraging habitat for wood storks migrating from more southern breeding grounds in mid to late summer. The ecological importance of productive, shallowly flooded foraging habitats to wood stork and other colonial wading bird nesting sites is well established (USFWS 1996). Wood storks are regularly observed feeding in riverine flood plains, intertidal mud flats, and estuarine impoundments throughout the lower ACE Basin. They employ tactile feeding strategies, forage extensively on small fish and other aquatic animals concentrated in shallow areas.

The greatest threat to the South Carolina population of wood storks is the loss of wetland feeding areas (USFWS 1996). The extensive managed impoundments in the ACE Basin provide feeding areas for hundreds of birds. Wood storks are sensitive to water level changes. Storks use medium to tall trees in flooded wetlands as nesting sites. The wetlands provide protection from predation by raccoons. During dry years or if wetlands are drained, fewer nesting sites will be available, thereby reducing nesting success. During wet years, water levels may be high, decreasing the availability of food. Wood storks have an optimum range of water depth for feeding between 5 and 40 cm (2 to 16 in). Management of the water levels in impoundments is an excellent means of providing optimum conditions for wood stork nesting and foraging.

Other Endangered Species

Other endangered or threatened species are likely to occur or pass through the ACE Basin area. During

West Indian manatee
(Trichechus manatus)

warmer months, the West Indian manatee moves as far north as New England along the Atlantic Coast (USFWS 1995) and have been documented to occur regularly in the ACE Basin (T. Murphy, 1998, pers comm.) with more than 500 occurring in South Carolina since 1993. A cow and calf were observed for several hours feeding on smooth cordgrass at the Parris Island Marine Depot immediately south of Otter Island (Sandifer et al. 1980). The size of the calf suggested that it was probably born in South Carolina waters. The first verified birth occurred in South Carolina near Hilton Head Island in the summer of 1997 and resulted in twins, a rare occurrence for manatees. Additional sightings of manatees feeding on smooth cordgrass have been noted in other estuarine rivers of South Carolina (Sandifer et al. 1980).

Several species of whales, including the Atlantic right, blue, finback, humpback, sei and sperm, occasionally occur in marine waters off South Carolina. In 1987, an adult finback whale stranded alive at Harbor Island, located in the extreme southwestern portion of the ACE Basin. This stranding represented the first documented occurrence of finback whales in coastal waters of South Carolina. In general, very little is known about marine mammal population levels or movements along the southeastern coast of the United States (Sandifer et al. 1980). Pondberry is also a federally endangered species that is suspected to exist in the ACE Basin but has not been confirmed. (See related section: Plants.)

Summary

Although involved in controversy and being considered for reauthorization (Clegg et al. 1995, USFWS 1998), the ESA has provided protection for endangered and threatened species that occur in the ACE Basin. The bald eagle, peregrine falcon, American alligator, and eastern brown pelican have all seen increases in their populations. Other species such as the loggerhead sea turtle have populations that have stabilized, at least in the short term, through protection and management of the human impacts on the species.

Recovery plans for many species have helped target the necessary habitats or management actions required for recovery of the species. For example, the American alligator's greatest threat was over harvest. Establishment of protection and the elimination of harvest allowed the species to recover. However, in cases in which the species is dependent on habitat, such as the Florida panther, restoration of the habitat may not be possible, and, therefore, the future of the species will remain in doubt (Clegg et al. 1995).

Of the remaining endangered and threatened species in South Carolina, all are primarily impacted by loss of suitable habitat. The red-cockaded woodpecker, Canby's dropwort, and shortnose sturgeon are residents of the ACE Basin and as such are dependent on the ACE for the resources they require. This makes responsible use of the existing habitats an important goal if these species, as well as others, are to remain in the ACE Basin.

NEXT CHAPTER: Species Gallery

Authors

G. Riekerk, SCDNR Marine Resources Research Institute

S. Upchurch, SCDNR Marine Resources Research Institute

M. Brouwer, SCDNR Marine Resources Research Institute

A. Sievert, NOAA Coastal Services Center

C. Layman, SCDNR Marine Resources Research Institute

T. Marcinko, SCDNR Marine Resources Research Institute

References

Bryon, A.L. Jr., T.M. Murphy, K.L. Bildstein, I.L. Brisbin Jr., and J.J. Mayer. 1996. Use of reservoirs and other artificial impoundments by bald eagles in South Carolina. pp 285-297. *In* D.M. Bird, D.E. Varland, and J.J. Negro (eds). Raptors in human landscapes: adaptations to built and cultivated environments. Academic Press, San Diego, CA.

Clegg, M.T., P.G. Risser, T.D. Pollard (Chairs), and L.R. Paulson (ed.). 1995. Science and the Endangered Species Act. National Academy Press, Washington, DC.

Crowder, L.B., S.R. Hopkins-Murphy, and J.A. Royle. 1995. Effects of turtle excluder devices (TEDs) on loggerhead sea turtle strandings with implications for conservation. Copeia 4:773-779.

Dadswell, M.J., B.D. Taubert, T.S. Squires, D. Marchette, and J. Buckley. 1984. Synopsis of biological data on shortnose sturgeon, *Acipenser brevirostrum* LeSueur 1818. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Technical Report 14. Seattle, WA.

Duncan, L. 1998. Personal communication. US Fish and Wildlife Service, Charleston, SC.

Forsythe, D.M. and W.B. Ezell (eds.). 1976. Proceedings of the first South Carolina endangered species symposium. South Carolina Wildlife and Marine Resources Department, Charleston, SC.

Grobowski, J. 1998. Personal communication. Westvaco. Summerville, SC.

Hoage, R.J. 1985. Animal extinctions: What everyone should know. Smithsonian Institution Press, Washington, DC.

Hopkins, S. 1998. Personal communication. South Carolina Department of Natural Resources. Charleston, SC.

Jackson, J.A. 1994. Red-cockaded woodpecker. The Birds of North America, No. 85

Loggerhead/Green Turtle Recovery Team. 1991. Recovery Plan for U.S. Population of Loggerhead Turtle (*Caretta caretta*). National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Silver Spring, MD.

Murphy, T. 1998. Personal Communication. South Carolina Department of Natural Resources, Charleston, SC.

Murphy, T.M. and J.W. Coker. 1978. The status of the bald eagle in South Carolina. *In* R.R. Odum and L. Landers (eds.). Proceedings of the rare and endangered wildlife symposium. Georgia Department of Natural Resources, Game and Fish Division. Technical Bulletin No. 4.

National Oceanic and Atmospheric Administration. 1996. Reference Book of Policies and Guidance for implementing the Endangered Species Act (ESA) US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Silver Springs, MD.

Rayner, D. 1988. Colleton County Cowbane Heritage Preserve management plan. Nongame and Heritage Trust Section, South Carolina Wildlife and Marine Resources Department, Columbia, SC.

Sandifer PA., J.V. Miglarese, D.R. Calder, J.J. Manzi, and L.A. Barclay. 1980. Ecological characterization of the Sea Island coastal region of South Carolina and Georgia, Vol. III: Biological features of the characterization area. United States Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-79/42.

Turtle Expert Working Group. 1998. Assessment of the Kemp's ridley (*Lepidochelys kempii*) and loggerhead sea turtle population (*Caretta caretta*) in the western north Atlantic. Technical Memorandum NMFS-SEFSC-409. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Miami, FL.

[USFWS] United States Fish and Wildlife Service. 1985. Red-cockaded woodpecker recovery plan. United States Fish and Wildlife Service, Atlanta, GA.

[USFWS] United States Fish and Wildlife Service. 1987. Revised peregrine falcon, eastern recovery plan. United States Fish and Wildlife Service, Newton Corner, MA.

[USFWS] United States Fish and Wildlife Service. 1990. Canby's dropwort recovery plan. United States Fish and Wildlife Service. Atlanta, GA.

United States Fish and Wildlife Service. 1995. Florida manatee recovery plan second revision. United States Fish and Wildlife Service, Atlanta, GA.

[USFWS] United States Fish and Wildlife Service. 1996. Revised recovery plan for the U.S. breeding population of the woodstork. United States Fish and Wildlife Service. Atlanta, GA.

[USFWS] United States Fish and Wildlife Service. 1998. The road back: endangered species recovery. U. S. Department of Interior, Fish and Wildlife Service, Washington, DC.

Wilkinson, P. M. 1983. Nesting ecology of the American alligator in coastal South Carolina. Study Completion Report. South Carolina Wildlife and Marine Resources Department, Columbia, SC.

MENU

Species Gallery

Birds | **Fish** | **Invertebrates** | **Mammals** | **Plants** | **Reptiles**

Introduction

The ACE Characterization Species Gallery contains short descriptions of 77 plant and animal species that occur in the ACE Basin. These species were selected for inclusion in the Species Gallery because of their ecological, commercial and/or recreational value in the ACE Basin ecosystem or because they have protected status.

Each description contains a picture and a narrative that describes the physical characteristics of the species; a little about its habitat and biology and aspects of its ecological, commercial, or recreational value.

The biological resources section of this product has additional information on many of the species found in the ACE Basin. The sections include the plant communities, phytoplankton, zooplankton, decomposers, insects, aquatic benthic invertebrates, decapods, fish, reptiles, birds, and mammals. (See related chapter: Biological Resources.)

Many of the species described here have commercial and/or recreational value. Additional sections of this product discuss these species with respect to their commercial or recreational value. (See related sections: Commercial Fisheries, Recreational Fisheries, and Hunting.)

Finally, some of the species in the gallery are threatened, endangered or are species of concern. The Endangered Species section further discusses many of these species.

NEXT SECTION: Birds

Authors

M. Brouwer, SCDNR Marine Resources Research Institute

S. Upchurch, SCDNR Marine Resources Research Institute

A. Sievert, NOAA Coastal Services Center

Birds

American Oystercatcher *Haematopus palliatus*

American oystercatchers *Haematopus palliatus*

.

Song, © Jim Stasz

Description

The American oystercatcher is one of two species of oystercatchers that breed in North America. Oystercatchers are large, conspicuous shorebirds (43-53 cm or 17-21 in) common to seacoasts in temperate to tropical parts of the world. The head and neck are black, and the wings and back are dark brown with distinct white patches that are visible when the bird is in flight. The breast and belly are white, the bill is bright red, and the legs and feet are a pinkish color.

Habitat and Biology

The American oystercatcher breeds along seacoasts from Baja, California, and Massachusetts southward. Wintering grounds are from North Carolina south to the West Indies and Brazil. In South Carolina, oystercatchers inhabit sandy or pebbly beaches, mudflats, and the borders of salt marshes.

Oystercatchers begin to breed in early to late April. During this time, they exhibit aggressive behavior towards neighboring pairs, often engaging in loud vocalization displays. Once the oystercatcher finds a mate, they form a long-term pair bond. Nesting in this species does not occur in large colonies as in other shorebirds. Two to four creamy white eggs with dark brown and lavender markings are laid in shallow depressions on isolated beaches. Eggs are usually laid over a 1 to 2-day period. The males generally incubate during the day, while the females incubate at night. Male investment of incubation tends to increase during the duration of incubation, lasting about 24 to 25 days. Oystercatcher young depend almost entirely on their parents for food, an uncommon characteristic among shorebird families. The females take care of brooding the chicks, giving the male time for territorial defense and provisioning the chicks. Some starvation is observed during this time due to the establishment of sibling hierarchies. During winter, oystercatchers change their solitary habits and gather in large flocks. The species' common name derives from its peculiar dietary habits. When the bird finds a gaping oyster, it inserts its long bill inside it, cutting the adductor muscle; the valves can no longer shut, and the oyster is easily obtained. American oystercatchers also feed on other bivalves, such as clams and mussels, snails, barnacles, fiddler crabs, aquatic insects, and sea worms.

Species Significance

Historically, oystercatchers were hunted for both culling and recreational purposes, causing a near extinction along the Atlantic coast. Their breeding success worldwide has been low. This reflects mortality rates during the egg stage, rather than the mortality of dependent chicks. Predators and storms are the main cause of egg loss from the nest. However, the population decrease may also be attributed to the exploitation of shellfish resources by man, coastal development, and off-road vehicles destroying natural habitats. Their numbers have recently increased due to the implementation of protection programs. Oystercatchers are now common in areas where they were absent a few years ago.

References

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Goss-Custard, J. D. (ed.). 1996. The oystercatcher: From individuals to populations. Oxford University Press, Oxford, U.K.

Nol, E., A. J. Baker, and M. D. Cadman. 1984. Clutch initiation dates, clutch size, and egg size of the American oystercatcher in Virginia. The Auk 101:855-867.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Barred Owl *Strix varia*

Barred owl ***(Strix varia)***

Song, © Thayer's Birding Software

Description

The barred owl is one of 18 species in two genera of wood owls, family Strigidae. Also known as the "Hoot Owl," the barred owl is one of the most common owls in North America. It is a large (40-60 cm or 16-24 in) owl similar in appearance to the great horned owl, except for its lack of ear tufts. Its plumage is olive-brown above with off-white cross bars and spots. Brown crescent-shaped bars are distinct against the pale chest, and its belly has brown longitudinal streaks. The barred owl's face is pale with concentric circles near the margin of the facial disk. Its eyes are dark brown, almost black, and are set close together. Like many owls, the barred owl has asymmetrical ears; not only is one ear bigger than the other, they are also at different positions on the bird's head. This is an adaptation that enables owls to pinpoint the exact location of an object (i.e. prey) by the minute differences in sound that the brain receives from each ear.

Habitat and Biology

The barred owl is a resident from British Columbia east to Nova Scotia, and south to northern California and the Gulf Coast states. It occurs in thick lowland forests and swampy areas such as those in the ACE Basin. This owl hunts in open country; however, since it swoops down from a perch to capture prey, large open spaces are not required.

The barred owl's distinct call may be heard early in the spring, when breeding season begins. Nesting takes place in an unlined cavity of a hollow tree or in the abandoned nest of a crow, hawk, or squirrel. Sometimes a suitable tree cavity may be used by generations of owls over many years. Two to five white eggs are laid over 2-3 days. The female incubates one egg at a time, starting with the one that was laid first. Thus, chicks hatch in succession after an incubation period of 28 days. The female remains in nest for 3 weeks after the chicks have hatched. Parental care extends beyond 4 months, with chicks finally leaving the nest in the fall. The barred owl is nocturnal, although it may hunt in the daytime during overcast conditions. It can see extremely well, even under low light conditions, and can pinpoint the location of prey by sound alone. Upon locating suitable prey, the owl dives feet first for the kill. However, the barred owl's feet are not very large, thus l limiting the size of prey it can capture. Its diet consists of a variety of rodents, birds, frogs, fish, and crayfish.

Species Significance

Currently, the biggest threat to the species is loss of suitable nesting habitat. Because the barred owl is extremely sensitive to changes in size, age, and fragmentation of its forest surroundings, it serves as an indicator species, much like its cousin, the northern spotted owl, in the Pacific Northwest. The species is not currently endangered or threatened in South Carolina; in fact, it is common in most of North and South Carolina, except in areas of high elevation.

References

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Hume, R. 1991. Owls of the world. Running Press, Philadelphia, PA.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

The Wilderness Society. 1998. Barred Owls prefer old forests. Wilderness and Science home page. http://www.wilderness.org/ccc/owls.htm. Accessed 30 April 1998.

Bobwhite Quail *Colinus virginianus*

Bobwhite quail ***(Colinus virginianus)***

Description

The bobwhite quail is a short-tailed, chunky brown bird. Color is sexually dimorphic with males having a white throat and a white stripe above the eye, while females have a buff-colored throat and eye stripe.

Habitat and Biology

The best quail habitats are well-drained, providing sufficient moisture for forage plants. Coveys, which are tightly knit associations of quail, occur near clumps of taller vegetation and large thickets. Quail prefer habitats that provide food, concealment, and cover for escape from predators and harsh weather.

The bobwhite quail nests on the ground, in brushy fields and under fences or hedgerows, usually within a few yards of a road or other open ground. Quail are late nesters, with egg production generally completed from June to August. The entire nesting season can involve production of multiple broods, which may be an adaptation to the large number of predators and high natural mortality experienced by bobwhite. If nest failure occurs due to fire, unfavorable weather, predators, or other factors, the birds will renest until a successful hatch occurs. Nest failures spread out the hatch dates and reduce the likelihood of mass mortality of the young, but subsequent nesting attempts generally consist of fewer numbers of eggs laid. The increased survival of late hatched birds is generally associated with plentiful stock for fall hunting. Quail form coveys from fall through winter when food is most plentiful. Coveys tend to maintain allegiance to their group unless their numbers are reduced by over-hunting or high predation rates. By early spring, coveys disband as selection of nesting sites begins.

Food has been reported to be a limiting factor to the health of the population, largely due to the selectivity of quail and the availability of food types. Their diet consists mainly of seeds, small fruits, insects, and green forage. Young birds feed heavily on insects, and animal matter also makes up a high percentage of the adult diet in warmer months. Food supply is influenced by local distribution and abundance of food plants and their seeding or fruiting characteristics.

Species Significance

Bobwhite quail are a popular species sought by sport hunters in the ACE Basin. Quail populations have been reduced in some areas due to habitat destruction. Hunters, land managers, and wildlife management organizations are working to improve habitat conditions for quail. The quail's high reproductive rate, in combination with suitable habitat conditions, will ensure that populations can be restored.

References

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Landers, J.L. and B.S. Mueller. 1992. Bobwhite quail management: A habitat approach. Tall Timbers Research Station, Tallahassee, FL and Quail Unlimited, Edgefield, SC.

Mahan, W.E. 1992. Bobwhite quail. South Carolina Wildlife and Marine Resources Department, Wildlife and Freshwater Fisheries Division, Columbia, SC.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Clapper Rail *Rallus longirostris*

Clapper rail *(Rallus longirostris)*

Song, © Joun R. Sauer

Description

The clapper rail belongs to the family Rallidae, which also includes gallinules and coots. Rails are marsh inhabitants with laterally compressed (flattened) bodies that enable them to slip between reeds and tall grasses. The clapper rail, also known as the marsh hen, is a relatively large bird (36-41 cm or 14-16 in) with long legs, large feet, and long toes. The bird's wings are rounded and short, its flanks are barred with black and white, and it has a long bill. This species is similar in appearance to the king rail but can be differentiated by its grayish-brown coloration as opposed to the more rusty color of the king rail. Also, the king rail is more often found in freshwater marshes, although it does frequent salt marshes during the winter. Clapper rail young are uniformly black, as are the young of all rail species.

Habitat and Biology

The species extends along the east coast of North and South America from New England to Brazil, and along the Pacific coast from California to Peru. Breeding grounds in the United States extend from central California and Massachusetts southward. Clapper rails spend winter months as far north as central California on the west coast and New Jersey on the east coast. They are common in salt marshes throughout the coastal region of South Carolina.

In South Carolina, clapper rails begin nesting in mid to late March, sometimes as late as April. Nests are shallow, saucer-shaped depressions or deep bowls of dead marsh grass usually constructed a couple of feet above the water. A dome-shaped canopy made of blades of grass is typically placed over the nest in order to conceal the eggs from predators. Average clutch size ranges from 8 to 10 creamy buff eggs with purplish or brown markings. Incubation, carried out by both sexes, lasts about 14 days, and young are able to leave the nest soon after hatching. Two broods may be raised each year, and both parents care for their young during the early stages of development. Because the nest is so close to the water, it is vulnerable to flooding; however, if the eggs are lost to a high tide or predation, the birds typically lay again. Perhaps the most distinct characteristic of the clapper rail, one that is often associated with Lowcountry salt marshes, is the bird's loud clattering call . When one bird begins to vocalize, neighboring birds usually join in. Clapper rails are nocturnal and rather secretive; thus, they are rarely seen. They seldom fly and they are good swimmers despite lacking webbed feet. Their diet consists of crustaceans, such as shrimp and crabs, fish, mollusks, insects, and some plant seeds.

Species Significance

Historically, clapper rails were hunted in many areas of their range, including South Carolina. Even though large numbers were taken, populations remained stable. Currently, they are listed as protected game in the South Carolina Department of Natural Resources Hunting Regulations EXIT.

References

[Anonymous]. Not dated. A guide to the Life in the Salt marsh poster. South Carolina Department of Natural Resources, Marine Resources Division.

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Meanley, B. 1985. The marsh hen--A natural history of the clapper rail of the Atlantic coast salt marsh. Tidewater Publishers, Centerville, MD.

Oney, J. 1954. Final report, clapper rail survey and investigation study. Georgia Game and Fish Commission, Game Management Division, Atlanta, GA.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Eastern Brown Pelican *Pelecanus occidentalis*

Eastern brown pelican
(Pelecanus occidentalis)

Description

Eastern brown pelicans are common throughout coastal South Carolina. They are one of the largest birds found on the east coast of the United States and the only pelicans in the world that are not white. The first eastern brown pelican was described in 1789 and came from Charleston Harbor. Adult males and females are similar in appearance and are easily identified by the characteristic long bill with an underlying gular (throat) pouch. The bird's head is white in front and dark brown behind, extending down the neck and back. During the breeding season, the white plumage turns a vibrant yellowish-gold color. Silver-gray feathers cover the rest of the pelican's body. Juveniles have grayish-brown feathers above and whitish plumage below. Pelicans measure approximately 120 cm (48 in) in length, with a wingspan reaching almost 200 cm (78 in). They can weigh up to 3.6 kg (8 lbs) and live up to 30 years in the wild.

Habitat and Biology

This large marine bird formerly nested along coastal areas from Mexico to North Carolina. Currently it only nests in North Carolina, South Carolina, Florida, and Louisiana. In the ACE Basin, pelicans nest on Deveaux Bank Heritage Preserve in the mouth of the North Edisto River. (See related section: Island Geomorphology.)

Eastern brown pelicans reach sexual maturity at 3 years of age and are monogamous, having only one breeding partner throughout the spring and summer breeding season. Nests are constructed on trees, such as mangroves, or in shallow depressions on the ground, on islands with sufficient high ground to avoid tidal flooding and far enough from land to escape mammalian predators such as raccoons. Pelicans nest in colonies and typically hatch 2 to 3 eggs after an incubation period of 30 days. Both parents take turns incubating the eggs and feeding their chicks. After about 9 weeks, young pelicans are ready to leave the nest; they fledge at 71 to 88 days. Although its eyes are not adapted for underwater vision, a pelican dives head first into the water in search of food. Upon surfacing, the bird tilts its bill downwards to drain out water and then up to swallow its catch. The pelican's diet consists exclusively of fish.

Species Significance

The eastern brown pelican was listed as an endangered species in 1970, when their population plummeted to less than 100. Widespread use of pesticides such as DDT caused thinning of eggshells, which subsequently broke during incubation. The United States ban on DDT in 1972 and similar pesticides spurred the pelican's recovery to much of its former range. The implementation of the Brown Pelican Recovery Plan of 1979 also contributed to the restoration of brown pelican populations. This species is no longer considered endangered and has been de-listed.

References

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The birder's handbook: A field guide to the natural history of North American birds, including all species that regularly breed north of Mexico. Simon & Schuster, New York, NY.

National Geographic Society. 1987. Field guide to the birds of North America. Second edition. National Geographic Society, Washington, DC.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Eastern Wild Turkey *Meleagris gallopavo silvestris*

Eastern wild turkey
(Meleagris gallopavo silvestris)

Call, © Catherine N. Ball

Description

Like other birds of the family Phasianidae, eastern wild turkeys are equipped with long, thick legs, large toes for walking and scratching, and a relatively short bill. Wild turkeys are unmistakable in their appearance. Males have dark iridescent plumage, bare heads and necks with blue and pink streaks, fan-shaped tails tipped with chestnut, and black-barred flight feathers. Male turkeys (gobblers) also have spurs and a "beard," a tuft of thick, hair-like feathers that protrude out of the animal's breast. Female turkeys look much like their counterparts but lack the spurs, and most do not have a "beard." The eastern wild turkey is North America's largest gamebird. Adults weigh between 5.5-11 kilograms (12-25 pounds) and can reach a length of 91 cm (36 inches) for females to 122 cm (48 inches) for males. Wild turkeys differ from domestic turkeys in that they are less stocky and the head is more tinged with blue.

Habitat and Biology

Like their name implies, eastern wild turkeys occur throughout the eastern United States. They inhabit mature deciduous forests and open woodlands as far north as New England. The species has also been introduced to California and other western states. Eastern wild turkeys are found throughout South Carolina, including the ACE Basin. They occur in a variety of habitat types, preferring mixed pine/hardwood stands interspersed with fields and/or wildlife openings (clearings maintained to attract wildlife).

The habitat choice of adult turkeys results from their dependence upon plant material, primarily acorns, for food and their need to avoid predators. Turkeys are opportunistic feeders with diet varying by season. Seeds, grain, acorns, and insects constitute a large portion of the diet, although fiddler crabs and frogs are important food items in coastal areas. Mast-producing hardwoods are prime turkey habitat, but a mixture of understory plants is also important for food and cover. Through fall and winter, wild turkeys are generally found in hardwood stands where mast such as acorns and dogwood berries are available as forage. Turkeys feed heavily in late winter to accumulate reserves for the spring breeding season. In spring, turkeys seek out new leaves of grasses and sedges, with acorns and other hard mast also comprising much of the diet.

Flocks of turkey are most commonly sighted in the ACE Basin during fall and winter months. The birds roost in trees at night and begin foraging at daylight. As spring approaches and daylight hours increase, the gobblers separate from the flock to set up mating territories. Courting begins in March and usually peaks in April, with completion of courting and mating by early July. During this time, the males consume little food and mainly devote time to gathering hens and mating. Turkeys are ground nesting birds. Hens that are mated set up nests that are usually placed at the foot of a tree or by a log. On barrier islands, the sides of grass-grown banks may be used for nesting. The nest is essentially a depression in the soil, lined with leaves and grass. The number of eggs varies from 8-15 with an incubation period of 28 days. Young turkeys (poults) are precocial; that is, they require little parental care after hatching. Poults are able to fly in 12-14 days and remain with the female for up to 6-8 months.

Young turkeys feed largely on insects early in life. A high protein diet is essential for their first few months of life. Vegetation, fruits, seeds, and mushrooms are also favored foods of young turkeys. Water is a daily requirement, necessitating that poults be located within 0.4 kilometers (0.25 mi) of a water source. At 12-14 days of age, the brood and hen begin roosting in small trees. Other broods may join in to form a flock that forages along edge habitats of fields, logging roads, and regenerated areas. These summer flocks remain together into fall; however, adult gobblers travel singly or in small groups.Turkeys forage on the ground for seeds, nuts, acorns, fruits, insects, and other small invertebrates. At night they roost in trees and, during the winter, congregate in flocks that number 40-50 individuals.

Species Significance

Wild turkeys are widely hunted for both food and sport. In South Carolina, the hunting season extends from March 15 or April 1, depending on location, to May 1 in all counties. In spring 1997, the harvest totaled 13,984 turkeys, a tremendous increase from the 132 individuals taken in 1970. Such statistics reflect successful re-stocking and management practices in the state. For additional information, review the Hunting section.

Currently, the wild turkey is not an endangered species. However, the species was almost extinct throughout its range around 1900 due primarily to hunting and habitat loss. From 1951 to 1958, the South Carolina Department of Natural Resources carried out a live-trapping and transplanting program in an effort to replenish turkey populations in the piedmont and mountain portions of the state. In 1975, a program to restore turkey populations in the coastal plain was initiated. A number of restoration sites were selected based on location and habitat characteristics, and each was stocked with about 5 gobblers and 10 hens. Thanks to the establishment of such re-stocking programs and habitat improvement, turkeys are now common in most areas where they were once absent. Wild turkeys now occupy all 46 counties in South Carolina, and populations are healthy.

References

Baily, R.W. and K. T. Rinell. 1967. Events in the turkey year, pp. 73-91. In: D.H. Hewitt, ed. The wild turkey and its management. The Wildlife Society, Washington, DC.

Baumann, D. Not dated. Wild turkey in South Carolina. South Carolina Department of Natural Resources, Columbia, SC.

Baumann, D. 1987. Bronze bird of the Southland. South Carolina Wildlife, 34(2): 6-10.

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

David, J. 1977. The grandest of game birds. *In* J. Culler, ed. Carolina's Hunting Heritage. South Carolina Wildlife 24(2):4-9.

Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The birder's handbook: A field guide to the natural history of North American birds, including all species that regularly breed north of Mexico. Simon & Schuster, New York, NY.

National Geographic Society. 1987. Field guide to the birds of North America. Second edition. National Geographic Society, Washington, DC.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Green-winged Teal *Anas crecca*

Green-winged teal ***(Anas crecca)***

Description

Green-winged teals belong to the family Anatidae, which includes ducks, swans, and geese. Similar to other duck species, green-winged teals exhibit marked sexual dimorphism; that is, males and females look different, with males typically more brightly colored. Male green-winged teals have chestnut heads with a dark green ear patch. Their sides are a pale gray color, and their breast is pinkish with a white stripe down the side. Females are mottled light to dark brown with a white underside. These small, 35 cm (14 in) long dabbling ducks are agile and quick in flight. They are similar in appearance to blue-winged teals, but the latter have pale blue shoulder patches.

Habitat and Biology

Over-wintering green-winged teals reside throughout most of the southern two thirds of the continental United States, including all of South Carolina. They prefer riparian areas such as saltwater and freshwater marshes, lakes, ponds, streams, and waterfowl impoundments in the ACE Basin.

Green-winged teals nest in well-hidden, shallow, down-lined scrapes in grassy areas. They produce one brood per year, with the female laying an average of 8-9 eggs. Male ducks leave prior to incubation, so only females incubate the eggs for a period of 21-23 days. Young can fly after 34 days and have one of the fastest growth rates of North American ducks. This species is well known for its wheeling mass flights similar to a flock of sandpipers. Teals eat aquatic invertebrates, tadpoles, seeds, and aquatic vegetation.

Species Significance

Green-winged teals are popular game birds throughout their range due to their quick flight. They are one of the fastest flying ducks. South Carolina Department of Natural Resources determines dates for the hunting season each year (available in SCDNR's Waterfowl Hunting Regulations). Green-winged teals are not threatened or endangered.

References

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The birder's handbook: A field guide to the natural history of North American birds, including all species that regularly breed north of Mexico. Simon & Schuster, New York, NY.

National Geographic Society. 1987. Field guide to the birds of North America. Second edition. National Geographic Society, Washington, DC.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Least Tern *Sterna antillarum*

Least tern ***(Sterna antillarum)***

Song, © Jim Stasz

Description

The least tern is the smallest of the North American terns. During the breeding season least terns exhibit gray plumage above with black on the head and nape of the neck. The birds' foreheads are white, their tails are forked, and their bills are yellow/orange with black tips. Juveniles are dusky with brown markings on the back, and they develop the adult plumage at 1-2 years of age. Female and male least terns are not sexually dimorphic; they exhibit the same coloration. Least terns measure 23 cm (9 in) long with a 50 cm (20 in) wing span.

Habitat and Biology

The least tern's breeding range includes coastal areas in California and along the eastern seaboard from Maine to Florida, as well as the Mississippi River area. Thus, they are summer residents in coastal South Carolina, and nesting terns are found at 12 locations on the coastal islands of the ACE basin. Winters are spent on the Pacific coast of Mexico and South America. For additional information on least tern nesting, review the section on birds and the GIS data on colonial waterbirds.

Least terns begin breeding at 2 years of age. They are monogamous (one breeding partner at a time) and produce one brood per year. In South Carolina, nesting occurs around mid-May. Terns nest in colonies on beaches and sandbars with abundant shells and pebbles and sparse vegetation. Females construct unlined nests on the ground, and both adults incubate 1-3 eggs for approximately 20 days. Least terns have the habit of shaking water on their eggs, which cools them as it evaporates. In an effort to protect their nests from predators, least terns actively harass and defecate over intruders. After hatching, young terns fledge in about 20 days. Constant hovering over water allows least terns to locate the aquatic invertebrates and small fish on which they feed.

Species Significance

The least tern is currently threatened in South Carolina. Among the most important factors that have contributed to the species' decline are over-hunting for the millinery industry (plumage hunters) in the early twentieth century and abandonment of nesting sites due to human disruption. Mammalian predators such as rodents, raccoons, and cats have also taken their toll. In addition, least terns tend to construct their nests in low-lying sandbars that are sometimes flooded by very high tides.

References

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The birder's handbook: A field guide to the natural history of North American birds, including all species that regularly breed north of Mexico. Simon & Schuster, New York, NY.

National Geographic Society. 1987. Field guide to the birds of North America. Second edition. National Geographic Society, Washington, DC.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Mourning Dove *Zenaida macroura*

Mourning dove ***(Zenaida macroura)***

Song, © Thayer's Birding Software

Sound, SCDNR

Description

Mourning doves are one of 310 species of doves and pigeons belonging to the family Columbridae. Only 11 species breed in North America. On the basis of appearance, there is no prescribed way of telling pigeons and doves apart; however, pigeons tend to be larger. Mourning doves have short legs and neck but a long, pointed tail edged with white. The rest of the bird's body is a grayish brown color with black spots on its wings. Males tend to be larger than females and of brighter color.

Habitat and Biology

Mourning doves are the most widely distributed birds in North America. They are found in all of the continental United States, the lower portion of the Canadian prairie provinces, Mexico, and the West Indies in habitats ranging from deserts to pine forests. In the United States, two subspecies are recognized: *Zenaida macroura carolinensis*, which occurs east of the Mississippi; and *Zenaida macroura marginella*, found from the prairie states westward. An intermediate form of the two races exists in the zone of overlap which extends southwest of Michigan through Missouri into eastern Texas.

Mourning doves are primarily granivorous ground feeders. They prefer small seeds and consume a large variety of species. Agricultural crops, particularly cereal grains such as oats, wheat, corn, millets, and rye, are important sources of food for doves. Doves utilize different habitats for foraging and roosting during fall and winter. Flocks move between roost sites and agricultural fields on a daily basis. Once the food supply is exhausted, the flock then seeks new feeding areas, so that considerable movement takes place during winter. Winter roost sites are generally small to medium woodlots that provide protective cover.

Mourning doves are monogamous; that is, they have only one mate. After mating, the male initiates selection of the nest site. Nests of mourning doves consist of twigs and pine needles, and are built either on the ground or in bushes and tall trees. Ground-nesting is uncommon in South Carolina. Females lay two eggs, which are incubated by both parents over a period of about 2 weeks. The nesting season in the coastal portion of South Carolina often begins as early as February and can continue into October. Both adults brood the nestlings, feeding them regurgitated food and "crop milk," also known as "pigeon milk," which is a fatty substance produced in the birds' crop. The newly hatched young, called squabs, develop rapidly and leave the nest 12-14 days after hatching. A complete nesting cycle, including several days for nest building and egg laying, requires approximately 30 days. Adults may nest as often as 5-6 times during th e nesting season in the South.

At the end of the breeding season, doves gather in large flocks and migrate south for the winter. Cold months are spent in the southeastern United States, Mexico, Central America, and the West Indies. They move back to their breeding grounds in late winter or early spring. Upon returning, birds typically go back to the same nesting area used the previous year, and sometimes even back to the old nest. Mourning doves feed primarily on plant material such as seeds, waste grain, and fruit. Doves and pigeons share an unusual characteristic: they drink without lifting their heads after each sip. That is, unlike most birds, they do not "scoop" water with their beaks.

The average life span of mourning doves is 1-1.5 years. Natural causes of mortality of mourning doves include predation by avian and mammalian predators; destruction of eggs and nestlings by squirrels, snakes, and birds; and disease. Man-related mortality factors have a considerable effect on the dove population and include destruction of habitat, pesticides and hunting.

Species Significance

This bird species offers more recreation in the way of hunting than any other resident or migratory bird. It is the job of the federal government to establish maximum limits for annual migratory bird hunting. Individual states may set regulations that can be more restrictive, but not more liberal, than federal regulations. Dove hunting season starts in most states in September and ends in October or November. In South Carolina, the season extends from September to January. Methods used for hunting doves differ according to area and climactic conditions, as well as personal preferences. In South Carolina, there is a bag limit of 12 doves per day. For further information on the rules and regulations of hunting, review the South Carolina Department of Natural Resources Hunting Regulations EXIT.

The mourning dove is a highly adaptable species whose numbers have increased in recent years due to clearing of forested areas. They are protected under the Migratory Bird Treaty Act of 1918 and under international conventions with Canada and Mexico. However, the Migratory Bird Treaty Act considers sport hunting a legal use of the migratory bird game resource. Federal regulations, established annually by the Secretary of the Interior, govern the hunting, selling, purchase, and possession of mourning doves in the United States. States must set their regulations within the federal framework.

References

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Dunks, J. H., R. E. Tomlinson, H. M. Reeves, D. D. Dolton, C. E. Braun, and T. P. Zapatka.

1982. Migration, harvest, and population dynamics of mourning doves in the Central Management Unit, 1967-77. Special Scientific Report--Wildlife No. 249. United States Department of Interior, Fish and Wildlife Service, Washington, DC.

Fenwood, L. 1986. Eastern mourning dove. South Carolina Wildlife 33(5): 6-10.

Ohio Department of Natural Resources. 1963. The mourning dove as a game bird. Ohio Department of Natural Resources, Division of Wildlife. Publication W-13. Columbus, OH.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Tomlinson, R.E., D.D. Dolton, R.R. George, and R.E. Mirarchi. 1994. Mourning dove. p. 5-28. *In*: T.C. Tacha and C.E. Braun (eds.). Migratory shore and upland game bird management in North America. International Association of Fish and Wildlife Agencies, Washington, DC.

Osprey *Pandion haliaeetus*

Osprey *(Pandion haliaetus)*

Song, © John R. Sauer

Description

Ospreys, locally known as fish hawks or fish eagles, are the only living representatives of the family Pandionidae and the genus *Pandion*. They are medium-sized birds (females being larger than males), measuring 53-61 cm (21-24 in) length with a 140-180 cm (55-70 in) wingspan. The osprey's back is brownish black, the breast is white with buff or brown speckles, and the tail is gray with dark bars. A dark stripe extends along the side of the face, through the bird's eye. The wings have characteristic dark "wrist" marks when viewed from below and are "bent" like those of a seagull. Juveniles are similar in appearance to adults, but the upper parts are more streaked and the long wing feathers are brownish-yellow. The adult plumage is gradually acquired through a series of molts and is usually complete when the bird is 18 months old. Ospreys are specialized for living near water, where fish constitute almost their entire diet. The legs are long and equipped with long, curved talons (claws), and the undersurface of the toes is covered with short spines, or spicules, that allow the bird to hold on to slippery prey. The plumage is dense and oily and enables the osprey to dive into the water, a unique behavior among birds of prey. Other fish eaters, such as the bald eagle, snatch fish from the surface without entering the water.

Habitat and Biology

The osprey's breeding range extends from Alaska east to Newfoundland and south to Arizona and New Mexico. It also breeds along the Atlantic coast to southern Florida and the Gulf coast. Wintering grounds are north to California and South Carolina and south to Mexico and Chile. Because osprey feed on fish, they must nest in the vicinity of water. The majority of ospreys in the United States are found in marine environments, but inland nesting along rivers, lakes, and reservoirs is also important.

Ospreys select habitat that has suitable perching structures and easy access to fish. Ospreys hover before landing, so they need nesting sites where they can easily land. They have been known to nest on both man-made and natural objects such as cranes, buildings, bridges, nest platforms, telephone poles, or partially rotten trees with no tops. All of these objects allow comfortable landing. Osprey build huge nests which eventually reach "eagle size." They are abundant in the ACE Basin as a result of the expansive saltmarsh and estuarine areas.

Most ospreys found in the United States are migratory birds, with an exception of those in southern Florida. Fall migration occurs from late August to November, peaking in September. They return to breeding grounds from late March to mid-April and begin nest construction or repair (often using the same nest as in the previous year) shortly thereafter. Historically, osprey nests were found on the tops of large dead, and sometimes live trees. Due to the reduced availability of nesting sites in some areas, especially along the mid-Atlantic coast, ospreys now regularly nest on man-made structures such as channel markers. Two to four eggs, pink or buff colored and blotched with brown, are laid in April. Incubation of the eggs, performed mainly by the female, last approximately 38 days. Young fledge at 44 -59 days and may continue to rely on parental care for another 6 weeks. Ospreys reach sexual maturity at 3 years of age. Their diet consists almost exclusively of live fish, although dead ones may be taken occasionally.

Species Significance

The osprey is not listed as threatened or endangered; however it is listed by the U.S. Fish and Wildlife Service as a species of "Special Emphasis." Populations of ospreys, along with those of other birds of prey, declined severely in the United States during the 1950s and 1960s due to pesticide poisoning that caused thinning of eggshells. This species is considered a biological indicator of environmental contamination, mainly of organochlorine pesticides. Ospreys are currently protected under the Migratory Bird Treaty Act and are now abundant in many areas where they had previously disappeared.

References

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Henny, C. J. 1986. Osprey (*Pandion haliaeetus*). U.S. Army Corps of Engineers Wildlife Resource Management Manual. Technical Report EL-86-5, Section 4.3.1. United States Fish and Wildlife Service, Patuxent Wildlife Research Center, Patuxent, MD.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Peregrine Falcon *Falco peregrinus*

Peregrine falcon
(Falco peregrinus)

Description

Adult peregrine falcons, also known as "duck hawks," are a slate-gray color on top and pale white or buff below with dark spots and bars. The adult also has a dark stripe beneath the eyes, and its size is similar to that of a crow. Young falcons are brownish-slate above with heavily streaked undersides. The beaks of peregrine falcons are equipped with a distinct notch used in severing the spinal cord of prey.

Habitat and Biology

This species of raptor has a worldwide distribution. However, it is absent from polar regions and tropical rainforests. The peregrine falcon is typically found on barrier island beaches and waterfowl impoundments in South Carolina and Georgia. They are also found in big cities where pigeons are easy and abundant prey. Peregrines do not build their own nests (called eyries); instead they use other birds' nests or crevices in trees or cliffs. Two to four creamy white eggs with reddish brown spots are laid and are incubated by both parents for about 30 days in the summer months. Young falcons are cared for by their parents and are ready to leave the nest in 35-45 days.

In South Carolina, peregrines are seen during the winter season or during their migration. There is no nesting along the coastal plains of South Carolina. A pair of falcons was observed nesting at Caesar's Head in Greenville County in 1933. Since then, no other falcons nested in the state until May of 1990. In 1990, a nesting pair was reported at Table Rock, and this area has been successfully nested ever since. Peregrine falcons feed almost exclusively on other birds, which they catch in midair. This raptor is reputedly one of the fastest animals on earth, reaching speeds of up to 200 miles per hour in a dive.

Species Significance

Populations of peregrine falcons declined precipitously in the 1950s and 1960s due primarily to pesticide use. Pesticide residues, which remain in the environment for many years, can accumulate in the tissues of small animals, such as birds and mammals, at low enough levels as not to harm the animal. However, when predators consume enough contaminated prey items, pesticides can reach harmful levels. This process is called biomagnification or bioconcentration. In the case of the peregrine falcon, DDT and related pesticides were responsible for the production of very thin eggshells that broke during incubation. The use of DDT was banned in North America, and other pesticides are closely regulated. However, countries in other areas of the world where falcons winter do not have restrictions for pesticide use.

Thanks to the implementation of captive breeding programs, populations of peregrine falcons are making a comeback. The peregrine falcon was listed as endangered under the United States Endangered Species Act of 1973. Currently it is endangered upon Similarity of Appearance because of its close resemblance to the Arctic peregrine falcon. The population is presently in good enough condition that it is being considered for de-listing as an endangered species.

References

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Prothonotary Warbler *Protonotaria citrea*

Prothonotary warbler (Protonotaria citrea)

Song, © Thayer's Birding Software

Description

The prothonotary warbler takes its name from "protonatary," an official of the Catholic church who wears a bright yellow hood. As its name implies, this beautiful bird is very brightly colored. The male prothonotary has a lemon yellow body with an olive back and bluish or slate gray wings. Its tail is black with white areas, and its bill is also black. As in many species of birds, females resemble their counterparts but their colors are duller. Female prothonotary warblers also differ from male warblers in that the top of the head and the back of the neck are olive green.

Habitat and Biology

This species breeds in southeastern states north to Minnesota, Michigan, and New York and spends its winters in the tropics. Prothonotary warblers are characteristic birds of southern swamplands. They build their nests in tree cavities that are in close proximity to water.

Most warbler species construct their nests in dense bushes. However, the prothonotary warbler is only one of two species of wood warblers that uses tree cavities for nesting (the other one being Lucy's warbler, *Vermivora luciae*). Nesting season extends from late April to early May. Nests are placed within natural cavities of stubs, trees, or wooden structures. Clutches usually contain 4-7 eggs, one or two broods are raised, and incubation requires 10-14 days. Southward migration from South Carolina occurs about mid-July.

References

Blem, C. R., and L. B. Blem. 1992. Prothonotary warblers nesting in nest boxes: clutch size and timing in Virginia. The Raven 63(1): 15-20.

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Red Knot *Calidris canutus*

Red knot *(Calidris canutus)*

Description

The red knot, a member of the family Scolopacidae, is a short legged, robin-sized shorebird. Scolopacids include familiar coastal birds such as sandpipers, the smallest of which also belong to the genus *Calidris*. During the breeding season, red knots exhibit black, brown and chestnut colored plumage above and a pinkish-cinnamon breast and face. In winter, the plumage changes to pale gray above and white below. Its legs are a greenish color, and the bill is slightly tapered and black. Red knots are not sexually dimorphic; both males and females look the same.

Habitat and Biology

Red knots winter in the coastal United States from Cape Cod to Mexico and South America and spend the summer on islands in the High Arctic. They over-winter all along the South Carolina coast, primarily on sandy beaches and mud flats.

Red knots raise only one brood per year. Nests are constructed near water on shallow depressions lined with leaves and lichens. Both adults incubate 3-4 olive-buff eggs for about 3 weeks. Young red knots fledge 18-20 days after hatching. This species feeds on mollusks, marine worms, and horseshoe crab eggs. During migration, knots gather in huge flocks, stopping along coastal areas to recharge their energy reserves for their flight to wintering grounds in Central and South America. Near Delaware Bay, their migration stopover coincides with the horseshoe crab's annual spawning. The abundance of horseshoe crab eggs provides ample protein for the migrating knots. In recent times, however, habitat alteration and human activities have threatened populations of horseshoe crabs thus indirectly putting migrating birds such as the ret knot, at risk.

References

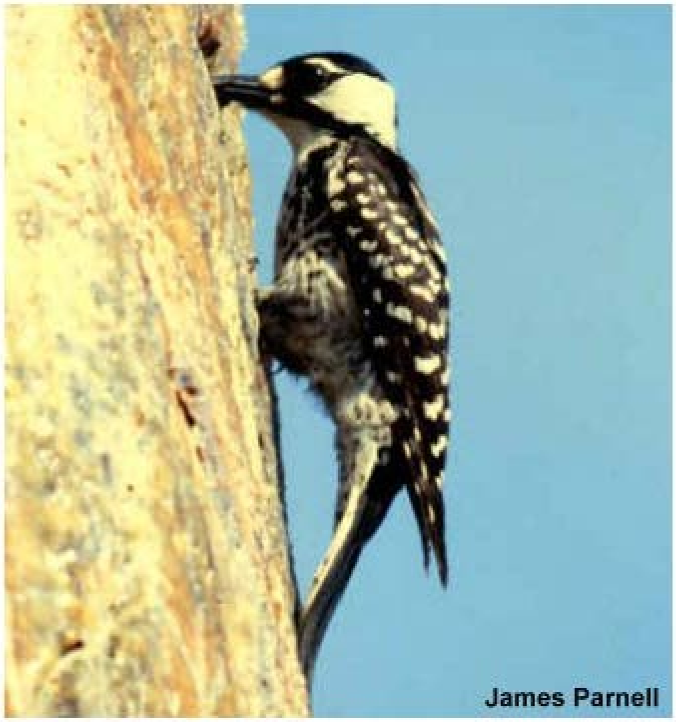
Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The birder's handbook: A field guide to the natural history of North American birds, including all species that regularly breed north of Mexico. Simon & Schuster, New York, NY.

National Geographic Society. 1987. Field guide to the birds of North America. Second edition. National Geographic Society, Washington, DC.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Red-cockaded Woodpecker *Picoides borealis*



Red-cockaded woodpecker
(Picoides borealis)

Sound, SCDNR

Song, © Guy McGrane

Description

The red-cockaded woodpecker is a member of the family Picidae. Similar to other members of the woodpecker family, this small bird has a chisel-like beak used for drilling holes and strong claws that enable it to move along the side of a tree. Male and female red-cockaded woodpeckers look alike, with the exception of the characteristic feature for which they are named: males have a red cockade, a streak of red feathers behind the eye. However, this feature is small and difficult to see. Both males and females have black heads with white cheek patches, and their backs are barred with black and white. Their underside is white, and they have black spots on their flanks.

Habitat and Biology

The range of the red-cockaded woodpecker extends from southeastern Oklahoma and Maryland to the Gulf coast and central Florida. It is a permanent resident of mature pine forests, with an age of 60 years or greater, that lack a hardwood understory, such as those maintained by sporadic wildfires. Many of the woodpeckers in South Carolina reside in Francis Marion National Forest; others inhabit the Sea Islands and coastal regions of South Carolina. Historically, the red-cockaded woodpecker may have lived in the are that has become the ACE Basin. However, the species has not been documented in the ACE.

Red-cockaded woodpeckers are the only woodpeckers to dig a nest cavity in a living tree. Suitable trees for cavity building typically have been infected with red heart disease, a fungal infection that causes the core of the tree to rot, which eases digging for the woodpeckers. Cavity building may last an entire year or more. The birds then proceed to dig smaller holes around the nest cavity. Tree sap oozes out of the holes and presumably serves as a deterrent for potential predators such as raccoons and rat snakes.

Red-cockaded woodpeckers live in family groups, called clans, of four to six individuals: the male and female and several helper birds, usually the male offspring. Helpers assist in incubating eggs, feeding the young, and digging tree cavities. Each member of the clan has its own roost cavity. Two to four white eggs are laid in spring, from late April to mid-May. Young hatch in 10-12 days and spend a little over 3 weeks in the nest. These woodpeckers feed on larvae of wood-boring insects, grubs, beetles, spiders, and other arthropods, Adults occasionally eat berries of wax myrtle, blueberry, poison ivy, and sweet bay.

Species Significance

The red-cockaded woodpecker was listed as an endangered species throughout its range in 1970 and continues to be considered endangered in most states where it occurs, including South Carolina. The primary factor leading to its decline is habitat loss. Because red-cockaded woodpeckers are so specialized with respect to habitat requirements, they are extremely vulnerable to land-use changes. Current forestry practices do not usually allow pine trees to attain the age necessary for woodpecker habitat. Management practices should include the use of controlled fires in order to provide suitable habitat by destroying the hardwoods but not the pines. Currently, there are no colonies documented in the ACE Basin. (See related section: the Endangered Species.)

References

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The birder's handbook: A field guide to the natural history of North American birds, including all species that regularly breed north of Mexico. Simon & Schuster, New York, NY.

Murphy, S. H. and G. Barnette (eds.). South Carolina's endangered species portfolio. South Carolina Department of Natural Resources, Wildlife Diversity Section, Columbia, SC.

National Geographic Society. 1987. Field guide to the birds of North America. Second edition. National Geographic Society, Washington, DC.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Red-tailed Hawk *Buteo jamaicensis*

Red-tailed hawk ***(Buteo jamaicensis)***

Song, © Thayer's Birding Software

Description

Red-tailed hawks are the most common members of the genus *Buteo* in North America. The name *Buteo* means "buzzard," a term that correctly refers to some Old World hawks but is commonly misused to refer to vultures. Locally, red-tailed hawks are also known as hen hawks or rabbit hawks. They are medium sized birds, reaching 46-64 cm (18-25 in) in length with a wingspan of 1.2 m (4 ft). Their plumage is dark brown above and white below. The belly is streaked with brown, and the tail is "solid' rust color (with a black subterminal band). There are two variations in coloration in the red-tailed hawk, the light phase and the dark phase. An individual hawk will retain the coloration that it is born with throughout its life.

Juvenile hawks resemble the adult except in tail plumage. The juvenile tail is usually tan colored with thin black stripes, while the adult has the rust-colored tail with a black subterminal band. Red-tailed hawks are stockier and have broader, more rounded wings than both the red-shouldered and broad-winged hawks. Also, both the red-shouldered and broad-winged hawks lack the white chest feathers of the red-tailed hawk. Albinism has been reported to occur more frequently in this species than in any other bird of prey.

Habitat and Biology

Red-tailed hawks inhabit deciduous forests and open country throughout the United States and Canada. The species breeds from northern Manitoba and southeastern Quebec to eastern Texas and northern Florida. Wintering grounds are from South Dakota and southern Maine to southern Texas and Florida. In South Carolina, where they are common residents during winter, red-tailed hawks are usually spotted soaring or perching near telephone poles or fence posts where they can scan open areas for prey. Golf courses and highways are also favorite hunting grounds for these raptors.

In South Carolina, red-tailed hawks nest in late February and March. They do not begin breeding until their third year. Nests are constructed on large pines or rock ledges, 9-12 meters (30-40 feet) above ground in grasslands or marsh shrub habitats. The nest is concealed by building it in the "crotch" of two main branches and is rather bulky, made of sticks and twigs with fresh green vegetation lining the interior.

Clutch size in this species is two to three white eggs spotted with brown. Incubation lasts approximately 28 days, and hatchlings emerge in March. Hatchlings are immobile, have downy plumage, and are hatched with their eyes open. They continue to need parental care for approximately 6-7 weeks. After this time they are ready to fly, yet continue to fly and hunt with their parents until they are ready to be on their own. Adult plumage is obtained at 2-3 years of age, and sexual maturity is probably reached before this time.

Like other hawks of the genus *Buteo*, red-tailed hawks are commonly seen soaring over open country in search of prey. Their diet consists mainly of mice, rats, and rabbits; consequently, red-tailed hawks are extremely effective at controlling rodent populations. Red-tails also eat birds, squirrels and some insects.

Species Significance

The Audubon Society's Christmas Bird Count data for the 1970s and 1980s suggest an increase of about 33% for wintering populations of the red-tailed hawk in the United States and Canada. These raptors are abundant in South Carolina; however, they are often hit by cars, possibly due to the abundance of litter that collects on roadsides, attracting rodents, the prey of red-tail hawks.

References

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Red-winged Blackbird *Agelaius phoeniceus*

Red-winged blackbird *(Agelaius phoeniceus)*

Song, © John R. Sauer

Description

Blackbirds belong to the family Icterinae, whose members live exclusively on the American continent. Of the 95 species included in this family, 23 breed in North America. Red-winged blackbirds are one of the more conspicuous and vocal birds in coastal areas. Males are easily identified by glossy black plumage and a bright red shoulder patch with a yellow stripe. Females are less ornate, with dark brown plumage and a pink-reddish tinge on the chin and neck. Young are similar in appearance to females with heavy, dusky brown streaks. Red-winged blackbirds are small birds, measuring approximately 23 cm (9 in) in length.

Habitat and Biology

Red-winged blackbirds reside year-round in most of the continental United States except for the far northern areas. They prefer riparian habitats such as fresh and saltwater marshes and open fields, both of which are common in South Carolina coastal areas.

Pairs of red-winged blackbirds typically raise two to three broods during the breeding season, which extends from April to June in South Carolina. Females construct a saucer-shaped nest from grass, rushes, and sedges. Nests are usually located in shrubby bushes near water. Two to six eggs, pale-blue and scrawled with dark brown or purple, are incubated by the female for 10-12 days. Young blackbirds fledge 11-14 days after hatching. After the breeding season, males and females gather in separate flocks reported to number in the millions; hence their genus, *Agelaius*, meaning "gregarious." Red-winged blackbirds favor seeds, grasses, and insects as their diet.

References

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The birder's handbook: A field guide to the natural history of North American birds, including all species that regularly breed north of Mexico. Simon & Schuster, New York, NY.

National Geographic Society. 1987. Field guide to the birds of North America. Second edition. National Geographic Society, Washington, DC.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Short-billed Marsh Wren *Cistothorus platensis*

Short-billed marsh wren
(Cistothorus platensis)

Song, © John R. Sauer

Description

The short-billed marsh wren, also known as the sedge wren, belongs to the family Troglodytidae. It is one of nine species of wrens found in North America. Wrens are generally small birds with short, upturned tails varying in color from brown to gray to buff. The short-billed marsh wren is small (10-11 cm or about 4 in) with fine streaks on top of the head and back and a pale eyebrow stripe. The bird's back is light brown, and its underside, chest, and sides are a cinnamon color.

Habitat and Biology

Short-billed marsh wrens breed from Saskatchewan, Manitoba, and New Brunswick to Kansas, Missouri, and Delaware. Winter ranges extend from southern Illinois and Virginia, and south to southeastern Mexico and southern Florida. In South Carolina, it is a fairly common winter resident over most of the state, although it is more numerous along brackish and freshwater marshes in coastal areas.

Like its relatives, the short-billed marsh wren has secretive habits and is therefore difficult to spot among the tall grasses where it lives. It also shares with other wrens the characteristic behavior of constructing several "dummy nests" or "false nests." Such nests are built during the breeding season but are used for roosting rather than breeding. Nests are a round-shaped mass of marsh grass lined with feathers woven into the upper portion of a thick stand of grass or sedge. Short-billed marsh wrens breed polygynously (one male mates with more than one female), although not all the time, and males sing prolifically throughout the breeding season. In South Carolina, eggs are usually laid in early June, sometimes as early as the end of April and as late as the beginning of August. Clutch size is five to seven white eggs that incubate for an average of 14 days, with the young fledging approximately 14 days after hatching. This species' diet consists almost exclusively of insects and spiders.

Species Significance

The short-billed marsh wren is not currently threatened or endangered and is a fairly common winter resident of the ACE Basin.

References

[Anonymous]. Not dated. A guide to the Life in the Salt marsh poster. South Carolina Department of Natural Resources, Marine Resources Division.

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Crawford, R. D. 1977. Polygynous breeding of short billed marsh wrens. The Auk 94: 359-362.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Southern Bald Eagle *Haliaeetus leucocephalus*

Southern bald eagle ***(Haliaeetus leucocephalus)***

Song, SCDNR

Description

Bald eagles are magnificent birds of prey. The bald eagle's common name comes from "balde," an Old English word meaning "white." Its scientific name, *Haliaeetus leucocephalus*, means "white-headed sea eagle." Actually, it is the only representative of the group of eagles known as sea eagles in the New World. Except for the rare golden eagle, the bald eagle is the largest raptor in South Carolina, with a wingspan of 180 -230 cm (70-90 in). Adult bald eagles have dark brown plumage except for the head, neck, and tail, which are white. The birds' bill, feet, and eyes are yellow. Young eagles have dark to light brown plumage; their eyes and bill are also dark. The characteristic white plumage does not begin to develop until eaglets are 3 years old, and may not be complete until 5-6 years of age.

Habitat and Biology

Bald eagles build their nests in tall trees along coasts or on the banks of rivers and lakes. Suitable nest sites are chosen based on proximity to water, vantage point, and height of the tree. In South Carolina, eagle nests are often found in tall, live pines with a higher canopy than surrounding trees. Usually, nesting sites are close (within 1 mile) to large bodies of water such as impounded marshes. Each year during the breeding season, new branches are added to the original nest. Over time, bald eagle nests can measure 3 meters (10 feet) across and weigh more than 1 ton. Nesting in South Carolina occurs along the major river drainages of the Lower Coastal Plain. The ACE Basin constitutes the most important nesting area in the state, with 40% of nesting eagles living within its boundaries. In summer 1997, nesting bald eagles numbered 114 in 27 counties in South Carolina. This is a considerable increase from an initial 13 pairs in five counties when the South Carolina Department of Natural Resources began a monitoring program for this species 20 years ago.

Bald eagles mate for life. In South Carolina, eggs are laid in late December to early January. Male and female bald eagles take turns incubating the eggs that are laid in clutches of one to three. Eaglets hatch after approximately 35 days. In the spring and summer, juveniles and adults migrate north. Eagles banded in South Carolina have been reported to migrate as far north as Canada. However, the Chesapeake Bay area appears to be a favored location for South Carolina eagles during the non-nesting season. Bald eagles feed mainly on fish, which are snatched out of the water with the eagles' talons or stolen from ospreys. However, during winter eagles also feed on coots, injured ducks and, occasionally, rabbits and other small mammals. Carrion, usually dead fish, is a regular part of their diet.

Species Significance

In the past, eagles have been protected under the Eagle Protection Act of 1940, the Migratory Bird Treaty Act of 1918, and the Lacey Act. However, loss of habitat, indiscriminate shooting, and pollutants such as pesticides were primary factors contributing to the eagle's reduced numbers. Between 1947 and 1972, eagle populations throughout the country plummeted. Scientists determined that harmful chemicals, such as the pesticide DDT, were accumulating in the food chain and affecting top level predators. Birds that fed on fish contaminated with DDT residue laid eggs with very thin shells that broke easily before the eaglets could hatch. Since then, use of certain pesticides has been banned in the United States, and bald eagle populations are slowly recovering; their status changed from endangered to threatened in July of 1995.

References

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Heritage Trust Data Base. 1997. Heritage Trust Program, South Carolina Department of Natural Resources, Columbia, SC.

Murphy, T.M., Jr. and J.W. Coker. 1978. The status of the bald eagle in South Carolina. p. 89-93. *In*: R.O. Odom and L. Landers (eds.). Proceedings of the rare and endangered wildlife symposium, 3-4 Aug. 1978, Athens, GA. Georgia Department of Natural Resources, Game Division, Technical Bulletin WL 4. Atlanta, GA.

Murphy, S. H. and G. Barnette (eds.). South Carolina's endangered species portfolio. South Carolina Department of Natural Resources, Wildlife Diversity Section, Columbia, SC.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

The Wilderness Society. 1998. Wilderness and Science home page. http://www.wilderness.org/ccc/owls.htm. (30 April 1998).

Wood Duck *Aix sponsa*

Wood duck ***(Aix sponsa)***

[Call](), recorder unknown

Description

The wood duck's species name, *sponsa*, meaning "bride," refers to this bird's handsome appearance. Males have a dark green, purple, and blue-crested head with white face stripes and chin. The bill is reddish orange, the neck is white, and the chest is a deep chestnut color. The bird's flanks are barred with black and white, and its belly is white. Female wood ducks have less ornate plumage than their partners. They are mostly gray with a distinct white eye ring. Juveniles resemble females but are spotted below. Another distinctive characteristic of wood ducks is their habit of perching on snags or stumps near water. Wood ducks may measure 47 cm (18 in) from head to tail.

Habitat and Biology

The wood duck's breeding range extends over much of the continental United States and southern Canada. During the winter, the birds move south out of Canada into the lower 48 states. They are year-round residents of South Carolina, preferring to live in wooded swamps, bottomlands, marshes, and ponds.

The wood duck occurs year-round in South Carolina and is the only migratory duck species that breeds abundantly in all geographic regions of the state. In South Carolina, the mating season for this species typically begins in March with the search for a nesting site. Wood ducks are prevalent in the rivers and swamps of the ACE Basin, where the female constructs a nest of chips lined with down inside a tall tree or in man-made nesting boxes fitted with dome-shaped predator guards. The female lays eggs over a period of 12 days with hatching occurring after 28-30 days of incubation. Wood ducks typically raise one brood per year, but may have two in southern extremes of their range. Six to 15 whitish eggs are laid and incubated for 28-37 days. Young ducks leave the nest 56-70 days after hatching, jumping from the tree cavity or nest box to the ground or water below, where they forage on insects and invertebrates. They are protected by the hen for 8-10 weeks until they are able to fly. Ducklings are subject to predation by snapping turtles, alligators, bull frogs, snakes, and wading birds. Mortality may be as high as 50% from a clutch. The female may re-nest, with as many as three clutches initiated in an effort to have one successful brood (Beach 1989). Wood ducks feed upon seeds, berries, grains, aquatic invertebrates, and insects.

Species Significance

Sportsmen hunt these ornate and showy woodland ducks during the waterfowl season in autumn/winter. Hunting season is set by the South Carolina Department of Natural Resources each year by mid-August. The wood duck is a common resident in the ACE Basin.

References

Beach, V. 1989. Carolina's duck. SC Wildlife, 36(6): 27-35.

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The birder's handbook: A field guide to the natural history of North American birds, including all species that regularly breed north of Mexico. Simon & Schuster, New York, NY.

National Geographic Society. 1987. Field guide to the birds of North America. Second edition. National Geographic Society, Washington, DC.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Wood Stork *Mycteria americana*

Wood stork ***(Mycteria americana)***

Description

Wood storks are some of the largest wading birds inhabiting South Carolina. They stand over 1 meter tall, and their wingspan is over 150 cm (60 in). The bird's body is white with black flight feathers (on the edges of the wings) and tail. Its head and neck are bare and of a dark gray color, a fact that has earned the wood stork the name "flinthead." Adults have a dark gray beak that is long and slightly curved. Young storks have dull yellow beaks. Unlike other wading birds such as herons, storks extend their necks during flight. Their reputation as magnificent fliers is well established. Wood storks are not very vocal birds, except when they are around their nest; adults make low croaking sounds, and young make rattling noises with their beaks.

Habitat and Biology

Wood storks are distributed from South Carolina to southern South America. In the United States, wood storks concentrate on coastal areas of Florida, Georgia, and South Carolina. They are the only species of stork that resides in the United States. After the breeding season, wood storks can be found throughout the Southeastern Coastal Plain. They have been reported as far west as California and as far north as Massachusetts. In South Carolina, wood storks nest in four counties, including Colleton County. Three nesting colonies are found within the boundaries of the ACE Basin study area. Nests are typically located on trees surrounded by water, such as in cypress swamps, shallow creeks, and impoundments. An average of three eggs is laid, and the parents take turns incubating them for about 30 days. Hatchlings then remain in the nest for approximately 55 days. As of the summer of 1997, the nesting population of wood storks in the state was over 950 pairs. Wood storks form nesting colonies that may contain up to 10,000 nests. In South Carolina, the seven nesting colonies in existence contain an average of 102 nests. In the mid to late 1990s, five of these colonies were in the ACE Basin. These large wading birds are commonly seen walking slowly through the marshes in search of food. They dip their open beaks in shallow water and "feel around" for small fish or crustaceans. The daily food intake of an adult is about 1 pound of fish. When several birds feed in a pool, they typically shuffle their feet to stir fish out of their hiding places so they can be picked up by the other birds. Additional information on wood stork nesting can be found in the Bird section and in the GIS data portion of this product.

Species Significance

In the 1930s, wood storks were commonly found in all coastal areas from South Carolina to Texas. However, wood stork populations have declined drastically in recent times, primarily because of habitat alteration. The availability of suitable feeding areas has been reduced due to draining of wetlands, flood control practices, land development, and lumbering. In South Carolina, they were listed as endangered under the Nongame and Endangered Species Act of 1974. In 1984, wood storks were placed on the U. S. Endangered Species List.

References

Bull, J. L. and J. Farrand, Jr. 1995. National Audubon Society Field Guide to North American Birds. Eastern Region. The Audubon Society field guide series. Alfred A. Knopf Inc., New York, NY.

Dodd, M. G. and T. M. Murphy. 1997. The status and distribution of wading birds in South Carolina, 1988-1996. The Chat 61(3): 129-181.

Murphy, S. H. and G. Barnette (eds.). not dated. South Carolina's endangered species portfolio. South Carolina Department of Natural Resources, Wildlife Diversity Section, Columbia, SC.

Sprunt, A., Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

NEXT SECTION: Species Gallery - Fish
RETURN TO: Species Gallery - Intro

General Introduction | Cultural Resources | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perceptions | Image Atlas | Bibliography | Glossary | About This CD-ROM | Site Map | Search

M
E
N
U

American Shad *Alosa sapidissima*

Atlantic Croaker *Micropogonias undulatus*

Bay Anchovy *Anchoa mitchilli*

Black Drum *Pogonias cromis*

Flathead Catfish *Pylodictis olivaris*

Hardhead Catfish *Arius felis*

Largemouth Bass *Micropterus salmoides*

Mummichog *Fundulus heteroclitus*

Red Drum *Sciaenops ocellatus*

Redbreast Sunfish *Lepomis auritus*

Sheepshead *Archosargus probatocephalus*

Shortnose Sturgeon *Acipenser brevirostrum*

Silver Perch *Bairdiella chrysoura*

Southern Flounder *Paralichthys lethostigma*

Southern Kingfish *Menticirrhus americanus*

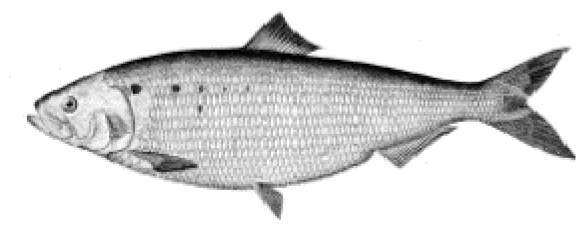
Spot *Leiostomus xanthurus*

Spotted Seatrout *Cynoscion nebulosus*

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Fish

American Shad *Alosa sapidissima*



American shad *Alosa sapidissima*

Description

American shad are the largest members of the family Clupeidae (which includes herrings, alewives, menhaden and sardines) in the United States. Clupeids are generally deep-bodied, silvery fishes that have relatively large, easily-shed scales and often associate in large schools. They have rough scales, or scutes, along the ventral edge of the body, forming a "saw-belly," a single dorsal fin midway along the body, and a deeply forked caudal fin. In addition, Clupeids have no lateral line and lack spines on all their fins. American shad are a metallic green color dorsally with silvery sides and have a dark shoulder spot behind the gill cover, sometimes followed by a series of smaller spots.

Habitat and Biology

American shad are distributed from the Gulf of St. Lawrence to Florida and are most abundant between Connecticut and North Carolina. They are anadromous; that is, they migrate upriver from brackish water to spawn. Upstream migration coincides with favorable water temperatures and typically begins in the spring. In South Carolina, adult migration to freshwater begins in January, peaks in February and March, and ends in April. Similar to salmon, American shad return to the same tributary system where they were hatched.

Spawning usually occurs in tidal and nontidal freshwater areas over shallow flats, sometimes hundreds of miles inland, where currents are strong enough to keep the eggs suspended in the water. Usually, American shad travel far enough upstream that the drifting eggs hatch before reaching saltwater. Males are 3-4 years old and females are 4-5 years old at sexual maturity. They spawn only once or twice (rare in South Carolina) during their life. During spawning, females are followed by 1-3 males who fertilize the eggs as they are released into the water. Each female may release between 100,000 and 700,000 eggs over the spawning season. The eggs sink slowly and drift along the bottom of the river, hatching within 4-6

Striped Bass *Morone saxatilis*

Striped Mullet *Mugil cephalus*

days. Larval and juvenile shad move downriver towards the ocean but remain in the rivers and estuaries until the following spring, when they move into the ocean and join the adult population. They remain there in large schools during fall and early winter. However, not all adults survive the spawning event. In northern latitudes, where water temperature changes gradually and shad do not migrate far upstream, large numbers of adults find their way back to the ocean and survive to spawn the following year. In the southern part of their range, however, water warms up rapidly in the spring and shad tend to move well upriver to find suitable spawning sites. Consequently, less than 10% of spawning adults survive the migration back out to sea. Juveniles spend an average of four years along the Atlantic coast before they undertake their first spawning migration. This species lives to be 5 to 7 years old.

American shad are primarily planktivores. Juvenile shad feed on small invertebrates, insects, fish eggs, and algae. Adults use their gill rakers (comb-like structures on the gill arches) to filter small planktonic animals from the water for food during the riverine and oceanic phases of their life cycle. Adults do not feed during the upstream migration to their spawning areas.

Species Significance

American shad are important commercial and game fish. Fisheries for American shad have existed along the Atlantic coast since the nineteenth century, but have been declining since then due to overfishing and degradation of spawning habitat. In South Carolina, the shad fishery is the single most important finfish fishery. Since 1987, there has been a continuous decline in numbers of shad landed; however, landings in 1996 were considerably higher than in previous years. Female shad, referred to as roe shad, are prized for their egg mass (roe), which is considered a delicacy. Male shad, called bucks, are popular for their meat. In South Carolina, a recreational fishery for American shad exists exclusively in fresh water where fish are taken with dip nets or with artificial lures during their spawning migration.

The once huge populations of shad started to decline in the mid nineteenth century due to dam construction, pollution, and overfishing. However, stocks have shown some recovery in recent years. In the Edisto, Ashepoo and Combahee Rivers, however, shad populations are not as healthy as they were in years past. This species is currently not threatened or endangered.

References

MacKenzie, C., L.S. Weiss-Glanz, and J.R. Moring 1985. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic): American shad. Biological Report 82(11.37). U.S. Department of Interior, Fish and Wildlife Service, Division of Biological Services, Washington, DC.

Moore, C. 1996. Review of the 1995 finfish season. South Carolina Department of Natural Resources, Charleston, SC.

Murdy, E.O., R.S. Birdsong, and J.A. Musick. 1997. Fishes of the Chesapeake Bay. Smithsonian Institution Press, Washington, DC.

Walburg, C.H. and P.R. Nichols. 1967. Biology and management of the American shad and status of the fisheries, Atlantic coast of the United States, 1960. Special Scientific Report - Fisheries No. 550. U.S. Department of Interior, Fish and Wildlife Service, Washington, DC.

Atlantic Croaker *Micropogonias undulatus*

Atlantic croaker ***(Micropogonias undulatus)***

Description

As members of the drum family (Sciaenidae), croaker are well known for producing "drumming" sounds, which they do by vibrating special muscles on either side of their swimbladder. They are common inhabitants of South Carolina estuaries, including the ACE Basin, during spring and summer months. Croaker are easily recognized by numerous short barbels on either side below the mouth and a sharply jagged preopercle. The latter can be painfully evident upon holding a croaker, as the fish tend to flare their opercles when disturbed or frightened. Croaker have a rather long head with an inferior mouth, appropriate for feeding on the bottom. They have silvery bodies with a series of copperish or brownish markings arranged in diagonal bars that tend to become less distinct as the fish grows. Pectoral and pelvic fins are bright yellow to orange.

Habitat and Biology

Atlantic croaker are in the same family as spot (Sciaenidae) and have a life history similar to spot. This species has a protracted spawning season from late summer through early spring; however, peak reproductive activity is in late fall. Spawning takes place in near-shore ocean waters, and the resulting early-life stages utilize some of the same behavioral patterns as spot to gain entrance to estuarine systems. Atlantic croaker are about 1/4 inch (4-6 mm) at the time of recruitment into the estuarine habitats. This species also utilizes the shallow marsh habitat as its primary nursery area. The small fishes feed on crustaceans and benthic infauna and epifauna. After a short residence period, they move from the shallows to other areas of the estuary such as the channels. Some Atlantic croakers are sexually mature between age one and two, and all are mature the following year. Throughout their life, Atlantic croakers eat small crustaceans and small fishes either on the bottom or near the bottom.

Species Significance

Landings of Atlantic croaker in South Carolina have represented a limited contribution to the commercial catch for the South Atlantic region. Since 1950, commercial landings in South Carolina have fluctuated widely, reaching a peak in the early 1970s. As of 1987, when a Fishery Management Plan for Atlantic croaker was instituted by the Atlantic States Marine Fisheries Commission (ASMFS), commercial landings in South Carolina resulted mainly from a limited fall haul seine fishery and from shrimp trawl bycatch. Currently, most Atlantic croaker that are sold commercially are caught incidentally.

The recreational harvest in South Carolina is also relatively limited. Catches since 1981 were at their highest in 1984 and at their lowest in 1993. Currently, there are no restrictions governing the catch of Atlantic croaker in South Carolina.

References

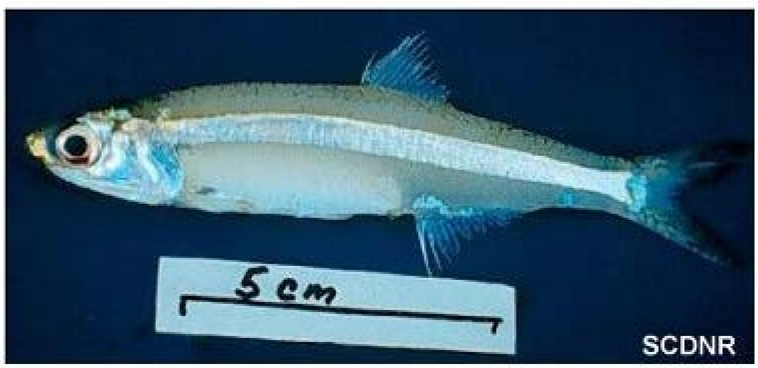
McErlean, A.J., S.G. O'Connor, J.A. Milhursky, and C.I. Gibson. 1973. Abundance, diversity and seasonal patterns of estuarine fish populations. Estuarine Coastal Marine Science 1:19-36.

Miglarese, J.V., C.W. McMillan, and M.H. Shealy, Jr. 1982. Seasonal abundance of Atlantic croaker (*Micropogonias undulatus*) in relation to bottom salinity and temperature in South Carolina estuaries. Estuaries 5(3):216-223.

Moore, C. 1993. South Carolina report for Atlantic croaker. *In*: Proceedings of a Workshop on spot, (*Leiostomus xanthurus*) and Atlantic croaker (*Micropogonias undulatus*). Special Report No. 25. Atlantic States Marine Fisheries Commission, Washington, DC.

Wenner, C. 1998. Personal communication. South Carolina Department of Natural Resources, Marine Resources Division, Charleston, S.C.

Bay Anchovy *Anchoa mitchilli*



Bay anchovy *(Anchoa mitchilli)*

Description

The bay anchovy is one of 10 species of anchovies on the Atlantic coast of North America and is the most abundant fish in estuarine and coastal habitats along the eastern United States. Bay anchovies (and other anchovy species) are similar in appearance to fishes of the herring family (Clupeidae). However, they can be distinguished by a prominent silver stripe on either side of the body and lack of scutes (bony scales) along their bellies. Bay anchovies are of a greenish color above and silvery below and have a single dorsal fin, which is located midway along the body. They are often confused with silversides (*Menidia* spp.), but the two can be easily distinguished--anchovies lack a spine in the dorsal fin and have a large, gaping mouth that extends almost to the edge of the opercle, whereas silversides have two distinct dorsal fins, the first with four spines, and a very small mouth that is tilted upwards.

Habitat and Biology

Along the Atlantic coast, the species is distributed from the Gulf of Maine to Florida. It is also abundant along the Gulf coast to Yucatan, Mexico. Bay anchovies inhabit primarily shallow bays and estuaries but also occur in tidal freshwater habitats.

Bay anchovies, as other members of the family Engraulidae, typically aggregate in large schools. They are planktivorous fish which use gill rakers--comb-like structures on their gill arches--to strain the water for food. In South Carolina, spawning occurs in the evening during the summer months. Eggs are pelagic, and larvae hatch within 24 hours. Growth in this species is rapid, especially at higher temperatures, with a fish reaching maturity a few months after hatching. Bay anchovies seldom live past the age of two.

Species Significance

Bay anchovies are often very abundant and are important food for commercially valuable species such as striped bass, bluefish, spotted seatrout and southern flounder. They also are a very important link between the plankton community and higher order consumers. Thus, even though the species itself has no recreational or commercial value, it fulfills a crucial role in the coastal food web.

References

Dorsey, S.E., E.D. Houde, and J.C. Gamble. 1996. Cohort abundances and daily variability in mortality of eggs and yolk-sac larvae of bay anchovy, *Anchoa mitchilli*, in Chesapeake Bay. Fishery Bulletin 98:257-267.

Jones, P.W., F.D. Martin, and J.D. Hardy, Jr. 1978. Development of fishes of the mid-Atlantic Bight: an atlas of egg, larval, and juvenile stages. Volume I: Acipenseridae through Ictaluridae. U.S. Fish and Wildlife Service, Office of Biological Programs. FSW/OBS-78/12. Ft. Collins, CO.

Luo, J. and J.A. Musik. 1991. Reproductive biology of the bay anchovy in Chesapeake Bay. Transactions of the American Fisheries Society 120:701-710.

Murdy, E.O., R.S. Birdsong, and J.A. Musick. 1997. Fishes of the Chesapeake Bay. Smithsonian Institution Press, Washington, DC.

Black Drum *Pogonias cromis*

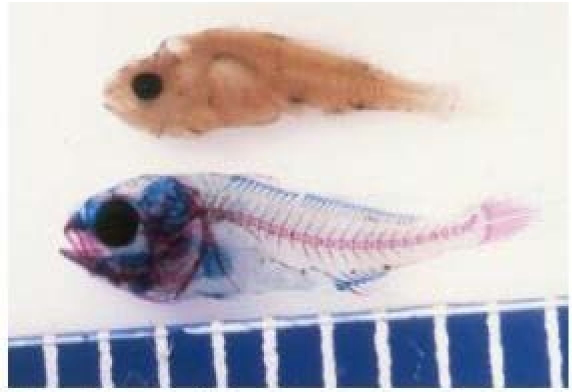
Black Drum ***(Pogonius cromis)***

Sound, SCDNR

Description

Black drum are large, long-lived members of the drum family (Sciaenidae), reaching over 1 meter (3.3 ft) in length and weighing over 50 kg (110 lbs). They are one of only four members of this family that possess chin barbels set in pairs. Along the South Carolina coast, only the Atlantic croaker, *Micropogonias undulatus*, shares this characteristic. Black drum, as their name suggests, are dark in color with a silvery luster. Their body shape is characteristic in that their back is distinctly elevated. When young, they possess four to five dark vertical bars that fade and eventually disappear as the animal grows.

Habitat and Biology



Larval black drum

Black drum are members of the family Sciaenidae, and they spawn during the spring (late March through April) in high salinity waters near inlets. Eggs and larvae are planktonic, and eventually the larvae gain access to the shallow dendritic creeks of the tidal marsh habitat. Juveniles remain in these creeks for four to six months, after which they are found on the shallow tidal mud flats, often co-occurring with red drum and southern flounder. Black drum feed on invertebrates such as small clams and crustaceans, which are easily crushed by the strong molar-shaped pharyngeal teeth. These prey items are commonly found in association with oyster bars, and catches of small black drum (150-500 mm) occur primarily in these shallow-water habitats.

Black drum have a long life span, with the oldest fish being 30+ years of age. They have a fast growth rate for the first three years, after which the rate slows considerably. Sexual maturity appears to be attained at age 3 to 5. At the present time, there are numerous gaps in the life history of this species.

Species Significance

Historically, black drum were harvested commercially in South Carolina. Trotlines were set in the spring and baited with crabs to catch the large fish entering the estuaries. Currently, no commercial landings are reported from South Carolina, and the National Marine Fisheries Service offers no data on commercial landings for any state in the South Atlantic. Black drum are caught recreationally in South Carolina with hook and line in deep holes near the mouth of estuaries. There are no size restrictions or bag limits governing the recreational harvest of this species.

References

McErlean, A.J., S.G. O'Connor, J.A. Milhursky, and C.I. Gibson. 1973. Abundance, diversity and seasonal patterns of estuarine fish populations. Estuarine Coastal Marine Science 1:19-36.

Murdy, E.O., R.S. Birdsong, and J.A. Musick. 1997. Fishes of the Chesapeake Bay. Smithsonian Institution Press, Washington, DC.

Roumillat, W. 1998. Personal communication. South Carolina Department of Natural Resources, Marine Resources Division, Charleston, S.C.

Wenner, C. 1998. Personal communication. South Carolina Department of Natural Resources, Marine Resources Division, Charleston, S.C.

Flathead Catfish *Pylodictis olivaris*

Flathead catfish *Pylodictis olivaris*

Description

Catfishes, members of the family Ictaluridae, are easily recognized by conspicuous barbels around their mouths and scaleless bodies. The pectoral and dorsal fins are equipped with spines that can inflict wounds causing considerable discomfort, depending on the particular species. The flathead catfish is the only member of the genus *Pylodictis*. This species can be distinguished by a white blotch on the dorsal lobe of the caudal fin (except in large adults), an adipose fin which is fused to the body along its entire length, and an anal fin with less than 17 rays. The fish are typically yellowish with brown mottling. The species gets its scientific name from its flattened head, protruding lower jaw, and coloration. Adults commonly reach 115 cm (45 in) long and generally weigh up to 23 kg (50 lbs). The current South Carolina record weighed 33.5 kg (74 lbs).

Habitat and Biology

Flathead catfish are typically found in freshwater rivers and reservoirs, but they can also inhabit brackish water. They are benthic inhabitants and utilize their barbels to locate food in the substrate. They are very secretive and spend the daylight hours associated with some type of aquatic cover. Foraging occurs at night, often in areas so shallow that their dorsal fins are exposed. Juveniles feed on immature insect larvae in riffle areas, and adults primarily target fish and crayfish. Adults are generally a solitary species, except during the spawning season. They prefer deep pools with heavy submerged cover. At night they move to shallow areas to feed. Young fish can be found in shallower areas around roots or riprap.

This species spawns in June or July. The eggs are laid in a large nest fanned out on the bottom in a natural cavity or near a large, submerged structure. An egg mass of up to 100,000 eggs can be produced by a large female. The eggs are agitated continuously by the male parent, which helps to provide oxygen and flush away silt from the nest. After the eggs hatch, the fry remain in a compact school around the nest for several days, guarded by the male fish. They soon disperse and begin a solitary existence. The fry first feed on insect larvae, but as they grow, fish and crayfish become more important in the diet. Large adults are almost completely piscivorous. The species reaches sexual maturity at 4 or 5 years of age. Trophy size can be reached in about 10 years.

Species Significance

Flathead catfish are not native to the ACE Basin but are originally from the Mississippi River drainage. They were first introduced into Lake Thurmond and Lake Marion in the early 1960s. North Carolina stocked the species in the Pee Dee drainage, and they have migrated from there downstream into South Carolina. Because of unauthorized releases, they are now found in several coastal rivers of the state, including the Edisto River in the ACE Basin. In the Edisto River, they have been found throughout the main branch and are beginning to move into the north and south forks.

In the Edisto River system, flathead catfish have had profound effects on native catfish and sunfish species. All three of the once plentiful bullhead catfish species are now rare. Redbreast sunfish populations appear to have also been drastically reduced since the introduction of flathead catfish into the system. Because flathead catfish have been found in estuarine reaches of the river, it is speculated that they may also impact some marine and amphidromous species as well. Most notable would be their potential impacts on shortnose sturgeon, which use the estuarine reaches of the river as feeding grounds during the winter. Currently, the Freshwater Fisheries Section of the South Carolina Department of Natural Resources is gathering data on life history information, and investigating the impacts of this species on the ecology of the Edisto River.

This species is important commercially and is a popular game fish in many areas. (See related section: Recreational Fisheries.)

References

Allen, D. 1998. pers. comm. South Carolina Department of Natural Resources, Freshwater Fisheries Division, Barnwell, SC.

Allen, D.E. and C.S. Thomason. 1993. Survey and inventory of fisheries resources in the Combahee River. Study Completion Report F-32. SC Wildlife and Marine Resources Department, Columbia, SC.

Thomason, C.S., D.E. Allen, and J.S. Crane. 1993. A fisheries study of the Edisto River, SC. Wildlife and Marine Resource Department, Study Completion Report, Federal Aid Projects F-32 and F-30.

Hardhead Catfish *Arius felis*

Hardhead catfish ***(Arius felis)***

Description

Hardhead catfish are members of the family Ariidae. Even though members of this family are commonly known as sea catfishes, they are not confined to marine waters. Sea catfishes can be differentiated from freshwater catfishes (family Ictaluridae) by the number of barbels. Sea catfishes have three pairs, whereas freshwater catfishes have four. As other catfishes, hardhead catfish lack scales and they possess a fleshy adipose fin. Hardhead catfish vary in color, from dark brown to dark blue and reach up to 40+ cm (16 in) in length.

Habitat and Biology

Hardhead catfish are a seasonal resident of the ACE Basin. They first appear as water temperatures moderate in the late spring, and they remain in the system until the water cools in the fall. The catfish then move off-shore and south, where they over-winter. Hardhead catfish spawn during the early summer in estuarine and near-shore waters along the South Carolina coast. The large (8-12 mm) fertilized eggs are collected by the male, and held in his mouth until hatching. Males do not feed during the one-month period while larvae and small juveniles are protected in this fashion. Little is known about growth rates or age at maturity for this species. The only obvious seasonal migration is from shallow estuarine areas during cold water temperatures to warmer waters in lower latitudes. Hardhead catfish feed on epibenthic crabs, shrimps and small fishes.

Species Significance

Hardhead catfish are of no commercial value, and they represent a very small portion of the recreational catch in South Carolina. This species is abundant in South Carolina waters.

References

Jones, P.W., F.D. Martin, and J.D. Hardy, Jr. 1978. Development of fishes of the mid-Atlantic Bight: an atlas of egg, larval, and juvenile stages. Volume I: Acipenseridae through Ictaluridae. U.S. Fish and Wildlife Service, Office of Biological Programs. FSW/OBS-78/12. Ft. Collins, CO.

Murdy, E.O., R.S. Birdsong, and J.A. Musick. 1997. Fishes of the Chesapeake Bay. Smithsonian Institution Press, Washington, DC.

Roumillat, W. 1998. Personal communication. South Carolina Department of Natural Resources, Marine Resources Division, Charleston, S.C.

Largemouth Bass *Micropterus salmoides*

Largemouth bass *(Micropterus salmoides)*

Description

The genus *Micropterus* includes some of the well-known freshwater game fishes including the small- and largemouth basses. The latter belong to the sunfish family (Centrarchidae) and should not be confused with either the temperate basses of the family Percichthyidae, which includes the striped and white basses, or the sea basses and groupers of the family Serranidae. They are the largest members of the sunfish family, often reaching a weight of 2-4 kg (5-8 lbs), and the South Carolina record is currently over 7 kg (16 lbs). Large and smallmouth bass can be distinguished from other sunfish in the family Centrarchidae by their rather elongate body and olive coloration.As with all sunfish, largemouth bass have a spinous first dorsal fin followed by a soft-rayed second dorsal. Coloration depends on water clarity, but generally their color is olivaceous, green dorsally fading to a pale underside with a distinct black stripe running from the fish's opercular flap to the base of the tail. The corner of the mouth extends past the eye (thus the name "large mouth"), and no teeth are present on the fish's tongue. The fish has a moderately elongate and slightly compressed body. They usually have 12 dorsal rays and 3 anal spines.

Habitat and Biology

The native range of largemouth bass is from the lower Great Lakes to the Mississippi River drainage, the Gulf Coast, and Florida. Along the Atlantic coast, the species occupies rivers and ponds as far north as Virginia. Bass are generally confined to fresh water, but they may move into low salinity areas of tidal rivers for short periods of time. They prefer very slow-moving water, especially lakes and larger streams or rivers, inshore waters of ponds, lakes, reservoirs, sloughs of the Delta, creeks, and some irrigation ditches. Largemouth bass are often found around or near submerged structures such as a fallen trees, stumps, rocks, grasses, or an overhanging bank.

The largemouth bass is native to the ACE Basin. In the ACE Basin the largemouth bass is commonly found in the riverine ecosystem, a freshwater community. They prefer slow-moving water and are found throughout the area from small creeks to the low salinity areas of the estuary. They are often stocked in private impoundments as a predatory species. They commonly lurk near cover during the day and move into shallow areas to feed at dark.

Largemouth bass found in the ACE Basin appear to be closely linked genetically to the Florida subspecies. Sexual maturity occurs in the second year. Spawning occurs in the spring from late April to June when water temperatures near 65°F. Spawning occurs over a nest constructed along the shallow margins of their habitat. Male fish clear a shallow, circular depression in a gravelly or sandy bottom of a deep pool and establish a territory. Several females spawn in the nest of a single male. The female deposits up to 1 million eggs that are fertilized by the male as they are deposited in the nest. The male then devotes full time to guarding the nest from predators and fans the eggs to increase oxygen levels and reduce siltation on the nest. While guarding the nest and the young, he does not feed. When the fry hatch they form a school and stay around the nest for several days. The attentive male continues to protect the fry for some time after they leave the nest.

Young bass feed on zooplankton, insects, and small fishes and are also sometimes cannibalistic. They grow up to 20 cm (8 in) in the first year. Adults are top level carnivores in their respective habitats, feeding primarily on crawfish and many fish species, as well as on snakes, frogs, and even baby ducks. Feeding activity takes place during both day and night and is initiated by both hunger and reflex. Largemouth bass are sight feeders and actively hunt for food. This genetic reflex is behind the success of many of the fishing lures used to capture them. The average maximum life span of largemouth bass is typically 10 to12 years.

Species Significance

Along with trout, largemouth bass are the most sought after game fish in the United States. The world record largemouth was 10 kg (22.25 lbs.) captured in Montgomery Lake, Georgia. In South Carolina, fishing for largemouth bass occurs in lakes and creeks in riverine ecosystems.

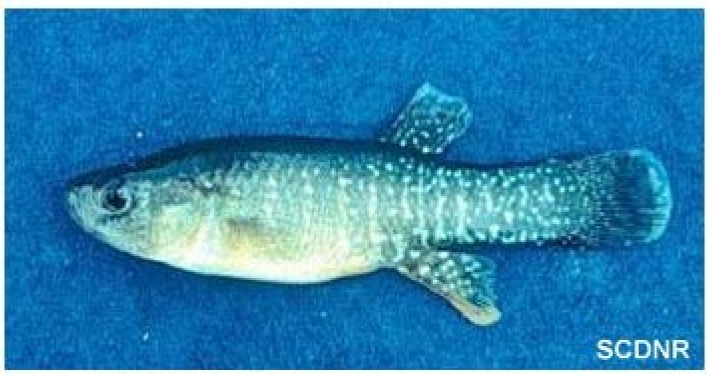
References

Chew. R.L. 1968. Annual progress report for investigations project: Largemouth bass study. State of Florida Game and Freshwater Fish Commission, Tallahassee, FL.

Thomason, C.S., D.E. Allen, and J.S. Crane. 1993. A fisheries study of the Edisto River, SC. Wildlife and Marine Resource Department, Study Completion Report, Federal Aid Projects F-32 and F-30.

Wisconsin Conservation Department. 1961. The largemouth bass: Its life history, ecology, and management. Publication 232-67. Madison, WI.

Mummichog *Fundulus heteroclitus*



Mummichog ***(Fundulus heteroclitus)***

Description

Mummichogs, locally called mud minnows, belong to a group of fishes known collectively as killifish. Killifish are members of the family Cyprinodontidae. They make up a large portion of the small fish in tidal creeks, saltwater marshes, lagoons, and other shallow coastal habitats. Mummichogs have a single, spineless dorsal fin and pelvic fins positioned near the anal fin. The head is flattened and the mouth is tilted upwards. Most species in the family Cyprinodontidae are sexually dimorphic; that is, males and females look different. Small female mummichogs are brownish above and pale below with 12-15 dark vertical bars. The dorsal and anal fins are tinged with green. Distinctive markings disappear as females grow larger. Males are darker in color, usually dark green or olive with a yellowish underside; spawning males have a dark spot towards the rear of the dorsal fin. Their sides are silvery with approximately 15 vertical bars and many small spots that continue on to the f in membrane, varying in color from white to yellow. Maximum adult size is 12 cm (4.7 in), with females growing larger than males.

Habitat and Biology

This species is very common along the eastern U.S. coast, from the Gulf of St. Lawrence to northern Florida. Mummichogs are especially abundant in salt marshes and tidal creeks of the ACE Basin and coastal South Carolina. The spawning season extends from spring to fall and varies with latitude. During this time, male mummichogs become brighter in color. Spawning takes place during the new or full moon (when the tide is at its highest) in water of various salinities. Eggs may be laid in a variety of substrates, depending on availability. Mummichog eggs may be found in the empty shells of ribbed mussels, on the leaves of marsh grass, in pits dug out and covered by the female, or spread directly on the bottom. The eggs develop out of the water, and hatching takes place upon immersion during the successive moon tide. Mummichogs are extremely hardy and can tolerate widely fluctuating environmental conditions. During winter months, they may burrow in the mud or move to deeper water at the mouths of channels. The word "mummichog" comes from an Indian word meaning "going in crowds." Various age classes will gather, often close to shore, in schools that may number several hundred fish. Feeding occurs at the marsh surface, in mid-water, or on the bottom even though this species' upward tilted mouth is specialized for surface feeding. Mummichogs eat a variety of foods including marine worms, crustaceans, small shrimps, insects, and other fish.

Species Significance

Mummichogs are an important food source for many commercially valuable fish species, as well as wading birds and seabirds. They are an important link in the coastal food chain. Mummichogs have little commercial (small industry for selling as bait) and no recreational value. Mummichogs and other species of killifish are used extensively in scientific studies, including medical and environmental research, and have been introduced to many areas for controlling mosquito larvae.

References

Abraham, B. 1985. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic)--Mummichog and Striped Killifish. U. S. Fish and Wildlife Service Biological Report 82 (11.40). U. S. Department of Interior, Washington, D.C.

Boschung, H.T,. Jr., J.D. Williams, D.W. Gotshall, D.K. Caldwell, and M.C. Caldwell. 1983. The Audubon Society field guide to North American fishes, whales and dolphins. Alfred A. Knopf, New York, NY.

Murdy, E.O., R.S. Birdsong, and J.A. Musick. 1997. Fishes of the Chesapeake Bay. Smithsonian Institution Press, Washington, DC.

Red Drum *Sciaenops ocellatus*

Red drum ***(Sciaenops ocellatus)***

Sound, SCDNR

Description

The red drum, also called "channel bass" or "spottail bass," is a member of the drum family, Sciaenidae, and a close relative of Atlantic croaker, spot, and kingfish. Red drum have elongate bodies, reddish-bronze color, and a distinct spot or spots at the base of the caudal fin. Scientists believe that the prominent spot on the tail confuses predators into attacking the fish's tail instead of its head, thus giving the fish a better chance to escape. Similar to other members of the drum family, the red drum has an inferior mouth and a lateral line that extends to the tip of the caudal fin. Also, red drum males produce "drumming" sounds during the spawning season to attract females. Males also undergo a color change during this time, becoming dark red or bluish gray on top with a pale underside.

Habitat and Biology

Along the Atlantic coast of the United States, red drum are found from Delaware to southern Florida. They also inhabit the Gulf of Mexico, from southern Florida to northeastern Mexico. In South Carolina, red drum can be found in estuarine areas, including those in the ACE Basin. Red drum utilize different habitats as they develop. The large, adult fishes do not live in the same habitat as the subadults. In general, adults are found in nearshore and coastal waters, whereas subadults are usually found in larger creeks and rivers, although they have been observed in waters off barrier islands and sandbars. Juveniles are abundant in the shallow creeks that meander through cordgrass (*Spartina alterniflora*) marshes. As juveniles mature, their habitat preferences change and they move from the shallows of the estuaries into deeper inlets and along the front beaches. Because of difficulty in sampling the adult stock, very little is known of their biology. After spawning i n August and September, the adults can be found around the front beaches and inlets. As water temperatures decline in the fall (late October-November), the adults move gradually offshore to deeper, warmer water. This offshore movement initiates a flurry of successful surf fishing. The movement is repeated in the opposite direction in the spring. As inshore water temperature warms in the spring, the red drum move from the deeper, warmer offshore waters to the inlets and front beaches, where they are once again available to anglers.

In general, individuals found inside the state's estuaries are juveniles; that is, they have not as yet reached sexual maturity and are frequently called subadults. Males mature at age three (68.6-76.2 cm or 27-30 inches long); females mature at age four (81-91 cm or 32-36 inches long). Reproductive activity in this species coincides with cooling temperatures and shorter days in late August. Spawning in South Carolina waters is thought to occur in coastal inlets, including St. Helena Sound, although some nearshore spawning activity is believed to occur in South Carolina during August and September. At this time, male red drum produce characteristic "drumming" sounds by contracting muscles near the swim bladder, in an effort to attract females. Fertilized eggs are pelagic, and hatching occurs in 28 to 29 hours, depending on water temperature (longer in cool water and shorter in warmer water).

Larval red drum
(Sciaenops ocellatus)

Upon hatching, larvae face the difficult task of reaching nursery grounds in the upper reaches of estuaries. They are transported to the mouths of estuaries in currents generated by wind and tides. By swimming towards the surface when currents are rising (flood tide) and staying close to the bottom when the tide is ebbing so as not to be swept back out to sea, they eventually reach the shallow tidal creeks, where they settle out of the plankton community and spend the first few months of life. As larvae, after yolk sac reserves are exhausted, red drum feed on zooplankton in the water column. Once in the estuary, larval red drum feed on crustaceans and small fishes. The smallest fish feed on copepods, and as they grow, they eat ghost shrimp known as mysids and eventually consume grass and penaeid shrimps. As waters cool in December, these small fishes (2.54-7.62 cm or 1-3 inches long) leave the shallow marsh creeks for the relative warmth of deeper creeks and estuarine rivers. When water temperatures rise in the spring, small red drum re-enter these tidal marsh creeks and begin to grow very rapidly. At this time they feed on small fishes and crustaceans. In May and June, these 20.3-25.4 cm (8-10 inch) fish, along with fish of previous year classes, begin to leave the small creeks to inhabit the open estuarine shallows. At one year of age, red drum are 25.4-30.48 cm (10-12 inches) long, and weigh just under .45 kg (1 pound). Most meet the minimum legal size of 35.56 cm (14 inches) in October (13 months of age) and weigh on average slightly more than .45 kg. By December (15 months of age), many of these fishes may weigh almost .9 kg (2 lbs).

Many of the 1 to 3 year old red drum inside the estuary show an interesting pattern of movements and feeding that is related to the stage of the tide. During the warmer months of the year, as the incoming tide begins to reach the smooth cordgrass, fish move into the grass, where they feed on fiddler crabs (80% of their diet), mud crabs, grass shrimp, and fishes that are associated with this structured habitat. As the tide ebbs, the red drum move off the marsh surface and are generally found on mud bars with oyster reefs in shallow water adjacent to the marsh. In the winter when water temperatures are low and the fiddler crabs are no longer active, red drum display the same pattern of tidal movement, but they become sluggish and less active since they are unable to regulate their body temperature. During the warmer months, their movements reduce their exposure to bottlenose dolphin, which is a major predator. In the coldest part of the year, they tend to be more vulnerable to predation by this marine mammal.

Species Significance

In South Carolina, red drum are classified as a gamefish and can only be bought or sold through a mariculture operation or imported from a state that allows commercial fishing. Moreover, this species can only be harvested by hook and line and by gig during the appropriate season. Drum that are less than 14 inches and are caught in South Carolina State waters must be released by law. Also, there is a bag limit of five fish per angler per day, only one of which can be longer than 27 inches. (See related section: Recreational Fisheries.)

In recent years, the red drum has been placed among the nation's important recreational and commercial species which have been fished into a state of decline. Red drum numbers in

South Carolina have increased in recent years, but commercial fishing is still restricted. The fisheries for red drum have been conducted almost entirely within the internal waters of the states; therefore, management has traditionally been by individual state regulation. In South Carolina, restrictions have been issued to help manage red drum populations.

References

Mercer, L.P. 1984. A Biological and fisheries profile of the red drum, *Sciaenops Ocellatus*. Special Scientific Report No. 41. North Carolina Department of Natural Resources and Community Development, Division of Marine Fisheries, Morehead City, NC.

Vaughan, D.S. and T.E. Helser. 1990. Status of the red drum stock of the Atlantic coast: Stock assessment report for 1989. National Oceanic and Atmospheric Administration, Beaufort, SC.

Wenner, C.A. 1992. Red drum: Natural history and fishing techniques in South Carolina. Educational Report No. 17. South Carolina Department of Natural Resources, Marine Resources Division. Charleston, SC.

Wenner, C.A., W.A. Roumillat, J.E. Moran Jr., M.B. Maddox, L.B. Daniel III, and J.W. Smith. 1990. Investigations on the life history and population dynamics of marine recreational fishes in South Carolina. Part I. Report to Fish Restoration Act under Project F-37. South Carolina Department of Natural Resources, Marine Resources Division. Charleston, SC. .

Redbreast Sunfish *Lepomis auritus*

Redbreast sunfish *(Lepomis auritus)*

Description

Redbreast sunfish are close relatives of well-known fish species such as the large- and small mouth basses, bluegill, and crappie, all of which are members of the family Centrarchidae. Sunfish typically have compressed bodies and a spinous dorsal fin followed by a soft-rayed fin. These two dorsal fins are joined, so they appear as one. Identification of sunfish is often difficult, especially when closely related species mate to produce hybrids. Adult redbreast sunfish are brownish above with olive green or violet hues. Their heads have lines and spots of a pale blue color, and the flap of the gill cover is black with a pale yellow edge. The sides of the fish are greenish with vertical bars that tend to be more distinct in females than in males. The underside is yellowish white, except during breeding season, when it becomes bright orange in the males and yellow in the females (hence the redbreast sunfish's common name). Redbreast sunfish are more elongated than other *Lepomis* species and generally attain lengths of up to 25 cm (10 in). The current South Carolina record is 0.9 kg (2 lbs).

Habitat and Biology

This species is commonly found in freshwater habitats from Maine to Florida and westward along the Gulf Coast to Texas. Sunfish are common in the upper blackwater reaches of all rivers and streams in the ACE Basin. The sunfish can survive in a variety of environmental conditions, such as headwater streams to coastal plain rivers and lakes. They prefer flowing water and are most often found associated with stumps or logs in mainstream habitats, but can exist in impoundments. They can survive in lakes and streams at elevations of up to 1,000 meters (3,500 feet) and waters less than 8 ppt. Redbreast sunfish can withstand pH ranges from 4.8 to 8.4; however, they cannot survive in waters warmer than 37° C.

Spawning generally occurs in May and June in the ACE Basin. The full moon of May is the "traditional" time of the peak spawning season. Spawning occurs over sandy or gravel bottoms in lakes, ponds, streams and rivers. When spawning in rivers, this species tends to do so in faster flowing water than other sunfishes. The nest consists of a circular depression on the bottom that is lined with pebbles. Most often it is associated with some type of cover and is in the main channel of the stream. Occasionally, redbreast sunfish will occupy the nests of other species. They do not have community nests like other *Lepomis* species. Males guard the eggs until hatching and are continually fanning the nest to increase oxygen levels and remove siltation, Sexual maturity is achieved in the second year, and females can lay up to 14,000 eggs. Most redbreast live to an age of three or four years.

Similar to most sunfish, redbreast sunfish are sight feeders and capture food either by lying in wait and making a sudden lunge or by actively foraging along the bottom. Preferred food items of redbreast sunfish include aquatic insects, small crustaceans, and fish. They most often feed in the middle of the water column. They are often associated with a particular haunt, such as a submerged tree, rock or overhanging bank. The abundance of snag habitats that provide a constant source of aquatic insects in a system is an important factor in regulating population health.

Species Significance

Redbreast sunfish are an important recreational species in South Carolina. According to creel census conducted in the Edisto and Combahee Rivers during 1987-91 by the South Carolina Department of Natural Resources, redbreast sunfish were the most popular fish among anglers during late spring and early summer, dominating harvests in terms of abundance. They are a forage fish for other predators such as largemouth bass. Predation by flathead catfish may have significant impacts on sunfish populations.

References

Allen, D.E. and C.S. Thomason. 1993. Survey and inventory of fisheries resources in the Combahee River. Study Completion Report F-32. SC Wildlife and Marine Resources Department, Columbia, SC.

Carlaner, C.D. 1977. Handbok of freshwater fishery biology. Vol. 2. Iowa State University, Ames, IA.

Fisheries Habitat Committee. 1995. Fishes of the Edisto River basin. SC Department of Natural Resources, Water Resources Division Report 6. Columbia, SC.

Jenkins, R.E. and N.M. Burkhead. 1994. Freshwater fishes of Virginia. American Fisheries Society, Bethesda, MD.

Sheepshead *Archosargus probatocephalus*

Sheepshead ***(Archosargus probatocephalus)***

Description

Sheepshead have stout, oval-shaped bodies with short heads, the most obvious feature of which are rows of broad, peg-like teeth (hence their common name). They are grayish in color with five or six broad black, vertical bars on either side of the body and an incomplete head bar. These bars are usually more distinct in younger animals. The dorsal fin is continuous, with sharp, strong spines preceded by a small spine that points forward and is embedded in the skin. The second spine on the anal fin is large and very strong. The pectoral fins are greenish and pointed and extend past the anal opening when pressed against the body of the fish.

Habitat and Biology

Sheepshead spawn in near-coastal waters during the winter and early spring (December - March). During this time they are frequently seen on artificial reefs, as well as natural reef habitats in depths of 18 to 22.5 m (60 to 75 feet). This species is a member of a fish family (Sparidae) more frequently found in offshore waters. Members of the Sparidae commonly are hermaphroditic and undergo sex-reversal. Sheepshead, however, apparently show no evidence of hermaphroditism; each mature individual functions as a male or female throughout its entire adult life.

Eggs and larvae are transported to the estuaries, and small sheepshead are recruited to the shallow tidal creeks that meander through the *Spartina* marshes. They prefer the higher salinity creeks that have an abundance of oysters and submerged structure. The young sheepshead are cryptic; that is, they are attracted to structure and use it as a hiding place.

Little is known about their early life history, but young sheepshead can frequently be caught near dock pilings or other submerged structures. Submerged structures are covered with a community of encrusting organisms such as barnacles, bryozoans, etc. The pattern of dentition of sheepshead enables them to effectively pick or scrape encrusting organisms from underwater structures from the time they are small juveniles through their adult lives. Throughout life, they feed on attached fauna such as barnacles and mussels, as well as small crabs and shrimp.

Sheepshead display a seasonal migration in the fall from inshore higher salinity waters to offshore waters. The pattern is reversed in the spring when, as the inshore waters warm, they move back into the higher salinity parts of the ACE basin. They are relatively long-lived, with the oldest individual reported having an estimated age of 23 years. They grow quickly during the first three years of life; but after reaching sexual maturity, the growth slows dramatically.

Species Significance

Sheepshead are sold commercially in South Carolina, although no directed commercial fishery exists. Commercial landings result from incidental catch. They are, however, an important recreational species in South Carolina waters. Anglers who target sheepshead seek them near structures such as pilings or oyster bars. This species is not currently threatened or endangered, and there are no size or bag limit restrictions on it.

References

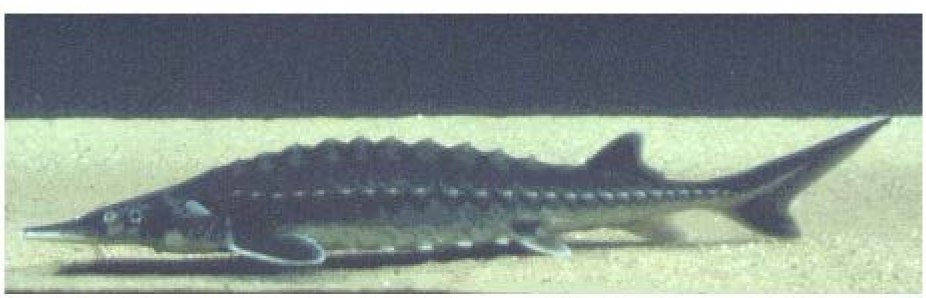
Bearden, C.M. 1961. Common marine fishes of South Carolina. Bears Bluff Lab Contribution No. 34. Bears Bluff Laboratory, Inc., Wadmalaw Island, South Carolina.

Boschung, H.T,. Jr., J.D. Williams, D.W. Gotshall, D.K. Caldwell, and M.C. Caldwell. 1983. The Audubon Society field guide to North American fishes, whales and dolphins. Alfred A. Knopf, New York, NY.

Johnson, G.D. 1978. Development of fishes of the mid-Atlantic Bight: an atlas of egg, larval and juvenile stages. Volume IV: Carrangidae through Ephippidae. U.S. Fish and Wildlife Service, Office of Biological Services FWS/OBS-78/12. Ft. Collins, CO.

Roumillat, W. 1998. pers. comm. South Carolina Department of Natural Resources, Charleston, SC.

Shortnose Sturgeon *Acipenser brevirostrum*



Shortnose sturgeon ***(Acipenser brevirostrum)***

Description

Sturgeons are fish of an ancient lineage easily recognized by five rows of scutes (bony plates) along their bodies: one row along the mid-back, one along the middle, and one along the lower body on each side. Sturgeons have heterocercal tails; that is, the top lobe of the caudal fin is larger than the bottom one. Coloration varies from yellowish pink to yellowish brown on the fish's back and creamy white below. Sturgeons, the largest of the bony fishes, are bottom dwellers that use chin barbels to locate food on the substrate. The barbels on the shortnose sturgeon are rather small, less than one half the width of the mouth. Sturgeons have protrusible, inferior mouths used to suck in benthic insects, crustaceans, and other food items. The shortnose sturgeon is smaller than the common Atlantic sturgeon, *Acipenser oxyrinchus,* and has a shorter, uncurved snout. It is also known as the blunt-nosed, round-nosed and small sturgeon, and it may grow up to 143 cm (56 in).

Habitat and Biology

Shortnose sturgeons are found from the Saint John River, Canada (New Brunswick), to the St. Johns River, Florida. They inhabit estuarine and riverine habitats and are typically not found offshore. In South Carolina they inhabit Winyah Bay Rivers, those that drain into Lake Marion, the Santee, Cooper and Savannah rivers, and the ACE Basin. In the latter, shortnose sturgeon are typically found at the freshwater-saltwater interface. Adult and sub-adult shortnose sturgeon are known to inhabit this area during spring through fall. Spawning may take place well upriver; however, the existence of a spawning stock in the ACE Basin is yet to be determined.

Shortnose sturgeons are semi-anadromous; they migrate from the estuary into rivers to spawn. Adults migrate upstream in early spring and forage in the lower reaches of rivers at the fresh tidal water and estuarine water interface. This area is also an important nursery habitat for juveniles, which do not usually migrate. Migration of shortnose sturgeons and the extent to which they utilize freshwater habitats vary throughout the species' range. For instance, in northern latitudes, sturgeon make use of freshwater habitats more extensively than in southern regions, and some do not frequent estuarine habitats at all throughout the year. Sturgeons can live more than 50 years and typically grow very slowly. Growth and age at sexual maturity vary with latitude. Fish from southern locations grow faster and mature at a younger age than fish in the north. Male sturgeons inhabiting South Carolina waters become mature at approximately age 4 and females at age 6-7. Male sturgeons repro duce 1-2 years after reaching maturity. However, females may not spawn until 5 years after becoming mature. In South Carolina, the age at which female sturgeons first spawn ranges from 7 to 14 years. Spawning periodicity varies among individuals, but spawning rarely takes place in consecutive years. A female typically produces 27,000 to 208,000 eggs and can carry an egg mass of over 1 million eggs, depending on her body size. Spawning in South Carolina occurs from February to April over gravel or rubble bottoms. High current velocity and adequate substrate for the attachment of eggs are important factors in spawning site selection. Sturgeons are benthic feeders preferring mollusks and crustaceans as adults and insects and small crustaceans as juveniles.

A related species, the Atlantic sturgeon, is anadromous, spawning in freshwater rivers and spending the rest of its life in estuarine and nearshore waters. Females may spawn only every 2-6 years. Spawning in South Carolina begins in February and continues through the spring, with a second spawning migration possibly occurring in the fall. Spawning populations of Atlantic sturgeon in South Carolina are found in the Savannah River, one or more of the rivers in the ACE Basin, the Santee River, Winyah Bay and its river systems, and possibly the Cooper River. Although definitive spawning locations have not been identified, spawning is believed to occur in tidal freshwater, in deep areas with high water flow rates. A "marl hole" approximately 15 meters (50 ft) deep above Givhans Ferry on the Edisto River may be one of these locations. Females may release between 400,000 and 3.7 million eggs during a spawning period. As the eggs are released, they are fertilized externally by a male and then sink to the bottom. Sturgeon eggs are sticky and will adhere to rocks, plants, and other solid material. The eggs hatch within a week or so. Within three weeks, juvenile sturgeon have absorbed their yolk sac and begun to feed on bottom-dwelling organisms such as small shrimp, worms, clams, snails, and small demersal fish. Juvenile Atlantic sturgeon spend their first few years in rivers and estuaries with some movement along the coast. Tagging studies in South Carolina indicate that higher growth rates occur during the winter, spring and fall, with slower growth rates during the summer. As the juvenile sturgeon reach 0.6 to 0.9 meters (2-3 ft) in length (age of 1-6 years) , they begin to move into oceanic waters and join the adult population, remaining there until sexual maturity (7-19 years and nearly 2 meters or 6-7 ft in length). Atlantic sturgeon may undergo long migrations up and down the coast.

Species Significance

Worldwide, sturgeons are commercially valuable as a source of high-grade caviar, and their meat is popular both smoked and fresh. In the past, both Atlantic and shortnose sturgeons were reported in the landings for sturgeon. In the United States, Atlantic sturgeon supported a commercial fishery; however, landings have not exceeded 300,000 lbs. since 1920, and all Atlantic states have closed their fisheries in recent years. The sturgeon fishery was closed in South Carolina in 1985 following precipitous declines in numbers landed in the early 1980s. Shortnose sturgeons are currently of no commercial value because of their status as an endangered species. There is no recreational fishery for this species in the United States.

Shortnose sturgeon were listed as endangered throughout their range under the Endangered Species Conservation Act of 1969. In 1967, the U. S. Fish and Wildlife Service cited pollution and overharvesting as primary factors for the decline in numbers of shortnose sturgeon. Other sources contributing to population declines include incidental catch in shad gillnet fisheries, dam and bridge construction, dredging, entrapment in power plant water intake screens, and reservoir operations. In South Carolina, the primary factors affecting populations of this species are habitat alteration, due to dredging and dam construction, and pollution. Construction of dams has the potential to reduce suitable spawning sites, and disturbance associated with dredging activities impacts the food supply for juvenile sturgeon.

References

Collins, M.R. and T.I.J. Smith. 1993. Characteristics of the adult segment of the Savannah River population of shortnose sturgeon. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 47:485-491.

Dadswell, M.J., B.D. Taubert, T.S. Squires, D. Marchette, and J. Buckley. 1984. Synopsis of biological data on shortnose sturgeon, *Acipenser brevirostrum*. Technical Report 14. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Seattle, WA.

Hall, J.W., T.I.J. Smith, S.D. Lamprecht. 1991. Movements and habitats of shortnose sturgeon, *Acipenser brevirostrum*, in the Savannah river. Copeia 1991(3):695-702.

Leland, J.G., III. 1968. A survey of the sturgeon fishery of South Carolina. Bears Bluff Laboratory Contribution No. 47. Bears Bluff Laboratory, Wadmalaw, SC.

Murphy, S. H. and G. Barnette (eds.). South Carolina's endangered species portfolio. South Carolina Department of Natural Resources, Wildlife Diversity Section, Columbia, SC.

Shortnose sturgeon recovery team. 1997. Recovery plan for the shortnose sturgeon-public review draft. Office of Protected Resources, National Marine Fisheries Service. National Oceanic and Atmospheric Administration, Silver Spring, MD.

Taub, S.H. 1990. Fishery management plan for Atlantic sturgeon. Fisheries Management Report 17. Atlantic States Marine Fisheries Commission, Washington, DC.

Silver Perch *Bairdiella chrysoura*

Silver perch ***(Bairdiella chrysoura)***

Description

Silver perch are among the smaller members of the drum family (Sciaenidae) and common in South Carolina estuaries. They have oval-shaped bodies and no barbels. Their coloration is relatively plain, with an olive, green or bluish back and a silvery white belly. Fins are all yellowish, with the dorsal, caudal and sometimes the tip of the anal fin somewhat darker. Silver perch have a few strong spines at the angle of the preopercle, the largest of which point down.

Habitat and Biology

Silver perch also belong to the sciaenid family. They spawn during the late spring and early summer inside the estuary, usually in the deeper sections of smaller tidal creeks in the higher salinity areas. Eggs and larvae remain in the estuary, and when larvae become capable of active swimming, they settle in the shallow tidal creeks. This habitat is also the silver perch's nursery area, and the young feed on small decapod crustaceans and fishes. During the fall, silver perch move from the shallow marsh habitat into the deeper creeks and main part of the estuaries of the ACE Basin. During high tide, the larger silver perch move into the tidal creeks, where they feed on grass shrimps. As the tide drops, they move back out into deeper water.

Species Significance

No commercial or recreational fisheries exist for this species. However, pier fishers often catch silver perch and use them for bait or for personal consumption. They are a forage fish for larger predatory fish such as spotted seatrout and red drum and also are an important food source for many birds.

References

Bearden, C.M. 1961. Common marine fishes of South Carolina. Bears Bluff Lab Contribution No. 34. Bears Bluff Laboratory, Inc., Wadmalaw Island, South Carolina.

Johnson, G.D. 1978. Development of fishes of the mid-Atlantic Bight: an atlas of egg, larval and juvenile stages. Volume IV: Carrangidae through Ephippidae. U.S. Fish and Wildlife Service, Office of Biological Services FWS/OBS-78/12. Ft. Collins, CO.

Murdy, E.O., R.S. Birdsong, and J.A. Musick. 1997. Fishes of the Chesapeake Bay. Smithsonian Institution Press, Washington, DC.

Wenner, C. 1998. Personal communication. South Carolina Department of Natural Resources, Charleston, SC.

Southern Flounder *Paralichthys lethostigma*

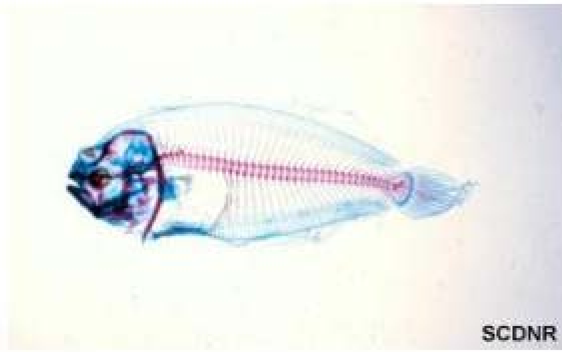
Southern flounder ***(Paralichthys lethostigma)***

Description

The southern flounder is one of approximately 130 American flatfish species. Southern flounder belong to the family Paralichthyidae. Flatfishes are compressed laterally (flat), with the dorsal side of the body pigmented in order to match their surroundings. Southern flounder are light to dark brown with darker spots and blotches that are not well defined. All flatfishes have eyes that migrate dorsally during larval development, so both eyes are found on the "ocular" side. The ocular side in southern flounder is the left side, but in other flatfishes it may be the right side. The underside of the fish, the ventral or "blind" side, is usually light in color. Maximum adult size in this species is 75 cm (30 in).

Habitat and Biology

Southern flounder are a benthic species found in coastal waters of the southeastern United States, from the Chesapeake Bay to Florida (except southern Florida), and along the Gulf of Mexico. They can tolerate a wide salinity range and commonly inhabit brackish and freshwater habitats. Females grow faster than males; each sex matures as they approach their second birthday (males are 20.3-25.4 cm or 8-10 inches long; females are 30.5-35.6 cm or 12-14 inches long). The average life span of a male is two years, and the oldest male southern flounder reported in South Carolina was age 3+. Females are dramatically larger than males at a given age and a three-year old female may weigh 0.7 to 2.7 kg (1.5 to 6 pounds).



Larval southern flounder

Beginning in late September of each year, southern flounders that are older than one year begin to mature and leave the estuaries for offshore spawning grounds. The locations of these offshore spawning grounds are unknown at this time. Males leave the estuaries and move towards the spawning grounds earlier than females. Their migration coincides with a 4°C to 5°C drop in temperature. Only the young-of-year that are approaching age one remain inside South Carolina estuaries from December through April. After they spawn and water temperatures rise, mature fish re-enter the estuaries. After hatching, the larvae feed and grow near the ocean surface as they are transported toward shore by currents initially associated with the Gulf Stream. The swimming ability of the juveniles, coupled with the presence of tidal currents in near-shore waters, provides a mechanism for the transport of the young to the estuarine nursery habitat. Settling (affiliation with creek bottoms and attainment of adult pigmentation) of the southern flounder occurs in lower and moderate salinity areas of South Carolina estuaries from January through March of each year. This species utilizes the same shallow marsh habitat as the red drum and spotted seatrout as a nursery area. In the shallow tidal creeks they feed on small shrimps and fishes. As they increase in size, fish become the preferred prey. Southern flounder remain in these creeks until they attain a length of about 20.3-25.4 cm (8-10 inches), at which time they disperse into other available estuarine habitats. They can even tolerate fresh water and have been taken by electrofishing.

Southern flounder are ambush predators with the ability to change coloration so that they blend in with the substrate. They are frequently found in shallow water near oyster reefs or the mouths of small rivulets draining the high marsh as the tide ebbs. Food items include grass shrimp, mummichogs, spot, and striped and white mullet. These prey animals are commonly associated with edge habitats in the estuary such as the edges of oyster bars and along salt marshes. Southern flounder are widely distributed in the ACE Basin and frequently co-occur with red drum.

Species Significance

Southern flounder are popular in both the commercial and sport industries in the Southeast and Gulf of Mexico. In the latter, much of the commercial catch of southern flounder results from bycatch from the shrimp fishery. Recreationally, southern flounder are caught by nighttime gigging in tidal creeks and marshes, as well as by hook and line

References

Fernandez, E. 1991. The juvenile life history of the southern flounder (*Paralichthys* *lethostigma)* in South Carolina. M.S. Thesis. University of Charleston, Charleston, SC.

Murdy, E.O., R.S. Birdsong, and J.A. Musick. 1997. Fishes of the Chesapeake Bay. Smithsonian Institution Press, Washington, DC.

Reagan, R.E., Jr. 1985. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico)--Southern Flounder. U.S. Department of Interior, Fish and Wildlife Service, Biological Report 82(11.30). U.S. Army Corps of Engineers, Report TR EL-82-4. Washington, DC.

Wenner, C. 1998. Personal communication. South Carolina Department of Natural Resources, Charleston, SC.

Southern Kingfish *Menticirrhus americanus*

Southern kingfish
(Menticirrhus americanus)

Description

The southern kingfish, or whiting, is a member of the family Sciaenidae and a common inhabitant of South Carolina estuaries, including those in the ACE Basin. It has an elongated body and a characteristic single barbel on its chin. The mouth is small and inferior, as is characteristic of fishes that feed on the bottom. Coloration varies somewhat with habitat, but it is generally gray to brown above with silvery reflections and 6-8 broad oblique lateral bars. The latter are not always distinct, however. Fins are dusky, sometimes with a black margin, especially on dorsal and pectoral fins. The caudal fin of adult kingfish has an elongated lower lobe, making its margin appear "s" shaped. Pelvic, anal and caudal fins sometimes exhibit a yellowish coloration.

Habitat and Biology

This species spawns in the late spring and summer in near-shore coastal waters. Young juveniles occur in channels and along the coast in the penaeid shrimp fishing grounds. Males and females are sexually mature by age two, and the oldest individual reported in South Carolina is age five. Their absence in the coldest months of the year suggests that they move either south or slightly offshore to warmer waters. Southern kingfish feed on a variety of benthic infauna and epifauna such as polychaetes, crustaceans and mollusks.

Species Significance

In South Carolina waters, there is no directed commercial fishery for southern kingfish; the commercial catch is incidental to the penaeid shrimp-trawl fishery. Though not considered a gamefish by recreational anglers, whiting are an excellent food fish and are sought after by pier fishers and surf fishers throughout the state. This species is neither threatened nor endangered, and there are presently no size or bag limit restrictions on it.

References

Bearden, C.M. 1961. Common marine fishes of South Carolina. Bears Bluff Lab Contribution No. 34. Bears Bluff Laboratory, Inc., Wadmalaw Island, South Carolina.

Johnson, G.D. 1978. Development of fishes of the mid-Atlantic Bight: an atlas of egg, larval and juvenile stages. Volume IV: Carrangidae through Ephippidae. U.S. Fish and Wildlife Service, Office of Biological Services FWS/OBS-78/12. Ft. Collins, CO.

Smith, J.W. and C.A. Wenner. 1985. Biology of the southern kingfish in the South Atlantic Bight. Transactions of the American Fisheries Society 114:356-366.

Spot *Leiostomus xanthurus*

Spot ***(Leiostomus xanthurus)***

Description

Spot, which belong to the drum family (Sciaenidae), derive their common name from the presence of a dark spot or blotch behind the upper end of the opercle or gill slit. They have a short, flattened body with an elevated back, and, unlike Atlantic croaker, they lack barbels. Spot are purplish gray above, with a golden luster and oblique streaks that extend below the lateral line. Their caudal fin is darkish, while the other fins are usually pale yellow. In early fall, as spawning season approaches, South Carolinians often refer to the large males as "golden spot." Presumably, this is because males tend to acquire a more defined golden hue during this time of the year.

Habitat and Biology

Spot are found along the east coast from Florida to the Middle Atlantic states during the warmer months. These fishes are estuarine dependent, with a variety of habitats being utilized by various life history stages in the estuaries of the ACE Basin. In fall, spot migrate south and offshore to spawn during late fall and early winter in the warmer waters caused by the presence of the Gulf Stream. Larval spot use ocean and tidal currents to transport them from the offshore spawning areas to the estuarine nursery habitat. As they approach the coastal inlets, spot rise to the surface during the flood tides and move through the water column towards the bottom during ebb tide. By using differential current velocities from surface to bottom (surface currents are stronger than those near the bottom), spot gain access to the estuaries.

Although numerous authors have described the estuary as a nursery for small fishes and shellfish, not all habitats within the estuary are used by a given species. The shallow marsh habitat, with its series of dendritic creeks, mudflats, and shallows, is the principal nursery area for spot after they gain access to the estuary. They recruit to these shallows via tidal currents and settle from the water column to become demersal. In general, the smallest spot are found further upriver and in shallower water. The headwater regions of salt marshes are not only a refuge from predators but also have an abundant food supply for juveniles. Spot apparently live in association with estuaries and shallow coastal waters until they attain maturity (about 2 years old), at which time they migrate to deep ocean waters to spawn. Spot feed on benthic infauna, primarily polychaetes, crustaceans, and mollusks.

Species Significance

Spot are harvested commercially throughout their range. Along the east coast, the commercial catch of spot has averaged 3.7 million kg (8.2 million lbs) per year since 1950. Spot are also a large constituent of the by-catch from the South Atlantic penaeid shrimp-trawl fishery. Recreational catches throughout the region averaged 1.7 million kg (3.9 million lbs) per year since 1981. In South Carolina waters, recreational anglers target spot mainly in the fall, as the fish move out of the estuaries towards offshore spawning grounds. Spot are abundant and ubiquitous inhabitants of South Carolina waters. They are a regular part of the diet of many of the predators in the estuary such as spotted seatrout, red drum, herons, and osprey. There are no size restrictions or bag limits governing the harvest of spot in South Carolina.

References

Bearden, C.M. 1961. Common marine fishes of South Carolina. Bears Bluff Lab Contribution No. 34. Bears Bluff Laboratory, Inc., Wadmalaw Island, South Carolina.

Johnson, G.D. 1978. Development of fishes of the mid-Atlantic Bight: an atlas of egg, larval and juvenile stages. Volume IV: Carrangidae through Ephippidae. U.S. Fish and Wildlife Service, Office of Biological Services FWS/OBS-78/12. Ft. Collins, CO.

McErlean, A.J., S.G. O'Connor, J.A. Milhursky, and C.I. Gibson. 1973. Abundance, diversity and seasonal patterns of estuarine fish populations. Estuarine Coastal Marine Science 1:19-36.

Pacheco, A.L. 1962. Age and growth of spot in Lower Chesapeake Bay, with notes on distribution and abundance of juveniles in the York River system. Chesapeake Science 3(1):18-27.

Potter, I.C., P.N. Claridge, and R. M. Warwick. 1986. Consistency of seasonal changes in the estuarine fish assemblage. Marine Ecology Progress Series 32(2-3):217-228.

Shenker, J.M., and J.M. Dean. 1979. The utilization of an intertidal salt marsh creek by larval and juvenile fishes: Abundance, diversity, and temporal variation. Estuaries 2(3):154-163.

Weinstein, M.P. 1979. Shallow marsh habitats as primary nurseries for fishes and shellfish, Cape Fear River, North Carolina. Fisheries Bulletin U.S. 7:339-357.

Wenner, C. 1998. Personal communication. South Carolina Department of Natural Resources, Charleston, SC.

Spotted Seatrout *Cynoscion nebulosus*

Spotted seatrout ***(Cynoscion nebulosus)***

Description

The spotted seatrout is not a member of the trout family (Salmonidae), but of the drum family (Sciaenidae) which includes common inhabitants of South Carolina waters such as Atlantic croaker, red drum, and spot. Two other species of seatrouts inhabit state waters: weakfish, *Cynoscion regalis*, and sand seatrout, *Cynoscion nothus.* All seatrouts are elongate with a protruding lower jaw. Their mouths are rather large with sharp teeth. Spotted trout are gray with bluish reflections above and silvery below. The fins are yellowish green, except for the first dorsal fin which is dusky. They can be distinguished from other seatrouts by numerous black spots on their upper side, second dorsal fin, and caudal fin. Maximum adult size in this species is 90 cm (35 in).

Habitat and Biology

Spotted seatrout are found along the eastern coast of the United States from Chesapeake Bay to the southern tip of Florida and along the Gulf coast to the northeast Mexican coast. Spotted seatrout are estuarine dependent, and with the exception of forays into the nearshore waters during the warmer months of the year, they spend their whole lives inside estuaries. Male spotted seatrout mature at a much smaller size than females. Regardless of the month in which a male spotted seatrout was spawned the previous year, it will become mature and actively spawn the following May (as small as 19 cm or 7.5 inches). Female spotted seatrout do not become mature until they attain a size of about 25.4 cm (10 in) in length, approximately one year after spawning. Females spawned near the end of the spawning season of the previous year will not mature until the following spawning season.

Larval spotted seatrout
(Cynoscion nebulosus)

Seatrout spawn at specific locations in South Carolina's estuaries from May through early September. Typically, these sites have swiftly moving currents with obstructions on the bottom and are either in high salinity areas or are near the inlets. During the spawning season, mature males produce a "drumming" sound by contracting muscles near the swim bladder. All fish belonging to this family produce these noises (hence the common name of "drums"). Females are attracted by the drumming to areas where large numbers of males are gathered. Spawning occurs in such gatherings, or aggregations, near dusk. Larvae are transported by tidal currents to the shallow estuarine habitat such as dendritic tidal creeks, muds flats, oyster bars, and intertidal marshes. In these tidal creeks, juvenile spotted seatrout feed on crustaceans, mainly grass shrimp, and small fishes. They remain in this habitat until reaching a length of about 6 inches after ,which they move to larger, deeper estuarine creeks. In the coldest months of the year (December through early March), young-of-year spotted seatrout move to the deeper holes in the smaller creeks and on the edges of the main channels. As the waters warm in the spring, they form schools of like-sized individuals and move throughout the estuary feeding on small fishes and shrimp.

Spotted seatrout approximately 33 cm (13 in) feed on small fishes and shrimps found in shallow waters near flooded marsh grass, and as they grow, fish become the preferred prey. Males grow more slowly than females and reach a smaller maximum size. The oldest spotted seatrout aged in South Carolina was 8 years old.

Species Significance

The spotted seatrout is one of the most popular sport fish along the eastern coast of the United States and Gulf of Mexico. It ranks second by weight among recreational saltwater anglers mainly in the southeastern United States. In South Carolina, the species was officially declared a gamefish on July 1, 1986. Trout can only be harvested by means of hook and line or by gig in South Carolina waters. Hook and line harvest is allowed throughout the year, whereas use of gigs is permitted only from March through November. Currently, there is a size limit of 33 cm (13 in) and a bag limit of 10 fish per angler per day.

The Marine Division of the South Carolina Department of Natural Resources, in conjunction with the National Marine Fisheries Service, recently reported that the total recreational catch for spotted seatrout averaged 266,000 individuals per year over an 11-year period. The population of spotted seatrout in state waters is declining, albeit slowly, due to increased fishing pressure. However, changes in the way the spotted seatrout resource is managed in South Carolina and other Atlantic states can ensure a stable future for seatrout populations.

References

Boschung, H.T,. Jr., J.D. Williams, D.W. Gotshall, D.K. Caldwell, and M.C. Caldwell. 1983. The Audubon Society field guide to North American fishes, whales and dolphins. Alfred A. Knopf, New York, NY.

Murdy, E.O., R.S. Birdsong, and J.A. Musick. 1997. Fishes of the Chesapeake Bay. Smithsonian Institution Press, Washington, DC.

Wenner, C. 1998. Personal communication. South Carolina Department of Natural Resources, Charleston, SC.

Wenner, C.A. and J. Archambault. 1996. Spotted seatrout: Natural history and fishing techniques in South Carolina. South Carolina Department of Natural Resources, Marine Resources Research Institute Educational Report 18.

Striped Bass *Morone saxatilis*

Striped bass ***(Morone saxatilis)***

Description

Striped bass are members of the family Percichthyidae, the temperate basses. They are elongated with 7-8 dark stripes extending horizontally, a dark olive to steel blue back and silver underside with a brassy sheen. The two dorsal fins are separated by a gap, and two spines are present on the edge of the opercle. The caudal fin, or tail, of striped bass is clearly forked. Males reach a maximum length of 116 cm (45 in), whereas females grow to about 183 cm (72 in). Maximum weight is about 57 kg (125 lbs) with the South Carolina record being over 23 kg (50 lbs). In 1965, South Carolina biologists were able to cross, or hybridize, white bass (*Morone chrysops*) with striped bass. The resulting fry survived, and since then, other hybrids have been produced between striped bass and other species of the genus *Morone*. White bass are smaller than both striped bass and its hybrid. They are light green to gray above and silvery below with no distinct lines or stripes and have a small head and arched back. Striped bass are the largest of the three. As described above, their coloration is dark, they have a large head and mouth, and the back is not arched. The hybrid looks like a combination of the two, with the characteristic back-arch of the white bass, a small head, and dark gray or blue body and stripes that are frequently broken.

Habitat and Biology

Striped bass are native to the Atlantic coast, from the St. Lawrence River, Canada, to the St. John's River, Florida. On the Gulf coast, it is distributed from the Suwannee River, Florida, to eastern Texas. Because striped bass can live in fresh water for long periods of time, they are stocked in many inland reservoirs. However, only two East Coast reservoirs have self-sustaining populations: the Kerr Reservoir in Virginia and North Carolina, and the Santee-Cooper Reservoir in South Carolina.

Striped bass are native to the ACE Basin. They belong to the southern strain and behave quite differently from their northern relatives. Southern fish, unlike northern fish, never leave their riverine environments. Northern fish spend a considerable amount of time in near-shore waters and then ascend the rivers to spawn. Striped bass in the ACE Basin never enter the ocean, and it is strongly suspected that they never leave the river in which they are born. Striped bass are found in all the large rivers of the ACE Basin, and they over-winter in the estuarine areas of these systems near the saltwater-freshwater interface. Summers are spent in the cooler waters of the upper river, where springs and a dense canopy of trees keep water temperatures lower. They are often found in deep holes in the river or around structures such as old pilings.

Striped bass are schooling, anadromous fish; that is, they spend much of their time in salt water but migrate to fresh water rivers to spawn. However, landlocked populations spend their entire life in freshwater and do not migrate. Bass from North Carolina and the Chesapeake Bay are known to undertake coastwide migrations in addition to annual spawning migrations. They move north to New England and Canada during early spring and return between September and December. Bass inhabiting waters south of Cape Hatteras, North Carolina, typically do not take part in coastal migrations. Recent advances in molecular genetics have allowed researchers to investigate differences in populations of striped bass. Evidence strongly indicates that the rivers of the ACE Basin contain a population of striped bass that is unique to the basin.

In South Carolina, spawning migrations typically begin in March, when water temperatures exceed 58°F, and continue through early summer, with males arriving at spawning grounds before females. Fish move to areas just upstream of the saltwater-freshwater interface, where the female releases her eggs to be fertilized by any pursuing males. The semi-buoyant eggs then drift in the tidal currents for several days until they hatch. Spawning success is often sporadic because of the limited range of environmental conditions required for eggs to hatch and larvae to grow. Sexual maturity occurs around the fifth year at about 71 cm (28 in) in length. Eggs are pelagic, and larvae hatch in approximately 2-3 days. Larvae depend on endogenous nutrition for the first 5-10 days. Endogenous nutrition means that larvae derive nutrients and energy from the material contained in their yolk sacs. After this stage, once larvae have well-developed mouths, they begin to feed on zooplankton . Juveniles feed on a variety of worms, small crustaceans, insects, and fishes. In freshwater impoundments, fish such as herring, alewife, and shads constitute the main diet of the adult striped bass, while fishes, squid, clams, lobsters, crabs, shrimps, and other invertebrates are taken by adults in open-water habitats.

Species Significance

This species of bass has historically been America's most important recreational and commercial fish. Sportfishing attracts many fishermen to South Carolina. Historically, the commercial industry for striped bass has added millions to the state's economy, being an important income and employment opportunity in the coastal areas. Hatcheries exist throughout the East Coast. This bass species is also used as a "biological control" to regulate gizzard shad and herring populations in large reservoirs.

In the 1950s, the striped bass population in South Carolina exploded, causing an increase in recreational fishing, especially in the Santee-Cooper Reservoir. This population growth eventually caused a decrease in striped bass's feeding fish, the herring and shad, causing their populations to plummet. Consequently, the striped bass population in the Santee-Cooper also began to decline due to starvation. This "boom-bust" cycle is common to many fish species. A significant decline of striped bass throughout the East Coast began in the late 1970s. The U.S. Congress responded to this in 1979 by amending the Anadromous Fish Conservation Act to include an emergency striped bass study. In 1981, the ASMFC published an Interstate Fisheries Management Plan for Striped Bass. In 1980 the Striped Bass Study was implemented to identify possible causes of the decline of striped bass and to outline an action plan and research program to address these causes. Possible causes of fish decline include over-harvesting, habitat deterioration, contaminants, and industrial development. In 1984 the U.S. Congress passed the Atlantic Striped Bass Conservation Act, requiring a federal moratorium on striped bass fishing in those states which have not adopted the recommended management measures of the ASFMC Plan or are not satisfactorily enforcing these measures.

References

Deuel, D., D. McDaniel, S. Taub. 1989. Atlantic coastal striped bass: Road to recovery. U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Washington, D.C.

Fay, C.W., R.J. Neves, and G.B. Pardue. 1983. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic)--Striped Bass. U.S. Department of Interior, Fish and Wildlife Service, Biological Report FWS/OBS-82/11.8. U.S. Army Corps of Engineers Report TR EL-82-4. Washington, DC.

Fuller, J.C., Jr. 1984. South Carolina's striped bass story. South Carolina Wildlife and Marine Resources Department, Columbia, SC.

Hardy, J.D., Jr. 1978. Development of fishes of the mid-Atlantic Bight: an atlas of egg, larval, and juvenile stages. Volume 3: Aphredoderidae through Rachycentridae. U.S. Fish and Wildlife Service, Office of Biological Programs. FWS/OBS-78/12. Ft. Collins, CO.

Jenkins, R.E. and N.M. Burkhead. 1994. Freshwater fishes of Virginia. American Fisheries Society, Bethesda, MD.

Williams, H.M. 1975. Characteristics for distinguishing white bass, striped bass and their hybrid (striped bass X white bass). South Carolina Wildlife and Marine Resources Department, Abbeville, SC.

Striped Mullet *Mugil cephalus*

Striped mullet ***(Mugil cephalus)***

Description

Mullet (family Mugilidae) are common inhabitants of freshwater, estuarine and offshore habitats and are well known for their habit of jumping, sometimes up to 1 meter (3 feet), out of the water. Striped mullet, also called grey mullet and black mullet, are elongate with a series of dark stripes that run the length of the body. The dorsal, or upper part of the fish's body, is a bluish-gray color, the underside is white, and there is a purplish blotch on the upper base of the pectoral fins. Similar to other mullets, striped mullet possess a well-developed adipose eyelid, a thick membrane that covers part of the eyeball and presumably functions in protection. Striped mullet have two well-separated dorsal fins (the first one with four spines), pectoral fins that join the fish's body above the midline (towards its back), and no lateral line. The mouth, when viewed from below, appears as an inverted "V."

Habitat and Biology

This species of mullet is found in temperate and tropical waters throughout the world. Along the western Atlantic, striped mullet are distributed from Brazil to Nova Scotia, including the Caribbean and the Gulf of Mexico. Adult mullet aggregate in large schools and migrate from shallow estuarine areas and freshwater rivers to offshore spawning grounds in the fall and winter. The spawning season for this species is from October to February, with peak activity in November-December. After hatching, larvae remain offshore until they reach about 20 mm (< 1 inch) in length. At this time, they begin migrating back to shallow coastal areas, such as estuaries, where they complete their development. In the fall, young mullet either move to deeper waters or remain in estuaries to spend the winter. Once they become adults, mullet are found in various habitats including freshwater rivers, saltmarshes, estuaries, and the open sea. The feeding habits of striped mullet vary with age. Young mullet feed primarily on small crustaceans and other zooplankton, whereas adults ingest plant matter. They feed by sucking in bottom sediments that contain decaying plant material, algae, and inorganic particles. They may also extract algae and microorganisms from scum that accumulates on the water surface or from the surface of submerged vegetation or other substrates. Swarming marine worms (polychaetes) have also been reported as part of their diet.

Species Significance

Striped mullet have both commercial and recreational value. They are commonly used as bait for favored sport fishes, such as billfish, but they are also a popular food fish in the southeastern United Sates and Gulf coast, where they are sought after for both their meat and their roe (egg mass). The heaviest commercial fishing for mullet is done during spawning migrations, when fish are gathered in large schools near the surface. Gill nets and cast nets are used in the commercial harvest of mullet, whereas recreational fishermen find cast netting to be particularly effective since mullet tend to congregate near the surface.

Striped mullet are neither threatened nor endangered. However, in recent years, the Japanese demand for mullet roe has increased, causing American stocks of this species to decline sharply.

References

Bearden, C.M. 1961. Common marine fishes of South Carolina. Bears Bluff Lab Contribution No. 34. Bears Bluff Laboratory, Inc., Wadmalaw Island, South Carolina.

Boschung, H.T,. Jr., J.D. Williams, D.W. Gotshall, D.K. Caldwell, and M.C. Caldwell. 1983. The Audubon Society field guide to North American fishes, whales and dolphins. Alfred A. Knopf, New York, NY.

Collins, M.R. 1985. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (South Florida)--striped mullet. Biological Report 82(11.34). U.S. Fish and Wildlife Service, Washington, DC.

Murdy, E.O., R.S. Birdsong, and J.A. Musick. 1997. Fishes of the Chesapeake Bay. Smithsonian Institution Press, Washington, DC.

NEXT SECTION: Species Gallery - Invertebrates
RETURN TO: Species Gallery - Intro

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

MENU

American Oyster *Crassostrea virginica*

Blue Crab *Callinectes sapidus*

Fiddler Crab *Uca pugnax*

Grass Shrimp *Palaemonetes* spp

Hard Clam *Mercenaria mercenaria*

Horseshoe Crab *Limulus polyphemus*

White Shrimp *Penaeus setiferus*

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Invertebrates

American Oyster *Crassostrea virginica*

Eastern oyster *(Crassostrea virginica)*

Description

Oysters, like other bivalves, have two shells that are hinged at one end. The shape of the shell and its weight vary according to the oyster's habitat. For instance, oysters that live in subtidal areas do not form clusters and tend to have regular, heavy shells. Cluster-forming, intertidal oysters have shells that are typically thin, elongated, and irregularly shaped. All oysters are attached to the substrate or one another by their left valve. This valve tends to be thicker and more deeply curved than the right one. Inside an oyster's shell, the internal organs are covered by a thick fold of tissue called the mantle, whose primary function is to secrete the shell. Unattached parts of the mantle enclose a space known as the mantle cavity which, in a living oyster, is always full of seawater. This keeps the oyster's organs constantly bathed in water even when it is exposed to air at low tide.

Habitat and Biology

Although they occur at depth down to about 30 meters (100 feet), oysters' primary habitat is in shallow water. In South Carolina, oyster reefs develop in intertidal areas and subtidal areas (less abundant in South Carolina) to about a depth of 2-3 meters (6-9 feet). Oysters typically form intertidal beds that become established on firm substrates where salinities are moderately high, food supplies are sufficient, and siltation is not excessive. In contrast, the oyster beds of Chesapeake Bay and Apalachicola Bay are primarily subtidal. Most of the extensive oyster beds in South Carolina develop within a short distance of high salinity sources of water.

The spawning activity of oysters is influenced by temperature and salinity; its onset varies throughout the oyster's range. In South Carolina, the spawning season extends from April through October, with a peak during the summer (Burrell 1986) when water temperatures are above 20 °C. Oysters are broadcast spawners, ejecting sperm and eggs into the water, where fertilization occurs. Female oysters are induced to spawn by the presence of male sperm in the water, and they may spawn several times during one season. Oysters may spawn multiple times during the season, with each female releasing millions of eggs during each spawning event. Oysters are "protandric" because they develop first as males and then become females due to regression of the testes and subsequent development of the ovaries.

Free-swimming oyster larvae hatch approximately 24 hours after fertilization. The fertilized eggs develop in a free-floating or planktonic environment, and a trochophore larva hatches from the egg 6-9 hours after fertilization. The larvae remain planktonic for about three weeks and progress through a number of larval stages. Larvae are distributed throughout the estuarine environment by tidal currents, rising to the surface on flooding tides, and sinking to the bottom on ebbing tides. This vertical migration behavior helps keep the larvae from being washed out to sea. The last larval stage, the pediveliger, has a muscular foot that it uses to crawl on the bottom, searching for a suitable place to attach. Attachment sites include almost any hard surface such as other living oysters, oyster shell, rocks, docks, pilings, and glass bottles. When they attach, the larvae are called "spat," and the process of settling and changing from a free-swimming to an immobile lifestyle is called "spatfall." Larvae often settle on top of other oyster shells, forming large beds or oyster reefs. Once attached, the newly settled oysters stay in the same location throughout their life. Most of the oyster larvae settling do not find suitable habitats, but rather they end up on muddy or sandy areas which lack the solid surfaces required for survival. Others may find solid substrates to settle on but may encounter poor water quality or inadequate food resources that prevent larval growth. Only those larvae that settle in areas with adequate substrate, water quality, and food resources have a chance of surviving. Because the presence of oysters and oyster shell suggests that there are suitable resources for growth and survival, larvae may select oyster shell as a substrate. This behavior results in the formation of oyster reefs throughout many intertidal areas in South Carolina. In addition, commercial oyster harvesters often "seed" areas with oyster shell (called "culch") to promote spat settlement.

Oysters feed by filtering bits of food out of water that is drawn in by the beating of small hair-like structures (cilia) that are located on the gills. Cilia create water currents that supply oxygen to the gills and remove carbon dioxide. These currents also carry food particles and other small pieces of material to the gills. The particles are sorted by ciliary action and food particles are carried to the mouth while other material that is not ingested gathers on mucus on the gills, which is then expelled. The primary component of the diet of oysters and clams is phytoplankton, which are small, single to multicellular algae.

Species Significance

The American oyster, also called the eastern oyster, is the only commercially important oyster species on the East Coast of the United States. In South Carolina, it is among the most popular local seafoods. Harvesting is done by handpicking clusters of oysters at low tide in authorized areas. In addition to providing commercial and recreational benefits, oysters also fulfill several important ecological functions. For instance, their filtering action serves to remove suspended sediments from the water as well as certain pollutants. Oyster reefs provide valuable shelter and habitat for many other species, such as stone crabs, and prevent erosion by stabilizing marsh edges. Several marine species--some of commercial importance--seek habitats where the bottom is covered with loose oyster shell. (See related section: Commercial Fisheries.)

The oyster population in South Carolina is currently stable. However, oyster harvesting in the United States has declined more than 50 percent since the 1930s, while the demand for oysters has continued to increase. The population decline is primarily due to over-harvesting, pollution, and disease. Diseases such as *Perkinsus marinus*, MSX, and Seaside disease all have similar effects on oyster populations. These diseases wipe out populations before they are able to reach a harvestable size. Many shellfish beds in the United States have been closed to reduce health risks from consumption of contaminated shellfish.

References

Burrell, V. G., Jr. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic)--American oyster. United States Fish and Wildlife Service Biological Report 82(11.57). Washington, DC.

Keith, W. J. and W. D. Anderson. 1995. Oysters and clams. Information & Education Series. South Carolina Department of Natural Resources, Charleston, SC.

Kennedy, V. S., R. I. E. Newell, and A. F. Eble. 1996. The eastern oyster, *Crassostrea virginica*. Maryland Sea Grant College, College Park, MD.

Blue Crab *Callinectes sapidus*

Blue crab ***(Callinectes sapidus)***

Description

Blue crabs are members of the most abundant group of animals on Earth, the arthropods. Their Latin name, *Callinectes sapidus*, translates to “beautiful, savory swimmer.” Like all true crabs, they have five pairs of legs: three pairs of walking legs, one pair of paddle-like swimming legs, and one pair of claws. Their bodies are dorsally compressed, and their carapace ends in two sharp points on either side. Male crabs may be differentiated from females by their size and the shape of their abdomen. An adult male is typically larger than the female, with an abdomen that looks like an upside-down “T” embedded in its underside. Immature females have a triangular abdomen, while that of mature females is rounded and can be easily pulled away from the body. Coloration also varies between the sexes. Males usually have bright blue claws, while those of the female have orange tips.

Habitat and Biology

Blue crabs rely on estuarine habitats during most of their life cycle, although the larval stages develop in the ocean. The species ranges from Nova Scotia to Uruguay; however, it is most common in estuarine and nearshore habitats from Massachusetts to Texas. Shallow intertidal marsh habitats, such as those that line the South Carolina coast, are important nursery areas for young crabs, whereas larger adults prefer deeper waters.

In South Carolina, the mating season extends from February to November. Spawning peaks occur from March to July and again in October and November. Mating, which takes place in waters of low to moderate salinity, is a once-in-a-lifetime event for a female blue crab. After an elaborate courtship ritual a few days before mating, a male pairs with a female which is about to shed her shell for the last time (pubertal molt). He cradles her and carries her until she molts. Mating takes place while the female is still soft. Sperm that is transferred from the male is stored in receptacles on the female's body and used to fertilize her eggs throughout the following year or two. After mating, the male continues to carry and protect the female until her shell hardens. Spawning occurs during late spring and summer near inlets and in nearshore ocean waters. As the eggs are extruded, they are fertilized and attached to pleopods, located on the female's abdomen. The female crab carries the eggs under her abdomen until they hatch. Following mating, females move seaward, carrying their eggs in an external mass called a "sponge." Ovigerous females have been collected in Charleston Harbor from April through October, with a peak in July. Hatching occurs in nearshore waters where larvae undergo a series of seven developmental stages as zoea and transform to the postlarval or megalopal stage to begin the cycle again. Megalopae enter inshore waters during the summer and fall. Young crabs typically move up estuaries to mid and low salinity water and grow quickly. Growth is rapid, and blue crabs reach maturity and the five inch legal harvest size in one to two years. Blue crab larvae feed primarily on coastal zooplankton, whereas adults are opportunistic, feeding on fish, other crustaceans (including blue crabs), mollusks and decaying plant and animal matter.

In addition to movements related to the crab's life cycle, weather conditions are known to affect the distribution of crabs. If water conditions become too warm or too cold, crabs move to more favorable areas. Typically, cold water forces crabs, especially mature females, to deep water where they bury themselves in the sediment and become inactive. Crabs have also been known to leave shallow waters because of extreme heat on both a daily and a seasonal basis.

Species Significance

Blue crabs are harvested commercially and recreationally in South Carolina, with crab traps, or pots, as the primary method used in their harvest. The trap is cube-shaped and made of wire mesh. A partition bearing two holes separates the trap into an upper and lower chamber. The lower chamber is equipped with two to four entrance funnels and a bait well. Crabs are attracted into the lower chamber and, once confined, try to escape by

Crab trap

swimming upwards. This response causes them to move into the upper chamber, decreasing their chances of escape. Commercially, blue crabs are also harvested by means of trawling and as incidental catch in the shrimp trawl fishery. Recreational fishermen can use several harvest methods besides crab pots, such as dip nets, drop nets, and collapsible baskets.

A small portion of the blue crab fishery targets softshell crabs. Softshell crabs are those which have recently molted and whose shell is still soft. These crabs are sought after by seafood lovers and typically earn a fisherman a substantially higher price than hard crabs. The shell of the blue crab is only soft for short periods. The outer hard shell of crabs cannot grow larger at the crab grows. Periodically, crabs go through a "softshell" stage by shedding their outer hard shell. Prior to molting, a new shell develops underneath the old shell. It remains soft until the animal crawls out of its old shell once a new shell has developed underneath. Over a period of a few hours, the premolt or peeler crab molts, and the underlying softshell hardens to become the familiar hard shell. Some commercial crabbers have learned to predict the time of the next molt based on changes in color of the crab's exoskeleton in the region of the dactyl of the fifth pereopod. Blue crabs are not attracted to bait during the premolt or peeler softshell stage; thus methods other than bait odor must be employed to attract them.

The population of blue crabs in South Carolina is stable, and there are no indications that this resource has been or is currently being overexploited. (See related section: Commercial Fisheries.)

References

Low, R., R. Rhodes, E. R. Hens, D. Theiling, E. Wenner, and D. Whitaker. 1987. A profile of the blue crab and its fishery in South Carolina. South Carolina Marine Resources Center. Technical Report No. 66.

Sandifer P. A., J. V. Miglarese, D. R. Calder, J. J. Manzi, and L. A. Barclay. 1980. Ecological characterization of the Sea Island coastal region of South Carolina and Georgia, Vol. III: Biological features of the characterization area. United States Fish and Wildlife Service, Office of Biological Services, Washington, D.C., FWS/OBS-79/42.

Whitaker, D. J. 1995. Blue Crabs. Sea Science Educational Series. South Carolina Department of Natural Resources, Charleston, SC.

Fiddler Crab *Uca pugnax*

Fiddler crab *(Uca pugnax)*

Description

Fiddler crabs are easily recognized by their square body and marked difference in size between the right and left claws of males. As the male grows to maturity, the relative weight of its large claw, or cheliped, changes from 2% to 65% of its total body weight. Mud fiddlers, *Uca pugnax,* have an H-shaped depression in the middle of the carapace and their eyestalks are long and thin. They are brown in color, with the front of the shell and eyestalks ranging from blue to turquoise. The large claw of the male is usually yellowish orange to yellowish white, and its walking legs are dark and banded. Besides mud fiddlers, two other species of fiddler crabs are common along the southeastern Atlantic coast: *Uca pugilator,* the sand fiddler; and *Uca minax*, the red-jointed fiddler. The three are easily differentiated on the basis of anatomical features and preferred habitat: sand fiddlers inhabit sandy habitats, they are typically a pinkish-purple color, and the inside of the male's large claw lacks a row of small bumps; mud fiddlers are a brownish-yellowish color, they prefer muddy areas, and the inside of the male's large claw has a row of small granules; red-jointed fiddlers are larger than the other two species, and the joints of the male's large claw are red.

Habitat and Biology

Fiddler crabs are one of the most conspicuous inhabitants of the intertidal zone, and they often can be seen foraging in large groups along creek banks when the tide is out. They thrive in marsh habitats where the substrate is stable enough to allow for the construction of burrows, which can be up to 60 cm (23 in) deep. Mud fiddlers range from Massachusetts to Florida and are common along the South Carolina coast.

Male fiddler crabs wave their oversized claw up and down to attract the attention of females for mating and to intimidate potential male competitors. They also stomp their walking legs and make noises with them in an effort to attract mates. Such displays reach a peak during spring tides, and mating occurs thereafter inside the male's burrow. The female remains inside the burrow during the 2-week incubation period and then comes out to release her eggs, which are swept out to sea by neap tides. After hatching, larvae go through several developmental stages (five zoeae and a megalopal) over the two-week period that they are adrift in the ocean. They are then transported back inside estuaries on the subsequent spring tide. Larvae are predatory and feed on zooplankton in the water column. They remain pelagic for some time after reaching the megalopal stage, gradually adopting a benthic existence. Adult fiddler crabs feed on organic material extracted from mud, which is rolled into small balls after the food is removed and deposited back onto the substrate. Pellets formed during burrow excavation are much larger than feeding pellets. Mud fiddlers are adept at regulating their metabolism over a wide range of temperatures, which may explain their widespread abundance.

Species Significance

This species has no directly quantifiable commercial value but constitutes an important food source for estuarine animals such as clapper rails, other marsh birds, blue crabs and many other species. As are other estuarine-dependent animals, fiddler crabs are under continuously increasing threat of habitat loss due to land use practices that alter or destroy suitable habitat.

References

Ruppert, E. and R. Fox. 1988. Seashore animals of the southeast. University of South Carolina Press, Columbia, SC.

Williams, A. B. 1984. Shrimps, lobsters and crabs of the Atlantic coast of the eastern United States, Maine to Florida. Smithsonian Institution Press, Washington, DC.

Grass Shrimp *Palaemonetes* spp.

Grass shrimp ***(Palaemonetes vulgaris)***

Description

Grass shrimp, sometimes called hardbacks or popcorn shrimp, are among the most common estuarine inhabitants of South Carolina waters. Their bodies are nearly transparent, except for orange (*Palaemonetes vulgaris*) or yellow (*P. pugio*) pigment in the eyestalks. Grass shrimp also have a well-developed rostrum (horn) with teeth along the edges, four spines on the telson (the pointed structure in the middle of the tail fan), and heads that are longer than the rest of the body. Unlike white shrimp (for which they are sometimes mistaken), grass shrimp lack claws on the third pair of walking legs and rarely grow larger than 5 cm (about 2 inches).

Habitat and Biology

Grass shrimp are found in estuarine waters along the Atlantic and Gulf coasts, usually associated with beds of submerged vegetation or oyster shells. Although both can live in a wide range of salinity, *P. vulgaris* can tolerate somewhat higher salinities than *P. pugio*; thus, there is some separation of the two species based on preferred habitat.

The grass shrimp spawning season extends from April to September, although this may vary depending on species and geographic location. During mating, which occurs within 7 hours of molting, the male transfers a spermatophore to the female. The eggs are fertilized externally as they are extruded, and the female attaches them to her pleopods, where they remain until hatching 12 to 60 days after they are fertilized. The incubation period varies among species and is shorter in warmer climates. The female molts again a few days after spawning and may produce another brood. Grass shrimp larvae undergo a series of developmental stages (10 zoeae and a postlarva) whose duration depends on water temperature and food availability. Larvae are planktonic and feed on zooplankton, algae, and detritus. However, adults consume a wider variety of foods, including microalgae attached to aquatic plants, small marine worms, and crustaceans. The fecal pellets that are produced by grass shrimp from the unused part of their diet are rich in nutrients and therefore an important component of energy cycling in estuarine ecosystems.

Species Significance

Grass shrimp have no commercial or recreational importance as food for humans, and they have limited value as bait or as food for cultured fish. However, they are an important species from an ecological perspective by serving as a link for energy transfer between trophic levels in the coastal food web. Grass shrimp feed on detritus, algae, and dead plant and animal material. In turn, grass shrimp are consumed in large quantities by commercially important fishes and forage species such as spotted seatrout, red drum, and mummichogs.

References

Ruppert, E. and R. Fox. 1988. Seashore animals of the southeast. University of South Carolina Press, Columbia, SC.

Williams, A. B. 1984. Shrimps, lobsters and crabs of the Atlantic coast of the eastern United States, Maine to Florida. Smithsonian Institution Press, Washington, DC.

Hard Clam *Mercenaria mercenaria*

Hard clam *(Mercenaria mercenaria)*

Description

Clams are bivalves, a group of mollusks with a shell consisting of two roughly equal-size valves that are hinged at one end. Concentric growth rings are usually visible between the margin of each valve and the hinge swelling, or umbo. External shell color is off-white or pale yellowish-brown, while the inside is white or pale yellow with purple margins. Hard clams have two short siphons through which water is filtered. The siphon which takes in water is called the incurrent, or inhalant siphon, and it lies on the ventral side (underside) of the clam. Water is expelled through the excurrent, or exhalent siphon, which is located dorsally (back side). Coloration of the siphons varies from cream to dark brown or black. Similar to other bivalves, clams have a fleshy tissue membrane, called the mantle, covering the internal organs. The mantle is in contact with the valves but not attached to them. Its primary function is to secrete the substances that make up the clam's shell. A hard clam also possesses a hatchet-shaped foot that it uses to move around and bury itself in the mud.

Habitat and Biology

Along the Atlantic coast, clams inhabit estuaries from the Gulf of St. Lawrence, Canada, to Florida. They also occur along the Gulf coast to the Yucatan Peninsula in Mexico. In the South Atlantic, hard clams are common in estuaries from the intertidal zone to depths of about 15 meters (50 ft) or more. They prefer muddy bottoms with loose shell and sand on top. Hard clams can bury to an average depth of 2 cm (1 in) in sand and 1 cm (0.5 in) in mud, with smaller individuals burrowing deeper than large ones.

The hard clam has a life history that is similar to that of the American oyster (Eversole 1987). Clams are also protandric. During the first phase of sexual maturity the clam functions as a male. Spawning is induced by rising water temperatures in the spring, when temperatures reach approximately 20°C. Because spawning activity is closely related to water temperature, times of spawning vary greatly with latitude. In South Carolina, the spawning season extends from spring until fall, with a pause during midsummer months. South Carolina clams are ready to spawn at two years of age. Females release eggs through the exhalent siphon, and fertilization by nearby males occurs freely in the water. Each female clam may release between 2 and 25 million eggs during a spawning season, depending on its size and condition. After about 10 hours, the embryo hatches and goes through a series of developmental stages before settling on the substrate. The hard clam has two non-shelled larval stages: a trochophore and an early veliger. Larvae propel themselves through the water column by use of a swimming structure, called a velum, until they finally adopt a benthic existence 20 to 60 days after hatching. Similar to oysters, the presence of other clams in the sediment induces settlement of clam larvae, resulting in dense patches of clams. Hard clams prefer sandy to muddy bottoms, especially those containing shell fragments near areas with turbulent currents and relatively high salinity. Small tidal creeks that are partly closed by oyster beds at the mouth appear to be one of the more productive habitats for this species. Although hard clams produce large numbers of eggs, mortality of pre-adult stages is extremely high. Once mature, clams experience lower predation pressure presumably due to a thicker shell.

Clams, like oysters, are filter feeders, passing water across the gills where food particles are removed. Food trapped on the gills is moved anteriorly to the clam's "mouth" by ciliary action. Large particles that the clam cannot eat are periodically expelled out of the mantle cavity into the water through the inhalant siphon, while waste products from digested food pass out the exhalent siphon as fecal pellets.

Species Significance

In the United States, hard clams have the highest dollar value of commercially harvested clams. They are sold under three categories based on size: littlenecks are the smallest and most expensive, cherrystones are medium-sized; and chowders, the largest, are least expensive and typically marketed to make clam chowder. In South Carolina, the same regulations that apply to the harvest of oysters apply to the harvest of clams. However, only one-half bushel of clams per person per day is legal. Similar to American oysters, clams perform the important ecological role of cleansing the water of suspended sediments through their filtering action.

References

Eversole, A. G. 1987. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic): hard clam. Biological Report 82(11.75). United States Department of Interior, Fish and Wildlife Service, Washington, DC.

Keith, W. J. and W. D. Anderson. 1995. Oysters and clams. Information and Education Series. South Carolina Department of Natural Resources, Charleston, SC.

Horseshoe Crab *Limulus polyphemus*

Horseshoe crab
(Limulus polyphemus)

Description

Despite their name, horseshoe crabs are not true crabs. Unlike true crabs, which have two pairs of antennae, a pair of jaws, and five pairs of legs, horseshoe crabs lack antennae and jaws, and they have seven pairs of legs, including a pair of chelicerae. Chelicerae are appendages similar to those used by spiders and scorpions for grasping and crushing. In addition, horseshoe crabs have book lungs, similar to spiders and different from crabs, which have gills. Thus, horseshoe crabs are more closely related to spiders and scorpions than they are to other crabs. Their carapace is divided into three sections: the anterior portion is the prosoma; the middle section is the opithosoma; and the "tail" is called the telson. Horseshoe crabs have two pairs of eyes located on the prosoma: one anterior set of simple eyes and one set of lateral compound eyes similar to those of insects. In addition, they possess a series of photoreceptors (light-sensitive organs) on the opithosoma and telson.

Habitat and Biology

Adult horseshoe crabs are benthic animals inhabiting both shallow estuarine areas and offshore habitats near the continental shelf. The range of the horseshoe crab extends from northern Maine to the Yucatan Peninsula. They are particularly abundant in Delaware Bay, the center of their distribution, and in coastal areas between Virginia and New Jersey. Different populations of horseshoe crabs are thought to inhabit every major estuary along the Atlantic coast. Each population can be differentiated from the others based on size of adult crabs, the color of their carapace, and pigments present in their eyes.

Early each spring, as estuarine water temperature approaches 20°C, adult horseshoe crabs move inshore to seek suitable spawning habitat. Throughout the spring, females with males attached to their carapace follow flooding tides high onto the beach, where they excavate nests and deposit thousands of eggs. During mating, the male grasps the female's carapace and fertilizes her eggs as she deposits them in the nest cavity. Oftentimes, other unattached "satellite" males may also fertilize some of the eggs. Mating and nesting coincide with high tides. Nests are excavated by the female on the intertidal zone of sandy beaches, and eggs are laid in clusters Spawning activity is especially heavy during nighttime spring tides.

Females nest several times per season, usually returning to deposit more eggs on subsequent high tides. After approximately two weeks, depending on temperature, moisture and oxygen levels, larval horseshoe crabs emerge from the nest. Larval *Limulus* are semi-planktonic for about three weeks before their transition to a benthic existence. They then settle to the bottom and assume a benthic existence, typically spending their first two years in intertidal sand flat habitats near beaches where they were spawned. Adults return to deeper estuary bays and continental shelf waters after the breeding season. Horseshoe crabs are long-lived animals; after attaining sexual maturity, in 9 to 12 years, they may live for another 10 years or more. Like other arthropods, horseshoe crabs must molt in order to grow. As the crab ages, more and more time passes between molts, with 16 to 19 molts occurring before a crab becomes mature, stops growing, and switches energy expenditure to reproduction. Adult horseshoe crabs feed on a variety of bottom-dwelling organisms including marine worms, shellfish, and decaying animal matter. The larvae and juvenile stages are preyed upon by many species of fish and birds, and adult horseshoe crabs are known to be a food item for the threatened loggerhead sea turtle, *Caretta caretta* .

Species Significance

Horseshoe crabs are an important species, both commercially and ecologically. They are currently the primary bait used in the whelk and eel fisheries along the Atlantic coast. Crabs in the ACE Basin were once harvested in small numbers for this purpose. However, the State of South Carolina prohibited this activity in 1991. Horseshoe crabs are also harvested for use in biomedicine. A clotting agent in the crab's blood, known as *Limulus* Amoebocyte Lysate (LAL), is used to detect microbial pathogens in medical intravenous fluids, injectable drugs, and supplies. Biomedical companies purchase large crabs, which are harvested by trawlers or by hand from spawning beaches. The crabs are transported to the LAL production facility, bled, then transported back to the general harvest vicinity and released alive. LAL is currently used worldwide as the standard (FDA required) test for microbial contamination in injectable pharmaceutical products. Horseshoe crabs have also been used in eye research and the development of wound dressings and surgical sutures. Ecologically, horseshoe crabs are an important component of coastal food webs. In particular, horseshoe crab eggs are the primary source of fat for at least 20 species of migratory shore birds. Larval and juvenile crabs are also food for many species of fish and invertebrates, while adult crabs are favored by loggerhead sea turtles and sharks. In addition, horseshoe crabs have been shown to be a controlling factor in benthic species composition through their feeding activities.

Resource managers are concerned that the health of horseshoe crab populations along the northeastern coast of the United States is threatened due to overharvest. New fishery regulations are being considered, and the National Marine Fisheries Service is currently developing a horseshoe crab fishery management plan for the East Coast. Recent studies (summer 1997) suggest that between 10% and 20% of crabs harvested for LAL production do not survive (even though the Food and Drug Administration mandates that they be returned to the water alive). In South Carolina, the harvest of horseshoe crabs is limited to the LAL industry, and a permit has been required since 1991. This species is not currently listed as threatened nor endangered.

References

Botton, M. L. and J. W. Ropes. 1987. The horseshoe crab, *Limulus polyphemus*, fishery and resource in the United States. Marine Fisheries Review 49(3):57-61.

Butowski, N. H. (ed.). 1994. Chesapeake Bay and Atlantic coast horseshoe crab fishery management plan. Agreement Commitment Report 1994. United States Environmental Protection Agency, Chesapeake Bay Program, Annapolis, MD.

Keinath, J. A., J. A. Musick, and R. A. Byles. 1987. Aspects of the biology of Virginia's sea turtles: 1979-1986. Virginia Journal of Science 38(4):329-336.

Sekiguchi, K. 1988. Post Embryonic Development of the Horseshoe Crab. Biological Bulletin. 174:337-345.

Shuster, C. N., Jr. 1982. A pictorial review of the natural history and ecology of the horseshoe crab, *Limulus polyphemus*, with reference to other Limulidae. Physiology and Biology of Horseshoe Crabs: Studies on Normal and Environmentally Stressed Animals. Alan R. Liss, Inc. New York.

Thompson, M. 1997. Species Profiles: Horseshoe crab. Atlantic States Marine Fisheries Commission, Fisheries Focus 6(8): 1, 6-7.

White Shrimp *Penaeus setiferus*

White shrimp *(Penaeus setiferus)*

Description

The white shrimp, *Penaeus* (recently renamed *Litopenaeus*) *setiferus*, is a commercially important species along the East Coast of the United States. It is similar in appearance to two closely related species of commercially important shrimp, the brown and pink shrimp. White shrimp are rather large, sometimes reaching 25 cm (10 in) in length. They have dark brown antennae that are considerably longer than the shrimp’s body. Their horn, or rostrum, is long and thin, and three of their five pairs of walking legs end in weak pincers. The uropods (appendages making up the tail fan) are dark at the base and have a yellowish green edge. In brown shrimp, the uropods have dark green and red pigmentation, whereas those of pink shrimp are usually bluish. Shrimp have different kinds of appendages used for moving around: walking legs (periopods) are used for moving over short distances; swimming legs (pleopods), located in two rows under the abdomen, are used in swimming over long distances; and uropods are used in conjunction with strong abdominal contractions that propel the animal backwards. The latter movement, called the tail flex, allows a shrimp to escape predators quickly.

Habitat and Biology

White shrimp thrive on muddy bottoms of estuaries from New York to Florida, and in the Gulf of Mexico from the Ocklocknee River, Florida, to Campeche, Mexico. They are most abundant in areas with extensive estuarine marshes, such as those along the South Carolina coast. The greatest concentration of white shrimp is in the Mississippi River Delta in Louisiana.

White shrimp spawn offshore, and in South Carolina this begins in May and June, with a few spawning events occurring as late as July or early August. In the Gulf of Mexico, the spawning season extends from March to September/October. During mating, the male transfers a packet of sperm, or spermatophore, to the female, who attaches it to her underside. Eggs are fertilized externally as they are broadcast into the water. White shrimp eggs sink to the ocean floor, and after 12 to 24 hours they hatch into planktonic larvae which go through 10 larval stages and a postlarval stage that resembles the adult. The life history of white shrimp indicates that their population dynamics are strongly influenced by larval and post-larval recruitment patterns. Success of larval recruitment to estuaries and subsequent survival are of paramount importance, since larvae form the reservoir of individuals from which the new year-class is derived. The abundance of white shrimp postlarvae entering estuaries is being used as one index for prediction of adult catch.

About three weeks later, the postlarvae enter estuaries in currents generated by tides and wind and migrate upstream to nursery areas. In the vicinity of an estuary, postlarvae utilize selective tidal stream transport to migrate to estuarine nursery areas; that is, they stay close to the bottom during the outgoing tide and rise off the bottom during the incoming tide in order to be transported upstream. Recruitment of white shrimp to South Carolina estuaries occurs from May to September, with peak recruitment in late May and early June.

Once in the estuary, young shrimp move into tidal creeks, where they find ample supplies of food and protection from predators. During high tide, juvenile shrimp move to the marsh surface, where they are protected among the dense vegetation. There they can feed on a variety of organic material including small benthic worms, plant matter, and decaying animals. White shrimp are opportunistic feeders, consuming any food that is available, including other shrimp. At low tide, shrimp move off the marsh surface and are concentrated in the channels of tidal creeks. Shrimp abundance and distribution is dependent on rainfall and winter water temperatures. Adult and juvenile shrimp are most abundant in salinities ranging from 8 ppt to 15 ppt (25 - 40 % of oceanic salinity). During periods of heavy rain, individuals leave shallow tidal creeks and move into the deeper, more saline waters of the rivers and harbors of the estuary.

Shrimp remain in these nursery habitats until late spring or early summer, when they begin to move into larger creeks and rivers in preparation for their offshore spawning migration. During this migration, they move progressively down the estuary into more saline waters. White shrimp are also known to make coastwide migrations of considerable distance, moving south down the Atlantic coast during winter and returning in spring. Juvenile and adult shrimp are bottom-feeding omnivores; that is, they consume any type of organic material they come across on the sea floor. Diet varies as shrimp grow, with larger individuals becoming more predatory and consuming animals such as marine worms, larvae of other crustaceans, small fishes, and even other white shrimp.

The other two species of penaeid shrimp inhabiting South Carolina waters, brown shrimp (*Penaeus aztecus*; recently renamed *Farfantepenaeus aztecus*) and pink shrimp (*F. duorarum*; recently renamed *Farfantepenaeus duorarum*), have similar life histories to the white shrimp. Brown shrimp spawn in inlets and offshore during the fall. The nearshore distribution of younger stages (nauplii) and offshore distribution of older stages (zoea and post-larvae) show a widespread larval distribution pattern. It is unclear whether post-larvae that move offshore return to the estuaries. One suggestion is that post-larvae over-winter far offshore and return in the spring using wind and tidal transport mechanisms. Peak recruitment of brown shrimp to South Carolina estuaries occurs in February and March.

The spawning period of pink shrimp overlaps that of white shrimp and occurs during the spring and summer. Both white and brown shrimp prefer the muddy bottom habitats that are characteristic of South Carolina estuaries. Pink shrimp, on the other hand, favor a sandy/shell bottom. While the latter type of habitat occurs in South Carolina estuaries, it is not as widespread as muddy and sandy habitats. This may explain the lower abundance of pink shrimp relative to white and brown shrimp in South Carolina waters.

Species Significance

The white shrimp was the first of the penaeid shrimps to be commercially marketed for food. Penaeid shrimp constitute the most important commercial fishery in South Carolina, with landings of white shrimp and brown shrimp producing $12.2 million in 1996. Methods of harvest include commercial trawling, shrimp baiting, and cast netting. For additional information on the shrimp fishery, review the Commercial Fisheries section.

The white shrimp resource in South Carolina waters is closely monitored, and its harvest is regulated by the South Carolina Department of Natural Resources. The annual abundance of shrimp is closely related to physical factors such as temperature, amount of rainfall, and meteorological events that influence recruitment to nursery areas. Drastic changes in environmental conditions can negatively impact white shrimp recruitment and survival. A serious threat to the population is loss of nursery areas due to filling, dredging and draining of critical marsh habitat. Also, land use changes in upland areas adjacent to marshes alter levels of freshwater runoff and create greater salinity variations that affect habitat suitability for white shrimp.

References

DeLancey, L. B., J. E. Jenkins, and J. D. Whitaker. 1994. Results of long-term, seasonal sampling for *Penaeus* postlarvae at Breach Inlet, South Carolina. Fisheries Bulletin 92(1):633-640.

Lam, C. F., J. D. Whitaker, and F. S. Lee. 1989. Model for white shrimp landings for the central coast of South Carolina. North American Journal of Fisheries Management 9:12-22.

Ruppert, E. and R. Fox. 1988. Seashore animals of the southeast. University of South Carolina Press, Columbia, SC.

Sick, L.V. 1970. Larval distribution of commercially important Penaeidae in North Carolina. Journal of the Elisha Mitchell Society 86:118-127.

Whitaker, J. D. 1995. Shrimp in South Carolina. Sea science educational series. South Carolina Department of Natural Resources, Charleston, SC.

Williams, A. B. 1984. Shrimps, lobsters and crabs of the Atlantic coast of the eastern United States, Maine to Florida. Smithsonian Institution Press, Washington, DC.

NEXT SECTION: Species Gallery - Mammals
RETURN TO: Species Gallery - Intro

Mammals

Bobcat *Lynx rufus*

Bobcat ***(Felis rufus)***

Description

The bobcat is easily distinguished from similar species of felines by its characteristic short (bobbed) tail. Its fur ranges from grayish to reddish-brown with black spots and its tail is tipped with black above and white below. This species has dark ears with white tips, stands 40 to 55 cm (16-22 in) at the shoulder and measures 60-100 cm (24-40 in) long (not including the 8-18 cm (3-7 in) tail). Bobcats range in weight from 5-30 kilograms (10-70 lbs), with males being slightly heavier than females.

Habitat and Biology

Bobcats are found throughout North America except in the central and lower Midwestern states. In South Carolina, bobcats typically inhabit areas of dense, thick brush such as bottomland forests in the coastal plain. They are found in many different habitats including swamps, mountainous regions, and forests.

Bobcats are polygamous; that is, they mate with more than one partner during the breeding season. They reach sexual maturity at 1 year of age and breed in late winter and early spring. After a 62-day gestation period, females give birth to two to four kittens whose eyes open in 10 days. By 4 weeks, kittens begin exploring their surroundings, and they are weaned by 7-8 weeks. Juveniles leave the den the following spring. Bobcats are opportunistic, feeding on a wide variety of prey depending on availability. Their diet includes mice, rats, squirrels, rabbits, birds, and occasionally white-tailed deer. They have been known to prey on deer during the fawning and hunting seasons, during which times they find young and wounded or crippled deer easy prey. Bobcats hunt primarily with their keen visual and auditory senses. Unable to outrun their prey, bobcats prefer to stalk and ambush unsuspecting creatures. They live to approximately 15 years in the wild.

Species Significance

Bobcats are a recreationally important species in South Carolina. They are hunted from Thanksgiving Day to May 1 with no bag limit. Bobcats are currently not endangered. Humans have historically trapped bobcats for their valuable pelts and caused subsequent population decline. Today, the bobcat population is rebounding due in part to both a decrease in hunting and the restocking of individuals. Bobcats are currently classified as protected game by the South Carolina Department of Natural Resources and may only be hunted during legally established seasons. For further information on the rules and regulations of hunting, review the South Carolina Department of Natural Resources Hunting Regulations EXIT

References

Golley, F.B. 1966. South Carolina mammals. Charleston Museum, Charleston, SC.

Webster, W.D., J.F. Parnell, and W.C. Biggs. 1985. Mammals of the Carolinas, Virginia, and Maryland. University of North Carolina Press, Chapel Hill, NC.

Whitaker, J.O. 1980. The Audubon Society field guide to North American mammals. Alfred A. Knopf, New York, NY.

Bottlenosed Dolphin *Tursiops truncatus*

Bottlenosed dolphin *(Tursiops truncatus)*

Sound, SCDNR

Description

The bottlenosed dolphin is one of 79 species of cetaceans. Its common name originates from its blunt snout, or rostrum. These aquatic mammals are silver-grey on top with pale grey, white or pinkish bellies. They may grow to 3.6 meters (12 ft) in length, but they commonly measure 2.4-2.7 m (8-9 ft) with an average weight of 180-270 kg (400-600 lbs). The lateral fins of a dolphin are called flippers, and its tail is called a fluke. Over time, their dorsal fins acquire notches and scratches that are used by scientists to identify individual dolphins. As all mammals, bottlenosed dolphins have hair (a few whiskers on their faces) and nurse their young.

Habitat and Biology

The bottlenosed dolphin is a common inhabitant of temperate oceans and coastal waters around the world. Along the east coast of the United Sates, bottlenosed dolphins range from Maine to Florida. This species of dolphin occupies different habitats throughout its range. Some dolphins are residents of coastal waters, and others lead a pelagic existence, traveling long distances across the world's oceans. In South Carolina, the bottlenosed dolphin is the most common mammal inhabiting estuarine habitats as well as open water.

Inshore dolphins live in bays, lagoons, and estuaries and travel short distances in groups of four or five. Offshore animals gather in groups that may number in the hundreds and migrate north and south during the year following prey. Oftentimes groups of dolphins associate with gatherings of other marine mammals such as whales. This association affords protection and makes it easier for both parties to find food. Dolphins use several different feeding techniques to catch fish, shrimp, crabs, and squid. Females reach sexual maturity at 7-10 years of age, breeding is seasonal with most activity in the spring, gestation lasts 12 months, and the young begin eating fish at 6-7 months of age.

Species Significance

Dolphins are not threatened or endangered but are protected under the Marine Mammal Protection Act. Dolphin are commonly residents in the estuarine areas of the ACE Basin and can be observed from shore and from boats.

References

Heyning, J.E. 1995. Masters of the ocean realm: Whales, dolphins and porpoises. University of Washington Press, Seattle, WA.

Kelly, W.J. 1993. Dolphins that feed on land. Undercurrents 2(3):2-5.

Simbeck, R. 1997. For wildlife watchers: Bottlenose dolphin. South Carolina Wildlife 44(3):42-43.

Eastern Cottontail Rabbit *Sylvilagus floridanus*

Eastern cottontail rabbit
(Sylvilagus floridanus)

Description

Distinguished from the other three rabbit species native to South Carolina by a white underside to its tail, the Eastern cottontail rabbit is the most common rabbit encountered. The upper body is reddish or greyish brown, and the underparts are white. The cottontail is also distinguished by a distinctly rust-colored nape and often has a white spot on the forehead. Average weight of Eastern cottontail rabbits is 0.9-1.8 kg (2-4 lbs), with females being larger than males.

Habitat and Biology

The cottontail rabbit prefers disturbed habitats, occurring most commonly in brushy areas, old fields, woods, cultivated areas, thickets, and brush piles. Habitats with heavy cover are needed for rest and escape from predators.

The life history of rabbits in the ACE Basin includes onset of breeding in mid-February, although timing is controlled mainly by temperature. The peak of breeding occurs in May and June. The female, or doe, seeks a well-drained location for her nest, which is an excavated pit lined with grass, leaves, moss, and fur that is plucked from her thoracic and abdominal areas. The doe provides care of the young for 2 weeks after birth. Rabbits are extremely prolific breeders and may have as many as seven litters during one breeding season. As many as half of the female rabbits born early in the season may reproduce during their first year, with some being sexually mature at 6 months.

Although rabbits are prolific, the vast number of predators keeps the population in check. Important predators include foxes, bobcats, owls, raccoons, hawks, snakes, and man. Fire ants, diseases, and parasites also reduce rabbit populations. Rabbits are often infested with fleas, ticks, and mites, which also contribute to the spread of tularemia, a microorganism that can decimate populations.

Food is not usually a limiting factor for rabbits, which consume a wide variety of plants.

During spring and summer, grasses, leaves, shoots, fruits, branch tips, buds, and bark are consumed. Preferred foods include clover, chickweed, goldenrod, strawberry, blackberry, wild cherry, and grape. During winter, rabbits consume primarily woody plants such as bark from dogwood, sumac, maple, and oaks. Grains such as corn and soybeans also provide a source of high-energy food.

Species Significance

Although rabbits are still hunted on a small scale, harvests have declined in recent years, as has the number of hunters. The cottontail rabbit is probably still an underutilized species statewide and in the ACE Basin study area. This species is a primary prey species for a wide range of predators including hawks, bobcats, and occasionally owls. Loss of habitat is the most serious threat to the cottontail rabbit in South Carolina. Expanding development, conversion of old fields into pine plantations, and the loss of edge habitat have reduced numbers more than have all of the rabbit's many predators.

References

Baker, O.E., III and D.B. Carmichael, Jr. 1991. South Carolina's furbearers. South Carolina Department of Natural Resources, Columbia, SC.

Lucas, G. 1991. Fleet foot, South Carolina Wildlife 38(6):6-10.

Whitaker, J.O. 1980. The Audubon Society field guide to North American mammals. Alfred A. Knopf, New York, NY.

Eastern Gray Squirrel *Sciurus carolinensis*

Eastern gray squirrel
Sciurus carolinensis

Description

Characterized by gray fur and a bushy tail, the Eastern gray squirrel reaches a length of 41 to 51 cm (16 to 20 inches), half of which may be tail. Weight averages from 0.45 to 0.68 kg (1 to 1.5 pounds).

Habitat and Biology

The gray squirrel is common in hardwood forests with nut-producing trees. It can also be found in residential areas where it eats twigs, buds, seeds, and nuts. Cover is important for bedding, nesting and protection from predators. Tree cavities are used as dens for litter raising and winter shelter. Leaf nests consisting of leaves and twigs are also utilized by gray squirrels, although litter survival has been reported to be higher in cavities.

Population levels of gray squirrel are closely correlated with availability of hard mast. Diet generally includes twigs and buds, fruit, seeds and nuts which are often stored by burial for winter. Other supplemental food items include insects, bird eggs, frogs and lizards.

Mating takes place over two distinct breeding periods. The winter-spring period peaks in January, with young produced in February and early March. The spring-summer mating period peaks in June, with young produced in July. Sexual maturity and litter production generally occur between 10 months to 1 year of age. Gestation takes about 44 days, with the young generally remaining with the female for as long as 12 weeks.

Life expectancy of gray squirrels is short, averaging only 1-2 years. Population declines occur primarily as a result of mast crop failures. Because squirrel populations are resilient and can naturally recover in 1-3 years if food and weather conditions are favorable, hunting has little effect on population numbers. The natural mortality of gray squirrels is particularly high within the first year, and those young born in summer appear to have a higher mortality than those born in spring. Parasites such as fleas, botflies, and ticks are likely contributors to mortality. Major predators such as bobcats, raccoons, owls, hawks, and snakes probably do not limit populations.

Species Significance

Squirrels are primarily hunted recreationally in South Carolina, although there has been a dramatic decline in harvest of gray squirrels in recent years. Squirrel populations have not suffered any declines in population.

References

Baker, O.E., III and D.B. Carmichael, Jr. 1991. South Carolina’s furbearers. South Carolina Department of Natural Resources, Columbia, SC.

Teaford, J.W. 1986. Eastern gray squirrel (*Sciurus carolinensis*). Section 4.7.1 U.S. Army Corps of Engineers Wildlife Resources Management Manual, Technical Report EL-86-6. U.S. Army Corps of Engineers Waterway Experiment Station, Vicksburg, MS

Webster, W.D., J.F. Parnell, and W.C. Biggs. 1985. Mammals of the Carolinas, Virginia, and Maryland. University of North Carolina Press, Chapel Hill, NC.

Eastern Woodrat *Neotoma floridana*

Eastern woodrat *(Neotoma floridana)*

Description

The Eastern woodrat has brown-gray fur with black tips and a white underside and feet. In the summertime, adults change color to a cinnamon brown above. The woodrat's eyes are black and large, its tail is bicolored, dark brown above and white below, and its ears are large with little hair. It typically weighs 7-12 ounces and measures 13-17 inches long, including its tail. It can be differentiated from the introduced Norway rat by its larger eyes, blunt snout, and scaleless tail.

Habitat and Biology

In the United Sates, Eastern woodrats live in much of the southeastern states and the central Midwest. They prefer deciduous forests, lowland forests, swamps, and the occasional abandoned building. In South Carolina, they inhabit the Coastal Plain and mountainous regions.

The Eastern woodrat breeds year round on the South Carolina coast. Females mate with multiple males and produce two to three litters per year, with an average of two to three young per litter. Following a 33-35 day gestation period, the female gives birth to altricial (helpless, usually blind, and lacking hair) young. After 15-21 days, young woodrats are able to open their eyes. They are weaned at 4 weeks and begin breeding the following year. Woodrats consume a variety of food including nuts, seeds, twigs, and fruit. Like other rodents, they must constantly gnaw in order to wear down their continuously growing incisor teeth. These solitary rats construct large, elaborate nests from sticks, twigs, leaves, and any other material deemed appropriate. Commonly referred to a "pack rats," they are well known for their habit of collecting shiny objects, such as coins, bottle caps, and pins.

Species Significance

Woodrats play an important role as prey in the ecological community. Many carnivores such as raptors, snakes, foxes, wolves, and bobcats utilize the woodrat as a food source, making it an integral part of the food web.The Eastern woodrat is not currently an endangered species.

References

Golley, F.B. 1966. South Carolina mammals. Charleston Museum, Charleston, SC.

Webster, W.D., J.F. Parnell, and W.C. Biggs. 1985. Mammals of the Carolinas, Virginia, and

Maryland. University of North Carolina Press, Chapel Hill, NC.

Whitaker, J.O. 1980. The Audubon Society field guide to North American mammals. Alfred A. Knopf, New York, NY.

Gray Fox *Urocyon cinereoargenteus*

Gray fox ***(Urocyon cinereoargenteus)***

Description

The gray fox is smaller than the red fox, standing about 38 cm (15 inches) at the shoulder and weighing 3.2-4.5 kg (7-10 lbs.). Fur color is gray with rust-colored areas under the throat, on the sides of the neck, and on the legs. A black-tipped tail distinguishes the gray fox from the red fox, whose tail has a white tip.

Habitat and Biology

The gray fox is common throughout much of the United States, with densities in South Carolina being among the highest. The gray fox outnumbers red fox more than three to one, with grays preferring wooded and mixed wooded/open areas. Gray foxes benefit from edge habitats where forest meets field or roadways intersect a forest and are active from dusk to dawn.

Dens may be built in hollow trees or logs, as well as under brush and wooden debris. Gray foxes are monogamous, with mating generally occurring from January to March. Young are born from March to May and the average litter size is 3-5 pups. Like other wild canids, gray fox are susceptible to periodic outbreaks of distemper and weakening by parasites. They can also contract rabies from dogs or other animals. The annual mortality rate is estimated at 52%.

Seldom seen except at night, the gray fox stays within its home range, where it concentrates its activities according to food sources in abundance. The gray fox is an opportunistic omnivore, consuming fruit and berries, corn, acorns, bird eggs, and insects, as well as field mice and rabbits.

The gray fox is capable of climbing and is reported to be the only member of the dog family that can climb. Its main predators are man, dog, bobcat, and great horned owls.

Species Significance

Prized for their fur, gray foxes are primarily taken by trappers. Once they were hunted by houndsmen, but such sport hunting is dwindling due to increased development, danger to hounds from car traffic, and diversion to other game such as deer. For additional information on the gray fox, review the Hunting section.

Harvesting actually helps to stabilize the fox population from a "boom and bust" cycle that occurs when numbers increase until starvation and disease depress population density. Current harvests of gray fox in Colleton County remain depressed compared to previous years. Demand for long-fur pelts may eventually increase pressure on this species.

References

Baker, O.E., III and D.B. Carmichael, Jr. 1991. South Carolina's furbearers. South Carolina Department of Natural Resources, Columbia, SC.

Simbeck, R. 1995. For wildlife watchers: Grey fox. South Carolina Wildlife 42(1):48-49.

Webster, W.D., J.F. Parnell, and W.C. Biggs. 1985. Mammals of the Carolinas, Virginia, and Maryland. University of North Carolina Press, Chapel Hill, NC.

Marsh Rabbit *Sylvilagus palustris*

Marsh rabbit
(Sylvilagus palustris)

Description

One of the coastal area's common residents, the marsh rabbit belongs to the family Leporidae. It is one of four species of rabbits in the genus *Sylvilagus* that are native to the Carolinas, Virginia, and Maryland. The marsh rabbit has dark chestnut-colored fur, a bluish-gray tail, and conspicuous claws on its hind feet. It differs in appearance from the cottontail rabbit in that it does not have a white tail and its ears are shorter, measuring approximately 7.6 cm (3 in). Marsh rabbits are approximately 40 cm (16 in) long and weigh 1-2 kilograms

(2-5 lbs). Like other rabbits, the marsh rabbit has two pairs of upper incisor teeth. The first pair has a chiseled edge, and the second is peg-like and is located directly behind the first. The function of this second pair of teeth is not clear.

Habitat and Biology

Marsh rabbits range from the coastal plains of North Carolina south to Alabama. They are abundant in marsh and bottomlands, in both brackish tidal marshes and wooded flood plains common to the South Carolina Lowcountry.

Marsh rabbits are polygamous. They begin reproducing before one year of age and continue breeding year round. Females typically produce an average of four young per litter, after a gestation period of 30-37 days, and can have four to six litters per year. Marsh rabbits are nocturnal and feed on a variety of plants including catbrier, centella, marsh pennywort, rushes, cane, and woody stems. They are themselves food for many carnivores in the maritime ecosystem including raptors, alligators, snakes, bobcats, wolves, and foxes. As a method of escape, marsh rabbits take to the water and are known to swim quite well.

Species Significance

Marsh rabbits are hunted for sport and food. In South Carolina, hunting season extends from November 27 to March 2, and there is a bag limit of five rabbits per day. Different counties and Wildlife Management Areas have different hunting times and regulations. Marsh rabbits are not threatened or endangered. Even though they are taken in such large numbers by top level carnivores, their high fecundity allows them to maintain stable populations.

References

Golley, F.B. 1966. South Carolina mammals. Charleston Museum, Charleston, SC.

Webster, W.D., J.F. Parnell, and W.C. Biggs. 1985. Mammals of the Carolinas, Virginia, and Maryland. University of North Carolina Press, Chapel Hill, NC.

Whitaker, J.O. 1980. The Audubon Society field guide to North American mammals. Alfred A. Knopf, New York, NY.

Norway Rat *Rattus norvegicus*

Norway rat *Rattus norvegicus*

Description

The Norway rat is a large rodent with short, coarse fur that is grayish-brown above and pale below. It weighs 280-540 grams (10-19 oz) and measures 30-50 cm (12-19 in) long including a 15-23 cm (6 -9 in) tail that is covered with scaly rings. This species is differentiated from the Eastern woodrat by its scaly tail and smaller eyes.

Habitat and Biology

The Norway rat is widespread throughout all of North America. It frequents diverse habitats such as salt marshes, wharves, garbage dumps, and sewers. However, this rat can be found anywhere it finds shelter and a food source. Since its introduction in the eighteenth century, it has spread prolifically throughout the United States.

The Norway rat is polygamous, breeds year round, and lives up to 3 years in the wild. It produces an average of seven litters per year with 7 to 11 young per litter. Gestation in this species lasts 21-23 days, after which the female gives birth to altricial young (naked and blind) who open their eyes after approximately 2 weeks. Young are weaned at 3 weeks and are ready to reproduce after approximately 4 months. Norway rats construct their nests out of rags, paper, or other suitable material. Colonies typically consist of 10 to 12 individuals with one dominant, older, larger male.

Norway rats consume almost anything organic they can find and have been known to kill poultry, birds, and rabbits. They are themselves important food for raptors, snakes, and predatory mammals.

In the late eighteenth century, Hessian troops hired to fight against the colonists in the American Revolution introduced this species to the east coast of the United States in boxes of grain brought aboard ships from Europe. The Norway rat arrived in Europe from central Asia in the sixteenth century and subsequently spread throughout the continent. This rodent derives its common name not because overly large populations of this species occur in Norway, but because Norway was where early scientific descriptions of the species originated. When local populations of the Norway rat become overcrowded, mass migrations tend to occur. This fact most likely led to the legend of the Pied Piper of Hamelin, who rid the town of rats by leading them into the Weser river to drown.

Species Significance

The Norway rat is abundant in the area. Like other rodents, Norway rats can carry diseases harmful, and even fatal, to humans such as typhoid, bubonic plague, and spotted fever. They can also be destructive to agricultural crops and property. White laboratory rats are a specially bred albino strain of the Norway rat used for scientific purposes.

References

Golley, F.B. 1966. South Carolina mammals. Charleston Museum, Charleston, SC.

Webster, W.D., J.F. Parnell, and W.C. Biggs. 1985. Mammals of the Carolinas, Virginia, and Maryland. University of North Carolina Press, Chapel Hill, NC.

Whitaker, J.O. 1980. The Audubon Society field guide to North American mammals. Alfred A. Knopf, New York, NY.

Raccoon *Procyon lotor*

Raccoon ***(Procyon lotor)***

Sound, SCDNR

Description

The raccoon is one of the most common and easily recognized mammals on the South Carolina coast. The two characteristic features of the raccoon are its brownish-black "face mask" and alternating black and white ringed tail. Raccoons have brownish to gray fur on the rest of the body. They measure 22-25 cm (9-10 in) tall at the shoulder, 70-100 cm (28-38 in) long, and weigh 3.6-21 kg (8 and 48 lbs), with males being substantially heavier than females.

Habitat and Biology

Raccoons inhabit most of the United States, including all of South Carolina, with population densities being higher along coastal areas than inland. In the ACE Basin, raccoons are found near wetlands, including tidal marshes, swamps, and bottomland hardwoods. They prefer mature woodlands and wetlands, which provide abundant food sources and shelter. Due to an omnivorous nature, raccoons have invaded most habitats including agricultural fields and urban areas, and are often considered to be pests. Field crops such as corn are a favored food, and turtle-nest depredation can be a severe problem on barrier islands.

Raccoons are monogamous and breed primarily in late winter (January and February) after their first or second year. Following a gestation period of approximately 2 months, females give birth in April or May to a litter of two to four pups in a hollow den tree. Female raccoons wean their young at 16 weeks and continue to care for them for approximately 9 months. By autumn, the family grouping of mother and cubs generally disperses. Females mature at 1 year and will leave to establish their own dens. Males, which mature after 2 years, may share a den with the mother until forced out in favor of a male suitor.

The average life expectancy of raccoons is about 3 years. In addition to disease, predation is an important population control. Predators such as bobcat and great horned owls take juvenile raccoons.

Raccoons are omnivorous and opportunistic feeders. Preferred foods include crayfish, crabs, shellfish, reptiles, eggs (both bird and reptilian), and vegetation such as fruits, nuts, and berries. The species name *lotor*, meaning "washer," comes from the raccoon's habit of "washing its food." In reality, the raccoon feels for inedible matter in its food, and wetting its paws enhances its sense of touch. The common name "raccoon" is derived from the

Algonquin Indian word "aroughcoune," meaning "he scratches with his hands." On South Carolina beaches, including those in the ACE Basin, raccoons prey on the eggs of threatened loggerhead sea turtles. Currently, wildlife managers live-trap raccoons and relocate them to help reduce loggerhead hatchling mortality due to predation.

Species Significance

Raccoon hunting and trapping are popular sports in South Carolina. The hunting season for this species extends from August 15 to May 14 with no limit on the take. Some sportsmen use dogs to hunt raccoons entirely for sport, while others harvest raccoons for their pelts. During the 1970s and 1980s, raccoons comprised 60% to 80% of the total commercial fur harvest in South Carolina. However, because of depressed fur values in the late 1980s, hunting pressure on raccoons declined and raccoon populations increased. Raccoon pelts from the Piedmont and upstate regions of South Carolina command a higher price than pelts from coastal raccoons because they are fuller and of a darker color. For additional information on raccoon harvest, review the Hunting section.

Raccoons are not an endangered species; in fact, they occur abundantly throughout South Carolina. Raccoons have adjusted to pressures that humans exert on their habitat and have assumed a scavenging existence in many urban and suburban areas. Recent raccoon population growth has increased the threat of rabies from wild animals throughout the country.

References

Golley, F.B. 1966. South Carolina mammals. Charleston Museum, Charleston, SC.

Webster, W.D., J.F. Parnell, and W.C. Biggs. 1985. Mammals of the Carolinas, Virginia, and Maryland. University of North Carolina Press, Chapel Hill, NC.

Whitaker, J.O. 1980. The Audubon Society field guide to North American mammals. Alfred A. Knopf, New York, NY.

Rafinesque's Big-eared Bat *Corynorhinus rafinesquii*

Rafinesque's big-eared bat
(Plecotus rafinesquii)

Description

Bats belong to a diverse group of mammals, second to rodents in numbers of species. Rafinesque's big-eared bat, however, is among the least known of all bats in the eastern United States. As its name implies, Rafinesque's big-eared bat is distinguishable from other bats in South Carolina by its large (3 cm or 1.25 inches) ears which, when laid back, are about half the length of the animal's body. The ears are thin, have fur only along the edges, and are joined at the base across the bat's forehead. Rafinesque's big-eared bat is gray/brown above and silvery below with thin and naked membranes on its wings and tail. This big-eared bat typically weighs 8-14 grams (less than 0.5 oz)and its wingspan ranges from 26 to 30 cm (10 to 11 in). This species can be differentiated from the federally endangered Townsend's big-eared bat primarily by its darker fur and hair that extends beyond the tips of the bat's toes.

Habitat and Biology

Rafinesque's big-eared bats inhabit the southeastern United States, west to Louisiana and north to Kentucky and North Carolina. In South Carolina they are permanent residents of the coastal plain and hibernate rather than move south during winter months. Big-eared bats characteristically roost in dilapidated buildings or tree cavities near water. In the ACE Basin, Rafinesque's big-eared bats are known to inhabit Donnelley Wildlife Management Area, where they roost in an old plantation house. One of the biggest colonies in the state resides in Hampton Plantation on the South Santee River. Although not documented in the South Carolina Department of Natural Resources Heritage Trust database, this species is suspected to be in the ACE Basin.

The breeding season in this species extends from late fall to early winter. During this time, both males and females occupy the same roost. For the remainder of the winter and on to early spring, the bats hibernate. In some portions of their range, hibernating bats are found in caves, wells, and similar habitats. Males are solitary or gather in small groups during summer months, whereas females congregate in maternity colonies of up to 100 individuals. In May-June females give birth to one hairless young, which can fly at 3 weeks of age and attains adult size by August or early September. Rafinesque's big-eared bats feed exclusively on moths but will eat other insects if moths are not available. They live at least 10 years in the wild.

Species Significance

Although this species has no direct commercial value, it is extremely beneficial, along with all other species of insectivorous bats. Bats are the most important predators of nocturnal insects, some of which are harmful to humans. Bats also provide recreational opportunities; an increasing number of bat enthusiasts watch for their emergence from colonies, and commercially available bat cry detectors are gaining popularity.

Rafinesque's big-eared bat is a rare species throughout its range and an endangered species in the state of South Carolina. Rafinesque's big-eared bat is very sensitive to human activities and will abandon a roost if disturbed. If awakened while hibernating, a bat will use up precious energy reserves meant to sustain it until insects are again available in the spring. Thus, starvation brought about by disturbance causes high mortality. Disturbance of maternity colonies is also a source of mortality since adults may abandon their young or drop them to the ground. Habitat loss and alteration have also contributed to the species' decline in the past decade. Large cavity trees used for roosting are increasingly scarce.

References

Best, T.L., J.S. Altenbach, M.J. Harvey, R.R. Currie, and K. Sutton. 1997. Bats of the eastern United States. Poster. Auburn University, Auburn, AL.

Bunch, M. 1998. Personal communication. South Carolina Department of Natural Resources, Clemson, SC.

Golley, F.B. 1966. South Carolina mammals. Charleston Museum, Charleston, SC.

Harvey, J.M. 1992. Bats of the eastern United States. Arkansas Game and Fish Commission, Little Rock, Arkansas.

Webster, W.D., J.F. Parnell, and W.C. Biggs. 1985. Mammals of the Carolinas, Virginia, and Maryland. University of North Carolina Press, Chapel Hill, NC.

Whitaker, J.O. 1980. The Audubon Society field guide to North American mammals. Alfred A. Knopf, New York, NY.

River Otter *Lutra canadensis*

River otter ***(Lutra canadensis)***

Description

River otters belong to the family Mustelidae, which includes weasels, minks, and skunks. They are semi-aquatic, large (90-120 cm or 35-50 in) mammals with a short, blunt snout and conspicuous whiskers used to locate food in turbid water. River otters have small eyes and ears, thick necks, legs that are short and stout, and webbed toes. The tail is long and thick and tapers at the tip, and the ears and nose are protected by flaps of tissue that close when the animal is under water. Many genera in the family Mustelidae are sought for the beauty of their fur. That of river otters is dark brown, oily and very dense, with the face and breast of the animal having a grayish sheen. Both sexes are similar in appearance, with males being larger than females.

Habitat and Biology

River otters are found in Canada, Alaska, the Pacific Northwest, the Great Lakes states and along the Atlantic coast and Gulf of Mexico. River otters are adaptable animals inhabiting a variety of aquatic habitats including ponds, rivers, and saltmarshes. In South Carolina, they are common along waterways of the coastal plain.

The reproductive biology of river otters, as in other Mustelids, is unusual in that they exhibit delayed implantation. The fertilized eggs float around in the uterus for about 9 months before implantation occurs, rather than implanting on the uterine wall shortly after fertilization. Gestation lasts about 60 days, and the young, called kits, are born almost 1 year after conception. The female otter usually gives birth to two to four kits in a den located in a hollow tree or some other type of shelter. Kits are helpless and blind at birth but are fully furred. Their eyes open after about 3 weeks, and they take to the water in about 8 weeks. Female otters teach their young swimming and foraging skills until they can look after themselves, usually by 6 months. However, kits usually stay with their mother until they are 1 year old. Adult male otters do not participate in caring for the young.

River otters establish home ranges that vary in size depending on the animal’s age and gender and on food availability. They are most active from dusk to dawn, but diurnal activity it is not uncommon. River otters are carnivores, feeding mainly on fish, especially slow-moving species. Crayfish, where available, are also important food items. Crabs, amphibians, and other aquatic organisms are also a part of the otter's diet. River otters are very curious and playful animals. They engage in more play behavior, either by themselves or with other otters, than do most other wild animals. River otters live about 15 years in the wild.

Species Significance

River otters were heavily harvested for their fur throughout much of their historic range. Currently, 27 states and 11 Canadian provinces have otter trapping seasons. However, otter harvest in North America is no longer considered to be a threat to the species. In South Carolina, the average number of otters harvested commercially over the past 20 years was 478.

Otter fur harvest, which peaked in the northern United States around 1800, was the main factor contributing to the decline of the species throughout North America. Currently populations of river otters are threatened by pollution (including pesticide poisoning), acid rain, habitat loss, and illegal hunting. The river otter is not an endangered species in South Carolina, but it is listed as such in other states where it occurs.

References

Foster-Turley, P., S.M. MacDonald, and C.F. Mason (eds.). 1990. Otters: An action plan for their conservation, International Union for Conservation of Nature and Natural Resources, Gland, Switzerland.

Golley, F.B. 1966. South Carolina mammals. Charleston Museum, Charleston, SC.

Webster, W.D., J.F. Parnell, and W.C. Biggs. 1985. Mammals of the Carolinas, Virginia, and Maryland. University of North Carolina Press, Chapel Hill, NC.

White-tailed Deer *Odocoileus virginianus*

White tailed deer
(Odocolleus virginianus)

Description

White-tailed deer are easily identified by the white underside of their tail, which is visible as the animal flees. They have a reddish-brown coat during most of the year, but their fur turns a grayish color during the winter. Adult white-tailed deer have a white belly and throat patch and a white band across the nose. Males grow their first set of antlers, which are shed on a yearly basis, during the summer of their first year. Antlers get progressively bigger as the deer matures; however, the size of a deer’s antlers is more related to the general health of the animal than to its age. White-tailed deer stand approximately 1 meter (3 ft) at the shoulder and are approximately 2 meters (6 ft) long. They range in weight from 20 to 160 kg (50 to 350 lbs), with an average of about 60 kg (125 lbs). Males generally are larger and heavier than females. Young, called fawns, exhibit white spots on their fur until after their first year.

Habitat and Biology

White-tailed deer range from southern Canada throughout all of the continental United States except for portions of the far West. They inhabit all of South Carolina, from coastal marshes to mountain forests, but have a preference for mixed young forests, old fields, and croplands.

The following discussion of whitetail natural history is summarized from Moore (1978). Male and female deer reach sexual maturity at 1.5 years of age or during their second fall. White-tails are polygamous breeders, with one male mating several females during the breeding season, which extends from late August through January. The gestation period ranges from 190 to 210 days. A doe giving birth for the first time generally bears a single fawn, with successive birthings often producing twins Sex ratio of new-borns is generally even with more males born in overpopulated herds and more females born in expanding herds (Verme 1985). Most deer herds in the ACE Basin are overpopulated and would produce slightly more male fawns than female. The mother nurses them for 8 months, after which time the young deer may remain with their mother for up to 1 year before setting out on their own. Many reproductive characteristics of the population, such as timing of breeding, fertility rates, conception rates, age at first breeding, and sex ratios, are dependent upon population density, habitat conditions, and genetics (Jacobson and Guynn 1995).

Male fawns exhibit rudimentary antler growth, resulting in small knobs known as "buttons."

Noticeable antler growth, usually two or more antler points, occurs on second year or yearling bucks. Antler development is largely dependent on adequate nutrition. Older deer generally have heavier, better-developed racks than younger animals if nutrition is comparable.

Bucks shed their antlers each year unless there is injury or physiological stress. Shedding typically begins in late December and peaks in mid-February, with few antlered deer seen by early March. Once shedding is complete, new growth immediately begins, with mature antlers present in 3-4 months. During summer, antlers are soft, engorged with blood, and covered with a hair-like membrane called "velvet." Antlers become solid and hard in late summer or early fall when annual growth is completed. The "velvet" is sloughed or rubbed off on shrubs and trees.

White-tailed deer are fairly social animals. As such, they employ two means of communicating with each other. The first method of communication involves the white patch under a deer's tail which is only visible as the animal flees. It is thought that this behavior maintains a social group's cohesiveness in a dangerous situation, such as when escaping from a predator. Each individual animal has a better chance of survival by staying in a group. Thus, the white patch serves as a "flag" for other deer to follow. Another important means of communication among deer is scent. Seven glandular areas on the body of a deer have been identified. Glands produce chemicals that are secreted at particular times for specific purposes. For instance, deer may get information on dominance status, reproductive state, sex, and condition from sniffing each other's tarsal gland, which is located on the inside of the hind legs.

Deer are diverse foragers, eating twigs, leaves, bark, and other herbaceous material such as grasses, weeds, and soft-stemmed plants. Deer also eats acorns, other nuts, fruit, mushrooms, algae, and mosses. Soil type, succulence, and seasonal occurrence of forage species affect utilization of food by deer. They forage primarily at dusk and dawn, but may also feed during the day.

Species Significance

White-tailed deer are eagerly sought-after by hunters throughout their range. In South Carolina, deer hunting season varies in the different Game Zones and Wildlife Management Areas. Generally, it extends from August 15 to January 1. For further information on the rules and regulations of hunting, review the South Carolina Department of Natural Resources Hunting Regulations EXIT

The white-tailed deer is not an endangered or threatened species. However, deer populations in some areas of the United States are not healthy. They have out-of-balance male to female ratios, which puts a social and reproductive stress on the population, and poor nutrition. Among the contributing factors are increasing numbers of deer with few natural predators, human encroachment into deer habitat, and poor deer management strategies. Their abundance in some parts of the country has even earned white-tailed deer "pest" status.

References

Golley, F.B. 1966. South Carolina mammals. Charleston Museum, Charleston, SC.

Jacobson, H.A. and D.C. Guynn, Jr. 1995. A primer. p. 81-102. *In*: K.V. Miller and R.L. Marchinton (eds.). Quality whitetails: The why and how of quality deer management. Stackpole Books, Mechanicsburg, PA.

Miller, K.V. 1994. Why the white tail? Quality Whitetails 1:30.

Miller, K.V. 1995. Deer scent communication: What do we really know? Quality Whitetails 2(2):16-17.

Moore, G. 1978. Natural history. p. 174-175. *In*: J. Culler (ed.). Carolina's hunting heritage. South Carolina Wildlife and Marine Resources Department, Columbia, SC.

Ozoga, J.J. 1995. Whitetail welfare. Quality Whitetails 2(1):19-21.

Verme, L.J. 1985. Progeny sex ratio relationships in deer: Theoretical vs. observed. Journal of Wildlife Management 49(1):134-136.

Webster, W.D., J.F. Parnell, and W.C. Biggs. 1985. Mammals of the Carolinas, Virginia, and Maryland. University of North Carolina Press, Chapel Hill, NC.

Whitaker, J.O. 1980. The Audubon Society field guide to North American mammals. Alfred A. Knopf, New York, NY.

NEXT SECTION: Species Gallery - Plants
RETURN TO: Species Gallery - Intro

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

MENU

Bald Cypress *Taxodium distichum*

Bracken Fern *Pteridium aquilinum*

Cabbage Palmetto *Sabal palmetto*

Canby's Dropwort *Oxypolis canbyi*

Live Oak *Quercus virginiana*

Loblolly Pine *Pinus taeda*

Longleaf Pine *Pinus palustris*

Poison Ivy *Toxicodendrum radicans (Rhus radicans)*

Pondberry *Lindera melissifolia*

Sea Oats *Uniola paniculata*

Smooth Cordgrass *Spartina alterniflora*

Wax Myrtle *Myrica cerifera*

Widgeon Grass *Ruppia maritima*

Wild Rice *Zizania aquatica*

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Plants

Bald Cypress *Taxodium distichum*

Bald cypress
(Taxodium distichum)

Description

Bald cypress belongs to the cypress family (Taxodiaceae). It is a large deciduous tree that can reach heights over 40 m (130 ft) tall with a diameter of 4 m (13 ft). The bark is thin (about 1 cm or 0.5 in thick), gray-brown, and rough in texture. The light green leaves are 1-1.5 cm (0.5-0.75 in) long and needle-like or flat linear in shape. The flowers are monoecious (individual flowers have either male or female flower parts). Male flowers (contain stigma, the pollen- producers) are minute, purple in color, and grow in drooping panicles that originate at the end of the previous year's twigs. The female flowers are inconspicuous and composed of several spirally arranged, overlapping scales that bear two ovules (seed producers). The cones are made of a few four-sided scales, and each scale bears two triangular seeds. Each cone contains 18 to 30 seeds that have a thick horny coat and irregular projecting flanges or wings along the sides. The most distinctive features of the trees are the swollen, fluted trunks at the base of the tree and the above-ground root structures, commonly known as "knees."

Habitat and Biology

The natural range of bald cypress extends from Delaware to Florida and west through Texas, almost to the Mexican border. It is also found in Missouri, Illinois, Indiana and Oklahoma, but a few trees have been planted as far north as Massachusetts and Michigan. In the ACE

Basin, the largest stands of bald cypress are found along the South Edisto and Combahee Rivers, above the intersection of U.S. Highway 17. Although bald cypress trees will grow under a considerable range of climatic conditions, they reach maximum heights in warmer climates. The trees typically inhabit the organic and clay soils in the deepest areas of swamps along water bodies and in flood plain forests. However, bald cypress trees planted in moderately well-drained fine sandy loams grow well.

Contrary to the popular belief that bald cypress are slow-growing trees, the growth rate of trees less than 100 years old is comparable to that of other trees growing in the swamp. Populations of bald cypress are maintained by sexual reproduction. Seeds are produced each year, and a good seed production occurs at intervals of about every 3 years. Seeds mature by fall, and they fall to the ground from late October to November. Although bald cypress trees grow well on moderately well-drained fine sandy loams, the trees are restricted to wetlands because of the water requirement for seed dispersal, germination and seedling growth. Water is necessary for seed dispersal because only a few seeds are disseminated by animals, and the wind cannot lift the large, small-winged seeds. The majority of the seeds will only germinate after 1-3 months of submergence after water has caused the hard seed coats to swell and soften. The best seed germination also occurs on wet, organic, or peaty soils. Seedlings sprout when the water recedes, and the ground remains saturated during the growing season. However, the water must remain below the leaves of the growing seedling except for short periods (5 weeks or less). Seedlings usually grow 40 to 51 cm (16 to 20 in) during the first two years. The species flowers during the winter, and pollination occurs before the leaves emerge in spring. The cones mature by late October and November, becoming brown and woody. The seeds then break away from the scales and fall to the ground. Occasionally the entire cone falls to the ground before the seeds are released.

Species Significance

Bald cypress wood is highly valued for its resistance to decay. The sticky, red resin on the seeds appears to repel many animals, and rarely are the seeds eaten by birds and mammals. The Florida crane, gadwall and mallards are a few of the animals that eat the seeds of bald cypress.

References

Langdon, O.G. 1958. Silvical characteristics of bald cypress. Southeastern Forest Experiment Station. Asheville, NC. U.S. Department of Agriculture, Forest Service.

Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. American wildlife and plants: A guide to wildlife food habits. Dover Publications Inc., New York, NY.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill, NC.

Bracken Fern *Pteridium aquilinum*

Bracken fern
(Pteridium aquilinum)

Description

The bracken fern belongs to the bracken fern family (Pteridaceae). It has a creeping subterranean rhizome that grows up to 3.5 m (11.5 ft) deep, is about 5 mm (2 in) in diameter, and can reach a length of 15 m (49 ft). The fronds are triangular in shape and up to 3 m (10 ft) tall, with lower pinnae (leaflets) nearly opposite on the rachis (stem) and almost dissected. The upper leaflets are alternate on the stem, less dissected and almost entirely near the apex of the fronds. Sori (reproductive organs) are located along the margins of the leaflets. The fiddleheads (developing fronds) are covered with silver-gray hairs and are coiled, unfurling as they grow.

Habitat and Biology

Bracken fern are found from Virginia to Alabama and West Virginia to Kentucky, primarily on acidic, nutrient-deficient soils. The species inhabits a wide variety of plant communities, including old fields and open areas in forests. Bracken fern is common in pine forests of the ACE Basin.

Growth of existing bracken fern colonies is through asexual reproduction (vegetative growth). During the growing season (July-September), new fronds sprout from the rhizomes, which spread an average of 1 meter, sometimes as much as 2 m (6.5 ft), into the surrounding area. New colonies are started by sexual reproduction. Each year, the ferns produce a crop of spores (seeds) that are dispersed by the wind to other areas. Initially, the developing fiddlehead (new frond) depends entirely on the rhizome's food reserves. As the pinnae (leaflets) develops and unfolds, the frond begin to photosynthesize and eventually no longer needs the rhizome's reserve.

Species Significance

Over the centuries, bracken fern has been used as vermifuge, diuretic, astringent and purgative. The Cherokee Indians used the plant as a tonic, antiseptic and antiemetic, and the

Europeans used it to reduce swelling and hardness of the spleen, as well as an ointment for flesh wounds. Today, the astringent chemicals found in the rhizome are used for tanning animal skins. Although many cultures used this species as food, including modern-day wild food enthusiasts, recent studies have shown it to be carcinogenic. Also, this species is not recommended as a food source for cattle and horses since it can cause severe poisoning. The bracken fern is one of the most common fern species throughout the world.

References

Dunbar, L. 1989. Ferns of the coastal plain: Their lore, legends, and uses. University of South Carolina Press, Columbia, SC.

Fletcher, W.W. and R.C. Kirkwood. 1979. The bracken fern (*Pteridium aquilinum* L. (Kuhn)); its biology and control. p. 591-637. *In*: A.F. Dyer (ed.). The experimental biology of ferns. Academic Press, London, U.K

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill, NC.

Watt, A.S. 1976. The ecological status of bracken. Botanical Journal of the Linnean Society 73:217-239.

Cabbage Palmetto *Sabal palmetto*

Cabbage palmetto
(Sabal palmetto)

Description

The cabbage palmetto belongs to the palm family (Arecaceace). This branchless evergreen tree grows to a height of 10 m (33 ft) tall. The leaves are up to 1 m (3 ft) across and are divided into filamentous segments with a midrib that is 5-20 cm (2 to 8 in) long. The palm produces several flowering stems (panicles) that bear numerous flowers during the flowering season. Flowers are 4-5 mm long, sessile and perfect (flowers contains male and female reproductive parts). The fruit is fleshy, 8-12 mm in diameter, and purplish at maturity.

Habitat and Biology

The cabbage palmetto is found in the coastal plain region from North Carolina to Florida. The palm inhabits maritime forests, "islands" within salt and brackish marshes, and the edges of ponds. It is also a commonly planted tree in urban areas throughout South Carolina.

The cabbage palmetto produces flowers during July. The fragrant flowers attract a wide variety of insects, bees, wasps, and ants that carry the pollen from flower to flower. Once pollinated, the flowers begin to develop a one-seed fruit that matures during October and November. Many of the mature fruit are dispersed by birds and mammals that disseminate the seeds throughout their local habitats. Some of the fruit are swept away by sea currents and are transported as far away as the North Carolina shores. Seeds are deposited on beaches, maritime communities and "islands" within coastal marshes. The timing of germination and the percentage of seeds that germinate are influenced by soil temperature, illumination, and salinity. Seed germination begins when the soil temperature exceeds 20°C and continues until the soil temperature exceeds 40°C, reaching a peak within the 27.5°C and 30°C soil temperature range. Only seeds deposited in the shady areas or buried under sand or organic debris will germinate. Over 90% of the seeds deposited on soils with a salinity less than 10 ppt germinate, and the percentage of seeds that germinate drops from 90% to 41% as the soil salinity increases to 15 ppt. The cotyledonary stalk (seedling root) first emerges from the germinated seed, and at 4 cm (1.5 in) long, the stalk becomes the primary root. Next, the leaf emerges and grows toward the soil surface, and once it breaks through the surface, the leaf begins to unfold, growing to a length of about 15 cm (6 in) and width of 1.5 cm (0.6 in) before the first frost. Only one seedling leaf is produced during the first growing season, and the rate of leaf production during subsequent years is not known. Soil salinity level above 15 ppt will cause abnormal root growth (stubby, non-branching primary roots) of seedlings.

Species Significance

The fruit of the palmetto is a favorite food of robins, raccoons, and fish crows. Mockingbirds, myrtle warbler, and pileated woodpecker also eat palmetto fruit. People like to eat the apical meristem (growing point at the tip of the main stem) of the tree because its taste is similar to artichoke and cabbage. During the Revolutionary War, coastal forts were made of palmetto logs. The soft stems would absorb the force of cannon balls and not shatter. Today, the trunks are used in the construction of wharves because the wood is resistant to sea-worm infestations. The cabbage palmetto is also prized as an ornamental tree. Cabbage palmetto is common throughout its range and is the state tree of South Carolina.

References

Brown, K.E. 1976. Ecological studies of the cabbage palm, *Sabal palmetto*. Principes 20:3-10.

Brown, K.E. 1976. Ecological studies of the cabbage palm, *Sabal palmetto*. II. Dispersal, predation, and escape of seeds. Principes 20:49-56.

Brown, K.E. 1976. Ecological studies of the cabbage palm, *Sabal palmetto*. III. Seed germination and seedling establishment. Principes 20:99-115.

Brown, K.E. 1976. Ecological studies of the cabbage palm, *Sabal palmetto*. IV. Ecology and geographical distribution. Principes 20:149-157.

Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. American wildlife and plants: A guide to wildlife food habits. Dover Publications Inc., New York, NY.

Porcher, R.D. 1995. Wildflowers of the Carolina Lowcountry and lower Pee Dee. University of South Carolina Press, Columbia, SC.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill, NC.

Canby's Dropwort *Oxypolis canbyi*

Canby's dropwort ***(Oxypolis canbyi)***

Description

Canby's dropwort belongs to the mint family (Apiaceae). It is a perennial herb which grows from 80 to 120 cm (30 to 50 in) tall. The "quill-like" hollow leaves and the thick, corky wings that extend out from the margins of the fruit are the most distinctive features of the plant. The stems are erect or ascending, round, and slender with arching/ascending or forking branches above the mid-stem. The flowers are monoecious or dioecious (flowers have either male or female parts or both) and small and white, sometimes tinged with red or pink. The flowers are borne on compound umbrella-like structures that extend from the base of the leaves, and the fruit is a schizocarp (fruit splits into one-seeded segments) about 4-6 mm long.

Habitat and Biology

Canby's dropwort is found in Delaware and Maryland and from North Carolina to Georgia. The plant inhabits a variety of coastal plain communities, including pond cypress savannahs, the shallows and edges of cypress/pond pine ponds, sloughs, and wet pine savannas. In the ACE Basin, the species grows in wetlands within the Colleton County Cowbane Preserve.

Canby's dropwort reproduces asexually by means of rhizomes, or lateral, underground rootstocks. Very little data are available on the life history and reproductive biology of the species. Boyer (pers. comm. 1988) with the North Carolina Plant Conservation Program conducted growth experiments and had some success with growing plants vegetatively but little success with germinating seeds. Her findings indicated that dropwort grows better on water- saturated soils than on intermittently dry soils. This may explain why the largest populations of dropwort occur in wetlands that are flooded most of the year.

Species Significance

Canby's dropwort was federally listed as endangered on February 25, 1986. Only 25 populations of the species are currently known to exist, one of which is found in the ACE Basin. The site of this population in the ACE is on state-owned land, so it is protected from habitat alterations. The most serious threat to the population is drought or too much rain. For example, two populations of Canby's dropwort in South Carolina were monitored during the severe drought of 1986. One population was located in Bamberg County, and the other was in Colleton County. During the drought, the water level at the Bamberg site dropped 33 cm (13 in) below the surface, while at the Colleton site the level dropped 177 cm (70 in) below the surface. At the Colleton County site, the population went from 500 plants in 1982 to fewer than five in 1986, presumably as a result of the drought, whereas the Bamberg site showed a slight decrease (Rayner 1988). No horticultural, medicinal, or other economic uses of the plant are known at this time.

References

Aulbach-Smith, C. 1985. Element stewardship abstract for *Oxypolis canbyi*. The Nature Conservancy, South Carolina Office, Columbia, SC.

Murdock, N. and D. Rayner. 1990. Recovery plan for Canby's dropwort (*Oxypolis canbyi* [Coulter and Rose] Fernald). U.S. Department of the Interior, Fish and Wildlife Service. Atlanta, GA.

Rayner, D.A. 1984. Inventory of botanical natural areas in Colleton County, South Carolina. SC Wildlife and Marine Resources Department, Division of Wildlife and Freshwater Fisheries, Columbia, SC.

Live Oak *Quercus virginiana*

Live Oak (Quercus virginiana)

Description

Live oak belongs to the beech family (Fagaceae). Live oaks are medium-sized evergreen trees with wide-spreading branches and dark, slightly ridged bark. The leaves are simple and thick with entire and curled margins. Live oaks are monoecious (flowers contain either male or female reproductive parts). The flowers grow in the axis of leaves: male flowers in clustered, drooping catkins, and female flowers on a short spike. Live oak leaves have a high content of fiber and are covered by dense hairs on the underside and cuticle (a waxy substance) on the upper side which protect the leaves from salt-laden breezes that would kill most other trees.

Habitat and Biology

Live oaks are found from Virginia to Florida and westward to Mississippi, where they grow in sandy soils on the coastal plain. In the ACE Basin, live oak is the dominant species in the maritime forests because of its tolerance to salt spray.

The growing season of live oak lasts about seven months, beginning in late February and continuing through late September. Radial growth begins before the leaves emerge, and in many cases, the rate of growth reaches its peak after the leaves are fully mature. The growth rate then levels off and continues at a fairly steady rate for the next 100 days or so. Over 50% of new radial growth occurs during this period of maximum growth.

Species Significance

Live oak acorns are eaten by many animals, especially during winter. They are consumed by upland game birds such as the bobwhite and wild turkey and are an important component of the diet of gray squirrels and grackles. Other animals known to eat live oak acorns include raccoons, gray foxes and rabbits. In the north, larger mammals, including the black bear, white-tailed deer and elk, are known to consume the fruits. During the colonial period, live oaks were important lumber trees. Shipbuilders would cut curved pieces from the junction of the limb and trunk and use the pieces for ribs in wooden ships. It has also been a favorite ornamental tree since the 1700s. Trees planted over 200 years ago are still in existence today. Live oaks are common throughout their range. During the antebellum period, plantation owners planted these trees on their property, especially along the main roads leading to their estates, and many of them are still alive today.

References

Eggler, W.A. 1955. Radial growth in nine species of trees in southern Louisiana. Ecology 36(1):130-136.

Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. American wildlife and plants: A guide to wildlife food habits. Dover Publications Inc., New York, NY.

Porcher, R.D. 1995. Wildflowers of the Carolina Lowcountry and lower Pee Dee. University of South Carolina Press, Columbia, SC.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill, NC.

Loblolly Pine *Pinus taeda*

Loblolly Pine *(Pinus Taeda)*

Description

Loblolly pine belongs to the pine family (Pinaceae). It is a large tree, reaching heights of 46 meters (150 ft). The leaves occur in bundles of three and are about 15 cm (6 in) long. The cones have stout prickles on them.

Habitat and Biology

Commercial stands of loblolly pine are found from Maine south to Florida and west to Texas, but the pine naturally occurs in Delaware, Maryland, throughout the southeast (North Carolina south to Florida and west to Mississippi River), Arkansas and Texas. The trees grow on a wide variety of soils, ranging from the poorly drained soils of the Coastal Plain to the better-drained soils of the Piedmont region. In the ACE Basin, both planted and natural stands of loblolly pine grow in moderately to poorly drained areas.

Loblolly pines grow best in soils with poor surface drainage, a deep surface layer, and a firm subsoil. The pine populations are maintained by sexual reproduction. The trees begin to produce seeds before the tenth growing season and continue for another 30 years or so. The development of a viable seed crop requires two growing seasons from the time of flower bud initiation. During the first year, flower buds grow during midsummer, reaching maturity during the winter. The following spring, the female flowers are fertilized by airborne pollen, and the seeds reach maturity in early October. The seeds are disseminated by the wind, and most of them are only carried 30 to 90 meters (100-300 ft) away from the parent tree. In most cases, less than 20% of the seeds reach the seedling stage. Many are eaten by birds and rodents before they germinate, and others die shortly after germination due to such factors as inadequate water supply or competition from faster-growing vegetation.

Species Significance

The seeds of pines constitute more than 50% of the diet of three birds: the red crossbill, Clarke nutcracker, and white-headed woodpecker. There are also quite a few species of other birds and mammals that feed on pine seeds. Pine needles are consumed by grouse and several browsers such as the white-tailed deer. Northern mammals, such as the porcupine, use the bark and wood as food. Pines are also a valuable cover for wildlife. They are a favorite roosting site for robins during migration and commonly provide nesting sites for bald eagles and other raptors. This species is very common throughout it range and is increasing due to plantings by landowners.

References

Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. American wildlife and plants: A guide to wildlife food habits. Dover Publications Inc., New York, NY.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill, NC.

Wenger, K.F. 1958. Silvical characteristics of loblolly pine. Station Paper No. 98. Southeastern Forest Experiment Station, Asheville, NC.

Longleaf Pine *Pinus palustris*

Longleaf pine
(Pinus palustris)

Description

Longleaf pine belongs to the pine family (Pinaceae). The leaves occur in bundles of five and are 25-40 cm (10 to 16 in) long. The young stems, before the leaves emerge, resemble large candles. For the first 5-7 years, the young plant looks like a tuft of coarse grass; however, when the stem does start elongating, growth is rapid, and the plant is very conspicuous, with a large clump of long leaves near the end of the stem.

Habitat and Biology

Longleaf pine occurs from Virginia south to Florida and west to Texas. Longleaf pine grows best in a humid, subtropical climate characterized by long, hot summers and mild winters. Longleaf pine grows on sandy soil with low organic content and poor to excessive drainage. In the ACE Basin, longleaf pine stands, both planted and natural, grow in moderately to poorly drained areas.

Longleaf pine populations are maintained by sexual reproduction. The trees normally do not bear seeds until they reach six inches in diameter. The development of a viable seed crop requires three growing seasons from the time of flower bud initiation. During the first year, flower buds grow during midsummer, reaching maturity during the winter. The following spring, the female flowers are fertilized by airborne pollen, and the seeds reach maturity in early October of the third growing season. The seeds are disseminated by the wind, and most of them are carried less than 120 feet away from the parent tree.

Seeds typically germinate within one week after seedfall. Germination rates of seeds are often above 90 percent, especially in recently burned areas. Fires reduce the grass cover, creating bare areas where seeds can germinate. Primary needles appear shortly after germination and secondary needles about two months later. Seedlings typically remain in a grass stage for three to seven years. During this period, diameter and height growth are slow; most plants only grow two inches tall and one inch in diameter. The next growth stage, the elongation period, is signified by rapid growth. Some seedlings are known to elongate 30 centimeters (12 inches) during the first growth spurt.

Species Significance

Many species of birds and mammals feed on seeds of the Longleaf Pine. Pine needles are also consumed by grouse and several browsers such as the white-tailed deer. Northern mammals, such as the porcupine, use the bark and wood as food. Pines are also a valuable cover for wildlife. They are favorite roosting sites for robins during migration and commonly provide nesting sites for bald eagles and other raptors.

The South Carolina Heritage Trust Program considers longleaf pine to be a species of concern. Approximately seven million acres (3%) of the estimated 97 million acres of the original longleaf pine habitat in the Southeast exists today. Efforts are underway throughout the Southeast to acquire and restore the best remaining examples of the habitat.

References

Fowells, H.A. (ed.). 1965. Silvics of forest trees of the United States. Agriculture Handbook No. 271. Division of Timber Management, Forest Service, United States Department of Agriculture, Washington, DC.

Frost, C.C. 1993. Four centuries of changing landscape patterns in the longleaf pine ecosystem. p. 17-43. *In*: S.M. Hermann (ed.). The Longleaf Pine ecosystem: Ecology, restoration and management. Proceedings of the Tall Timbers Fire Ecology Conference, No. 18. Tall Timbers Research Station, Tallahassee, FL.

Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. American wildlife and plants: A guide to wildlife food habits. Dover Publications Inc., New York, NY.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill, NC.

Poison Ivy *Toxicodendrum radicans (Rhus radicans)*

Poison ivy
(Toxicodendrum radicans)

Description

Poison ivy belongs to the cashew family (Anacardiaceae). The species is easily recognized by its leaf structure and adventitious roots. The leaves of the liana (woody vine) are deeply dissected into three thin leaflets that are hairy along the veins on the underside. The leaflet shape ranges from ovate to elliptic, with margins that are entire, shallowly lobed or serrated; usually all three margin types are found on one plant. Their tips are pointy, and the bases are rounded. Leaflet size is variable, ranging from 5-20 cm (2 to 8 in) long and 2-12 cm (1-5 in) wide. The flowers are monoecious (individual flowers have either male or female flower parts). Male flowers (contain stigma, the pollen-producers) and female flowers (contain pistils, seed producers) are greenish-white to cream and about 0.6 cm (0.25 in) across.

Habitat and Biology

Poison ivy is found throughout the southeastern United States (Virginia to Florida and west to the Mississippi River) where it grows in all types of communities, ranging from open areas to forests, as well as in disturbed sites such as ditches and roadsides. Poison ivy prefers shady, damp places such as mesic forests and swamps, but it is also a common species in maritime forests such as those in the ACE Basin.

The plants produce flowers in April and May, and various insects transport the pollen from the male flower to the female flower. The fruits mature in August and September, and the seeds germinate in the spring of the following year. Seedlings use adventitious roots to attach themselves to trees, rocks, and buildings. The plant also attaches to cypress “knees” (aboveground roots), and when it reaches the top of the knee, it branches out laterally, forming a dome-shaped growth over the cypress knee. When no host is available, poison ivy creeps along the ground.

Species Significance

It is estimated that 70% of the population in the United States is sensitive to the oil produced by the leaves and stems. The oil, urushiol, causes painful rashes and blistering of the skin.

However, its fruit is popular with wildlife. The fruit is consumed by many kinds of birds, particularly during the winter when other sources of food are scarce. In the Southeast, catbirds, Carolina chickadees, and wild turkeys are known to feed on it. The fruit is also consumed by several species of songbirds and a few mammals, who also eat the stems and leaves, including the black bear, wood rat, and mule deer.

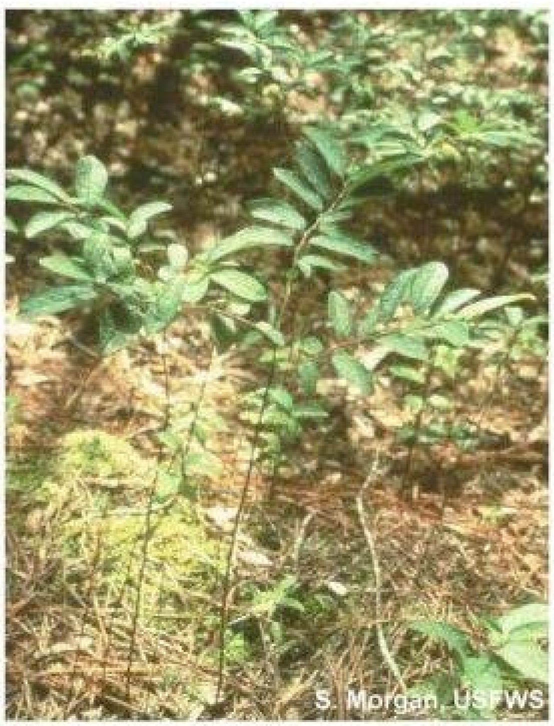
References

Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. American wildlife and plants: A guide to wildlife food habits. Dover Publications Inc., New York, NY.

Porcher, R.D. 1985. A field guide to the Bluff Plantation. Kathleen O'Brien Foundation, New Orleans, LA.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill, NC.

Pondberry *Lindera melissifolia*



Pondberry ***(Lindera melissifolia)***

Description

Pondberry belongs to the Laurel family (Lauraceae). It is a small, deciduous shrub (30-200 cm or 12-80 in tall) that is easily identified by the sassafras-like aroma of freshly crushed leaves. The leaves are thin and alternate, and their shape varies from oblong to oval, or a combination of the two. The tips of the leaves are somewhat pointed, and the bases are slightly tapered to rounded. The margins are entire, and the lower surface of the leaves is sparsely to densely covered with fine hairs. Flowers are dioecious (individual flowers have either male or female flower parts), small, and pale yellow. The fruits are nearly a half inch long and bright red at maturity.

Habitat and Biology

Pondberry is found in Arkansas, Missouri, and Mississippi and from North Carolina to Georgia. The species inhabits pond margins, swampy depressions, sandy sinks, and seasonally flooded wetlands. In South Carolina, pondberry grows along the margins of limestone sinks and shallow depressions. The plant also inhabits pinelands and recently burned open areas. Radford and others (1968) included Colleton County in the known distribution of pondberry, but Rayner (1984) did not find it during his survey.

The shrub generally grows in clones of numerous stems that are not highly branched. Clones expand vegetatively, eventually consisting of many well-rooted stems. The stems usually live about six or seven growing seasons, and new stems sprout from the base of dead stems; thus, a mature colony usually consists of numerous dead stems with younger leafy ones. Many populations consist predominately of male plants (only producing male flowers). Pondberry flowers bloom in the second to fourth years of growth. The clusters of yellow flowers bloom during February or March, before the leaves emerge. The fruits mature by late summer or fall, and each fruit produces one seed. However, very little data exist on the reproductive success of pondberry. A few studies indicate that insects, flies, wasps and small bees are the major pollinators, carrying pollen from the male flowers to the pistils of the females. The seeds are probably dispersed by mammals and birds and germinate during the next growing season.

Species Significance

Pondberry does not have any particular aesthetic value, nor are any horticultural, medicinal, or other economic uses known. Pondberry is a rare plant that was federally listed as endangered on July 31, 1986. Historically, the plant had a wider distribution, but only 37 populations of the species are currently found within its range. Fortunately, most of the plants are located on protected lands.

References

DeLay, L., R. O'Connor, J. Ryan, and R.R. Currie. 1993. Recovery plan for Pondberry (*Lindera melissifolia* [Walt.] Blume). U.S. Department of the Interior, Fish and Wildlife Service. Atlanta, GA.

Godfrey, R.K. and J.W. Wooten. 1981. Aquatic and wetland plants of southeastern United States: Dicotyledons. The University of Georgia Press, Athens, GA.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill, NC.

Rayner, D.A. 1984. Inventory of botanical natural areas in Colleton County, South Carolina. SC Wildlife and Marine Resources Department, Division of Wildlife and Freshwater Fisheries, Columbia, SC.

Steyermark, J.A. 1949. *Lindera melissifolia*. Rhodera 51(608):153-162.

Tucker, G.E. 1984. Status report on *Lindera melissifolia* (Walt.) blume. U.S. Fish and Wildlife Service, Southeast Region, Atlanta, GA.

Sea Oats *Uniola paniculata*

Sea oats ***(Uniola paniculata)***

Description

Sea oats, a salt-loving species, belongs to the grass family (Poaceae). The plant produces a well- developed rhizome (horizontal root) system, and 0.5-1.5 m (1.6-5 ft) tall culms (stems) sprout from the node along the rhizomes. The leaves are lance-shaped and are up to 20 cm (8 in) tall and 0.2-2.5 cm (less than 1 in) wide. Both surfaces of the leaves are free of hairs, with only a few at the leaf base, and the margins are scaberulous, long, and up to 2 cm (0.8 in) wide. The panicles (flowering stems) are 20-50 cm (8-20 in) long and 5-15 cm (2-6 in) wide, free of hair and ascending.

Habitat and Biology

Sea oats are found from Virginia to the Florida Panhandle and west to Mississippi. The plants inhabit sandy dunes on coastal islands and along the coastlines. In South Carolina, the plant grows on the dunes along the coastal mainland in Horry and Georgetown Counties, and the barrier islands that are found from Berkeley to Beaufort Counties, including Otter and Edisto Islands in the ACE Basin.

Sea oats thrive in the unstable, xeric environment of the dune community. When new sand is deposited, the plants extend their rhizomes (horizontal roots) over and through the new sands, which contain vital nutrients needed for plant growth. The newly established roots then produce shoots, and additional leaves sprout from the base of the new leaves, forming tussocks (clumps of leaves). Their extensive rhizome system helps to stabilizes the sand around the plants, and the tussock growth form acts as a wind break. The tussocks also enable the plants to trap sand near the base of the clumps. The species grows best under the low soil-moisture conditions in the dune community. In fact, frequent watering of the soil will retard plant growth and eventually kill the plants. New sea oat populations are established by sexual reproduction. Sea oats produce flowers in July, which are fertilized by wind-dispersed pollen, and by mid-August the fully developed, fertilized seeds are then dispersed by the wind to new dunes. The seeds remain dormant through the fall and winter and germinate during the spring. The percentage of seeds that sprout depends on how deep the seeds were buried under the sand. Studies have indicated that there is enough food reserve in the seed to support the first three to five inches of growth. The highest percentage of germination occurred in areas where the seeds were buried under two to four inches of sand. The root system of the seedlings develops rapidly during the first two months, and often the roots extend 10 times the height of the shoot. The extensive root system of the seedling functions like that of the adult plants: it enables the sea oats seedling to extend into and stabilize the shifting sands.

Species Significance

This species is among the most effective native sand-binding grasses. Therefore, this species is an important contributor to dune formation and stabilization. The South Carolina Department of Natural Resources, Heritage Trust Program, considers sea oats to be a species of concern. Current data indicate that their populations in the state may be declining due to habitat (i.e., wet or well- drained soils, loamy or sandy or mucky substrate) loss or alteration or pollution.

References

Oosting, H.J. and W.D. Billings. 1942. Factors effecting vegetational zonation on coastal dunes. Ecology 23(2):131-142.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill, NC.

Wagner, R.H. 1964. The ecology of *Uniola paniculata* L. in the dune-strand habitat of North Carolina. Ecological Monographs 34(1):79-96.

Smooth Cordgrass *Spartina alterniflora*

Smooth cordgrass
(Spartina alterniflora)

Description

Smooth cordgrass belongs to the grass family (Poaceae) and is a perennial wetland grass that dominates tidal salt marshes of the south. Each plant produces a tough rhizome (roots) system. The maximum height of the plants varies greatly, ranging from 20-150 cm (8-60 in) tall, and the stems are erect. Leaf blades are 4-15 mm wide, and the margins are smooth to somewhat scabrid.

Habitat and Biology

Smooth cordgrass is found from Newfoundland to Florida and west to Texas. The plant forms colonies in tidal salt marshes. In South Carolina, smooth cordgrass is found along all major estuarine waterways. The species dominates the regularly flooded marsh ("low marsh") and is a common species in the irregularly flooded marsh ("high marsh").

Existing populations of smooth cordgrass are maintained through asexual reproduction (reproducing vegetatively by means of rhizomes), and new sites are established by sexual reproduction. Smooth cordgrass produces flowers during the fall (October and November), and the seeds germinate during the following spring (March). The seeds are never dormant, but salt water will slow down the development. Smooth cordgrass seedlings grow about 20 cm (8 in), and produce flowers during their first growing season. In South Carolina, aerial growth of smooth cordgrass starts in March and ends in November, but the roots and rhizomes grow year- round. Maximum monthly growth rate occurs most commonly during July or August.

Soil salinity is a proximate determinant of inter-annual variation in primary production. Growth is negatively correlated with soil salinity-growth rate slows with increasing salinity. Highest growth rate occurs at salinities of 20 ppt or less, and the upper limit for salt tolerance is 60 ppt. Marshes with soil salinities above 75 ppt do not tend to have stands of smooth cordgrass. Height of smooth cordgrass is also inversely related to soil salinity levels. Along the creek and river banks where soil salinity level is lowest, smooth cordgrass reaches a maximum height of three meters. As the soil salinity increases with distance from the river bank, the average height of the species decreases from one meter on the levee to less than 20 inches tall at the upper reaches salt marsh where the soil salinity level is highest. Other factors that influence the growth of smooth cordgrass include soil aeration, nutrient availability, and hydroperiod.

Species Significance

Smooth cordgrass is an important food source for many endemic and migratory birds. The seeds are eaten by marshbirds, songbirds, sharp-tailed sparrows and several species of migratory waterfowl. Geese that winter along the coast are known to eat the rootstocks. Cordgrass also provides nursery and protective habitat for many aquatic species, especially juvenile crustaceans and fishes.

References

Godfrey, R.K. and J.W. Wooten. 1981. Aquatic and wetland plants of southeastern United States: Dicotyledons. The University of Georgia Press, Athens, GA.

Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. American wildlife and plants: A guide to wildlife food habits. Dover Publications Inc., New York, NY.

Morris, J.T. and B. Haskin. 1990. A 5-yr record of aerial primary production and stand characteristics of *Spartina alterniflora*. Ecology 71(6):2209-2217.

Waisel, Y. 1972. Biology of halophytes, In: T.T. Kozlowski (ed.). Physiological ecology, a series of monographs, texts, and treatises. Academic Press, New York, NY.

Woodhouse, W.W., Jr., E.D. Seneca, and S.W. Broome. 1974. Propagation of *Spartina alterniflora* for substrate stabilization and salt marsh development. Technical Memorandum No. 46. U.S. Army Corps of Engineers, Coastal Engineering Research Center. Fort Belvoir, VA.

Wax Myrtle *Myrica cerifera*

Wax myrtle *(Myrica cerifera)*

Description

The wax myrtle belongs to the wax myrtle family (Myricaceae), and is characterized by the aromatic glands found on the surfaces of its leaves. These glands release a sweet odor when crushed. The wax myrtle is an evergreen shrub or small tree (0.3-7 m tall), with nearly hairless twigs. Leaves are wedge-shaped, often leathery, and toothed, and they are up to 8 cm long and 2 cm wide. The plant is dioecious (flowers contain male and female reproductive parts), and its flowers lack petals and sepals and are arranged in a catkin (a cluster of flowers on a slender, often droopy, spike). The fruit is a nutlet that turns purple at maturity and is covered with a waxy substance.

Habitat and Biology

Wax myrtle is found from Virginia to Florida and in Alabama and Mississippi; however, a species of *Myrica* occurs in every coastal state of the United States. This species is mainly confined to the coastal areas, but locally it may extend a few miles inland. The shrub inhabits the moist, sandy soils of maritime and upland communities.

Existing populations of wax myrtle are maintained through asexual reproduction (reproducing vegetatively), and new sites are established by sexual reproduction. Flowers bloom during spring, typically first emerging in April. The fruits mature in the summer, releasing their seeds in early fall (October). Seeds germinate the following growing season, and the seedlings grow rapidly and form thickets through vegetative propagation.

High leaf photosynthetic rates, photosynthetic branches, an evergreen leaf habit, and the ability to reproduce vegetatively enable the shrub to rapidly expand in the sandy soils characteristic of coastal environments. The species also maintains a high level of productivity on nutrient poor soil by increasing nutrient availability in the rhizosphere. On soils low in nitrogen, the actinorhizal shrub forms a facultative symbiosis with *Frankia* (bacteria), fixing nitrogen needed for plant uptake. Wax myrtle develops cluster roots (aggregation of rootlets) when grown in low phosphorus soil. The cluster roots enhance the plant's ability to retain and absorb phosphorus in nutrient poor soil.

Species Significance

The wax-coated nutlets are eaten by many species of birds, including the insect-eating tree swallow. Since colonial times, wax myrtle foliage has been used ornamentally, and the waxy coating on the fruits has been used to make candles and scented soaps. Fresh and dried leaves are used as flavorings, and leaves are also grated or moistened seeds are used as condiments.

References

Louis, I., S. Racette, and J.G Torrey. 1990. Occurrence of cluster roots on *Myrica cerifera* L. (Myricaceae) in water culture in relation to phosphorus nutrition. New Phytologist 115:311-317.

Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. American wildlife and plants: A guide to wildlife food habits. Dover Publications Inc., New York, NY.

Peterson, L.A. 1977. A field guide to edible wild plants of eastern and central North America. Peterson Field Guide Series. Houghton Mifflin Company, New York, NY.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill, NC.

Young, D.R. 1992. Photosynthetic characteristics and potential moisture stress for the actinorhizal shrub, *Myrica cerifera* (Myricaceae), on a Virginia barrier island. American Journal of Botany 79(1):2-7.

Young, D.R., G. Shao, and J.H. Porter. 1995. Spatial and temporal growth dynamics of barrier island shrub thickets. American Journal of Botany 82(5):638-645.

Widgeon Grass *Ruppia maritima*

Widgeon grass ***(Ruppia maritima)***

Description

Widgeon grass belongs to the ditch-grass family (Ruppiaceae) and is a submersed aquatic grass. The stems are simple or branched, and the leaves are alternate and threadlike. The leaves reach a maximum length of 10 cm (4 in) and width of 0.6 mm. The flowers are small and white, and the fruits are roundish, dark and 2-3 mm long.

Habitat and Biology

Natural and cultivated populations of widgeon grass are found along the Atlantic and Pacific coasts and in wetlands throughout the Midwestern and Western states. They grow in alkaline, brackish or saline waters between 2 and 19 ppt. However, the plants have been observed growing in hypersaline waters (77 ppt) and in freshwater. Also, the species grows best in calm waters and permanently flooded wetlands.

Widgeon grass appears to have two growing seasons (spring and fall) that are controlled by water temperature ranging from 18.5°C to 30°C. When the temperature falls outside this range, vegetative growth ceases. Water depth and turbidity are the major factors influencing the vegetative growth of widgeon grass. The best vegetative growth of widgeon grass occurs when water depth is maintained between 40 and 61 cm (15-24 in) and the concentration of suspended material (a measure of turbidity) stays below 55 ppm. Turbidity was found to be most harmful to young plants before the stems reached the surface of the water. Reproductive activities are most affected by water temperature and soil salinity. Widgeon grass seeds do not germinate until the water temperature rises above 15°C, and the temperature must be above 20°C for seedling growth. Flowering and fruiting usually starts in May when the water temperature is above 29°C. Although widgeon grass is a halophyte (salt-tolerant plant) and adults can survive in soils with salinity as high as 3%, levels above 1.12% are extremely harmful to germination and in many cases will cause seed mortality.

Species Significance

Widgeon grass is one of the most valuable aquatic plants for migrating waterfowl. All parts of the plant are edible and are consumed by the ducks that frequent the impoundments of the

ACE Basin, including black ducks, mallards, and scaups. Widgeon grass is common throughout its range, and many landowners in the ACE Basin manage their impoundments for this species.

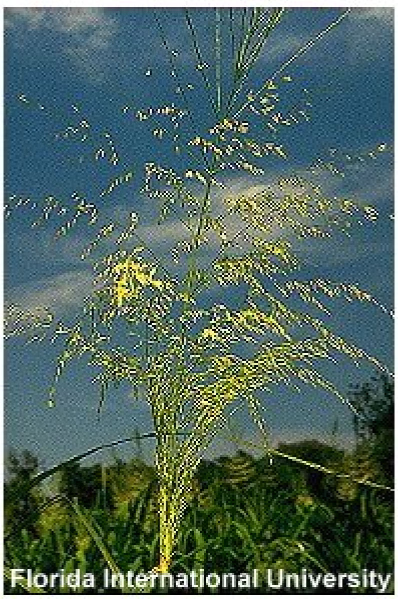
References

Godfrey, R.K. and J.W. Wooten. 1981. Aquatic and wetland plants of southeastern United States: Dicotyledons. The University of Georgia Press, Athens, GA.

Joanen, T. and L.L. Glasgow. 1965. Factors influencing the establishment of widgeongrass stands in Louisiana. Proceedings of the Nineteenth Annual Conference Southeastern Association of Game and Fish Commissioners. Published by the Southeastern Association of Game and Fish Commissioners. Columbia, SC.

Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. American wildlife and plants: A guide to wildlife food habits. Dover Publications Inc., New York, NY.

Wild Rice *Zizania aquatica*



Wild rice
(Zizania aquatica)

Description

Wild rice belongs to the grass family (Poaceae), and is an aquatic grass. The species is a perennial (lives for many years) grass in the South and an annual (plant dies each year) in the North and West. The plant is 1-4 m (3-12 ft) tall, and the stems are thick and spongy. The leaves are long, flat, and wide, and they have finely sharp-toothed margins. The species is monoecious, and male and female flowers appear on the same panicles (flowering stems). The panicles are large and terminal (at the apex of the plant). The lower branches of the panicles are pendulous, and the upper branches are stiffly ascending.

Habitat and Biology

Wild rice is found from Quebec, Canada, to Florida and west to Texas and North Dakota.

Populations of this grass are also found in Idaho and Arizona. Wild rice inhabits freshwater marshes and quiet waters of streams. In the ACE Basin, it grows in abandoned rice fields and tidal freshwater and brackish marshes. Wild rice thrives in shallow water, where the bottom is mucky or silty, and there is enough water circulation to provide sufficient oxygen for growth.

Wild rice grows vegetatively for a relatively long period (April-September). In July, flowers emerge and are pollinated. Seeds mature over the next two months. Wind disperses mature seeds throughout the marsh, where they remain dormant during the winter and germinate the following spring. By late August, vegetative growth and sexual reproduction cease.

Species Significance

In South Carolina, wild rice seeds are a favorite food of ducks, rails, blackbirds, and bobolinks. They are considered an excellent duck food. Wild rice is common throughout its range, and it has been planted with great success in many areas outside its native range.

References

Godfrey, R.K. and J.W. Wooten. 1981. Aquatic and wetland plants of southeastern United States: Dicotyledons. The University of Georgia Press, Athens, GA.

Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. American wildlife and plants: A guide to wildlife food habits. Dover Publications Inc., New York, NY.

Odum, W.E., T.J. Smith, III, J.K. Hoover, and C.C. McIvor. 1984. The ecology of tidal freshwater marshes of the United States east coast: A community profile. Report No. FWS/OBS-83/17. U.S. Department of the Interior, Fish and Wildlife Service. Washington, DC.

Porcher, R.D. 1995. Wildflowers of the Carolina Lowcountry and lower Pee Dee. University of South Carolina Press, Columbia, SC.

Whigham, D. and R. Simpson. 1977. Growth, mortality, and biomass partitioning in freshwater tidal wetland populations of wild rice (*Zizania aquatica* var. *aquatica*). Bulletin of the Torrey Botanical Club 104(4):347-351.

NEXT SECTION: Species Gallery - Reptiles
RETURN TO: Species Gallery - Intro

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Reptiles

American Alligator *Alligator mississippiensis*

American alligator
(Alligator mississippiensis)

Description

The name "alligator" comes from the Spanish "el lagarto," meaning lizard. English speakers, through mispronunciation, first converted the term to "aligarto" and later to "alligator." The American alligator is black in color with rows of rough scales, or scutes, along its back. The reptile's belly is creamy white, and its eyes are light brown. It can be differentiated from the American crocodile by its large, broad snout. Unlike adults, young alligators have several yellow and white bands along their bodies. Alligators that shared the earth with dinosaurs 180 million years ago looked almost the same and played similar ecological functions as their present-day relatives. The largest alligator on record measured 5.8 meters (19 feet 2 inches) and the heaviest, taken in recent times near Gainesville, Florida, weighed 473 kilograms (1,043 lbs). However, such large and heavy animals are quite uncommon.

Habitat and Biology

Along the Atlantic coast, American alligators are distributed from the Florida Everglades to North Carolina. They also inhabit wetland areas in Texas, Oklahoma, and Arkansas. In South Carolina, American alligators make extensive use of the state's coastal marshlands, with the ACE Basin being one of the most important nesting areas. High quality alligator habitat found on the coast was created as a result of wetland alteration during the rice-growing era. Rice was introduced to Charleston, South Carolina, around 1680, resulting in the clearing of forested, tidal swamps. (See related section: History.) Ditch and dike construction permanently altered natural drainage patterns and caused extensive change in wetland plant communities. After the rice industry's demise in the early 1900s, abandoned, diked fields began to deteriorate; however, some dikes and water-control structures were repaired and maintained by sportsmen as waterfowl hunting areas. Today, these impoundments support the highest alligator population and nest densities found in the ACE Basin and the state. Alligator populations gradually decline inland because habitats are seasonally flooded and prey density is reduced.

American alligators are cold-blooded animals, but generally are active year round in South Carolina. Breeding season for the American alligator varies throughout its range because the onset coincides with warmer weather. Nest site selection, construction, maintenance, and protection are important activities in the life of a female alligator. In South Carolina, the majority of nest construction and egg laying takes place during the month of June.

Nests are located on high ground, 1 to 5 meters (3 to18 ft) from the water's edge, and consist of a large mound of mud and crushed vegetation. In the ACE Basin, most alligator nests are found in managed impoundments and, to a lesser extent, in remnant impoundments and unaltered marshes. Most nests within impoundments are located on remnant dikes. Nest material is from surrounding vegetation, which is typically giant cordgrass (*Spartina cynosuroides*) and nests are about 1.5-1.8 m (5-6 feet) in diameter and average 0.5 m (20 in) in height.

Once the mound is complete, the female digs a conical chamber in the center of the mound and deposits 40-45 eggs into the chamber. Several layers of mud and vegetation are then added and compacted atop the egg chamber. Inside it, the eggs are kept at a constant temperature as a result of heat produced by decomposition of the nesting material. Sex of alligators is determined by nest temperatures during the middle third of embryo development. Females are produced at temperatures less than 31.5°C; mixed sex ratios occur at 32°C, and males only are produced when temperatures are between 32.5 and 33°C. Decreasing numbers of males are produced as temperatures approach 35°C, a temperature beyond which only females are produced. Incubation periods average between 63 and 65 days, but can be as long as 77 days. Hatching success averages approximately 70% in South Carolina. Hatchling alligators average about 24 cm (10 in) in total length and weigh 45-55 g (1.5-2.0 ounces). After hatching, juvenile alligators remain together in a group called a pod or creche, which may remain together for up to three years.

Both sexes grow to about 122 cm (4 ft) by age 5. After this age, female growth begins to slow, presumably channeling energy towards reproduction, while males continue to grow fairly rapidly. By age 25, males on average measure 316 cm (10 ft 4 in) and females average 253 cm (8 ft 3 in). Males can reach lengths greater than 394 cm (13 ft) while females rarely exceed 290 cm (9 ft 6 in). Males and females become sexually active when approximately 2.1-2.7 meters (7-9 ft) in length.

Alligator food habits vary by size class, with prey size increasing as alligators get larger. Hatchlings initially depend upon a yolk reserve but will begin feeding almost immediately on invertebrates such as insects, crustaceans, and snails and on small fish. As they grow, larger foods such as snakes, larger insects and frogs become common. Adults feed on aquatic organisms and animals that come to the water's edge to drink. In estuarine habits, the most common adult food item is blue crabs (*Callinectes sapidus*). Alligators are also known to feed on dead animals or carrion. Once alligators reach adulthood, they are top-level carnivores and have no natural predators. Raccoons (*Procyon lotor*), wading birds, and deer (*Odocoileus virginianus*) are prey items of the largest animals.

Species Significance

In South Carolina, the harvest of American alligators for both food and leather remained unregulated until the 1950s. In 1955, alligators benefited from a law, originally intended to protect deer, that banned night shooting. By the early 1960s, in an effort to reduce poaching, alligator trappers were required by law to possess a license and tags. However, numbers of American alligators in South Carolina continued to decline, resulting in the closure of the season in 1964. Poaching continued even after inclusion of the species in the Endangered Species Protection Act of 1966 and the Endangered Species Conservation Act of 1969. Finally, in 1970, American alligators were included under the Lacey Act of 1900, which prohibited the transport of illegally collected mammals and birds across state boundaries. Throughout the 1970s and 1980s, alligators continued to be protected under the Endangered Species Act of 1973 and were listed as endangered in coastal areas of South Carolina and threatened elsewhere in the state. In 1987, the U. S. Fish and Wildlife Service changed its status to one of "threatened upon similarity of appearance." This was necessary because, even though the species was no longer endangered at that time, such a status would indirectly provide protection to the American crocodile. In 1988, the S.C. Department of Natural Resources implemented a Nuisance Alligator Program. This program was established in an effort to alleviate increasing human-alligator encounters due to rapid urban development in coastal areas. After 31 years of closure, the alligator hunting season in South Carolina was re-opened in 1995. A permit, issued by the S. C. Department of Natural Resources and valid for one year, is required for the marketing and possession of any alligator product. (See related sections: Hunting and Endangered Species.)

References

Bara, M. O. 1976. American alligator investigations. Final Study Report. South Carolina Wildlife and Marine Resources Department, Columbia, S.C.

Conant, R. 1975. A field guide to reptiles and amphibians of eastern and central North America. Houghton Mifflin Company, Boston, MA.

Elsey, R. 1998. Personal communication. Louisiana Dept of Wildlife and Fisheries, Rockefeller Refuge, Grand Chenier, LA.

Ferguson, M.J.W. and T. Joanen. 1983. Temperature dependent sex determination in *Alligator mississippiensis*. Journal Zoological Society of London 200:143-177.

Ferguson, M.J.W and T. Joanen. 1982. Temperature of egg incubation determines sex in (*Alligator mississippiensis*). Nature 296:850-853.

Grenard, S. 1991. Handbook of Alligators and Crocodiles. Krieger Publishing Co., Malabar, Florida.

Lang, J. W. and H. V. Andrews. 1994 Temperature-dependent sex determination in crocodilians. Journal of Experimental Zoology 270:28-44.

Murphy, T. M. and J. W. Coker. 1984. American alligator population studies in South Carolina. Study Completion Report. South Carolina Wildlife and Marine Resources Department, Columbia, S.C.

Murphy, S. H. and G. Barnette (eds). not dated. South Carolina's endangered species portfolio - American Alligator. South Carolina Department of Natural Resources, Wildlife Diversity Section, Columbia, SC.

Rhodes, W. E. and J. W. Lang. 1995. Sex ratios of naturally-incubated alligator hatchlings: field techniques and initial results. Proceeding of the Annual Conference of the Southeastern

Association of Fish and Wildlife Agencies 49:640-646.

Rhodes, W. 1996. South Carolina Alligator Program 1996 Annual Report. South Carolina Department of Natural Resources, Division of Wildlife and Freshwater Fisheries, Wildlife Management Section.

Strange, T.H. 1987. Goals and objectives of water level manipulations in impounded wetlands in South Carolina. pgs 130-137. *In*: W.R. Whitman and W.H. Meridith, eds. Waterfowl and wetlands symposium: proceedings of a symposium on waterfowl and wetlands management in the coastal zone of the Atlantic Flyway. Delaware Department of Natural Resources and Environmental Control, Dover, DE.

Wilkinson, P. M. 1983. Nesting ecology of the American alligator in coastal South Carolina. Study Completion Report. South Carolina Wildlife and Marine Resources Department, Columbia, S.C.

Wilkinson, P. M. and W. E. Rhodes. 1992. Nesting habitat of American alligators in coastal South Carolina. Proceeding of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 46:260-265.

Wilkinson, P. M. and W. E. Rhodes. 1997. Growth rates of American alligators in coastal South Carolina. Journal of Wildlife Management 61:397-402.

Diamondback Terrapin *Malaclemys terrapin*

Diamondback terrapin ***(Malaclemys terrapin)***

Description

Diamondback terrapins belong to a family containing more genera and species than any other family of living turtles, the Emydidae. The diamondback terrapin is the only species included in the genus *Malaclemys*, but several subspecies are recognized even though experts have not come to an agreement on the exact number. The terrapins' shell, or carapace, ranges in color from light brown to gray to black with a honey-yellow or greenish underside. The sections of the carapace, called scutes, are large and have concentric growth rings. In addition, there is often a keel that runs the length of the carapace and varies in height. The turtle's skin is spotted, and its feet are distinctly webbed. This species shows marked sexual dimorphism; that is, males and females differ in appearance. In the case of terrapins, it is mainly a size difference, with females being considerably larger than males. Also, male terrapins have narrower heads and thicker, longer tails.

Habitat and Biology

Turtles found in South Carolina belong to the subspecies *Malaclemys terrapin centrata,* the Carolina diamondback. This subspecies ranges from Cape Hatteras to northeastern Florida, whereas the distribution of the species is from Cape Cod, Massachusetts, to Corpus Christi Bay, Texas. Diamondback terrapins inhabit brackish waters almost exclusively; they are the only turtle in North America known to do so. Along the Atlantic coast, they are commonly found in salt marshes, tidal flats, impoundments, and sounds behind barrier islands. In winter months, diamondback terrapins hibernate in muddy burrows along tidal creeks and ponds. Subtidal mud flats and shallow tidal creeks have been recognized as primary feeding grounds for this species. Favorite food items include a variety of crustaceans, mollusks, and other invertebrate fauna of coastal habitats. Courtship and mating take place in the water during early daylight hours in April and May. Females leave the water only during the nesting season, which varies latitudinally. Clutch size varies from 4 to 18 pinkish-white eggs and also changes with latitude. Females in southern regions tend to produce larger and fewer eggs than females in the North. Egg production does not peak until a female is 25 years of age. Eggs incubate in the nest, which is built in sandy substrates above the high tide mark, for 60-120 days depending on temperature. One of the major sources of mortality for this species is predation of eggs and hatchlings. Predators include raccoons, foxes, crows, and sea gulls. In addition, rootlets of the grass *Ammophila brevilingulata* invade nests and may cause egg mortality in some areas.

Species Significance

In the past, diamondback terrapins were popular food for humans, and turtle populations suffered large losses from the turn of the century until the mid to late 1920s. Terrapins are no longer considered a delicacy. Although still a legally harvestable species, no commercial permits have been issued. The lack of a commercial harvest has allowed populations in most areas to recover fully . Current causes of adult mortality include entrapment, and subsequent drowning, in crab pots; and fatal encounters with motorized vehicles (cars, boats). Alteration of estuarine habitat poses the most severe threat to this species.

References

Carson, J. 1998. Personal communication. South Carolina Department of Natural Resources, Marine Resources Division, Charleston, SC.

Martof, B. S., Palmer, W. M., Bailey, J. R., Harrison III, J. R. 1980. Amphibians and reptiles of the Carolinas and Virginia. The University of North Carolina Press, Chapel Hill.

Palmer, W. M., Cordes, C. L. 1988. Habitat suitability index models: diamondback terrapin (nesting)--Atlantic coast. Biological Report 82(10.151). U.S. Department of Interior, Fish and Wildlife Service, Washington, DC.

Zimmerman, T. D. 1992. Latitudinal reproductive variation of the salt marsh turtle, the diamondback terrapin (*Malaclemys terrapin*). Unpublished Masters Thesis. University of Charleston, Charleston, SC.

Eastern Diamondback Rattlesnake *Crotalus adamanteus*

Eastern diamondback rattlesnake
(Crotalus adamanteus)

Sound,

Description

The eastern diamondback rattlesnake is the largest of its species in the world and the most venomous snake in North America. It has a distinct coloration pattern consisting of dark diamond-shaped dorsal blotches defined by a border of yellowish scales. A dark bar bordered by two yellowish white stripes on either side extends back at an angle from the snake's mouth to its eye. The characteristic "rattle" comes from a series of loosely attached segments at the end of the tail. The buzzing noise is created when the snake rapidly vibrates its tail

Habitat and Biology

The eastern diamondback rattlesnake inhabits coastal lowlands from southeast North Carolina to the Florida Keys. It is also found as far west as the eastern portion of Louisiana. Its preferred habitat is the longleaf pine ecosystem, which is currently endangered. Longleaf pine forests are rapidly being converted to loblolly pine plantations and urban areas, thus threatening the existence of the eastern diamondback rattlesnake. Removal of tree stumps is a particular threat to the snakes, which use the stumps as refugia.

This species of rattler is holothermal; that is, it is ready to capture prey during all times of day. It is most active during the day and at dusk, feeding primarily on rabbits and rats and occasionally on mice, squirrels, and birds. Its dietary preference makes this species important in controlling populations of rodents which, if too high, can harm other species such as ground nesting birds. The breeding season for this species extends from August to September. The eastern diamondback rattlesnake is a viviparous snake; that is, a female gives birth to live young. This occurs in the fall, every two to three years, with average brood size ranging from 6 to 21. After the breeding season is over, rattlers resume foraging for prey and return to over-wintering locations. The coldest months of the year are spent in underground shelters.

Species Significance

According to a recent proposal by the Convention on the International Trade in Endangered Species (CITES), the eastern diamondback rattlesnake has been ignored in conservation efforts until recently. This situation likely results from the to "the sociological problems inherent in any conservation effort directed at a venomous species that threatens human life." In South Carolina, the eastern diamondback rattlesnake is listed as a Species of Concern, and its ecology is being studied by the Wildlife Diversity Section of the South Carolina Department of Natural Resources. Collection, sale, and purchase of this species is allowed in South Carolina without restrictions, and its status as a Species of Concern does not provide any legal protection.

References

Behler, J. L., King, F. W. 1985. The Audubon Society Field Guide to North American Reptiles and Amphibians. Alfred A. Knopf, Inc. New York, New York.

Bennett, S. H. 1995. Ecology and status of the eastern diamondback rattlesnake (*Crotalus adamanteus*) in South Carolina. South Carolina Department of Natural Resources, Columbia, SC.

Martof, B. S., Palmer, W. M., Bailey, J. R., Harrison III, J. R. 1980. Amphibians and reptiles of the Carolinas and Virginia. The University of North Carolina Press, Chapel Hill.

Loggerhead Sea Turtle *Caretta caretta*

Loggerhead sea turtle ***(Caretta caretta)***

Description

Loggerheads are one of seven species of marine turtles. Adult loggerheads have a reddish-brown shell, or carapace, with medium-yellow underside (plastron). The arrangement and number of scutes (the large scales or plates on the turtle’s shell and head) are used to identify each species of turtle. This species is third in size among marine turtles, with the leatherback and green turtles being the largest and second largest, respectively. Adult loggerheads average 113 kg (250 lbs) in weight. Hatchlings average 45 mm (1.7 in) in shell length, weigh about 20 g (0.6 oz), and are dull brown in color.

Habitat and Biology

Loggerhead sea turtles are found throughout the world’s oceans. In the western Atlantic, they are distributed from Newfoundland to Argentina. Pelagic immature individuals (dinner-plate size) are found in the eastern Atlantic near the Azores and Madeira. During summer months, loggerheads concentrate in lower latitudes to lay eggs. In the western Atlantic, four subpopulations of loggerhead turtles have been established based on nesting areas: the Northern Nesting Subpopulation, from North Carolina to northeast Florida; the South Florida Nesting Subpopulation from 29°N on the east coast to Sarasota on the west coast; the Florida Panhandle Nesting Subpopulation found at Eglin Air Force Base and the beaches near Panama City; and the Yucatan Nesting Subpopulation on the eastern coast of Yucatan, Mexico. Primary nesting sites in South Carolina are beaches between North Inlet and Price Inlet, with moderate nesting activity also occurring on beaches between Kiawah Island and Hilton Head Island. In the ACE Basin, loggerhead nesting activity occurs on beaches bordering St. Helena Sound, including Edisto Beach, Otter Island and Hunting Island. Loggerheads mate in coastal waters during the spring. Females then come ashore at night from May to August, to the same stretch of coastline where they hatched, to lay their eggs on sandy dunes. Upon reaching a suitable nest site, the female digs a flask-shaped cavity with her hind flippers and deposits an average of 115 round, leathery eggs. She then fills the cavity with sand, crawls over it, and obscures any tracks by using her front flippers to throw sand on the spot. The eggs incubate for approximately 2 months, and hatchlings usually emerge at night between 10 pm and 2 am. Then, as a group, they begin their crawl towards the ocean, where they mature in approximately 20-25 years.

Species Significance

The loggerhead sea turtle has been on the United States and South Carolina List of Endangered and Threatened Species since July 28, 1978. It is listed as a threatened species throughout its range and is still under intense pressure from local exploitation in many parts of the world. According to the South Carolina Department of Natural Resources, the numbers of nesting females in South Carolina beaches has declined at an alarming rate since 1980. This decline is attributed primarily to incidental catch in shrimp trawl nets. Federal law now requires the use of Turtle Excluder Devices, or TEDs, in shrimp trawls. Before the implementation of these devices, it is estimated that between 5,000 and 50,000 turtles died annually as a result of drowning in shrimp trawl nets. Other threats to the species include beach armoring (construction of groins, jetties, and similar structures to protect beachfront property from erosion) and nourishment, bright beachfront lighting, recreational beach equipment, non-native beach vegetation, nest depredation by raccoons and other predators, poaching, dredging, pollution, and commercial fishing gear. In South Carolina, raccoons are kept at bay from certain areas through volunteer trapping programs. In the ACE Basin, nesting beaches on Edisto and Hunting Islands are accessible enough to allow for trapping of raccoons. However, loggerhead nesting beaches on Otter Island are too remote to implement such programs. Of the four existing subpopulations in the western Atlantic, the South Florida Nesting Subpopulation is the largest one, averaging 64,000 nests per year in 1989-1995. It is the second largest loggerhead nesting assemblage in the world. Loggerheads that nest on beaches along the South Carolina coast belong to the Northern Nesting Subpopulation, which averaged 6,200 nests per year in 1989-1995.

References

Loggerhead/Green Turtle Recovery Team. 1991. Recovery Plan for U.S. Population of Loggerhead Turtle (*Caretta caretta*). National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Silver Spring, MD.

Murphy, S. H. and G. Barnette (eds). South Carolina’s Endangered Species Portfolio - Loggerhead Sea Turtle. South Carolina Department of Natural Resources, Wildlife Diversity Section, Columbia, SC.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1995. Status Reviews for Sea Turtles Listed Under the Endangered Species Act of 1973. National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Silver Spring, MD.

National Research Council. 1990. Decline of the sea turtle: Cause and prevention. National Academy Press. Washington, DC. 259 pp.

Turtle Expert Working Group. 1998. Assessment of the Kemp's Ridley (*Lepidochelys kempii*) and loggerhead sea turtle population (*Caretta caretta*) in the Western North Atlantic. NOAA Technical Memorandum NMFS-SEFC-409. National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Miami, FL.

Southeastern Five-lined Skink *Eumeces inexpectatus*

Southeastern five-lined skink
(Eumeces inexpectatus)

Description

Southeastern five-lined skinks belong to the family Scincidae, one of the two largest families of lizards. As their name suggests, southeastern five-lined skinks have five characteristic narrow stripes along their bodies that become lighter with age. The middle stripe tends to be narrower than the others, and the dark areas between stripes are black in young skinks but become brown with age. A similar species, the five-lined skink (*Eumeces fasciatus*), is smaller than the southeastern five-lined skink and has broader stripes. However, it is difficult to discriminate between these two species on the basis of physical appearance. Young southeastern five-lined skinks have a bright blue or purplish tail, especially towards the tip. Also, stripes become a bright reddish orange towards the head. Juvenile coloration may persist into adulthood, giving the head of the animal an altogether orange-brown appearance.

Habitat and Biology

Southeastern five-lined skinks are common inhabitants of wooded areas of the southeastern United States They are commonly found in small islands off the southeastern coast even in the absence of fresh water and vegetation.

Most species of skinks are small and are active during the day. Similar to other lizard species, skinks exhibit autotomy; that is, they purposely break their tails when confronted with danger. This break occurs at specialized vertebrae that are split by contractions of the surrounding muscles. Excessive bleeding is prevented by sphincter muscles in the tail stump that constrict the caudal artery. It is thought that the purpose of this behavior is to confuse predators. The wriggling tail draws the predator's attention away from the lizard, which makes a quick escape. The lost tail is then slowly regenerated. However, the new tail differs from the original in that it has a cartilaginous rod for support instead of vertebrae, its scales are of different size and shape, and its musculature and color are different. Southeastern five-lined skinks feed mainly on insects, preferring larger prey items such as grasshoppers. They are oviparous, and clutch size is 6 to 12 eggs, depending on the size of the female. There is indication of a latitudinal trend, with diminishing clutch sizes at higher latitudes. Female skinks brood their eggs and protect them from predators, including other skinks. Eggs are laid during the summer, and hatchlings emerge one month after being laid.

References

Conant, R. 1975. A field guide to reptiles and amphibians of eastern and central North America. Houghton Mifflin Company, Boston, MA.

Martof, B. S., Palmer, W. M., Bailey, J. R., Harrison III, J. R. 1980. Amphibians and reptiles of the Carolinas and Virginia. The University of North Carolina Press, Chapel Hill.

Smith, H. 1946. Handbook of Lizards. Cornell University Press, Ithaca, New York.

RETURN TO: Species Gallery - Intro

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

M E N U

Introduction

Study Area

Resident Characteristics

Local Economy

Regional Economy

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Socioeconomic Assessment

Introduction

To fully characterize the ecology of the ACE Basin, it is necessary to understand its human dimension. Ecologists are increasingly recognizing humans as an integral part of an ecosystem. Our interactions with the landscape – extraction of resources and alteration of the physical environment – have intentional, and often unintentional, results. For effective management, a synthesis of physical, biological, *and* human information is needed.

The aim of development is to provide economic benefits, but unchecked development can lead to problems, including conflict between uses and the degradation of natural resources and others. In the ACE Basin, high quality natural resources are seen as one of the area's greatest economic assets, and the formulation of strategies for conserving and capitalizing on those assets is the focus of several economic development studies (ACE Basin Economic Forum 1996, Beasley et al. 1996, Corporation for Enterprise Development (CFED) 1995, Lowcountry Council of Governments (LCOG) 1994, Perry et al. undated).

The interconnection between the natural environment and human economic development is receiving increased recognition, resulting in intensified efforts to use environmental concepts and methodologies in economics. In the area of environmental economics, environmental costs are integrated into economic strategies, and environmental concerns are a central part of development plans (Grigalunas and Congar 1995, Costanza et al. 1997). The ACE Basin Economic Forum conducted in 1995 and the ACE Basin Project were both guided by these concepts and motivated by the view that the ACE Basin's economic development and conservation agendas can be mutually beneficial.

The socio-economic information that follows is an attempt to synthesize demographic, social, and economic data relevant to the ACE Basin and frame them in this perspective.

In helping to characterize the basin's residents and businesses, these data help complete the framework of information necessary for effective management of conservation and development in the ACE Basin. And the socio-economic data provide important perspective, because, not only are the individuals and businesses that reside in the ACE Basin the primary stakeholders in the region's ecological health and economic development, ultimately, they are the determining factor for what strategies will or will not succeed in the area.

Back to Top

The Study Area

There is no economic unit that corresponds exactly with the ACE Basin study boundary, which is a hydro-geographic, rather than a political or economic, distinction. The study boundary comprises portions of five counties and divides county, subdivision, and block-group U.S. Census statistical groupings. Because no socio-economic data have been compiled specifically for the ACE Basin, discussion of the basin's socio-economics must be qualified by a definition of the spatial extent of the area for which data is presented. Although no one data set will capture the entire study area, by looking at a variety of data from various spatial subsets of the area, a general picture of the social and economic character of the ACE Basin can be cautiously inferred.

A map of population density within and adjacent to the ACE Basin shows that population within the basin boundary is sparse, with a few small clusters of higher density. Within the basin, population is centered near the three incorporated municipalities of Walterboro, Cottageville, and Edisto Beach in Colleton County. In the areas outside of, but within fifty miles of, the study boundary major population centers include Beaufort and Hilton Head in Beaufort County, Charleston in Charleston County, and Summerville in Dorchester County. All are significant tourism areas, and Charleston is also a major metropolitan area. (See related section: Urban Areas.)

The majority of the study area, 67%, is within Colleton County, so county-level economic data for Colleton will clearly help characterize the ACE Basin. A smaller percentage of the study area falls within Charleston and Beaufort Counties, 12% and 14%, respectively. However, economic data for these counties incorporate significant metropolitan and tourist areas adjacent to the basin. County-level data for Charleston and Beaufort are offered both to serve as point of comparison with Colleton County and to help capture the full diversity of socio-economic conditions from which economic development in the ACE Basin may proceed. Because just 5% of the ACE Basin study area lies within Hampton County and the area does not possess distinct socio-economic traits likely to skew the picture of the basin as a whole, data for Hampton County are not included here. Dorchester County data are also excluded, because only 1% of the study area falls within it.

U.S. Census county subdivision data (the primary subdivisions of counties, known as census county divisions, or CCDs) provide finer resolution economic, social, and demographic information at a sub-county level that can reasonably be used to characterize smaller communities within the basin. Data are presented from four Colleton County CCDs and one Charleston County CCD: Walterboro, Cottageville, Hendersonville, Green Pond, and Edisto Island (See map of economic units). Several of these subdivisions have distinguishing characteristics that should be borne in mind when considering the demographic and economic data for the area.

The Walterboro subdivision contains the Town of Walterboro, the largest town in Colleton County. Fifty-four percent of Colleton County residents reside here, as does the majority of the county's economic activity. Additionally, Walterboro is considered the only place in Colleton County with public water and sewer to support additional growth (Colleton County Land Use Planning Task Force 1997).

The Cottageville subdivision, which includes the Town of Cottageville appears to be serving a growing role as a bedroom community for Charleston and surrounding areas. The Cottageville subdivision has the highest commuting rates in Colleton County: 58% of its workers travel outside of the county to work (Colleton County Land Use Planning Task Force 1997).

The Green Pond subdivision contains the Town of Edisto Beach, a resort community economically atypical of the subdivision and county averages. Edisto Beach is characterized by a higher percentage of residents over age 65, a higher percentage of residents with bachelor’s degrees or higher, and significantly higher median household income than the rest of Colleton County. The Edisto Island subdivision of Charleston County is adjacent to the Town of Edisto Beach. Traditionally a rural population, the Edisto Island CCD has experienced some high-end residential development associated with Edisto Beach and with metropolitan Charleston.

Back to Top

Resident Characteristics

- Demographics
- Education
- Employment and Income
- Focus on Edisto Beach

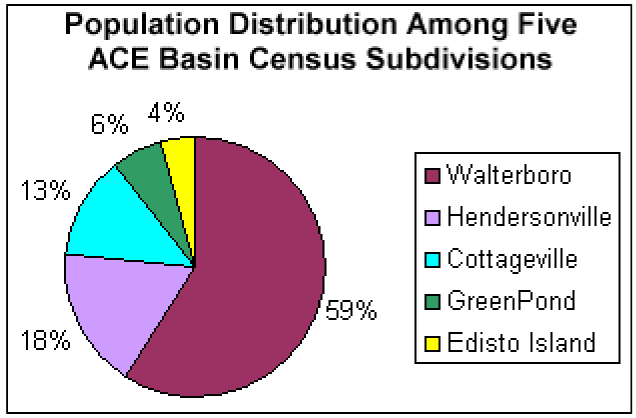
The ACE Basin’s early heritage is that of a community of plantations with large slave communities growing rice, indigo, and cotton for export. Walterboro’s historic position was as a resort community for farmers and plantation holders.

A typical plantation manor house in the ACE Basin

Today, the ACE Basin has characteristics typical of rural farming communities. According to 1990 census figures, less than 1% of residents in the five Census subdivisions highlighted above were not citizens of the United States. Nearly 87% of the residents of these communities had lived in the same house or elsewhere in the county for the last five years, and another 7.4% had moved from elsewhere within the state. During the ACE Basin Economic Forum in 1995, local residents reflected with pride on their community’s stability and traditions, an indication that community ties are very important to local residents.

Demographics

The population inside the basin is concentrated in a few pockets of development as seen in the population density map of the region. In 1990, 31,802 people were counted in the five census subdivisions of Walterboro, Hendersonville, Cottageville, Green Pond, and Edisto Island, with the majority residing in the Walterboro CCD.



Population distribution among the five ACE Basin Census subdivisions. (Source: United States Census 1990)

Of the residents of these five subdivisions, 55% described themselves in the 1990 census as Caucasian, and 44% described themselves as Black. This is in contrast to the state as a whole, which is approximately 69% Caucasian but in agreement with a recent report of the larger Edisto River Basin area (Roche 1993). Green Pond, Hendersonville, and Edisto Island report more African-American residents than Caucasian, while Cottageville and Walterboro report a majority of Caucasian residents.

Colleton County's population is expected to increase from 34,377 in 1990 to over 47,000 by the year 2010 (Colleton County Land Use Planning Task Force 1997). CFED (1995) suggested that this growth may be a "bedroom community" effect related to Charleston; this conclusion was based on the findings that of 15 similar rural counties in the United States Southeast, Colleton had the highest percentage of people commuting to work in another county. Perry et al. (undated) looked at Colleton County’s population growth for the period 1970-1990 and found that although the county’s growth was more rapid than that of the United States as a whole, it lagged behind the population growth rate for all of South Carolina over the same period.

Education

Educational attainment, as measured in the 1990 census, is low in the ACE Basin area. This represents a potentially significant economic barrier for the region. In Colleton County, 38% of residents 25 or older had no high school diploma, compared to 32% for South Carolina as a whole. The largest concentration of low educational attainment in the five ACE Basin subdivisions was in Edisto Island, where 22% of residents had not moved beyond the ninth grade. There are notable disparities in educational attainment by race, as measured in the 1990 census figures for the five subdivisions (Education).

School attendance recorded in the 1990 census shows that nearly 93% of primary school students attended public schools. This may reflect limited incomes and opportunities in the area, as well as community preferences. However, this educational reality may enhance the strong local sense of community.

Employment and Income

- Employment Status
- Earnings and Income
- Self Employment and Income

- Poverty

Employment Status
The United States has experienced record low unemployment rates in the late 1990s, and South Carolina has been no exception, with a 4.5% unemployment rate for 1997 (United States Bureau of Labor Statistics 1999). Walterboro, the main center of population within the ACE Basin, also had strong employment conditions, with 1997 unemployment at 5.3% (SC Department of Commerce 1999). Subdivision employment figures from the 1990 census indicate how well local sections of the community are participating in the economic mainstream. In 1990, the unemployment rate across the five subdivisions was 7%. Unemployment varied greatly among the subdivisions, from a low of 3% in Cottageville to a high of 16% in Edisto Island. However, approximately 27% of Colleton County residents traveled to work outside the county, compared to approximately 7% and 2% in neighboring Charleston and Beaufort Counties, respectively (South Carolina Budget and Control Board 1999). This highlights the need for more opportunities in the Colleton County area.

Earnings and Income
Average earnings per job have steadily increased in both South Carolina and Colleton County from the mid-1980s to the mid-1990s. During the 10 years from 1986-1996, average earnings per job increased by 46% in all of South Carolina and by 42% in Colleton County. Although the average earnings per job in Colleton County grew, they did so at a slower rate than average earnings at the state level. In 1996, the average earnings per job in Colleton County were $19,497, nearly $5,000 less than the state average (U.S. Department of Commerce 1998).

Income figures from the 1990 census are available for the identified subdivisions of the ACE Basin. Comparisons of the subdivision and county data with state averages indicate that ACE Basin residents, in general, earned below the state average (Comparison of household earnings). In 1989, 40% of all households earned less than $15,000; the comparable figure for the entire state was 28%. Approximately 7% of households in the 5 subdivisions earned $60,000 or more. Larger portions of Hendersonville and Green Pond households earned less than $15,000 a year -- 50% and 43%, respectively. There was a notable income gap by race as well. Of Caucasian households in the 5 subdivisions, 27% earned less than $15,000, in contrast to 58% of African-American households.

Per capita income is the average income computed for every man, woman, and child in a particular geographic grouping. It varied significantly among the ACE Basin subdivisions, ranging from a high of $9,713 in Walterboro to a low of $7,447 in the Hendersonville CCD. A racial income gap is evident here as well. The per capita income of the Caucasian residents ranged from $10,110 in Hendersonville to $16,957 in Green Pond, while income for African-American residents remained in the $5,000 range for all subdivisions (United States Census Bureau 1990).

More recent figures are available for Colleton County in comparison to South Carolina. Since 1970, per capita income in Colleton has been below the state average. From 1987 to 1997, per capita personal income at the county and state level rose significantly and at similar rates, growing 63.8% for all of South Carolina and 61.6% for Colleton County. In 1997, the per capita personal income for Colleton County was $16,017, well below the state figure of $20,508 (U.S. Department of Commerce 1998).

Annual data on dividends, interest, and rent (a figure which is often used to estimate the value of assets individuals possess) for Colleton County and South Carolina illustrate that the county lags behind the state in this measure as well. In 1997, dividends, interest, and rent per person were $2,987 for South Carolina, but only $1,657 in Colleton County (U.S. Department of Commerce 1998).

Self-Employment

About 7% to 9% of the United States working population were self-employed in the 1990s (Small Business Administration 1997). According to the 1990 census, 7% of the working residents of the five ACE Basin subdivisions were self-employed. Across all five subdivisions, 1,201 households received an average $15,752 from non-farm self-employment income for 1989. Self-employed farmers earned much less, $2,867 per self-employed farming household on average (United States Census Bureau 1990).

An examination of a decade of non-farm proprietors' earnings in all of Colleton County as compared to all of South Carolina indicates that although proprietors in Colleton once earned more than proprietors in the rest of the state, the growth in Colleton proprietors' income has slowed in the last decade. In 1986, Colleton non-farm proprietors earned an average of $13,682 compared to $11,312 for all of the state. By 1996, proprietors' earnings in Colleton had grown by 8% to $14,722, while earnings in the entire state had increased by 33% to $15,015 (U.S. Department of Commerce 1998).

Poverty

According to the 1990 census, 24% of the residents of the five ACE Basin subdivisions lived in poverty (incomes below the federally defined minimum, by family size, needed to meet basic needs), and 12.5% received public assistance (United States Census Bureau 1990). The difference in the 1990 poverty and public assistance rates reported implies that the region is not drawing upon state resources at a level equal to its poverty. More recent data show that in 1998 an estimated 15.1% of Colleton County residents received either food stamps or Family Independence income support (South Carolina Department of Social Services 1998). However, poverty data for the same year is not available.

Focus on Edisto Beach

Although census figures for 1990 show low average incomes for many ACE Basin residents, it is misleading to assume that average figures are representative of the whole region. The urban areas, and especially the pocket resort and high-end residential communities, have higher relative wealth and educational backgrounds than is apparent from the county or subdivision averages.

Edisto Beach Homes

The Town of Edisto Beach is one such pocket community within the Green Pond subdivision of Colleton County. It is a quiet resort community located on a 6-mile long barrier island at the mouth of the Edisto River. Its demographic characteristics differ significantly from the Colleton County average demographics and from those of the adjacent Edisto Island subdivision in Charleston County. Persons over age 65 make up just 13% of the population of all of Colleton County, yet they make up 36% of the population of Edisto Beach (United States Census Bureau 1990). The over-65 age group is increasing in the permanent population of Edisto Beach as people who have owned second homes there retire and move to the town full-time (Wood 1996). The education and income profile of Edisto Beach residents is significantly different from Colleton County as a whole. While just 9.6% of the Colleton County population hold a bachelor's degree or higher, 34% of Edisto Beach residents have attained this education level, and the median household income is nearly $13,000 higher for Edisto Beach than for Colleton County (United States Census Bureau 1990).

Adjacent to the Town of Edisto Beach is the Edisto Island census subdivision of Charleston County. Off the only highway leading into the town, there are marsh-view residential developments outside the Edisto Beach town limits and in the Edisto Island subdivision. These developments are socio-economically associated with the Town of Edisto Beach. The Edisto Island subdivision is currently predominantly rural in character and agricultural in economy, but increasingly, large plantations are moving from being farmed to being developed as high-end residential subdivisions (Wood 1996). The 1990 population of the Charleston County portion of Edisto Island (which does not include Edisto Beach) is expected to double by the year 2015 (Wood 1996). Those new residents, like the current residents of Edisto Beach, will likely have education and income profiles distinct from the traditional rural population.

Back to Top

Local Economy

Industry

In the 1990 census, 14,161 persons over the age of 16 in Colleton County were reported as employed. They were working in a variety of industries (Employment by job category). Of the 12 job categories listed, five are commonly classified as services. These five are health, educational, and other professional services (17%); personal services (5%); public administration (4%); business and repair services (2%); and entertainment and recreational services (<1%). Services accounted for approximately 29% of Colleton County's employment in 1990, roughly one third of which was in low-end service sectors. Services and retail (18%) account for over 45% of the county's employment. Based on the high percentage of workers in these sectors, the ACE Basin Economic Forum report (1996) concluded that Colleton County's economy shows a tendency toward low-end, low-tech, and low-value-added sectors because these categories are reported to have some of the lowest earnings of all sectors.

Although retail trade is reported to be one of the fastest growing industries in America (United States Department of Commerce 1996), it appears to be having little impact on the economic health of the ACE Basin. Detailed data for 1992 show that the average retail sales per capita in Colleton County was $5,386, approximately 75% of the state average (U.S. Department of Commerce 1998). The majority of ACE Basin retail activity is centered in the greater Walterboro area.

Manufacturing plant in Colleton county

Manufacturing is a significant sector of the Colleton County economy. During the early part of this century, manufacturing was the driving engine of the American economy and often provided high-wage jobs to low and moderately skilled labor. Throughout the country, employment in manufacturing has declined in recent years, as services have become more important. However, manufacturing continues to be strong in Colleton County. In 1990, manufacturing employed 25% of Colleton County workers, compared with 7% and 11% of Beaufort and Charleston County workers, respectively.

The ACE Basin Economic Forum report (1996) notes that manufacturing has shown significant increases in pay and the in number of large establishments in Colleton County, compared to all of South Carolina. According to the United States Department of Commerce, Regional Economic Information System (1998), earnings from those working in manufacturing have increased significantly, growing by 42% from 1991 to 1996, which is double the rate at which manufacturing earnings grew for the entire state of South Carolina. Records for 1996 show that 25% of Colleton's earnings came from manufacturing, far above the percentage of Beaufort and Charleston Counties' earnings from this sector (2% and 7%, respectively). There are almost 1 dozen manufacturers listed in the Colleton County Chamber of Commerce's Industrial Directory. Much of Colleton's manufacturing is in value-added wood products and thus closely tied to the natural resource-based forestry industry.

Further economic development in the region is dependent on the critical factors of transportation, water, and sewer infrastructure. For residential development, water and sewer infrastructure is desirable, though wells and septic systems can substitute. Walterboro is the only area in the county with current water and sewer capacity to accommodate additional growth (Colleton County Land Use Planning Task Force 1997). Access to transportation is critical for commercial and industrial development. In the Walterboro area, access to transportation is good, with Interstate 95, two United States highways, three South Carolina highways, and CSX railroad lines serving the area. These road and rail lines provide access to Charleston's international port facilities 48 miles away. For the ACE Basin to support traditional commercial or industrial expansion outside of the Walterboro area, however, a significant investment in infrastructure would be necessary.

Natural Resource Value

Most areas of the ACE Basin, outside of the few prosperous population clusters, are relatively poor by traditional economic measures. However, the traditional economic picture of "wealth" as captured in wage and income statistics does not include natural assets being held for future use or the market, as well as nonmarket, value of a conservation site. Nonmarket values are those not captured in the market place, such as the value of the pollution filtering services provided by a wetland or the value of a recreational activity like canoeing a scenic river. The characteristics that are preserved by conservation -- such as biological diversity, wildlife habitat, scenic views, and recreational opportunities -- help maintain a region's rural character and quality of life. These characteristics in turn have nonmarket value as well as market value associated with natural resource-based businesses. Unspoiled natural resources have nonmarket value, and natural resource-based businesses like nature tourism, outdoor recreational services, farming, fishing, and forestry can make important market contributions to an economy. Because these assets have been left uncounted in traditional economic statistics or development strategies, the true "wealth" of communities where such activities take place is commonly underestimated. (See related section: Natural Resource Value.)

Perry et al. (undated) argued that the ACE Basin Project conservation goals could negatively affect Colleton County, as some of the most attractive county land is made unavailable to developers. The study views Colleton's options for economic growth as reduced because the county will not be able to follow the development patterns of Beaufort or Charleston Counties. Consequently, it recommends the development of alternative types of economic growth, such as ecotourism and other nonconsumptive activities like birdwatching and hiking. The study also advances the point that the loss of tax revenues to the county due to the acquisition of county lands by conservation organizations and the establishment of conservation easements is, and will continue to be, of significant detriment to the county. However, studies in other areas indicate that traditional sprawling growth may not be the economic boon it was once thought to be, as the costs of providing the necessary services and infrastructure for a parcel of land developed for residential use are found to exceed the tax revenues generated by it (Smith 1998, Vineyard Conservation Society 1998). Also, it is widely recognized that land adjacent to protected resources increases in value.

How and in what sectors would ACE Basin residents like to see their economy grow? During the ACE Basin Economic Forum in 1995, task groups were formed to develop an action agenda for economic development. The work of the task groups resulted in three key strategies: 1) to create a framework for responsible growth; 2) to enhance the awareness, understanding and appreciation of the ACE Basin; and 3) to promote environmentally compatible business development.

Natural resource-based industries have played a key role in the ACE Basin's heritage, and they form much of the basis of the economic forum's business development strategy. Recommendations for accomplishing this strategy involve exploring new ways to make the ACE Basin's traditional natural resource-based industries in agriculture, timber, seafood, and local crafts develop higher value-added products and operate in a more sustainable fashion (ACE Basin Economic Forum 1996). New and increased nature-based tourism development is also desired. Specific recommended actions include

- creating a business development planning process and initial business feasibility plans for natural resource-based products
- creating and implementing branding and trademarking of area products
- developing a full-scale marketing plan for natural and cultural resource-based tourism efforts and assets, and building on existing rural tourism efforts and assets
- creating management standards for visitor safety and resource impacts for tourism
- establishing educational programs for businesses operating in the region about

how to operate in an environmentally conscious manner with respect to waste management, wildlife impact, and other resource considerations.

Nature-based tourism and small business developments, along with the region's traditional natural resource-based industries such as forestry, hunting, farming, and fishing, are among the desirable and environmentally compatible endeavors that hold the potential to capitalize on and protect the region's character and natural assets. The following section looks at each of these natural resource-based industries more closely. (See related section: Land Use Module.)

Nature-based Industries

- Tourism
- Hunting
- Forestry
- Agriculture
- Fisheries

Tourism

Tourism is the focus of additional community efforts in the ACE Basin. Strategy two of the ACE Basin Economic Forum (1996) includes raising the profile of the area as a tourism destination and a quality living environment with rich cultural traditions so that the area's tourism potential could be increased. The Artisans Center in Walterboro is one successful new initiative that drew 20,000 visitors and generated $275,000 in its first year.

The Town of Edisto Beach in the Green Pond subdivision of Colleton County is currently a popular seasonal destination for beach vacationers seeking a quiet community without the carnival-like commercial atmosphere found in and around many other beach resort areas (Wood 1996). Based on water usage, one estimate of summer population averages 5,500 people, which is nearly 4,900 more than the estimated 1995 permanent population (Wood 1996). The nearby Edisto Beach State Park in the Edisto Island subdivision of Charleston County is listed by the South Carolina Department of Parks, Recreation, and Tourism (SCPRT) as one of the top 12 attractions in the state, based on attendance records for 1997.

Tourism impacts the economy through the money visitors spend in an area, which helps create new jobs and encourages the establishment of new small businesses. When local residents employed by a tourist business spend their money in the community, they help strengthen the local economy as well. Local and state governments also benefit through sales taxes, hotel taxes, user fees, and additional income taxes from tourism workers.

In 1997, visitor spending in Colleton County was estimated at $53.1 million, compared to $666.7 million and $956.4 million in Beaufort and Charleston Counties, respectively (SCPRT 1997). Colleton County's tourism wage impacts for 1997 are estimated at $10.8 million (SCPRT 1997). In 1995, the direct payroll impacts (dollars initially spent and resulting employment where sales occurred) of tourism jobs in the four-county Lowcountry/resort islands region defined as Beaufort, Colleton, Hampton, and Jasper Counties, was estimated to be $267 million, approximately 3% above the 1994 estimate (SCPRT 1995).

Throughout Colleton County, there are a number of businesses to support tourism. Forty-three eating and drinking establishments, 13 hotels and other lodging places, and at least eight amusement/recreational services are recorded. Lodging and amusement businesses have grown in numbers of establishments and numbers of employees between 1993 and 1996 (Tourism-Related Businesses). Amusement services show the highest wages and have experienced the fastest growth. However, the small percentage of Colleton County residents employed in entertainment and recreational services suggests that this component of the tourism sector is not at strong as it might be.

The vast majority of hotels in Colleton County are chains in Walterboro and near Interstate 95. These lodgings provide a place for tourists, but because they are franchises, a portion of the corporate income flows out of the region, dampening its economic impact. The accommodations tax collected, however, does provide revenue to the county (Tax Collections and Net Revenues). The higher accommodations tax collections in neighboring Beaufort and Charleston Counties reflect the significant tourist centers of Charleston in Charleston County and Hilton Head and Beaufort in Beaufort County. Tourists in these adjacent areas could potentially be drawn to activities highlighting natural resources and cultural heritage in the ACE Basin. And increased nature-based tourism in the ACE Basin could lead to more place-based lodging and dining in the area rather than people patronizing chains as through-travelers or on day visits from Charleston or Beaufort. (See related section: Tourism Land Use Issues.)

Hunting

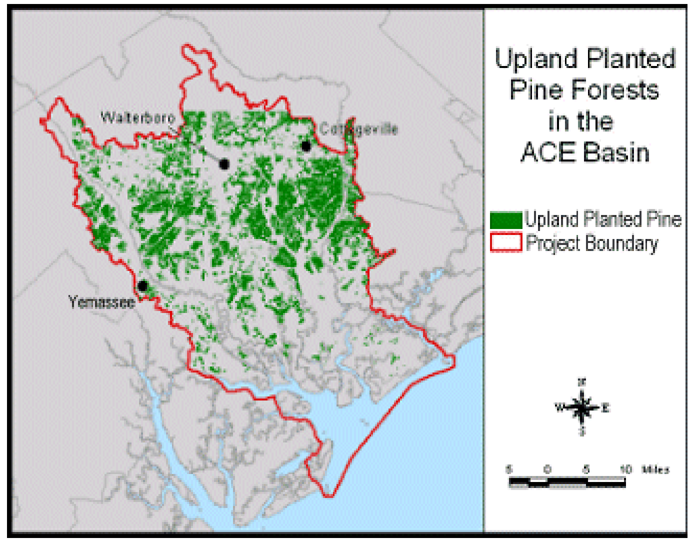
Hunting as a recreational activity is closely tied to the tourism industry. It has a significant economic impact statewide and, by inference, in the ACE Basin as well. A postal survey of South Carolina resident and nonresident hunting licensees estimated total hunter expenditures for the 1992-93 hunting season in the state at $125.2 million (Shipes 1993). Economic data on the impact of hunting at local levels are not specific to the ACE Basin region. However, a survey of the economic effect of hunting in neighboring rural Jasper County was conducted in 1990 (Richardson et al. 1996). The Jasper County survey found that half of the hunters surveyed paid for access at an average of $2.74 to $3.13 an acre. The lower average rates were paid to small landowners, and the higher average rates to large landowners. The hunters also directly supported community businesses through food, lodging, transportation, and equipment expenditures. Based on hunter expenditures reported in 19 categories, 2,395 private hunters in Jasper County spent $6 million in 1990. Because the study did not include private lands less than 50 acres, the total is considered conservative. The study concludes that hunting on private lands has a major impact on the local economy of Jasper County and may be a significant economic driving force in rural South Carolina.

In the ACE Basin, as in many rural areas, the demand for available hunting land has made the leasing of hunting rights on private property a growing enterprise. More than 90 hunting clubs have been formed in the ACE Basin, indicating clubs are a popular means of gaining access to private land. The existence of these clubs and inferences drawn from the Richardson study suggest that recreational hunting is a valuable supplement to the income of rural landowners and community businesses and may contribute significantly to the ACE Basin economy. (See related section: Hunting.)

Commercial harvesting of furbearers takes place in the region, but harvest values have declined rapidly since 1989 due to low market demand. The raccoon, opossum, and gray fox are the primary species of interest in commercial fur harvesting in Colleton

County. The state's most commercialized furbearer is the raccoon, and raccoon harvest in Colleton County is similar to the state pattern in that numbers have drastically declined since 1989. Although the 1995-96 commercial harvest showed an increase of 43% over the previous year's harvest, it was 61% below the 20-year average (SC Furbearer Data). The traditional sale of furbearers as pelts has decreased drastically, with approximately 85% of the total 1995-96 sales estimated to be from live furbearer sales, for which there is still a limited market. During the 1995-96 season, the estimated total value to South Carolina harvesters for all furbearers combined was just $113,897, nearly 85% below the peak values reached in 1987-88. (SCDNR 1996)

Forestry



Forestry has had a long and important economic role in South Carolina and in the ACE Basin region. The larger Edisto and Combahee River Basins, which cover the Lowcountry and southern parts of the Piedmont area, have historically supplied lumber to wood yards throughout South Carolina and Georgia (SCWRC 1992). Cash receipts from forest products sold from all South Carolina forests in 1994 totaled more than $760 million (South Carolina Budget and Control Board 1998). In the ACE Basin project area, approximately one half of the land cover is forest. From the 1960s through the 1980s, the volume of trees in the area increased significantly to become the region's largest "commodity" (SCWRC 1992). From 1986 to 1992, the volume of standing timber in Colleton County increased by 6% to 8% annually (Colleton County Land Use Planning Task Force 1997).

In Colleton County, forestry is considered one of the main local economic engines (Colleton County Land Use Task Force 1997). The county's 1993 cash receipts from forest products were more than $24 million, the second highest value of any county in the state. Colleton County's 1994 receipts, at more than $34 million, were the highest for all South Carolina counties (South Carolina Budget and Control Board 1998), and additional revenues of $12 million were generated from the logging and delivery of timber. Ownership patterns in the area are similar to those of the rest of the state, with the majority of timberland privately owned (Forest ownership). The stumpage value paid to nonindustrial private forest owners in Colleton County in 1996 was $22.2 million (SC Forestry Commission 1996).

In 1995, two sawmills, one veneer, or plywood, mill, and one miscellaneous mill were identified in Colleton County (Johnson et al. 1997). These enterprises represent the processing side of the forestry industry. Because the government does not release

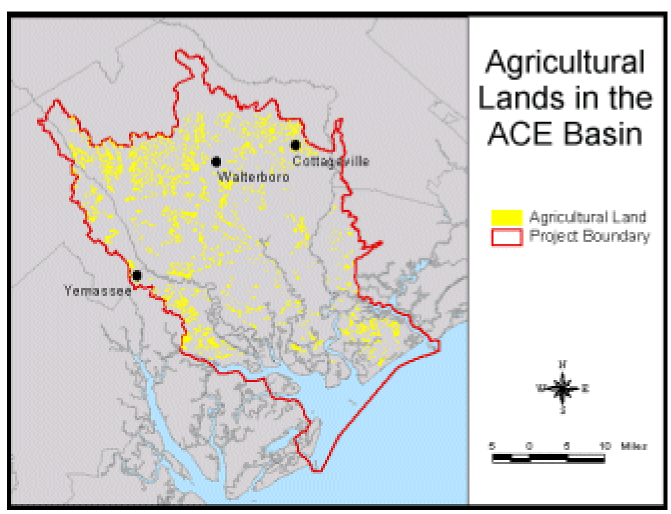
Pine plantation

data for four or fewer firms, there are no employment or payroll data for these individual forestry concerns. In addition to these four forestry enterprises, there were 30 lumber and wood products companies in Colleton County in 1995. All these businesses provide additional money for the local economy by employing local residents and paying taxes on their profits.

Though partly indicative of the demand for construction in the area, the lumber and wood products companies, being supplied by the forestry industry, help illustrate its strength as well. The 30 lumber firms in Colleton employed nearly 500 people at an annual 1995 payroll of $11.5 million, nearly 8% of the total 1995 payroll reported for county industries (United States Census County Business Patterns 1995). Much of this went to residents of the ACE Basin. It is also important to recognize that these earnings are taxed, generating revenue for the local government.

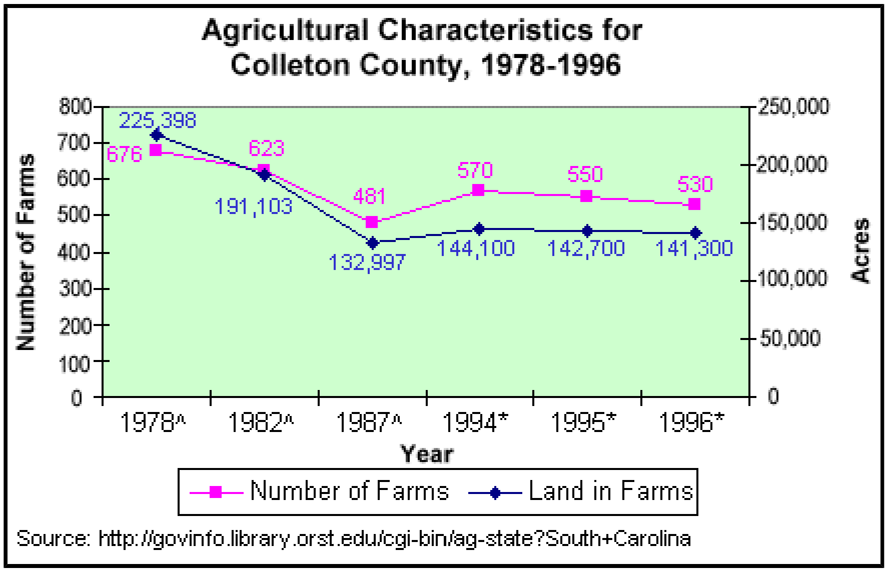
All these figures point to the productivity and strength of forestry in Colleton County and the ACE Basin region. Recognizing the significance of forestry in the county's economy, the Draft Colleton County Land Use Plan has placed a high priority on protecting forests through sound management and stewardship. Forest management is also one of the traditional natural resource uses that is endorsed by the ACE Basin Project. The natural beauty of the area's forests is an additional component of the forests' economic asset to the area, as both natural and planted forests provide a wide range of benefits for wildlife and people. (See related section: Forestry.)

Agriculture



Farming is an important economic activity in South Carolina, and agriculture was the dominant industry in the ACE Basin in the previous two centuries. Farming continues to be important economically, though it is no longer dominant, accounting directly and indirectly for approximately 18% of the state economy (Beasley et al. 1996). Although farming in the ACE Basin has declined, it continues to be a significant economic activity. In 1995, farms contributed more than $15.4 million in cash receipts to the Colleton County economy (South Carolina Budget and Control Board 1998). Most of Colleton County farming is for crops, with comparatively little livestock. Of 1995 farm receipts, 72% were for crops and 28% for livestock (South Carolina Budget and Control 1998). (See related section: Agriculture Land Use Issues.)

From 1978 to 1996, the number of farms in Colleton County declined by nearly 22%, and the acres of land farmed declined by 37% over the same period. According to 1992 Census of Agriculture statistics, 42% of Colleton County farmers were farming full time, and in the 1997 Census of Agriculture 40% percent were considered full-time farms. The implication is that it may be difficult for the majority of farming individuals to support themselves as full-time farmers.



Agriculture in Colleton County, 1978-1996.

In addition to the decline in farms and farmland, statistics from 1970 and 1996 show that the farming sector of the ACE Basin economy has weakened. Though the decline in farming employment was greater statewide than in Colleton County, the percentage of monetary increases over the same period was much smaller in Colleton County than in the state as a whole (Farm Employment and Earnings). Both net sales and proprietors' incomes have increased over the period -- likely attributable to technological and productivity advancements -- but the percentage gains in Colleton County are less than half those at the state level.

Fisheries

At the state level, total personal income in the fishing industry was $9.3 million in 1996, and fishing industry income in Colleton County was $407,000, approximately 4% of the state fishing industry total (U.S. Department of Commerce 1998). These figures represent earnings through fishing industry businesses, of which there are few in Colleton County. Undoubtedly, there are more individual fishing boat proprietors, but county-level census economic data on individual fishing proprietors are subsumed in self-employment income figures.

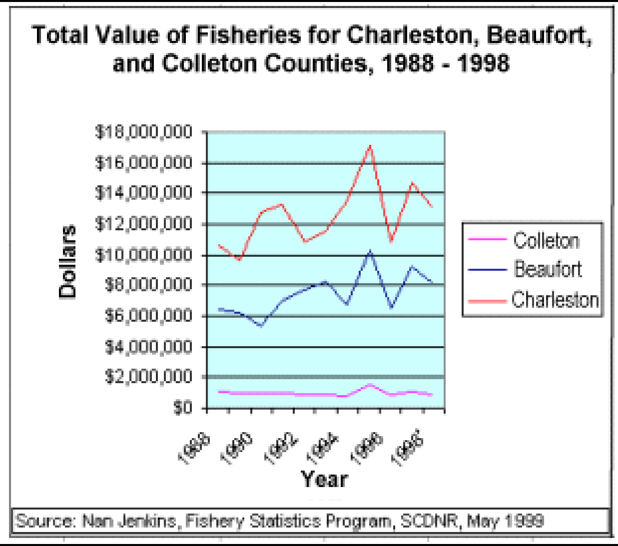
More than 90% of the commercial fishing industry in Colleton County is in shrimp. (Shrimp landings and their values are shown for Colleton County for the period 1979-1996 in commercial shrimp landings .) Perry et al. (undated) described the fishing industry in Colleton County as a relatively small but important component of the local economy, based of the total value of fishery landings in the county.

The total value of fisheries for Colleton County for 1988 through 1998 has been relatively flat at approximately $1 million annually, indicating an industry that is stable, but not growing. Comparison of the total fisheries values of Colleton, Beaufort, and Charleston Counties shows not only a much greater fishing effort in Charleston and Beaufort Counties, but perhaps a trend toward growth in fisheries values in those counties as well.

Total Value of Colleton County Fisheries 1988 - 1998

Year	Colleton Co.
1988	1,077,024
1989	997,682
1990	948,685
1991	995,614
1992	841,196
1993	816,338
1994	783,872
1995	1,483,340
1996	903,986
1997	1,085,640
1998'	819,677

Source: Nan Jenkins, Fishery Statistics Program, SCDNR, May 28, 1999



Colleton County's total fisheries value and growth in comparison to Beaufort and Charleston Counties, 1988-1998.

Recreational fishing in the rivers and creeks of the ACE Basin also contributes to the region's economy, though it is difficult to document just how much. In 1997, there were 4,325 boats registered in Colleton County, and 10,111 and 28,686 boats registered in Beaufort and Charleston Counties, respectively (South Carolina Budget & Control Board Office of Research and Statistics 1998). During 1989-90, a creel census conducted on the Edisto and Combahee Rivers estimated the economic worth of these systems as freshwater sport fisheries to be $1.725 million annually.

Back to Top

Regional Economy

- Relationship to Neighboring Urban Areas
- Relationship to the Larger Edisto River Basin

Relationship to Neighboring Urban Areas

An analysis of 1990 census data found that Colleton County's strongest economic ties at that time were to the north (CFED 1995). Journey-to-work data (which records where people live and where they work) found strong commuting patterns among Charleston, Berkeley, Dorchester, and Colleton Counties (CFED 1993). That study did not find significant commuting patterns between Colleton, Beaufort, and Jasper Counties. The Charleston economy has been very robust in the 1990s (Williams 1998, McDermott 1998), and the larger Charleston region ranks in the best third for its type, both in employment growth and the unemployment rates over the late 1980s and early 1990s. The region also ranks in the best third in average earnings per job and in the growth in average earnings per job (CFED 1995). These statistics indicate a strong regional economy centered on Charleston. During the economic expansion of the late 1990s, Charleston researchers and South Carolina Employment Commission officials noted the economic pull that an abundance of jobs in Charleston had on residents of

Colleton County (Williams 1998). As the Charleston region becomes increasingly more metropolitan, the quality of life offered by the ACE Basin's unspoiled natural areas may grow more appealing.

The Beaufort County Comprehensive Plan (Land Ethics, Inc. 1997) indicates that Beaufort County's economic base is also strong. From 1960 to 1990, Beaufort County was the fastest growing county in South Carolina, with the majority of its growth occurring on Hilton Head Island. The county has a higher per capita income and median household income than the rest of the Lowcountry (Colleton, Hampton, and Jasper Counties) and the state, with a higher labor participation rate and employment by occupation more weighted towards the executive/administrative and technical positions that pay higher wages. From 1951 to 1993, Beaufort County's job base grew 13 times over compared to a statewide increase of 3 times, and conservative estimates from the Bureau of Economic Analysis predict that job growth will continue to be strong in the county from 1995 to 2020. Much of the job base growth has been in expansion of low-wage employment concentrated in the services and retail trade, which may be a draw for Colleton County workers. Military jobs, as well as tourism and retirement/second income developments, are also an important component of Beaufort County's economy. The county's current economic development plan targets high technology, knowledge-based businesses that seek the higher-amenity surroundings and quality of life the county offers.

That nearly 27% of Colleton County residents travel to work outside the county, compared to approximately 7% and 2% in Charleston and Beaufort Counties, respectively (United States Census Bureau 1990), highlights the need for more opportunities in the Colleton area. It also highlights the potential for Colleton to become a bedroom community to more prosperous areas and the increased threat of subdivision of natural areas into residential developments. Colleton County appears much more likely to experience residential development pressure from Charleston County than from Beaufort County. Land use planning in the ACE Basin will be an important tool to guide development in a way that does not compromise the potential benefits of the area's natural resources.

If the ACE Basin's proximity to the economic resources of neighboring areas is used to support sustainable economic development of the Basin's natural resources, then the outflowing tide of economic benefits can be turned back toward the Basin. One promising and sustainable avenue for capitalizing on the proximity of more economically robust areas is in increased nature and heritage-based tourism. The continued encouragement of sustainable practices in natural resource-based industries, such as farming, forestry, and fishing, will further enhance the natural assets that form the basis of these industries themselves, as well as the nature tourism industry.

Relationship to the Larger Edisto River Basin

The larger Edisto River Basin comprises roughly 2 million acres draining into the longest undisturbed blackwater river in the United States. The southern end of the area extends into the ACE Basin along the Edisto River and includes Edisto Island, such that 18.4% of Colleton and 27.7% of Charleston Counties are within the larger basin boundary. The Edisto River Basin Project (Beasley et al. 1996) was an extensive community-based effort to evaluate the basin's assets and plan for its future, using local knowledge and geographic information systems (GIS) analysis.

The demographic and employment characteristics of the Edisto River Basin are much like those of the ACE Basin. Economic development is a high priority among Edisto Basin residents because unemployment is high in some areas, personal incomes are relatively low, and educational attainment levels are below the state average. Similar to the ACE Basin, about 26% of the workforce was employed in manufacturing in 1990, and farming accounts for about 5% of total employment, although the number of farms and the extent of farmland has steadily decreased since 1950. The recommendations resulting from the Edisto River Basin Project centered on the common themes of conservation and sustainable use of natural resources and compatible economic development. Recommended methods for achieving these goals included partnerships, education, local planning and decision-making, best management practices, incentives, and research.

NEXT CHAPTER: Resource Use

Author

D. Clones, Corporation for Enterprise Development

References

ACE Basin Economic Forum. 1996. ACE Basin economic forum: healthy economy, healthy environment. An action agenda for compatible economic development. June 1996. Walterboro, SC.

Beasley, B. R., W. D. Marshall, A. H. Miglarese, J. D. Scurry, and C. E. Vanden Houten. 1996. Managing resources for a sustainable future: The Edisto River Basin Project. Report. No. 12. South Carolina Department of Natural Resources, Water Resources Division, Columbia, SC.

[CFED] Corporation for Enterprise Development. 1993. The regional performance benchmarks system: policymaker's guide and users manual. Corporation for Enterprise Development, Washington, DC.

[CFED] Corporation for Enterprise Development. 1995. Economic health assessment of Colleton County. Prepared for the ACE Basin Economic Forum. Corporation for Enterprise Development, Washington, DC.

Colleton County Land Use Planning Task Force. 1997. Draft Colleton County land use plan. March 1997. Colleton County, Walterboro, SC.

Costanza R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. O'Neill, J. Paruelo, R. G. Raskin, P. Sutton, M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. Nature. 387:253-260.

Grigalunas, T. A. and R. Conger (eds.). 1995. Environmental economics for integrated coastal area management: valuation methods and policy instruments. Regional Seas Reports and Studies No. 164. United Nations Environment Programme, Nairobi, Kenya.

Johnson, T. G., A. Jenkins, D. P. Stratton, and P. S. Bischoff. 1997. South Carolina's timber industry: an assessment of timber product output and use, 1995. U.S. Department of Agriculture, Forest Service, Southern Research Station. Asheville, NC.

Land Ethics, Inc. 1997. Beaufort County comprehensive plan: get a grip on our future. Final Draft October 1997.

[LCOG] Lowcountry Council of Governments. 1994. Lowcountry enterprise community strategic plan and application. June 1994. Lowcountry Council of Governments, Yemassee, SC.

McDermott, J. P. 1998. Jobless rate in South Carolina hits 40-year low. The Post and Courier. 23 April 1998. Charleston, SC.

Perry, J. M., L. A. Woods, and J. W. Steagall. Undated. A study of the economic impact of the ACE Basin Project on Colleton County, South Carolina. University of North Florida. Jacksonville, FL.

Richardson. C. L., G. K. Yarrow, and W. M. Smoathers, Jr. 1996. Economic impact of hunting on rural communities. Quality Whitetails 3(2):5-8.

Roche, M. 1993. Socioeconomic conditions in the Edisto River Basin. Part 1: current conditions. Open File Report SCWRC-NRDSS-OFR 93-02. South Carolina Water Resources Commission, Columbia, SC.

Shipes, D. A. 1993. The utilization of wildlife resources by hunters licensed to hunt in South Carolina during 1991-1992 as determined by a postal survey. South Carolina Wildlife and Marine Resources Department. Columbia, SC.

Smith, L. J. 1998. Cost of community services for West Tisbury Massachusetts: a report on the fiscal implications of different landuses.

[SCBCB] South Carolina Budget and Control Board. 1998. South Carolina Statistical Abstract. http://orss.state.sc.us/ (accessed 9 June 1999).

[SCBCB] South Carolina Budget and Control Board. 1999. South Carolina County Profiles. http://plato.drss.state.sc.us/censusfrm.html (accessed 15 June 1999).

[SCDNR] South Carolina Department of Commerce. 1999. Walterboro, South Carolina: a community profile. http://www.callsouthcarolina.com/communitytable/mapframeLowCountry.htm (accessed 9 June 1999).

[SCDNR] South Carolina Department of Natural Resources. 1996. Furbearer Project 1995-96. South Carolina commercial furbearer harvest summary. South Carolina Department of Natural Resources, Columbia, SC.

[SCPRT] South Carolina Department of Parks Recreation and Tourism. 1995. The Tourism Industry in South Carolina: Annual report for 1995. South Carolina Department of Parks Recreation and Tourism. Columbia, SC.

[SCPRT] South Carolina Department of Parks Recreation and Tourism. 1997. The Tourism Industry in South Carolina: Annual report for 1996. South Carolina Department of Parks Recreation and Tourism. Columbia, SC.

South Carolina Department of Social Services. 1998. Statistical Report. Vols. 56, 61, and 62. South Carolina Department of Social Services. Columbia, SC.

South Carolina Forestry Commission. 1996. Value of South Carolina's Forest Resource and Industry. http://www.state.sc.us/forest/mval.htm (accessed 17 June 1999). South Carolina Forestry Commission, Columbia, SC.

[SCWRC] South Carolina Water Resources Commission. 1992. The economy of the Edisto River Basin. Volumes I-IV and Executive Summary. South Carolina Water Resources Commission, Columbia, SC. (Drafts prepared by the Fontaine Company).

United States Bureau of Labor Statistics. 1999. Region IV-Atlanta Ready Facts, South Carolina Annual Averages Employment Indicators. http://stats.bls.gov/ro4fxdm.htm (accessed 15 June 1999).

United States Census Bureau. Not dated. 1990 Census Summary Tape Files. United States Department of Commerce. http://www.census.gov/cdrom/lookup (accessed 9 June 1999).

United States Census Bureau. Not dated. County Business Patterns. Economic Profile: 1993, 1995, and 1996, Colleton County, South Carolina. http://www.census.gov/cgi-bin/datamap/cnty?45=029 (accessed 9 June 1999).

United States Department of Commerce. 1996. United States Industrial Outlook: 1994, 1995, 1996. United States Department of Commerce, Washington, DC.

U.S. Department of Commerce. 1998. The regional economic information system [CD-ROM]. U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economics Measurement Division, Washington, DC.

Vineyard Conservation Society. 1998. Open space pays off for all. http://www.vineyard.net/org/vcs/html/open.html (accessed 9 June 1999).

Williams, C. 1998. Local economy upbeat. The Post and Courier, section D-11. 28 September 1998. Charleston, SC.

Wood, L. (ed.). 1996. Town of Edisto Beach comprehensive plan. Town of Edisto Beach and the Lowcountry Council of Governments, Yemassee, SC.

M
E
N
U

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Resource Use

Protected Lands | Significant Natural Areas | Urban Areas | Forestry | Agriculture | Commercial Fisheries | Recreational Fisheries | Hunting | Tourism |

Introduction

The ACE Basin Characterization study area is primarily rural with only five incorporated communities. The main land use types in the ACE Basin are agriculture and silviculture, which together generated $58 million for 1994-95 in Colleton County. In addition to forestry and agriculture, the ACE Basin is utilized for hunting, commercial and recreational fishing, and tourism. Tourism in the ACE Basin is centered on its relatively undeveloped natural environment. Lack of development in the ACE Basin study area is primarily due to the efforts of state and federal governments, private landowners, and private organizations. Approximately 19,830 hectares (49,000 acres) are protected from development with an additional 30,350 hectares (75,000 acres) protected by conservation easements and other management agreements. Furthermore, 246 significant natural areas or features, as defined by South Carolina's Heritage Trust Program, occur in the ACE Basin. The Traditional and Current Resource Use chapter of this Characterization describes the above mentioned resource uses of the ACE Basin.

NEXT SECTION: Protected Lands

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Significant Natural Areas

Throughout South Carolina as well as in the ACE Basin study area, significant natural areas are designated using The Heritage Trust Program. Nationally, the Heritage Trust Program was developed by The Nature Conservancy (TNC) in the early 1970's. The South Carolina Department of Natural Resources initiated a Heritage Trust Program in South Carolina in 1976. The program uses common, standards-based methodologies to collect, maintain, and share information about endangered, threatened, or rare plants, animals, and ecological communities. For more information, refer to The Heritage Trust Program's web site EXIT .

Site Selection Process

Aerial view of South Williman Island

Over the years, the staff of South Carolina's Heritage Trust Program have recognized two hundred and forty-six sites in the ACE Basin study area as significant natural areas (Heritage Trust Database 1997). By definition, these are natural areas that contain endangered or threatened animal and plant species; outstanding remnants of an undisturbed plant community or ecosystem; unusual or outstanding scientific, education, aesthetic, or recreational characteristics; or unique landforms. Significant natural areas in the ACE Basin study area and throughout South Carolina are selected through a process that involves a systematic search for sites of high natural value (i.e., containing endangered or threatened species), an evaluation of the sites' value, and the application of various legal mechanisms for protecting the most highly valued sites. The first step of the process is to identify and characterize the natural communities. Heritage Trust staff and other professionals, including the staff of The Nature Conservancy, naturalists, and botanists, employ aerial photo interpretation, as well as aerial and ground survey techniques, to locate and characterize potential natural areas. During aerial and ground surveys, the size, natural quality (i.e., lack of disturbance), and unique character of the species or community type are recorded. Additional information that the scientists compile includes the total number of occurrences of the species or community type range-wide, and the status of the species population or community types throughout its range (i.e., increasing or declining in numbers).

Next, this information is used to evaluate the significance of the natural areas. Criteria used to rank the areas include the uniqueness of the elements (i.e., species or plant communities) and the natural quality (i.e., level of disturbance) of the sites. Sites that contain elements that are rare, threatened, or endangered throughout their range and have a high natural quality (undisturbed maritime forest) receive the highest priority. In contrast, sites that contain elements that are only rare in part of its range and have a low natural quality (i.e., ditches) are ranked as low priority sites, or not significant (Rayner 1984, TNC 1994). Other factors considered during the evaluation process include the availability of the sites and the ability of Heritage Trust to protect the sites.

Bald eagle on the nest

Finally, various mechanisms are employed to protect the areas that have high priority (SCDNR undated). If possible, the State of South Carolina either buys or acquires an easement on the high priority sites. These protected properties are dedicated as Heritage Preserves in perpetuity to SCDNR under the terms of the Heritage Trust Act. Some sites are further protected by placing them in the SC Heritage Trust. This protection specifies the public as the beneficiary and SCDNR as the trustee. For sites that are unavailable for purchase or a permanent conservation easement, the State attempts to obtain a Registration agreement in which the Heritage Trust Program and the property owner agree to protect the natural area by appropriate management. However, these agreements are voluntary and may be canceled with a thirty-day notice (SCDNR undated). In addition, the Heritage Trust staff employs the Threatened and Endangered Species Act to protect the habitat of endangered and threatened species.

Back to Top

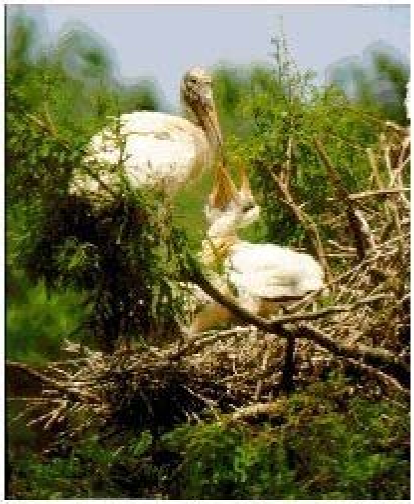
Sites of Significance in the ACE Basin

- Sites with Endangered and Threatened Species Habitat
- Sites with Species of Concern Habitat
- Sites with Outstanding Remnants of Plant Communities
- Sites with Outstanding Scientific Characteristics

The two hundred and forty-six significant natural areas in the ACE Basin study area differ in size, natural quality, and uniqueness in regard to species and community type. Some of these natural areas are as small as a few square feet (i.e., a bald eagle nesting site). Others are larger than a thousand acres (i.e., Snuggedy Swamp). The quality of the natural areas in the

Basin varies from highly disturbed to pristine (e.g. Otter Island). Some areas contain federally or state endangered or threatened species. Other sites include species that may be threatened or endangered in their range. Consequently, the priority ranking of ACE Basin study area's natural areas ranges from national to local significance.

Sites with Endangered and Threatened Species Habitat


Wood stork feeding chicks

Eighty-three of the two hundred and forty-six significant natural areas harbor five federally endangered or threatened species and twelve sites provide habitat for two state threatened species. Ten natural areas serve as nesting, roosting and feeding habitats for the wood stork (*Mycteria americana*), a federally endangered species, and three are active rookeries (See wading birds). The rookery near Jacksonboro, was the first known wood stork nesting colony in South Carolina (Dodd and Murphy 1997). Since 1981, the average colony size has increased from twenty to one hundred and two nests. By 1996, the number of colonies in the ACE Basin study area had increased to three. Roosting and feeding habitats are primarily located near impoundments and shallow creeks of the ACE Basin study area where the birds feed on fish. One natural area within the ACE Basin study area harbors the federally endangered Canby's dropwort (*Oxypolis canbyi*), one of twenty-five populations of this species remaining in the United States (Murdock and Rayner 1989). The plant grows in wet depressions within the Cowbane Heritage Preserve, a state-owned property in Colleton County (Rayner 1984). The depressions are scattered throughout the swamp communities that dominate the Preserve. Shortnose sturgeon (*Acipenser brevirostrum*), the third federally endangered species, utilizes the South Edisto River as a feeding habitat.


Loggerhead sea turtle *(Caretta caretta)*

In 1996, twenty-eight nesting pairs of federally threatened bald eagle (*Haliaeetus leucocephalus*) were utilizing sixty-six sites as nesting, roosting, and feeding habitats. Bald eagles usually nest within a mile of estuarine rivers and impoundments of the ACE Basin NERR, and the nest areas are less than 0.4 hectares (one acre) in size (USFWS 1987, Charlotte Hope, SCDNR Wildlife and Freshwater Fisheries Division, pers. comm.). Nests are found in the tops of the tallest and largest loblolly pines in pine and mixed hardwood-pine forests of the ACE Basin study area. Most of the roosting trees and feeding habitats are within the watersheds of the Combahee and South Edisto Rivers. The federally threatened loggerhead sea turtles (*Caretta caretta*) use several natural areas. Nesting sites for this species in South Carolina are on the beaches of Edisto, Otter and Harbor islands.

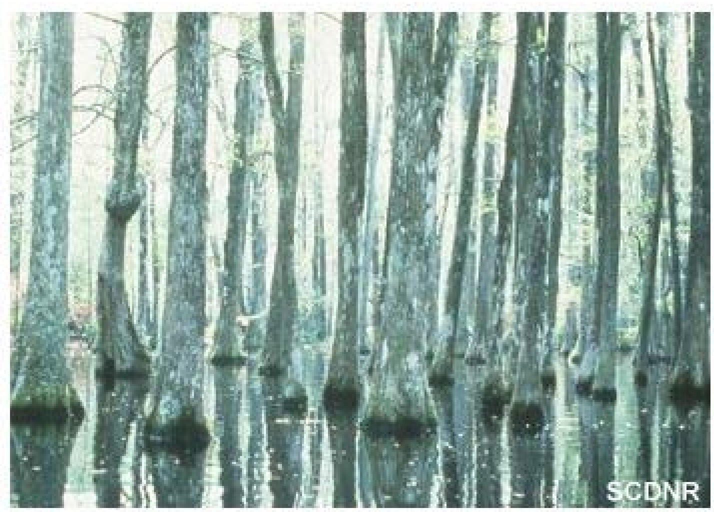
Two statewide threatened species, Wilson=s plover (*Charadrius wilsonia*) and the least tern (*Sterna antillarum*), reside in the ACE Basin study area. Both species nest on Edisto Beach, and least terns have also been found nesting on a bird key (small island in St. Helena Sound) near Harbor Island. (See related sections: Birds: Beach Community and Bird Keys .)

Sites with Species of Concern Habitat

Brown pelicans

Sixty significant natural areas within the ACE Basin study area harbor species of concern (Species of concern). The twenty-seven species of plants and animals may be threatened or endangered on a national, regional or state level. Current data suggest that their populations in the may be declining due to habitat loss, alteration, or pollution. Seventeen species inhabit shallow freshwater wetlands; each year, acres of shallow wetlands are drained for crop production, timber production, and mosquito control (The Governor's Office 1990). Another six species inhabit maritime communities on coastal islands, where residential development is increasing (Water Resources Division 1996). Five of the species (eastern creekshell, barred pygmy sunfish, Cooper's hawk, green-fly orchid, and crested-fringed orchid) are included because few data exist to adequately evaluate their status. Although their numbers are increasing in the state, the brown pelican is still a species of concern (Williams 1976). To date, the only known pelican colony in the ACE Basin study area is on Deveaux Bank, a multi-colony site that large number of shorebirds, including black skimmers, royal terns, least terns, and laughing gulls also use (Tom Murphy, SCDNR Wildlife and Freshwater Fisheries Division, pers. comm.).

Sites with Outstanding Remnants of Plant Communities



Snuggedy Swamp

Thirty-three natural areas are recognized as outstanding examples of coastal plant communities (Plant communities in the ACE Basin study area. The Nature Conservancy initially characterized the communities within the ACE Basin watershed (TNC 1993). Twelve of these significant natural areas are maritime and upland communities, and the remaining sites are estuarine and freshwater wetlands. The maritime and estuarine communities are within the ACE Basin National Estuarine Research Reserve (NERR), which contains some of the largest undeveloped estuarine wetlands on the East Coast. A diverse group of representative outer coastal plain plant communities characterizes the Reserve, including the full array of communities typically associated with barrier islands, marsh islands, and estuarine rivers. Especially well represented are estuarine and maritime communities. Many freshwater wetlands are found in a relatively undisturbed region of Snuggedy Swamp which is near the saltwater-freshwater transition zone on the South Edisto River. This 930-hectare (2,300-acre) parcel of swamp represents the largest grass-sedge-marsh/loblolly-bay complex in South Carolina. Aerial surveys show that most of Snuggedy Swamp is a mosaic of freshwater marsh and swamp communities with a few small ponds and 'islands' scattered throughout the area. Other representative sites of coastal plain communities are on the large plantations (more than 400 hectares in size) that border the rivers and creeks of the ACE Basin study area.

One natural area in the study area is the relatively undisturbed Otter Island, a 1,300-hectare (3,232-acre) barrier island. The island encompasses a full array of maritime estuarine, and palustrine communities, including dunes, maritime forests, *Spartina* marshes, and fresh to brackish ponds. The island has several nesting colonies of rare birds and populations of rare plants.

Sites with Outstanding Scientific Characteristics

Fifty-seven of the natural areas have outstanding scientific characteristics. They include rookeries and feeding habitats of colonial waterbirds such as the great blue heron and its allies (i.e., great egret, little blue heron, tri-colored heron, glossy ibis, white ibis). The U.S. Fish and Wildlife Service conducted a survey of these birds in 1975 to determine their status and distribution along the Atlantic Coast (Custer and Osborn 1978). Previous studies suggested a correlation between nesting success and environmental conditions such as water quality. Therefore, the birds are a good biological indicator (a population or assemblage of populations that reflects the ecological health of the environment). A more extensive survey was initiated in 1988, by the South Carolina Department of Natural Resources, Freshwater Fisheries and Wildlife Diversity Division, to quantify normal fluctuations in colony location and species abundance and to characterize habitat and reproductive successes (Dodd and Murphy 1997). These data will be used to determine the relationship between nesting success of waterbirds and environmental conditions.

Back to Top

Conclusion

Heritage Trust staff continuously updates information about natural areas as new occurrences are found, existing populations change, and the status of species or plant communities are reclassified. The Heritage Trust Program relies on the assistance of professionals that can track and document the occurrences of rare species and communities. The staff will provide technical guidance and appropriate forms and maps to all who are interested in helping with this process.

NEXT SECTION: Urban Areas

Author

S. Upchurch, SCDNR Marine Resources Research Institute

References

Custer, T.W. and R.G. Osborn. 1978. Wading birds as biological indicators: 1975 colony survey. United States Department of Interior, Fish and Wildlife Service. Special Scientific Report - Wildlife No. 206. Washington, DC.

Dodd, M.G. and T.M. Murphy. 1997. The status and distribution of wading birds in South Carolina, 1988-1996. The Chat 61(3): 129-181.

Heritage Trust Database. 1997. List of threatened and endangered species. South Carolina Department of Natural Resources, Freshwater Fisheries and Wildlife Diversity Division.

Martof, B.S., W.M. Palmer, J.R. Bailey, and J.R. Harrison III. 1980. Amphibians and reptiles of the Carolinas and Virginia. University of North Carolina Press, Chapel Hill.

Murdock, N. and D. Raynor. 1989. Agency draft recovery plan for Canby=s dropwort (*Oxypolis canbyi* [Coulter and Rose] Fernald). U.S. Department of the Interior, Fish and Wildlife Service. Atlanta, Georgia.

Porcher, R.D. 1995. Wildflowers of the Carolina Lowcountry and lower Pee Dee. University of South Carolina Press, Columbia.

Potter, E.F., J.F. Parnell, and R.T. Teulings. 1980. Birds of the Carolinas. University of North Carolina Press, Chapel Hill.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill.

Rayner, D.A. 1984. Inventory of botanical natural areas in Colleton County, South Carolina. *In* Inventory of botanical natural areas in Colleton, Dorchester, Horry, and Jasper counties, South Carolina. South Carolina Wildlife and Marine Resources Department, Division of Wildlife and Freshwater Fisheries, Heritage Trust Section, Columbia, SC.

Rohde, F.C. and R.G. Arndt. 1987. Two new species of pygmy sunfishes (Elassomatidae, *Elassoma*) from the Carolinas. Proceedings of The Academy of Natural Sciences of Philadelphia 139: 65-85.

The Governor=s Office. 1990. Report of the Governor=s Freshwater Wetlands Forum. The Governor=s Office, Division of Energy, Agriculture and Natural Resources. 1205 Pendleton Street, Columbia, South Carolina.

[NOAA] National Oceanic and Atmospheric Administration. 1992. Ashepoo-Combahee-Edisto (ACE) Basin National Estuarine Research Reserve in South Carolina, Final Management Plan. U.S. Department of Commerce, NOAA, National Ocean Service, S.C. Coastal Council, and S.C. Wildlife and Marine Resources Department.

SCDNR. undated. South Carolina Heritage Trust brochure. Published by SC Wildlife and Marine Resources Dept (currently SCDNR).

TNC. 1993. ACE Basin biological inventory report, 1990-1992. The Nature Conservancy. Charleston, South Carolina.

TNC. 1994. Rare plant communities of the conterminous United States. Prepared by The Nature Conservancy, Arlington, South Carolina. Prepared for the U.S. Fish and Wildlife Service.

USFWS. 1987. Habitat management guidelines for the bald eagle in the southeast region. U.S. Department of the Interior, Fish and Wildlife Service. Atlanta, Georgia.

Water Resources Division. 1996. Managing resources for a sustainable, the Edisto River Basin project report. Sponsored by the United States Department of Commerce, National Oceanic and Atmospheric Administration. Published by the South Carolina Department of Natural Resources, Columbia.

Webster, W.D., J.F. Parnell, and W.C. Biggs, Jr. 1985. Mammals of the Carolinas, Virginia, and Maryland. University of North Carolina Press, Chapel Hill.

Williams, L.E. 1976. Recovery plan for the eastern brown pelican (preliminary draft). U.S. Department of the Interior, Fish and Wildlife Service. Atlanta, Georgia.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

M
E
N
U

Introduction

Walterboro

Cottageville

Edisto Beach

Other Unincorporated Communities

Growth of Urban Areas in Colleton County

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Urban Areas

Introduction

Although the ACE Basin study area is primarily dependent on agriculture and silviculture as sources of income, diversification in the form of manufacturing and light industry has helped with economic growth and employment in urban areas. (See related section: Socioeconomic Assessment: Industry Characteristics.) Because of this economic growth, residential and urban land use in the study area increased by over 2,000 acres between 1989 and 1994.

Colleton County, in which the majority of the ACE Basin study area is located, is the fifth largest county in South Carolina (See South Carolina counties). Of the six incorporated communities in the county, three (Edisto Beach, Walterboro, and Cottageville) lie within the study area (See Incorporated communities). The unincorporated communities of Hendersonville, Jacksonboro, Green Pond, and Bennet's Point also lie within the study area portion of Colleton County.

Colleton County's 1990 population of 34,377 people is expected to grow to over 47,500 people by the year 2010 (Colleton County Land Use Planning Task Force, 1997). Although a relatively small amount of the county population lives within the incorporated communities (1990 population), these communities are the centers of population growth in the county. In 1990, more than 54 percent (18,701) of the county's population lived in the Walterboro area (Census County Division). Hendersonville (5,595) and Cottageville (4,144) were the next most populous areas of the county in 1990. Rates of population growth in the ACE Basin are projected to be most rapid in Cottageville and Hendersonville with more modest rates of growth occurring in and around the towns of Edisto Beach (Green Pond County Census Division) and Walterboro. Walterboro will likely continue to be the center of greatest population in the ACE Basin for some time to come.

Walterboro

The city of Walterboro is Colleton County's largest incorporated municipality with a population of 5,492 in 1990. Established in 1784, Walterboro was the summer colony for rice planters and offered a haven from the malaria-causing mosquitoes of the coastal swamps and marshes.

Downtown Walterboro

In 1817, Walterboro was designated as the county seat. It continued to grow in the 1800s with the railway connection to Charleston and Savannah. By 1905, a number of industries, including cotton mills, iron works, and oil companies, were located in Walterboro. During the Depression, Walterboro did not experience a major loss of population as occurred in other parts of Colleton County. It fared better because it had become a popular winter home for many Northerners, attracted many visitors, and was the county seat (Walterboro-Colleton Chamber of Commerce, not dated).

Today, the central business district of Walterboro has numerous retail trade businesses and support services, and the city has well-equipped police and fire departments. Walterboro has two National Register Historic Districts, the Walterboro District and the Hickory Valley District, which were designated in 1980. Walterboro also has four historic landmarks, the "Old" Jail, Colleton County Courthouse, "Little Library", and Old Walterboro High School/University of South Carolina-Salkehatchie, which are listed in the National Register of Historic Places.

Land use patterns) in the Walterboro area indicate that development has spread beyond the commercial downtown and adjacent residential areas to the outskirts of the city, along the major highways leading into town and up to the I-95 interchanges (Colleton County Land Use Planning Task Force 1997). Walterboro is currently the only area in the county with public water and sewer systems to accommodate additional growth. Recent growth trends indicate that the highest growth potential will occur in areas east of Walterboro along Highway 17A toward Cottageville and north of Walterboro along Highway 15, where land is available for development.

Back to Top

Cottageville

The large amount of developable land in the Cottageville area increases the likelihood of substantial population growth (See Cottageville Land Cover). Currently, Cottageville has a small, centralized area of commercial and residential development, but growth is spreading along the highways leading from the town and along the banks of the Edisto River. In spite of the absence of public sewer and water systems, projections for population growth show an increase of about 98 percent from 1990 to the year 2010 (Colleton County Land Use Planning Task Force 1997). County planners are faced with the challenge of containing the dispersed development in the Cottageville area and providing the needed infrastructure of public water and sewer, while balancing market needs with traditional uses of farming, forestry, and environmental conservation.

Back to Top

Edisto Beach

Dawhoo Bridge

Another urban center in the ACE Basin is the town of Edisto Beach on Edisto Island. The first Europeans landed on Edisto Beach in 1520. The Dawhoo Bridge, which connects Edisto Island to the mainland, was built in the 1920s. During the 1960s, a portion of Edisto Island underwent an urbanization boom and as a result, in 1970, Edisto Beach was incorporated as a town. (See related section: History.)

As of 1996, this residential beach resort community had a small population of 500 permanent residents. The population greatly increases during the resort season that extends from March to November. Approximately 9,000 people visit Edisto Beach on a daily basis during the peak season from Easter through Labor Day. With an excess of 1,800 homes, Edisto Beach is close to reaching its maximum capacity of homes (Linda Woods, Edisto Beach Administrator, pers. communication). Based on recent projected growth patterns, Edisto Beach could reach its build-out capacity by 2015 (Lowcountry Council of Governments 1996). The population of Edisto Beach has grown significantly over the period 1980 to1990, experiencing an annual average increase of nearly 5.9 percent (Perry et al. not dated). The permanent population of Edisto Beach is not expected to increase dramatically in the near future, unless housing units that are currently rented or used seasonally are converted into permanent or prim ary residences.

The only land approach to Edisto Beach is across Edisto Island. This area is still predominantly rural with agriculture contributing most to the economy. Development of land outside the town of Edisto Beach is limited by the capacity of the public sewer system and difficulty of access. The population of the Charleston County portion of Edisto Island (not including Edisto Beach) is expected to double by the year 2015.

Back to Top

Other Unincorporated Communities

In Colleton County, the unincorporated communities of Green Pond, Hendersonville, Jacksonboro, Ruffin, and Bennett's Point function as cultural, historic, social, or economic focal points for their immediate surrounding areas (See unincorporated communities). These areas, which are predominantly rural with low-density residential development, will be limited in expansion by lack of public sewer and, in some areas, public water supply. Limited growth of small-scale businesses that serve local needs may occur but is not expected to extend in area beyond a half-mile radius of the communities' centers.

Back to Top

Growth of Urban Areas in Colleton County

Because the urban areas of Colleton County are expected to significantly expand over the next decade, the Colleton County Land Use Planning Task Force is developing a land use plan. Potential goals of this plan are to improve the quality of development, minimize the loss of farm and forested lands, discourage urban sprawl, provide better affordable housing, safeguard wetlands, and protect historic and cultural resources. The proposed land use plan can be implemented through application of performance standards and land development regulations that must be met or exceeded before a use is changed or intensified, or a development is permitted. (See related section: Stewardship Development Practices.) The success of the plan depends on the willingness of residents to accept land use planning and development standards as a means of channeling growth in ways that not only enhance economic assets but also maintain the rural way of life.

NEXT SECTION: Forestry

Author

E. Wenner, SCDNR Marine Resources Research Institute

References

Colleton County Land Use Planning Task Force. 1997. Draft Colleton County Land Use Plan. Walterboro, SC.

Lowcountry Council of Governments. 1996. Town of Edisto Beach Comprehensive Plan. Yemassee, SC.

Lowcountry Council of Government. 1997. City of Walterboro Comprehensive Plan. Yemassee, SC.

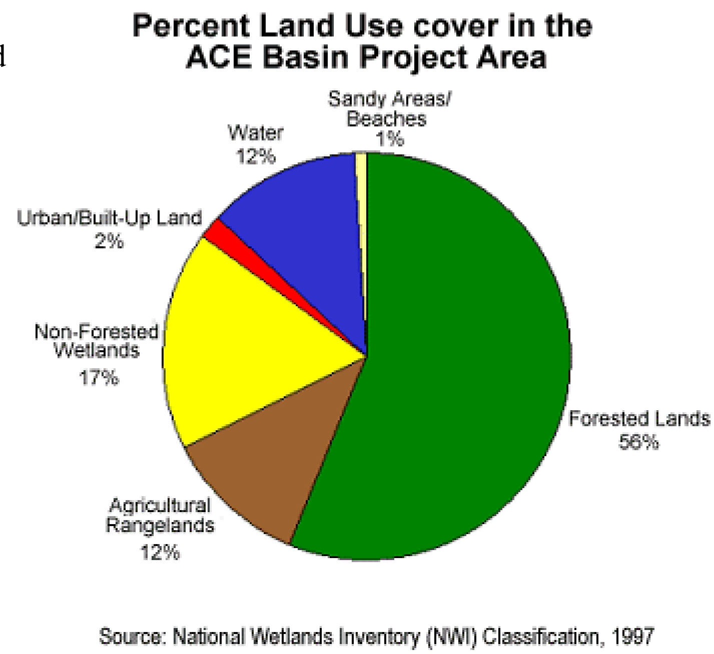
Perry, J.M., L.A. Woods, and J.W. Steagall. Not dated. A study of the economic impact of the ACE Basin Project on Colleton County, South Carolina. University of North Florida, Jacksonville, FL.

Walterboro-Colleton Chamber of Commerce. Not dated. Demographics of Colleton County. Walterboro, SC.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Forestry

Introduction



The forests of the ACE Basin are a vital part of its ecology, economy and beauty, and the practice of forest management is one of the traditional methods endorsed by the ACE Basin Task Force to husband this natural resource and maintain the natural character of the area. Forests are a renewable resource and a new forest can be produced after harvesting, though permanent effects on the ecosystem may not be taken into account. Both natural and planted forests, however, provide a wide range of benefits for wildlife and people. Forest survey reports for 1993 (Conner 1993) indicate that 56 percent of the land use cover (457,069 acres) in Colleton County is classified as timberland. This acreage is dominated by upland planted pine and forested wetlands, with evergreen upland forest, mixed upland forest, and deciduous upland forest being less important (Composition of forested lands). Hardwood-dominated forests constitute only 1.4 percent of the total forested area. Of the total forested acreage for the county, 70 percent is classified as nonindustrial private forest land. This reflects the ownership patterns statewide, where individuals own most of the commercial forest land.

The demand for forest products and the bounty of forests in South Carolina help make timber, with an annual stumpage value of $454 million, South Carolina's most valued agricultural crop. The forestry industry is the third largest industry in the state and ranks fourth in total wages paid among all manufacturing segments. (See related section: Forestry Land Use: Economic Considerations .) The ACE Basin's forests are an important contributor to the economy of the area and the state. In 1994, the value of forest products harvested exceeded $31 million, with additional revenues of $12 million from logging and delivery of timber (Draft Colleton County Land Use Plan 1997). The stumpage value paid to nonindustrial private forest owners in Colleton County in 1996 was $22.2 million (SC Forestry Commission 1996).

Back to Top

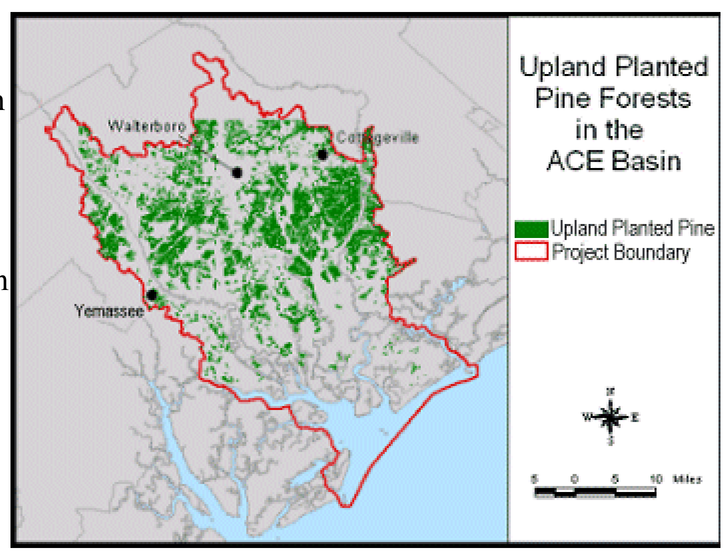
History

Harvesting of pines

Improvement of private forest land through site and tree management has been a major goal of public and private organizations in recent years. Tree planting and tree farming, however, have been fairly recent means of forest replenishment, gaining popularity (and profitability) just since the 1950s. Forestry in coastal South Carolina has undergone a major change in conservation ethic from the days of clearing, cropping, and abandonment that occurred in the cypress-oak-gum dominated flatwoods of the coastal plain in the 1700s (Larson 1951). This trend of clearing and abandonment was repeated in the 1800s, when intensive clearing of forests and conversion to cotton plantations occurred following the invention of the cotton gin. During the post-Civil War reconstruction period, and again, following the 1921 decimation of cotton crops by the boll weevil, land abandonment resulted in the slow regrowth of forests as pines seeded into the abandoned fields. Fewer fires and heavy cutting of pine favored the establishment of aggressive hardwood species and resulted in reinvasion of hardwoods on the original hardwood sites (Larson 1951). Reduction of native longleaf pine forests due to its use in the production of naval stores in the 1800s, the arrival of railroad logging and large bandmills, and the reduced use of fire for management created a niche for loblolly and shortleaf pine in the coastal plain. These became the preferred species for regrowth. For a cultural perspective on the development of the forestry industry of the southern coastal plain, see the account in Hanlon (1970).

Back to Top

Present Status



In recent years, forestry efforts in South Carolina have been oriented toward growing pine for timber, with a resulting 14% increase in pine and oak-pine stands. (Koontz and Sheffield 1993). As of 1993, loblolly-shortleaf pine constituted 212,457 acres (47%) of timberland in Colleton County, followed by forested wetlands, consisting primarily of oak-gum-cypress stands totaling 133,401 acres (29 %). In contrast, longleaf-slash pines constituted of only 20,294 acres (4%) of the total timberland acreage

(Coverage by forest type). In the ACE Basin study area, 185,296 acres are classified as upland planted pine based on the 1997 National Wetlands Inventory, which constitutes most of the total forested land cover. In addition to directed efforts to grow pines by converting scrub oak and other low-quality hardwood stands, natural reseeding of idle or abandoned agricultural land has also favored establishment of loblolly-shortleaf pine.

In 1995, softwood product volume far exceeded hardwood volume in Colleton County. Loblolly and shortleaf pine species provided the greatest volume of any softwood species, while white and red oaks and sweetgum accounted for most of the total hardwood output. Saw logs and pulpwood were the principal products with a combined output of 20.7 million cubic feet. Saw log volume for Colleton County was higher than that produced for other counties in the southern coastal plain (Johnson et al. 1997). Plantings of seedlings since the 1950s has resulted in an increase in growing-stock-- commercially important species qualifying as desirable or acceptable based on tree size (Knight and McClure, 1969; 1979). The net annual growth of growing-stock of all species in Colleton County, exceeded removals for the period from 1986 to 1992. The overall volume of Colleton's standing timber increased an average of 6 - 8% (Draft Colleton Land Use Plan 1997). Sawtimber also increased, with pine constituting 74% of the total board feet for all species. These trends reflect an improvement in tree stocking as a result of intensive forest management.

Back to Top

Forest Management

A common forest management practice in the southeastern United States and Colleton County is the establishment of loblolly or slash pine plantations. After years of rapid growth, these plantations are harvested to produce fiber, lumber, and wood-based chemicals. New trees are then planted and the cycle is repeated (See related section: Forest Regeneration). Each cycle is called a rotation. The length of the rotation is dependent on tree species, economic and growth factors, and landowner objectives (e.g. production of pulpwood, chip and saw, or sawtimber products). During each rotation, the forest must be protected from insects and diseases and cultivated. (See related sections: Insect Infestation and Forest Diseases.) Each year, approximately one percent of the timber in southern forests is lost to fire, insects, and disease. This amounts to 2 billion cubic feet and equates to nearly one-fourth of the harvest volume (SC Forestry Commission, not dated).

Back to Top

Sustainable Forestry

Forestry practices have been associated with a number of negative effects on the environment over the years. These include impacts on habitat, water quality, biodiversity, and scenic vistas (see Forestry Land Uses: Ecological Considerations). Conversion of forests to pine monocultures produces a reduction in diversity of forest-dependent animals, and canopy and subcanopy vegetation (Meffe and Carroll 1994). In a 14-year study of wildlife response to loblolly pine conversion in Alabama, major declines in forb and vine cover were found in the fifth year following pine planting. Populations of quail, raccoon and opossum also declined in later years (Johnson 1986). Although deer forage was reduced, deer populations remained high, possibly due to the mosaic of conversion plots in the study area.

The effect of even-aged pine plantations on the quality of wildlife habitat has become an issue in forestry. Wildlife habitat enhancement will not occur by itself under current timber operations (Yarrow 1990). By using some alternatives in physical design, location, and management of pine plantations, however, habitat quality can be improved (Allen et al. 1996). Modern forest management, where implemented, can increase the diversity and amount of habitat available for a variety of game and non-game species (Hurst and Warren 1980; Dudderer, 1987).

Management practices that use ecological principles to achieve good harvests while maintaining natural biodiversity are gaining acceptance. One approach being used in the southeastern United States involves development of selective harvesting techniques that ultimately produce uneven-aged stands of pine and hardwood as well as a diverse understory (Hunter 1990). This mixed forest community improves habitat quality for game species such as deer and turkey while providing a reasonable economic return from the harvested timber.

Pine plantation

This multiple-use forestry aims at developing and maintaining diverse habitats for wildlife. Forest management practices can be prescribed for the creation of different forest types and trees of different ages across a property.

For this purpose, maintaining scenic vistas is another important forest management issue. Maintaining roadside buffers along well-traveled highways and waterways reduces the visual impact of forest harvests to visitors and residents of the ACE Basin. Expanded roadside buffers can also provide additional wildlife habitat.

Protection of water quality is an important consideration in forest management planning. Management practices described in the South Carolina Forestry Commission's Best Management Practices (BMP) Manual offer guidelines for protecting water quality and maintaining environmental quality. A key feature of BMPs is the establishment of Streamside Management Zones (SMZs) to protect water quality. In SMZs, a forest overstory is maintained in close proximity to a stream system. This helps to stabilize water temperature, protects stream banks from erosion, and provides a habitat for wildlife. Streamside Management Zones protect headwaters, perennial, and intermittent streams, and reduce sedimentation by forming a buffer around sensitive environmental areas.

Many private forest landowners in the United States, including those in the ACE Basin, are using sustainable forest management techniques. The American Tree Farmer System is an organization with more than 70,000 members nationwide and upwards of 60 members in Colleton County who are committed to excellence in forest stewardship. Members strive to protect watersheds and wildlife habitat, conserve soil, and maintain aesthetics of forests while continuing to harvest wood products. The benefits of membership in the Tree Forest System include recognition of the importance of, and satisfaction in, practicing sustainable forestry. Other benefits are improvement in timber yield, tax benefits, improvement in habitat and water quality, and preservation of the aesthetic beauty which is inherent in forested lands.

The application of sustainable forest management by

Sweetgum tree
(Liquidambar styraciflua)

private landowners is also encouraged by federal, state, and industry-sponsored assistance programs. The federal government offers several federal assistance programs that provide financial assistance for reforestation and timber stand improvement (Varnedoe 1993; USDA Forest Service, not dated).

Seven states, including South Carolina, have financial assistance programs for private timberland owners. The Forest Renewal Program in South Carolina was established in 1982 to assist woodland owners in reforesting poorly stocked or idle forestland. Eligible practices include site preparation and planting, timber stand improvement, and natural regeneration techniques. The assistance is available to any private individual or group which is not involved in the manufacture of wood products provided there is a minimum of 10 acres and the land is capable of producing at least 50 cubic feet of industrial wood per acre per year. Currently, the average cost-share is 50% and the maximum is limited to the amount needed to complete the practice on 100 acres (Varnedoe 1993).

Industry-sponsored landowner-assistance programs are operated by many forest industry companies in the South. Since 70% of the forested lands in the ACE Basin are privately owned, industry depends heavily on private lands in the area for its raw material. Industry-sponsored programs benefit both landowner and industry because the landowner receives good management advice from professional foresters to maximize their forest investment, and the forest industry ensures a renewable resource to meet its needs for wood and paper products. Industry foresters aid landowners by helping them develop a forestry management plan and suggesting ways to lower costs and take advantage of available forestry programs. Specific services provided by some landowner assistance programs include free seedlings, boundary and fire line maintenance, insect and disease control, and relevant tax advice. Each company's program is different but the goal remains the same: the growth of trees to meet future needs for wood and timber products (Shaddeau 1993). In the ACE Basin, Westvaco and Georgia-Pacific are major industry foresters who have landowner assistance programs.

In 1994, the American Forest and Paper Association, whose members own 90% of the industrial forestland in the US, adopted the Sustainable Forestry Initiative Program (SFI). This program is a comprehensive system of principles, guidelines, and performance measures that integrates the growth and harvesting of trees with the protection of wildlife, plants, soil, air and water quality. The five principles and twelve guidelines established by the SFI program are designed to assist member companies in practicing sustainable forestry and improving their performance. Since its inception, the SFI program has enrolled 54

Mixed loblolly pine hardwood forest

million acres of forestland, educated 20,000 loggers and foresters in sustainable forestry practices, distributed information on sustainable forestry to 86,000 landowners, and spent $178 million on research related to forestry, wildlife biodiversity, ecosystem management, and the environment (American Forest & Paper Association, 1998).

An example of an industrial landowner that is practicing sustainable forestry in the ACE Basin is Westvaco Corporation, the single largest private landowner there. The company manages its property in South Carolina to produce a continuous supply of wood and wood fiber for two company sawmills and a paper mill. Whenever possible, Westvaco applies an award-winning "Ecosystem-Based Multiple Use Forest Management System" on a comprehensive basis throughout entire watersheds. These same techniques are promoted for use by private landowners who are enrolled in the company's Cooperative Forest Management program. Westvaco's system promotes the use of intensive management practices on portions of each landholding while remaining portions are managed less intensively for timber production and more intensively for water quality and habitat diversity. These latter areas provide older forest habitats which are of value to certain wildlife species (Muckenfuss 1994).

Back to Top

The Future of Forestry

Conversion to agriculture and expansion of urban and suburban areas poses the largest threat to the natural forests of the ACE Basin. The outlook for forestry in the ACE Basin, however, is one which reflects advances in science and technology balanced with conservation. These advances will continue to help forest landowners meet increasing needs for renewable wood and paper products for local and global markets.

At the same time, more and more forest management schemes which seek to use ecological principles to achieve sustained harvests are being implemented. For example, foresters must comply with the Forestry Commission's Best Practices Manual EXIT where ever there is discharge of dredge or fill materials into jurisdictional wetlands or where there is a potential for violating the water quality criteria of the South Carolina Pollution Control Act. In summary, an increasing awareness of forest ecology and protection of soil and water in concert with sustainable forest management will help maintain the integrity of forests and contribute to the quality of life in the ACE Basin (see Forestry Land Use: Management).

NEXT SECTION: Agriculture

Authors

E. Wenner, SCDNR Marine Resources Research Institute

L. Zimmerman, SCDNR Marine Resources Research Institute

References

Allen, A. W., Y. K. Bernal, and R. J. Moulton. 1996. Pine plantations and wildlife in the southeastern United States: an assessment of impacts and opportunities. U.S. Department of the Interior, National Biological Service. Information and Technology Report No. 3.

[AFPA] American Forest and Paper Association. 1998. Sustainable forestry initiative program-showing the world a higher standard. Tree Farmer Special Issue. American Forest and Paper Association, Washington, DC.

Anderson, R. L. and H. D. Brown. 1993. Disease control in southern forests. Forest Farmer 29:45-49.

Conner, R. C. 1993. Forest Statistics for South Carolina, 1993. Resource Bulletin SE-141. U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station, Asheville, NC.

Draft Colleton County Land Use Plan. 1997. Report of the Colleton County Land Use Planning Task Force to the Colleton Area Joint Planning Advisory Commission.

Dudderer, G. 1987. How harvest methods affect wildlife. American Forestry 93(9/10):23,77.

Hanlon, H. A. 1970. The bull-hunchers: A saga of the three-and-a-half centuries of harvesting the forest crops of the Tidewater Lowcountry. McCain Printing Company, Parsons, WV.

Hunter, M. L. 1990. Wildlife, forests, and forestry: Principles of managing forests for biodiversity. Prentice Hall, Englewood Cliffs, NJ.

Hurst, G. A. and R. C. Warren. 1980. Intensive pine plantation management and white-tailed deer habitat. Annual Forestry Symposium 29:90-102. Louisiana State University, Baton Rouge, LA.

Johnson, T. G., A. Jenkins, D. O. Stratton, and P. S. Bischoff. 1997. South Carolina's timber industry - an assessment of timber product output and use, 1995. Resource Bulletin SRS-16. U.S. Department of Agriculture, Forest Service, Southern Research Station, Asheville, NC.

Johnson, K. G. 1986. Responses of wildlife to large scale even-aged silvicultural practices. Alabama Department of Conservation. Final Report, Project No. W-35.

Knight, H. A. and J. P. McClure. 1968. South Carolina's timber, 1968. U.S. Department of Agriculture, Forest Service, Forest Experiment Station. Resource Bulletin SE-13. Asheville, NC.

Knight, H. A. and J. P. McClure. 1979. South Carolina's forests. U.S. Department of Agriculture, Forest Service, Forest Experiment Station. Resource Bulletin SE-51. Asheville, NC.

Koontz, B. L. and R. M. Sheffield. 1993. Forest statistics for the southern coastal plain of South Carolina, 1993. U.S. Department of Agriculture. Resource Bulletin SE-140.

Larson, R. W. 1951. The timber supply outlook in South Carolina. Forest Resource Report No. 3. United States Department of Agriculture, Forest Service, Washington, DC.

Meffe, G. K. and C. R. Carroll. 1994. Principles of conservation biology. Sinauer Associates Inc., Sunderland, MA.

Muckenfuss, E. 1994. Cooperative ecosystem management in the ACE Basin. Journal of Forestry 92(8):35-36.

Pase, H. A. III. and R. F. Billings. 1993. Old and new pests in the southern forest. Forest Farmer 29:50-54.

South Carolina Forestry Commission. 1996. Value of South Carolina's forest resource industry. Website http://www.state.sc.us/forest/mval.htm. Accessed September 1998.

South Carolina Forestry Commission. Not dated. SCFC Forest Management Facts. Website: http://www.state.sc.us/forest/refmgt.htm. Accessed September 1998.

Shaddeau, S. 1993. Industry sponsored landowner assistance programs. Forest Farmer 29:35-37.

United States Department of Agriculture, Forest Service. Website: http://www.fs.fed.us/. Accessed August 1998.

Varnedoe, L. E. Jr. 1993. Government programs available to timberland owners. Forest Farmer 29:32-34.

Yarrow, G. K. 1990. Wildlife management: Farms and woodlands. Clemson University Pamphlet EC 666. Clemson University, Clemson, SC.

M
E
N
U

Introduction

Current Crops

Economy of Agriculture

Declines in Agriculture

Environmental Effects of Agriculture

Conservation Measures

Conclusion

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Agriculture

Introduction

Sea island agriculture - tomato fields in Edisto Island

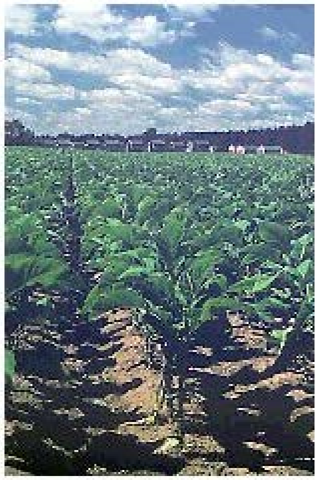
Agriculture is a dominant activity that has significantly altered the landscape in the ACE Basin study area. Its importance to the area dates back to the 1600s when rice, indigo and cotton were the principal crops. Early colonists to the ACE Basin study area were planters and the agrarian society created by them shaped the landscape and urban developments of the region. Agricultural lands occur throughout the ACE Basin study area with high concentrations of croplands on Edisto Island, northwest of Walterboro, and southeast of Yemassee. Twelve percent of the land in the study area has been developed for agriculture, orchards, vineyards or groves. Because the majority of the study area (67%) lies within Colleton County and most agricultural statistics are reported on a county level, most information reported here will concern Colleton County (Agricultural lands).

Back to Top

Current Crops

Today, agriculture in the ACE Basin study area focuses on crops such as soybeans, wheat, corn, and hay, although cultivation of watermelons and other vegetables has increased over the past five years (Perry et al not dated; Graham and Pavlasek 1996) Soybean is the most cultivated crop in the counties within and surrounding the ACE Basin study area. In 1996, 714,500 bushels of soybeans were produced in Dorchester, Charleston, Hampton, Beaufort and Colleton Counties combined. Wheat was the second most cultivated crop in these counties with 593,700 bushels produced.

Colleton County alone produced 215,600 bushels of soybeans and 129,500 bushels of wheat during 1996. In 1995, Colleton County ranked seventh in the state for the production of corn for grain, with 12,650 acres harvested. (Crop production data for Colleton



Tobacco field

County 1989, 1995). In 1996, 1500 acres of cotton were planted, 426 acres of tobacco were planted, and a very small amount of peanuts were cultivated (Graham, R. A., pers. comm.).

Livestock and livestock products are also significant with 21,600 head of cattle, 19,500 head of swine and 45,700,000 eggs produced during 1996 in the counties within and surrounding the ACE Basin study area. Colleton County produced 8,500 head of cattle, 7,800 head of swine, and 7,800,000 eggs in 1996.

In recent years, commodity prices have declined and farmers in the ACE Basin are attempting to diversify. One means of diversification is truck farming. Truck farming is the large-scale production of vegetable crops with long distance distribution to markets by road or rail. Currently, the largest truck crop in Colleton County is watermelon with 2800-3000 acres harvested. Other truck crops in Colleton County and the other counties surrounding the ACE Basin include cabbage, collards, squash, cantaloupe, and strawberries. These crops are generally distributed to supermarket chains along the northern east coast of the United States.

Back to Top

Economy of Agriculture

Farming is an important economic activity in the ACE Basin study area. Farming in Charleston, Dorchester, Hampton, Beaufort and Colleton Counties contributed $108 million in cash to the economy in 1996. In Colleton County, farming directly contributed $15.8 million in cash to the local economy, with 75% resulting from crops and the remainder from livestock. However, there has been a decline in full-time farming in the counties within and surrounding the ACE Basin study area since 1978 (Agricultural characteristics for Colleton County). The number of farms has declined at an average annual rate of 1.2% from 1982 to 1996. This is greater than the statewide decline of 0.98% over the same time period.

Acreage of farmland has also decreased substantially (1.6% average annual rate) in these counties and the average size of farms has decline in Colleton, Beaufort and Hampton Counties (0.75% average annual rate). In comparison, farmland declined 0.075% per year at the state level for the period 1982-1996, with farm size increasing at an annual average of 0.3% per year.

Back to Top

Declines in Agriculture

Urbanization is probably a leading cause of the reduction of farmlands in South

Using tractors to cultivate fields

Carolina. As urbanization increases, land prices escalate (The Community Leader's Letter 1997). High land prices, which exceed $950 an acre in Colleton County, mean that farmers often profit more from selling the land than from farming the land. However, farmers who are effective at direct marketing of fruit and vegetable crops can make a substantial profit in the new urbanized environments (The Community Leader's Letter 1997). Reduction of federal farm support programs has also allegedly contributed to loss of farms and farmland (Beasley et al. 1996). Concomitant with declining farm acreage, there has been a reduction in the number of full-time farmers. The number of individuals reporting farming as their primary occupation in Colleton County declined from 251 to 209 over the 1982-1992 period. In 1992, nearly 60% of farm operators in Colleton County were part-time farmers.

Declines in farm acreage have not necessarily resulted in decreased yields. In general, yield per acre has increased in the coastal plain without additional land under cultivation (McKenzie et al. 1980). In Colleton County, several major crops showed an increased yield per harvested acre from 1989 to 1995 (Crop production data for Colleton County 1989, 1995). Modern advances in the use of fertilizers, pest control, plant genetics and mechanization of farming have contributed to more efficient production.

Back to Top

Environmental Effects of Agriculture

Pest management uses natural enemies to control agricultural pests

Although the importance of agriculture to the ACE Basin study area is rooted deep in history and has contributed significantly to the area's economy, farming has also had a major impact on the environment. Activities such as land clearing, irrigation, impounding of wetlands, ditching, and soil cultivation have markedly altered the landscape of the region. Agricultural effects on water quality have also had a noteworthy impact. Soil erosion and compaction are major contributors to increased sediment load in surface waters. Nonpoint source runoff from agricultural areas carries fertilizers (nitrates and phosphates), pesticides, animal waste, and sediment into the watershed. These compounds may be directly toxic to aquatic life or may contribute to eutrophication and oxygen depletion. Agricultural nonpoint source pollution is a concern of most farmers, not only because it degrades surface and ground waters, but it can also lower productivity through loss of topsoil, nutrients and chemicals.

Conservation measures have been developed that help the farmer minimize agricultural nonpoint source pollution. Many of these are described in the handbook *Farming for Clean Water in South Carolina* (DeFrancesco 1997).

Back to Top

Conservation Measures

There are many different types of agricultural practices utilized in Colleton County. These practices attempt to provide maximum crop and livestock yields while minimizing environmental impacts (Agricultural practices in Colleton County). The agricultural practices most widely used (in terms of acreage) in Colleton County are: (1) crop rotation; (2) integrated pest management; (3) weed management; (4) runoff management; (5) nutrient management; and (6) pasture management.

Insect trap

The Conservation District office in each county of South Carolina provides advice to farmers on how to best manage their land (See related section: Agricultural Best Management Practices). Conservation Districts are part of a nationwide group of local organizations directed by local farmers and other individuals (DeFrancesco 1997). The Conservation District has staff available from both the South Carolina Department of Natural Resources Land Resources and Conservation Districts (LRCD) and the USDA Natural Resources Conservation Service (NRCS). This staff is available to provide free advice concerning wildlife, forestry, and other natural resources topics. The NRCS provides on-site technical assistance in planning and installing conservation measures and the LRCD offers educational and other benefits through the Department of Natural Resources. The Cooperative Extension Service is another agency, which promotes best management practices.

Numerous programs administrated by the USDA are designed to promote conservation. These programs are designed to protect the economic stability of farmers and ensure a continuous supply of agricultural products for the public while promoting the conservation of land, water, and other natural and historic resources (USDA Conservation and Environmental Programs, not dated). Several **federal assistance programs** (CRP, EQIP, WRP, and WHIP) are available to foresters. **Conservation plans** that are available include the Farmland Protection Program, Conservation of Private Grazing Land Initiative, and the Conservation Farm Option.

Back to Top

Conclusion

Maintenance of agricultural operations in the ACE Basin study area is dependent upon a broad economic base of cash crops and livestock. In order for agriculture to continue as a viable practice, prime agricultural land must be protected as a valuable natural resource, farming practices must be improved and agriculturally-based businesses enhanced (Beasley et al. 1996). The agricultural landscape adds to the quality of life by providing open space to balance that of urban areas in the ACE Basin study area and contributes in the long-term to the economic, social and ecological fabric of the area.

NEXT SECTION: Commercial Fisheries

Author

E. Wenner, SCDNR Marine Resources Research Institute

References

American Farmland Trust. Not dated. Farmland Protection Program Fact Sheet website: http://farm.fic.niu.edu/fic-ta/tafs-fpp.html. Accessed August 1998.

Beasley, B. R., W. D. Marshall, A. H. Miglarese, J. D. Scurry, C. Vanden Houten. 1996. Managing resources for a sustainable future: The Edisto River Basin project report. Report 12. South Carolina Department of Natural Resources, Water Resources Division. Columbia, SC.

DeFrancesco, D. J. 1997. Farming for clean water in South Carolina: A handbook of conservation practices. South Carolina Department of Natural Resources, Division of Land and Conservation Districts, and U.S. Department of Agriculture, Natural Resources Conservation Service. Columbia, SC.

Graham, R. A. pers. comm. U.S. Department of Agriculture, National Agriculture Statistics Service. 1996.

Graham, R. A. and S. Pavlasek, Jr. South Carolina Agricultural Statistics--Crops, Livestock, and Poultry 1994-1996. South Carolina Agricultural Statistics Service, Columbia, SC.

McKenzie, M. D., J. V. Miglarese, B. S. Anderson, and L. A. Barclay, (eds.). 1980. Ecological characterization of the Sea Island coastal region of South Carolina and Georgia. Vol. II: Socioeconomic features of the characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-79/41.

North Carolina State University, Not dated. Watersheds Wetland Protection website: http://h2osparc.wq.ncsu.edu/info/wetlands/protect.html#swamp. Accessed August 1998.

Perry, J. M., L. A. Woods, and J. W. Steagall. not dated. A study of the economic impact of the ACE Basin Project on Colleton County, South Carolina. Department of Economics and Geography, University of North Florida, Jacksonville, FL.

The Community Leader's Letter. 1997. Urbanization makes state's farm land too expensive for growing row-crops. Community and Economic Development Program Clemson University, Clemson, SC.

United States Department of Agriculture. Not dated. Conservation and Environmental Programs Divisions website: www.fsa.usda.gov/dafp/cepd/cepdmission.htm. Accessed August 1998.

United States Department of Agriculture. Not dated. Conservation Programs website: http://www.nrcs.usda.gov/NRCSProg.html#Anchor-Conservation. Accessed August 1998.

Commercial Fisheries

Introduction

The estuaries of South Carolina have a long history of commercial and recreational fisheries (McKenzie et al. 1980, Sandifer et al. 1980). Historically, these have included shrimping, crabbing, oystering, as well as hook-and-line fishing for a variety of fish species. Commercial fisheries have significant economic and social impacts on the coast of South Carolina, including the ACE Basin. The communities of Bennetts Point and Edisto Beach serve as focal points for both shrimp and shellfish fisheries. The ACE Basin also serves as an entry point for commercial vessels that work offshore areas for sharks, black sea bass, and other finfish. Although not addressed in this product, those landings make an economic impact on the ACE Basin region.

Fishery products landed in the ACE Basin are consumed locally as well as transported to larger regional markets. In addition to the direct economic impacts of the fisheries, fishing communities also serve as focal points for residents not directly supported by the fisheries, as well as for tourists from other areas of the state and southeast region.

What makes up a commercial fishery? It is a combination of a particular harvestable resource such as shrimp or oysters, the ecosystem that supports the resource, and the individuals and materials that are required to harvest the species and prepare it for final sale to the end user.

Until the late 1940s and early 1950s, most commercial fishing was done out of small non-motorized vessels using simple fishing gear (Bishop et al. 1994; Iversen 1996). The development of larger vessels with diesel engines and hydraulic winches allowed fishermen to remain at sea for longer periods under a wider range of weather conditions, increasing the efficiency of commercial fisheries. The total value of South Carolina commercial fisheries in 1996 was just under $25 million.

With advances in technology and more efficient fishing techniques, serious impacts to the fortunes of various fisheries worldwide have become more apparent (Iversen 1996). Within South Carolina fisheries, these included the closure of the sturgeon fishery in 1985 (Taub 1990); restrictions on fishing season, catch limits, and legal trawling areas for the shrimp fishery (McKenzie et al. 1980); and designation of several species as game fish, including red drum and spotted seatrout, in order to reduce harvest pressure. Other fisheries also had limits placed on them to reduce fishing pressure and protect stocks.

These management efforts were based on extensive fisheries research as well as considerations of the social and economic impacts that result from changing the status of a fishery. Currently, fisheries management is focused on allowing a sustainable harvest of each regulated species. This requires extensive efforts to educate commercial and recreational fishermen on the benefits and costs of managing a fishery. Fisheries managers must weigh the benefits of stock protection against the social and economic impacts to individual fishermen and the local economy. (See related section: Fisheries Management.)

Back to Top

Dependence of Commercial Fisheries on Estuarine Habitats

Many of the species that are important to commercial and recreational fishermen are dependent on the freshwater and estuarine habitats that make up South Carolina's coast. Small, incremental changes in coastal habitats associated with the use and development of the coast may be affecting marine fisheries (Iversen 1996; Royce 1996). Obvious changes, such as the construction of dams which change flow patterns and become obstacles to fish migration, are relatively easy to identify (Taub 1990). More subtle changes, such as dredging and filling wetland estuarine areas and upland habitat modifications such as suburban and urban development, can also affect commercial and recreational species in ways that are difficult to identify as to cause and effect. These subtle changes are having impacts on many commercial species worldwide, requiring fisheries managers to consider the effects of environmental changes on fish stocks and fishery management plans (Royce 1996). In South Carolina, this is most evident in the closing of shellfish beds because of increased fecal coliform bacteria counts in the water. Bed closures are slowly increasing in number and area as coastal areas are developed (Trends in fecal coliform levels).

Back to Top

Agencies Responsible for Fisheries Management

The management of commercial fisheries in South Carolina is done by a variety of governmental agencies, including the United States National Marine Fisheries Service (through the Endangered Species Act), the Atlantic States Marine Fisheries Commission, and the South Carolina Department of Natural Resources. The principal government organization responsible for scientific research, management, and the enforcement of fisheries laws is the South Carolina Department of Natural Resources. In many cases managed fish populations cross political borders, requiring the SCDNR to interact with other state and federal organizations such as the South Atlantic Fishery Management Council or the Atlantic States Marine Fisheries Commission. Within the SCDNR, estuarine and marine species are managed by the Marine Resources Division's Office of Fisheries Management, while freshwater species are managed by the Freshwater Fisheries Section of the Wildlife and Freshwater Fisheries Division.

Back to Top

Commercial Fisheries in the ACE Basin

In the ACE Basin, the principal commercial fisheries target Penaeid shrimp (white and brown), blue crab , and oyster and clams . Other species of lower commercial importance are whelk, shad , sturgeon , horseshoe crab , flathead catfish , spot, kingfish, and sharks. The total commercial landings for Colleton County, which largely encompasses the ACE Basin, have an estimated value between $750,000 and $1,500,000 per year. Over 90% of this is from the shrimping industry.

To date, there has been no accurate mechanism to evaluate the number of individuals active in the fishery industry of the ACE Basin. A rough estimate of 200-400 individuals, including fishermen, dockworkers, and seafood dealers, was provided by the Office of Fisheries Management of the SCDNR. Due to the limited number of individuals working in some of these fisheries, landings and value of particular fisheries are not reported for reasons of business confidentiality. Individuals requiring more complete data may contact: SCDNR, Marine Resources Division, Office of Fisheries Management, Fisheries Statistics Section.

NEXT SECTION: Recreational Fisheries

Author

G. Riekerk, SCDNR Marine Resources Research Institute

References

Bishop, J. M., G. Ulrich, and H. S. Wilson. 1994. We are in trim to due it: A review of Charleston's mosquito fleet. Reviews in Fisheries Science 2(4):331-346.

Iversen, E. S. 1996. Living marine resources: Their utilization and management. Chapman and Hall, New York, NY.

McKenzie, M. D., J. V. Miglarese, B. S. Anderson, and L. A. Barclay, (eds.). 1980. Ecological characterization of the sea island region of South Carolina and Georgia. Vol. II: Socioeconomic features of the characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington DC. FWS/OBS-79/41.

Royce, W. F. 1996. Introduction to the practice of fishery science. Academic Press, San Diego, CA.

Sandifer P. A., J. V. Miglarese, D. R. Calder, J. J. Manzi, and L. A. Barclay. 1980. Ecological characterization of the Sea Island coastal region of South Carolina and Georgia, Vol. III: Biological features of the characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-79/42.

Taub, S. H. 1990. Fishery management plan for Atlantic sturgeon. Fisheries Management Report 17. Atlantic States Marine Fisheries Commission. Washington, DC.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Introduction
Access
References

M E N U

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Recreational Fisheries

Introduction

Recreational fishing is an activity that attracts people, regardless of race, sex or income level, and can often influence the economy of a given area (Hammond and Cupka 1977; Smith and Moore 1981). A variety of fishing opportunities exist in the ACE Basin study area, in habitats that range from black water streams and swamps to intertidal marshes (See related section: Flats Fishing), creeks and the ocean surf (Beasley et al. 1996). People have utilized the freshwater and marine fishery resources of the ACE Basin study area ever since the Native American tribes lived in the area.

In modern times, marine and freshwater recreational fishery resources of the Basin have become very important to the economics and aesthetics of the area. Most of the fishing activity is centered in the Edisto, Ashepoo, and Combahee Rivers, but other small streams in the watershed do provide some opportunities, especially for bank anglers. Most recreational fishing is done from small boats, but bank anglers use areas around landings and bridges. Because of the remoteness of the area, travel upstream in the rivers is often difficult due to obstruction by fallen trees.

Bank fishing

In general, participants in the recreational harvest of fishes approach this activity in two different ways. The first, undirected fishing, occurs when anglers fish without having a target species (i.e., it does not matter what species they catch). Directed fishing occurs when anglers target specific species of fishes. For example, many saltwater recreational participants target red drum in the ACE Basin study area. Most fishermen who utilize shore-based access points are undirected in their efforts. These anglers who fish from bridges and piers or in the surf are general in their preferences and usually keep all of their catch, which is likely comprised of the more numerous small fishes which commonly inhabit freshwater areas (sunfish), estuarine creeks, or surf zones (spot, Atlantic croaker, silver perch, hardhead catfish, southern kingfish and pinfish) . Those anglers who target specific fishes (directed anglers) use small boats to seek the preferred habitats for the more desirable recreational fishes (largemouth bass, red drum, spotted seatrout, southern flounder, sheepshead).

Although the species composition sampled from creels of both types of anglers may show considerable similarity, undirected fishermen catch what they can and largely keep what they catch.


Recreational fishing in the ACE Basin

High levels of exploitation by fishermen coupled with the loss of productive habitat due to coastal development and pollution, have a major impact on the stocks harvested by recreational fishers. Regulations that provide for the maintenance of exploited populations at acceptable and healthy levels of abundance require basic knowledge of the dynamics of the individual species that comprise the catch. The most fundamental information required for an assessment of an exploited population is total catch (i.e. harvest) and a measure of fishing effort. The estimation of the total fishing effort is the product of the number of participants in the fishery, the average number of trips made by each participant, and the average number of hours fished by the angler. Using creel survey techniques, interviews of participants at access points can provide the data necessary to evaluate fishing effort.

Back to Top

Recreational Fishing Access

Fishing in waters of the ACE Basin study area is a year-round activity; however, the number of individuals pursuing this pastime decreases in winter. Opportunities to catch many different species and sizes of fishes result from the diversity of habitats in the Basin. In fresh water, fishing ranges from tidally influenced areas to constantly free-flowing sections of rivers and creeks. Impoundments in the ACE Basin study area also provide an opportunity for freshwater anglers; however, most of these are privately owned and require permission for access. The majority of freshwater angling is done from small to medium size boats (3.0-4.6 m or 10-17 ft.). Much of the access to area waters is gained by public boat ramps located throughout the ACE Basin study area. There are also many private ramps in freshwater reaches of the study area. A smaller percentage of angling is done by bank anglers, whose activity is concentrated around bridges, landings and private docks.

Estuarine waters in Cape Romain Wildlife Refuge and the ACE Basin study area are considered to be the best inshore saltwater fishing locations in the state. In the latter, inshore anglers may fish in the surf of the front beaches of the barrier islands as well as

Surf fishing

from bridges, piers and boats throughout the many rivers and tidal creeks in the ACE Basin study area and St. Helena Sound. An important and commonly overlooked sector of the marine recreational fishing community is the group of anglers who fish from shore and as such are not required to purchase a fishing stamp. Statewide, most shore-based anglers use fishing piers (69%) which extend into the ocean (Low et al. 1996). Fishing from natural beaches, piers, docks and bridges provides other means of participation, and the popularity of these access points has increased. Shore-based fishermen catch a variety of species in the marine section of the ACE Basin study area, including spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogonias undulatus*), bluefish (*Pomatomus saltatrix*), summer and southern flounders (*Paralichthys dentatus* and *P. lethostigma*), spotted seatrout (*Cynoscion nebulosus*), red drum (*Sciaenops ocellatus*), black drum (*Pogonias cromis),* pinfish (*Lagodon rhomboides*), southern and gulf kingfish (*Menticirrhus americanus* and *M. littoralis*), and sheepshead (*Archosargus probatocephalus*), as well as several different types of small sharks and rays.

In those areas where the public has access to beaches in the ACE Basin study area (Edisto Beach, Edisto Beach State Park, and Hunting Island State Park), surf fishing is popular. On Edisto Beach, anglers walk from the State Park to fish near Jeremy Inlet. The southwest end of Edisto Beach, known as Big Bay Break, is also a popular place to surf fish. Hunting Island State Park has approximately four miles of beachfront for surf fishing as well as a fishing pier in the inlet. Species of primary interest at these sites are the two species of flounder, spotted seatrout, southern kingfish, spot, Atlantic croaker and small sharks (Waltz and Moore 1987).

Paradise fishing pier

Fishing from man-made structures such as piers, bridges, catwalks and docks provides the angler an opportunity to fish in waters that are not reachable from natural shorelines. The popularity of these sites is due to their accessibility by land, which allows fishing by those without boats. The only commercial pier located in the ACE Basin study area is Paradise fishing pier at Hunting Island State Park.

Most boat ramps have a catwalk and a floating dock next to them. Although the primary function of these is to facilitate loading and off-loading of people and equipment, they are a favorite location for recreational anglers to fish, crab and shrimp. In many areas, the demand for public fishing platforms is so great that docks are used frequently by many anglers. The high rate of usage of these structures has given rise to conflicts between boaters and anglers. In Colleton County, Chehaw Boat Landing, West Bank, and Brickyard Ferry Boat Landing are public piers with fixed and/or floating docks (W. Waltz, 1998, pers. comm.).

Bridge fishing is discouraged in the ACE Basin study area due to safety issues. The Brickyard Ferry Boat Landing, which was converted into a fishing pier from part of an abandoned bridge, provides fishing near the SC 26 bridge over the Ashepoo River.

Because of the remote nature of the ACE Basin study area, most recreational anglers gain access to the tidal salt and estuarine waters in private boats that leave from ramps or marinas (Boat landings) In terms of number of participants, those fishing from small boats constitute the largest segment of the recreational finfish fishery. From a telephone poll of coastal households in the State, Low et al. (1996) reported that 63% of the 1.5 million trips made by recreational anglers were in private boats. About 72% of the trips originated from public access points, with launching ramps accounting for 56% of all trips. The most popular species sought by boat anglers were red drum, spotted seatrout, and southern flounder.

Most of the launching ramps in the ACE Basin study area are owned and operated by local county governments. Other public ramps fall under the jurisdiction of federal, state and municipal agencies. Upgrading and expanding existing landings to accommodate other activities such as shore-based fishing would enhance their usage and help meet the growing need for water-based and related recreation. Commercial boat ramps are also available to the general public for a daily user fee. These are generally associated with marinas and provide access to additional facilities such as bait, tackle, food, and fuel not found at public ramps. The Edisto Island Marina on Big Bay Creek is the only marina located in the ACE Basin study area.

For more information, link to **Freshwater Fisheries** and **Saltwater Fisheries**.

NEXT SECTION: Hunting

Author

E. Wenner, SCDNR Marine Resources Research Institute

References

Beasley, B.R., W.D. Marshall, A.H. Miglarese, J.D. Scurry, and C. Vanden Houten. 1996. Managing resources for a sustainable future: The Edisto River Basin Project Report. South Carolina Department of Natural Resources, Water Resources Division, Columbia, SC.

Hammond, D.L. and D.M. Cupka. 1977. An economic and biological evaluation of the South Carolina pier fishery. South Carolina Marine Resources Center Technical Report, No. 20. South Carolina Wildlife and Marine Resources Department, Charleston, SC.

Low, R.A., C.W. Waltz, and D.B. Stone III. 1996. South Carolina marine recreational fishery survey, 1995. Marine Resources Division Data Report, No. 24. South Carolina Department of Natural Resources, Charleston, SC.

Smith, J.W. and C.J. Moore. 1981. An inventory of access points and areas available to saltwater recreational fishermen in coastal South Carolina, with recommendations for upgrading and expansion of these facilities. Report submitted to South Carolina Coastal Council for contract #80-105. South Carolina Wildlife and Marine Resources Department, Charleston, SC.

Waltz, W. and C.J. Moore. 1987. Public access to marine recreational fishing in South Carolina. Unpublished report. Recreational Fisheries Program, South Carolina Wildlife and Marine Resources Department. Charleston, SC.

Waltz, W. 1998. Personal communication. South Carolina Department of Natural Resources, Charleston, SC.

MENU
Overview
White-tailed Deer
Wild Turkey
Bobwhite Quail
Mourning Dove
Eastern Gray Squirrel
Rabbit
Terrestrial Furbearers
Waterfowl
Alligator
The Future of Hunting
References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Hunting

Overview

Prescribed burning

Hunting has a long history in the ACE Basin study area. Native Americans co-existed with wildlife species taking what they needed to survive. The Indian tribes hunted white-tailed deer for a variety of uses including food, tools made of bone, clothing, and temporary housing made of hides. They even practiced controlled burning as a form of wildlife management that is still used today. Their goal was to burn off the understory, thereby driving game from cover. However, this technique also opened the forest for new growth, thus benefitting the deer herds and other wildlife (Culler 1978).

The arrival of European settlers marked the beginning of unregulated hunting to meet market demands. From 1755 to 1773, the hides from 600,000 deer were shipped to Europe from Savannah. Between 1739 and 1762, the port of Charles Town shipped between 59,420 and 161,024 kg (131,000 to 355,000 pounds) of deer hides annually. As the coastal region became more populated, settlers engaged in large-scale land clearing for crop production. For wildlife, this resulted in loss of habitat and competition with livestock for forage. Excessive harvest and loss of habitat forced deer and turkeys into the deep swamps while small game species proliferated around agricultural fields, ditches, and edge habitats (Culler 1978).

Declines in the deer population became evident in the 1700s when settlers passed laws providing a bounty on deer predators such as bobcats, bears, and wolves. In 1752, an act was passed that prohibited making wagers on the maximum amount of game killed. In 1769, the first law regulating deer hunting was passed in South Carolina. This act, "for the preservation of deer and to prevent the mischief arising from hunting at unreasonable times," established some of the first rules for hunting, including specific seasons for does and bucks, a penalty for night hunting, and a limit on hunting area to within 11.26 km (seven miles) of a hunter's place of residence (Culler 1978).

During the period from 1850 to 1925,

Game reserve

recreational hunting became popular in the ACE Basin study area. During this period, rice plantations were purchased by wealthy sportsmen who repaired and maintained dikes and water control structures to provide waterfowl hunting areas. Linder (1995) provides a history of the rice plantations of the ACE Basin study area and notes that preservation of land in the Basin is due largely to wealthy Northerners who used the rice fields as hunting preserves. Lavington, Pon Pon, and White Hall Plantations are examples of properties purchased as private hunting preserves. Social events centered on hunting became increasingly popular and continue to this day at private hunting clubs in the ACE Basin study area.

The old rice plantations were managed to provide habitat for game. Some rice was grown to attract ducks and natural foods were kept on hand. Small ponds were also dug in the marsh and were baited with shelled corn or rice. Hunting occurred from morning until night and there was no limit on the number of waterfowl shot (McKenzie et al. 1980). William Elliot (1859) provided details of duck hunting on Chee-Ha Plantation in his book, *Carolina Sports by Land and Water*. Elliot was an advocate of wildlife conservation during a time when there were few restraints on hunters.

Relatively unrestricted hunting was the norm at the turn of the century as many hunters ignored game laws and seasons. In the 1900s, efforts were made to improve enforcement of the game laws. The empowerment of the Game and Fish Department to enforce these laws helped bring about a reversal in the downward population spiral of many hunted species. Changes in land use were also an integral part of this gradual improvement. When industry moved into South Carolina, many marginally productive farms were shut down as farmers sought other occupations. Abandoned fields eventually reverted to second growth forest, which provided ideal habitat for a variety of species. For those farms that survived, agriculture shifted to larger, managed fields and forestry shifted to management of even-aged pine plantations (Culler 1978).

Management of hunting today emphasizes the importance of habitat in maintaining populations and enhancing hunting opportunities for game species. One of the predominant goals of habitat management in the ACE Basin study area has been creation of edge habitat. Maintenance of edge habitat is a management feature of Bear Island and

Edge habitat between shrub and forested communities

Wildlife Management Areas in the ACE Basin study area. (See related sections: Protected Lands: Bear Island WMA and Donnelley WMA .)According to Beasley et al. (1996), optimal edge habitat ideally consists of a habitat block of at least 100 acres and a combination of at least two land cover types that each contributes a minimum of 20% to the habitat block (Hunting Criteria). Where these conditions exist, a buffer zone of 500 feet on each side of the line between land use types represents important habitat for species such as white-tailed deer, quail, rabbit, fox, and dove, and consequently these areas are prime hunting land. Habitats, other than edges, that are important to recreational hunting include forested wetlands, croplands, and coastal non-forested wetlands (Beasley et al. 1996).

In addition to improved habitats and better enforcement, management for wildlife has been actively undertaken by private landowners, hunt clubs, federal and state agencies and timber companies. Hunter-based conservation organizations such as Ducks Unlimited, National Wild Turkey Federation, Quail Unlimited, Quality Deer Management Association, South Carolina Waterfowl Association, and South Carolina Wildlife Federation have been instrumental in educating landowners and sportsmen and in promoting sound management practices (Beasley et al. 1996).

Hunting has an economic impact both statewide and in the ACE Basin study area. Based on the 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, it was estimated that 300,000 individuals (16 years and older) hunted in South Carolina and made total hunting expenditures of $3.49 million (US Fish and Wildlife Service 1996). A total of 201,579hunting licenses was sold in FY 1991-92 (Hunting licenses) (Shipes 1993). In the ACE Basin study area, over 200 hunting clubs were operating in 1996 (Hunt clubs). A survey of the economic impact of hunting in rural Jasper County indicated that hunting on private lands has a major impact on the economy and may be an economic driving force in rural South Carolina. The economic significance of hunter expenditures as a source of revenue was estimated as 79.5% of the new monies brought in from outside Jasper County (Richardson et al. 1996).

Species primarily targeted by hunters in South Carolina include deer, turkey, dove, quail, squirrel, rabbit, furbearers such as gray fox and raccoon, and waterfowl (Game Hunters). In 1984-85, the most sought-after groups were deer, dove, and gray squirrel; however, rabbit replaced quail as the fourth most sought after group in the 1991-92 survey and turkey moved from seventh to fifth place.

The SCDNR collects information from field surveys, big game check stations, and hunting participants in an effort to determine trends in hunting success and wildlife populations. In general, recent surveys indicate that 78% of all licensees hunted deer at least one day during 1991-92. This reflects a change in hunter activity from seeking primarily small game to big game (Shipes 1993).

White-Tailed Deer

White tailed deer
(Odocolleus virginianus)

The white-tailed deer is the most popular species sought by hunters in South Carolina. Its popularity predates colonization of the New World, as deer were heavily hunted by Native Americans. The population characteristics of deer herds were shaped by early hunting pressure from Native Americans, as well as predators, diseases, and habitat conditions.

There is no information on whitetail population dynamics from the colonial era; however, the demography of the herds was likely quite different from what exists today in our heavily harvested populations (Miller et al. 1995). Densities were probably lower than those found in intensively managed herds of today, and the original herds probably had a greater number of older individuals and a more even sex ratio. Understanding the life history and population dynamics of deer is necessary in order to understand modern management principles. Management of deer is based on healthy habitat as well as harvest principles. Habitat quality is largely determined by soil fertility, habitat age, arrangement of timber types and agricultural management (Kammermeyer and Thackston 1995). A single forest type or agricultural plot rarely provides all the components that deer need. The best habitat contains a great diversity of plant life and as many successional stages as possible. Managers enhance diversity by dividing woodlands or agricultural lands into smaller units, thereby creating edge; and using timber management practices of thinning and prescribed burning, as well as providing food plots. Generally, those areas with well-interspersed edge habitats have greater capacity for deer. Edge makes food, cover and water available in a relatively smaller area, thereby reducing the need for foraging over long distances.

bottomland hardwood forest">Silviculture management that promotes a variety of plant species within timber stands will enhance habitat quality. In the ACE Basin study area, pure stands of pine are common; however, these generally are poor habitat for deer because forage

Bottomland hardwood forest

quality is low and mast-producing hardwoods are scarce (Moore 1978). Thinning of dense pine stands is recommended to open understory and encourage desirable understory vegetation. A mixture of pine and hardwood species is important for mast, fruit, and browse food. The bottomland hardwood forests of the ACE Basin study area provide another quality habitat for deer. These forests contain oak, gum and ash which supply browse and mast, especially where white and red oak species are present.

Prescribed burning has been a commonly used technique in pine dominated forests of the ACE Basin study area. Fire is used to increase legume abundance, browse production and palatability, soft mast production and protein content of selected plants (Kammermeyer and Thackston 1995).

Management of white-tailed deer for harvest must include consideration of reproduction, mortality, population size, and population structure. Essentially, a herd is managed as two separate populations (Jacobson and Guynn 1995). Females are managed to maintain health and productivity, while males are managed to produce and maintain the age structure. In determining how many deer to harvest and in what proportion by sex, information on herd size, sex ratio, reproductive success, habitat conditions and hunting pressure in the area is needed. For most management situations, maintaining population density anywhere from 40-80% of carrying capacity will provide similar sustainable yields. This can generally be achieved by annually harvesting 35-40% of the females and 30% of the antlered bucks in a herd. Following these guidelines, nutrition should be adequate and the health of the population will be good.

The number of hunters who pursue deer in South Carolina has increased steadily over the years (Deer Harvest). Recent estimates of 157,483 deer hunters is a 4.3% increase from 1984 and a 197% increase from 1963.

The harvest of deer increased to an all time statewide high in 1995. Harvest reports obtained from private and public lands in the state represent the minimum number harvested, largely because reporting harvested animals is not required and many deer killed go unreported. The 148,123 deer reported as harvested in 1995 increased 6.6% over 1994 and 3.7% over the previous record harvest in 1993. Surveys of the deer hunting population indicated that the estimated deer harvest was much higher than that reported (Deer harvest) (Shipes 1993). Earlier surveys have also indicated larger deer harvests than reported. Trends in deer harvest for Colleton County have remained relatively stable since 1988 (Deer in Colleton County). The record reported harvest of deer for the County occurred in 1993.

The relationship between man and white-tailed deer involves three distinct phases: co-existence, exploitation, and reconstruction. With current deer densities being the highest in history, the present-day phase of the deer-man relationship must be one of stewardship. Rising deer populations are causing problems by damaging crops, suburban yards, and forest regeneration, and by degrading habitats used by other wildlife species and domestic livestock. The ever increasing human population along South Carolina's coast demands the infrastructure necessary for development; yet new roads, utility right-of-ways and development only contribute to habitat decline and fragmentation. The advent of organizations such as the Quality Deer Management Association which promote stewardship of the resource through the education of hunters should help in maintaining a healthy deer population in balance with the habitat (Miller and Marchinton 1995).

Back to Top

Wild Turkey

Eastern wild turkey
(Meleagris gallopavo silvestris)

Like so many species, populations of wild turkey have undergone dramatic changes since the arrival of European settlers. Historically, wild turkeys were abundant in coastal South Carolina and were not used heavily as a source of food by the Indian tribes, although their feathers were used extensively as ornamentation on clothing and weapons. When the European settlers came to North America, harvesting of the birds by the expanding colonial population put tremendous pressure on turkeys so that their numbers began to decline rapidly. The clearing of prime habitat for agriculture further contributed to their decimation. From 1930 to 1950, wild turkey populations had declined to such low levels that only about 30,000 remained nationwide (Baumann 1987).

Due to efforts by sportsmen who found wild turkeys a challenge to hunt, the pure strains were protected and reestablished. Remnant pure strains were isolated from hunting and interbreeding in an attempt to restore pure wild turkey populations in coastal South Carolina. Establishment of a wild turkey refuge, careful management and restoration, and strict law enforcement in the state contributed to the rejuvenation of populations that were succumbing to hunting pressure, disease and habitat loss (Laurie 1977).

As with any game animal, an understanding of the quarry's habitats, habitat requirements, food preferences and terrain is important. Such knowledge is especially true in turkey hunting. Primarily a denizen of the forest, wild turkeys prefer open story woods bordering swamps. Turkey also occur on some of the heavily wooded barrier islands. Creek bottoms, low oak ridges, swamps, woodland openings, fields, and abandoned home sites are other prime locations for turkey (Sprunt and Chamberlain 1970). Flocks of turkey are most commonly sighted in the ACE Basin during fall and winter months.

Turkey hunting requires that the hunter have wiles that match the prey. Thoroughly scouting likely habitat for roosting and feeding sites is recommended. Once a strutting location (which is generally free of brush and tall grasses) is identified, the hunter relies upon concealment, absence of movement and calling ability. In the coastal plains of South Carolina hunting occurs during the spring months. All hunting is restricted to gobblers only, but bag limits are liberal with two birds per day or five per season allowed. No special permits are required to hunt turkey in S.C., and the mandatory turkey tags are issued free to individuals with a driver's license and big-game permit. Turkey harvest in Colleton County has increased steadily since 1989, with the 1997 harvest being the highest (Turkey in Colleton County).

Turkey hunting generates considerable revenue at the state and local level. A survey of randomly selected turkey hunters from South Carolina estimated that resident hunters spent an average of $428 during the 1989 spring season. Land leasing was a significant portion of the expenditure (Baumann et al. 1990).

Although restoration of wild turkey populations has been successful, there are several factors that could influence the future of wild turkey in the ACE Basin study area and coastal plain of South Carolina. Clearing of habitat by conversion of hardwood forest to short-rotation pine monoculture affects turkey populations by removing suitable habitat. In areas with increased human population density, the existence of wild turkey is threatened. Unlike white-tailed deer which can thrive in disturbed, cut-over areas, turkey are less adaptable to habitat changes. The creation of fields or openings planted with forage plant species is a common management practice for turkeys. These openings are planted with oats, rye, millet, corn, clover, chufa and field peas, which provide habitat diversity as well as a supplemental food source. Preservation of mature stands of mast-producing hardwoods interspersed with open areas that provide food and cover for nesting should be a major goal toward assuring a bright future for turkeys and those who enjoy hunting them (Laurie 1977).

Back to Top

Bobwhite Quail

The bobwhite quail is a popular gamebird in the ACE Basin study area and, indeed, the southeastern U.S. It is a native species that had flourishing populations up until the 1920s and 1930s. Prior to colonist settlement, quail populations were relatively low. This was due to vast unfragmented tracts of forest which provided poor habitat owing to the density of stands and underbrush. Land-use by early settlers consisted mostly of patchy farms with adequate cover between crops that provided ideal habitat for quail (Mahan 1992).

Several factors may be responsible for the decline of quail, and the most significant appears to be changes in land use. In recent years, quail habitat has been reduced by changes in land use to pine monoculture, open pasture, and intensive "clean" farming.

Bobwhite quail ***(Colinus virginianus)***

Many small farms have been consolidated into a few large ones in which hedgerows have been removed to create expansive fields. Managed tree farms have replaced row crop agriculture and the resulting habitat is not generally suitable for quail. The restricted use of fire has encouraged dense growth in woodlands which is also unsuitable for habitation by quail. Controlled burning, which is a quail management technique that does enhance preferred habitat, has been limited in pine-dominated forests. Another factor contributing to a decline in quail populations is increased use of herbicides and insecticides that eliminate weeds and insects that are a vital component of quail diet (Carmichael and Thompson 1994). The expansion of urban areas has also depleted much quail habitat. Natural phenomena, such as too little or too much rainfall during critical hatching and brood-rearing periods, can also have a negative effect on quail populations. Hunter-reported harvest numbers for 1991-92 were only 511,900 statewide, compared to 1.9 million in 1975-76. Numbers of quail hunters have also declined over this same time period (Carmichael and Thompson 1994).

A survey of quail hunters in South Carolina over a ten-year period indicates a slight downward trend in the number of coveys found per hour. There has also been a noticeable decline in the number of quail bagged per hour (Quail hunter survey results). On a statewide basis, hunting effort expended, as reported in the 1996-97 Quail Hunter Survey (SCDNR unpub. data), was greatest in the Midlands region. The number of coveys found per hour was similar between the northern lower coastal plain and the Midlands, and both were significantly higher than the southern coastal plain and the Piedmont (Quail hunter survey results). Declining populations and the popularity of quail as a gamebird have prompted propagation of the species. Pen-reared birds have been reared and released in large numbers throughout the bird's range. This practice has not been without controversy. Studies revealed that stocked birds were generally released into poor quality habitat and survival rates were very low. Also, the danger of introducing disease into the native quail population from pen-raised birds was considered an unacceptable risk (Mahan 1992). In recent years, management of quail has moved towards an approach that seeks improvement of food and cover as restorative measures. Adequate cover is seldom a limiting factor in the ACE Basin study area, but quail population densities depend on the amount and distribution of forests, brush, grass, and cultivated lands. Bobwhites prefer those areas where all these habitat types may be found within their normal 16-hectares (40 acre) range (McKenzie et al. 1980).

Proper management of agricultural fields and forests will influence the quality of habitat and general abundance of quail. Seed source and production by a variety of vegetational species should be encouraged by burning, plowing, disking, firebreak establishment, and management. Forest practices that encourage complex plant communities will provide a stabilized food base for quail (Reid and Goodrum 1979). Establishing transition zones in agricultural fields is extremely important to quail which are an "edge" species. Properly managed and maintained, these transition zones between forest and field will provide nesting cover, a suitable environment for insect prey, as well as plant forage and seeds. In areas where disking, burning or row crops don't produce desired foods, then plantings of high quality food should be established. These plantings not only concentrate birds for hunting but provide forage during winter periods of low food availability (Mahan 1992). A thorough discussion of land management practices that enhance quail populations can be found in Landers and Mueller (1992).

Field transition zone

The future of quail populations in the ACE Basin study area appears bright. Over-hunting is not considered to be a serious problem since quail coveys persist through winter in areas where there is little or no hunting. Successful management programs on private and public lands have shown that quail populations can be revived through habitat restoration. Organizations such as Quail Unlimited stress preserving and re-establishing upland game habitat. The emphasis on quail management is to improve land, habitat and forage foods in order to produce a large number of quail, and not attempt to decrease natural mortality due to predation or other natural causes (Mahan 1992). Proper management of deer herds through regulated antlerless deer harvest is beneficial in reducing over-browsing of native and planted quail foods. These increased management efforts by private and public landowners, quail organizations and state and federal agencies will, one hopes, ensure that bobwhite populations remain healthy.

Back to Top

Mourning Dove

The eastern mourning dove is a permanent resident and favorite game species in South Carolina. Heavily hunted in the state for years, average harvest was more than 2.5 million birds during the 1900s (Rhodes 1997). More mourning doves are harvested each year than all other migratory game birds combined.

Mourning dove *(Zenaida macroura)*

Known to adapt to a variety of habitats, mourning doves generally avoid deep woods or forest and select edge habitats along fields. Because of human modification to original vegetated habitats, mourning dove populations have fluctuated over the years. The clearing of forests in the coastal plain of South Carolina created favorable nesting conditions. Additional nesting and roosting habitat was created when trees and shrubs were planted in cities and towns associated with farming communities (Tomlinson et al. 1994). In recent years, however, there have been changes in agricultural and other land-use practices that have contributed to a decline in the dove population of South Carolina (Rhodes 1997). Dove nesting and roosting habitats have been severely decimated during the past 50 years through urban development, agricultural practices and other activities associated with human endeavors. Routine and heavy use of poisons to control pests on crops has also been detrimental to doves. Whereas doves once foraged on grains from planted fields, the decline in number of farms and more intensive and efficient farming practices have reduced feed for doves. In addition, farmland has been converted to forests, further reducing prime dove feeding areas.

Habitat management to improve dove populations requires trees balanced with open areas for nesting and roosting; a combination of wild and cultivated seeds for food; and a supply of freshwater to prevent dehydration and aid in digestion of food. Mowing and disking fields can enhance dove feeding areas. Tall pine trees with bare limbs are important as congregating areas for birds alighting in fields.

Although habitat loss has contributed to declining dove populations, the dove harvest per man-day has been rising. The state's breeding dove population has declined at 4.4 percent annually for the past ten years (Dolton and Smith 1998). Yet, harvest has remained high with more than 4 million doves harvested annually in the early 1980's (Dove Harvest). The number harvested per hunter has risen from an average of four in the 1960's to almost six doves per hunter per day over the last 10 years (Rhodes 1997).

Changes in hunting practices and liberalization of baiting regulations may account for some of the increased harvest. Beginning in the early 1970's, doves could be hunted over grains that were scattered as a result of "normal" agricultural harvesting and planting. The practice of top-sowing wheat, which was legalized in the 1980's, tended to concentrate resident birds and expose them to heavy hunting pressure early in the season. The non-hunting public as well as some hunters, viewed the practice negatively as constituting baiting. In 1995, the SCDNR voted to eliminate dove hunting on fields prepared by top-sowing, which was determined by the state extension service not to be a normal agricultural practice; thereby, the state would have been in conflict with federal regulations had it continued to allow hunting over top-sown wheat (Rhodes 1997). This change should benefit the dove population by increasing planted food and reducing harvest mortality.

A major goal in mourning dove management is to maintain the population at a level that will provide continued good hunting and non-hunting recreation. Although landowners in the ACE Basin study area routinely plant crops to attract doves, incentives to grow these crops is one possible way to increase dove habitats and populations in the ACE Basin study area. Statewide, management recommendations include improved population and harvest appraisals, regulations that prevent over-harvesting of the breeding population, habitat improvement, and a program of conservation education (Keeler 1977).

Back to Top

Eastern Gray Squirrel

Eastern gray squirrel
Sciurus carolinensis

The eastern gray squirrel is a small game animal that occurs throughout South Carolina. Historically, squirrels were hunted for fur, as food, and more recently for sport. Today, squirrel furs have a very limited market value in the United States (Gurnell 1987). Squirrels are primarily hunted recreationally in South Carolina. The number taken in the state is difficult to determine but was estimated to be 513,672 from hunter surveys (Shipes 1993). Since 1980, there has been a dramatic decline in the harvest of gray squirrels, although the number of hunters has remained relatively stable over time (Gray squirrel harvest) .

The preferred habitat of squirrels is extensive hardwood stands dominated by mature, mast-producing species. Pure pine stands and young hardwood stands are generally avoided. Stands of mature and overmature trees with canopies dense enough to permit travel through tree crowns provide optimum habitat. The density of understory is important but the relationship to gray squirrel abundance is not clear (Teaford 1986).

The most effective management for gray squirrel is to promote the development and retention of old-growth, mixed oak-hickory forests. Large extensive hardwood tracts are most desirable but smaller stands and woodlots also provide good habitat. Major factors to be considered in squirrel management are: (1) a large, consistent supply of hard mast; (2) several auxiliary foods to supplement hard mast and provide seasonal diversity; (3) an ample number of den cavities; and (4) a supply of water (Teaford 1986).

Back to Top

Rabbit

Two species of rabbit, eastern cottontail and marsh rabbit, are common in the ACE Basin study area and coastal plain of South Carolina. The cottontail rabbit is by far the most abundant and ubiquitous in South Carolina, occurring within every county. The marsh rabbit occupies

Eastern cottontail rabbit
(Sylvilagus floridanus)

marshes and bottomland and is especially common in or near tidal salt marshes (Lucas 1991), but also occurs in the Piedmont.

Rabbit populations largely benefited from settlement of the coastal plain by introduction of agriculture. Rabbits are an "edge species" that inhabits the transition zone between forest and field. With a home range as small as an acre, rabbits seldom leave; however, the range depends on the quality and availability of food and cover. Cover, in the form of hedges, thickets, weedy growth or fence rows, provides a haven from predators. Changing landscape and loss of habitat has resulted in a decline in rabbit populations. The conversion of old fields into pine plantations and the consolidation of many small farms into larger ones that are intensively farmed, has done much to reduce numbers of rabbits (Lucas 1991).

Hunting pressure on rabbits varies widely in different localities. In recent years, however, the popularity of small game hunting in South Carolina has declined in favor of deer hunting. Surveys of hunting pressure conducted in the 1960's indicated that, at the time of the survey, hunters killed at most a third of the state's existing rabbit population (Mayer 1973) has declined in recent years as has the number of hunters. In Colleton County, the number of rabbits harvested per hour of hunting effort was estimated to be 1.16 for the 1996-97 survey year (SCDNR, Rabbit Hunter Survey Report). The cottontail rabbit is probably still an underutilized species in the ACE Basin study area and statewide (Rabbit harvest).

Back to Top

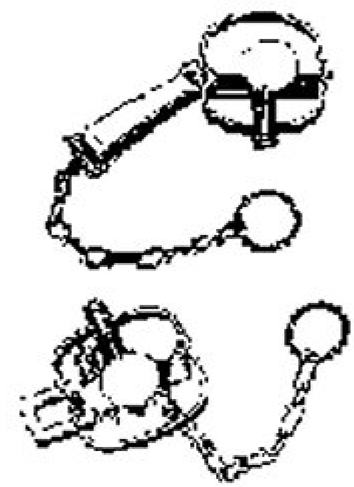
Terrestrial Furbearers

Overview

Furbearers are wild mammals that are seldom seen due to their nocturnal habits. The raccoon, gray fox and opossum are the primary species of interest in commercial fur harvesting in the ACE Basin study area.

- Raccoon
- Gray Fox
- Opossum

The history of furbearer harvest in South Carolina began with early settlers who commercially traded pelts.



Foothold traps

Introduction of the leghold trap in the early 1800's provided an effective means for capture of furbearers. However, concern by hunters over markedly reduced populations of foxes and raccoons in certain areas and the danger of injury to valuable hunting dogs, prompted passage of a bill in 1977 that outlawed the leghold trap in South Carolina and required anyone selling furs in the state to purchase a license (Laurie 1978). By statute, the authorization or prohibition of the use of foothold traps can be declared by a majority petition from the legislative delegation in each game zone. Thus, the areas approved for use of the foothold trap are subject to change each year. Foothold traps have been permitted continuously in Game Zone 11, which encompasses Colleton County, since 1983. Trapping is regulated by specific guidelines that govern trap size and type and harvesting season. Trappers must have written permission from the landowner and are required to check their traps daily. The use of regulated trapping is one means of maintaining populations within the carrying capacity of the environment. Furbearer seasons are set so surplus animals are harvested before late winter when disease, parasitism and starvation take their toll (Baker and Carmichael 1991). Trapping is an emotional issue that, in many states, aligns humane anti-cruelty groups with hunters who use dogs in an effort to outlaw trapping altogether. In South Carolina, legislation to restrict trapping has been initiated almost exclusively by fox and coon hunters (Laurie 1978). It is unlikely that the trapping debate will subside although research, education, and regulation of all involved in the harvest of furbearers may help to alleviate some of the controversy.

Statewide from 1974-1988, the number of furbearing animals harvested ranged from 23 to 51,000 thousand. A weak fur market that began in 1988, however, led to a reduction in hunting and trapping (Commercial Fur Licenses) and a consequent reduction in harvest, such that fewer than 11,000 animals have been harvested annually since the 1989-1990 season (Furbearer harvest) (SC Dept. of Natural Resources 1996).

The SCDNR monitors and regulates furbearer harvest. Fur buyers are required to submit a report indicating the amount of each furbearer species purchased in South Carolina. Each fur harvester is required to report annually on the number of furbearers caught and the county of harvest. This information is vital in determining harvest pressure and population changes. Management of the furbearer species also utilizes data on age in order to evaluate changes in the number of animals in each age class. Information on population age structures indicates how a furbearer species has responded following a disease outbreak or a season of harvest. Such information is particularly useful in identifying areas where a species may be under- or over-harvested (Baker and Carmichael 1991).

Raccoon

The raccoon is a furbearing species whose population has been stabilized by harvest. The current status of the raccoon population in South Carolina is one bordering on overpopulation. Following declines in the price of raccoon fur in the early 1980's and a reduction in commercial harvest, raccoon populations have exceeded the carrying capacity of the environment in many areas. The result has been a tendency for raccoon populations to vary with declines largely due to diseases such as canine distemper, parvo, rabies and leptospirosis. Acorn production, which determines condition of the breeding female, appears to be a good predictor for the next year's raccoon population. Overall mortality within South Carolina as a result of predators, parasites and disease is about 35 percent of the population per year, (Baker and Carmichael 1991). Harvest by hunting and trapping is one means of keeping the population within carrying capacity and reducing boom-and-bust cycles. It is anticipated that harvest numbers for raccoon will soon rise since demand for raccoon fur is currently increasing (Renshaw 1992).

Raccoon *(Procyon lotor)*

Recreational coon hunting is a popular activity and the raccoon is also the state's most commercialized furbearer. The price of a raccoon pelt has fluctuated from as much as $15 per pelt in the late 1970s to a low of about $1.50. A limited market for live raccoons exists with hunting clubs (Renshaw 1992). Although the commercial raccoon harvest increased by 47% in 1995-1996, it remains less than historic levels, being 87% below the 20-year average statewide (Furbearer harvest). Depressed pelt prices and a shift in interest of trappers to live fox contributed to this decline. Until 1989, raccoon harvest levels exceeded the total harvest of all other furbearers combined (SC Furbearer Harvest: Raccoon vs. Others). (Raccoon harvest in Colleton County) shows a similar pattern to statewide harvest in which numbers have declined drastically since 1989. Although the raccoon is still popular with fur harvesters in the ACE Basin study area, interest in gray fox is increasing and, in 1996, more gray foxes were harvested than any other furbearer. Large numbers of raccoons are also harvested by non-commercial sportsman (SC Dept of Natural Resources 1996).

Gray Fox

Gray fox populations have been subject to fluctuation over the years. Economic instability in Russia, Eastern Europe, and Germany has resulted in a decreased market for fox pelts, which were previously in demand. An overproduction of pelts in the late 70's and early 80's also caused prices to plummet. Although harvesting was heavy then, it actually helped to stabilize the population from a "boom and bust" cycle that occurs when numbers increase until starvation and disease depress population density (Simbeck 1995).

Gray fox *(Urocyon cinereoargenteus)*

The decline in fox pelt values continues to influence harvest of gray fox in South Carolina. In 1995-96, gray fox harvest declined by 65% from the previous year (Gray Fox Harvest). Sales of live foxes for hound coursing is the main market at the current time. Sport hunting by houndsmen is dwindling in the state due to increased land development and the amount of traffic on highways which threatens the hounds (Baker and Carmichael 1991). Current harvests of gray foxes in Colleton County remain depressed compared to the 1988 peak harvest.

Opossum

Opossum
(Didelphus marsupialis)

The opossum is the only marsupial in the United States. Although reported as one of the more abundant fur bearers harvested in the ACE Basin study area, opossum harvest is usually incidental to that of other furbearers. Occurring throughout South Carolina in wooded areas and farmlands, the opossum population has remained fairly steady, although habitat reduction in more urbanized areas has reduced numbers somewhat. Opossum populations are largely controlled by predation, parasites, and highway fatality (Baker and Carmichael 1991). The opossum's success in the wild can be attributed to its ready adaptation to various habitat types and its omnivorous diet that includes insects, mice, fruit, nuts, vegetables, meat (including carrion), and eggs. Mating generally occurs in winter with young born 12-13 days later. The young spend 4-5 weeks in the marsupium, then another 8 weeks clinging to their mother's back (Simbeck 1997).

When hunted, opossum is sought for its meat and fur. Harvest of opossum has never been high in the state and the increase noted in 1995-96 statewide and in Colleton County probably resulted from incidental capture in response to increased pressure on gray fox (Opossum statewide harvest , Opossum harvest for Colleton County).

Back to Top

Waterfowl

- Harvest Management of Waterfowl
- Wood Duck
- American Widgeon
- Mallard
- Teal

Overview

Waterfowl hunting has been a long-standing tradition in coastal South Carolina and the ACE Basin study area. Early explorers of the North American continent found waterfowl to be so abundant that ducks and geese became one of their principal sources of food. Later, market hunting became a major enterprise which resulted in a decline in waterfowl populations. Drought and loss of habitat further reduced populations. Today, strict bag limits and seasons are in effect, with enforcement stepped up by state and federal conservation agencies. The Migratory Bird Treaty Act provided for protection of waterfowl by the Federal government. Perhaps the most important federal legislation was the Migratory Bird Hunting Stamp that was initiated in 1934. Revenues from the sale of this stamp have provided the funding needed to preserve waterfowl habitat (Campbell 1975). (See related section: Waterfowl

Habitat Management .)

South Carolina has one of the most successful state stamp programs in the country. Passed in 1981, the SC Waterfowl Conservation Stamp, a revenue-bearing stamp-license, is required of all waterfowl hunters. The state program is similar to its Federal counterpart, in that it provides a means of funding waterfowl and wetland conservation projects. Duck stamp prints also generate revenue to support conservation of waterfowl in the Canadian breeding grounds through Ducks Unlimited Atlantic Flyway projects. The South Carolina stamp program has contributed to efforts to provide adequate, quality wintering habitat for migrating waterfowl and it has been instrumental in increasing propagation of the state's native nesting duck, the wood duck (Campbell 1990).

Habitat loss continues to be a critical issue for waterfowl. Nesting habitat is of particular concern and agencies such as Ducks Unlimited have worked in cooperation with national and international agencies to preserve nesting habitat and, in some cases, improving habitat for the benefit of nesting birds. The North American Waterfowl Management Plan (NAWMP) is a major effort involving the US government, Canada, Mexico, state governments and private organizations whose goal is the reversal of destruction of North American wetlands. The goals of the plan are a continental population of 62 million breeding waterfowl with specific targets set for 32 species, and protection of 2.4 million hectares of important wetlands. The Plan proposes to increase, over a 15-year period, the average number of birds and breeding indices to levels of the 1970s. The intent is to achieve a fall flight in excess of 100 million waterfowl by the year 2000. Improved land use in Canada and protection and improvement of waterfowl nesting, migrating and wintering habitats are a major focus of the plan. To accomplish goals of the plan, 34 geographical sites will be targeted in a partnership of public and private groups working in wetland preservation. The ACE Basin study area is included in the East Coast joint venture to preserve wetland habitats. The NAWMP employs several methods to protect and restore wetlands such as purchases, leases, and easements, as well as providing landowners with economic incentives. South Carolina's waterfowl population largely depends on the success of such protection and restoration efforts. The NAWMP not only benefits waterfowl but a number of other wildlife species benefit from the recovery of wetland habitats. Although the state has the necessary resting and feeding habitat, fewer birds every year are coming to South Carolina. Partially a result of nesting habitat loss in northern climes, waterfowl decline also results from a management practice called "short-stopping" in which birds are concentrated by feeding and remain in northern areas long after the time of their normal migration. By concentrating birds in large numbers, disease epidemics have the potential to decimate populations. Another factor that historically harmed waterfowl populations was heavy use of lead shot which caused lead poisoning and death in some areas where hunting was intense (Campbell 1975). Other impacts include acid rain, increased predation, oil spills and pollution (Campbell 1987). Acidic conditions in eastern Canada kill the organisms on which young ducklings feed and the insects that nesting hens consume. Land use practices in the prairie regions of North America have upset the predator-prey balance, with the consequence that red foxes, skunks and raccoons have increased in number. Intensive "clean" farming has reduced cover to such an extent that nests are more vulnerable to predation.

Harvest Management of Waterfowl

Hunting accounts for about 50% of the mortality waterfowl experience each year in North America. Hunting mortality is estimated with an annual Waterfowl Harvest Survey conducted by the U.S. Fish and Wildlife Service. Data from the Harvest Survey, in conjunction with the reported sales of waterfowl stamps, are used to estimate the total harvest of waterfowl for each state and flyway. The harvest survey does not account for the illegal harvest of waterfowl, which may equal or exceed the legal harvest (Baldassarre and

Bolen 1994).

Waterfowl hunting poses a particular dilemma for managers because of the birds' migratory nature. Unlike resident species, waterfowl experience several months of continuous hunting pressure as they migrate southward. Intense pressure can occur on opening day of the season for each area into which the birds move. During their migration, they also encounter new habitat conditions and tend to be concentrated in specific types of habitat within an area. These characteristics enable hunters to locate and harvest waterfowl effectively even when populations are at diminished levels.

Inferences have been made that hunting becomes a direct means of regulating the size of waterfowl populations. The debate continues over whether hunting mortality increases total mortality and is additive to other causes of mortality experienced by waterfowl. Alternatively, studies have indicated that hunting mortality, up to a threshold level, is compensatory and not additive to total mortality. Despite major research efforts, the relationships between hunting regulations, hunting mortality and population size are not well understood. Even when survival is high during years of restrictive regulations, it is not clear how harvest is related to population dynamics of waterfowl. Part of this difficulty is due to the fact that other variables such as population size and habitat conditions affect mortality and natality. Based on recent studies, it appears that populations compensate for hunting mortality depending on conditions. When habitat conditions are poor and recruitment is low, populations may have little ability to compensate and hunting mortality may indeed be additive. However, when population densities are high and habitat conditions are excellent, compensation may be high and the threshold where hunting mortality becomes additive is reached much later. Generally, managers favor protecting the resource by advocating the view that hunting mortality for waterfowl is more additive than compensatory.

Regulation of the harvest remains one of the essentials of waterfowl management. Harvest management employs a variety of strategies that control the size, distribution and composition of species harvested. The dates of the hunting season, season length and daily bag limit form the framework for most regulations and are the ones most often changed by waterfowl managers. Special regulations may also be implemented that are specific for a species, area, or situation. Although such strategies remain controversial because the effects of various hunting regulations on waterfowl populations is largely unknown (Baldassarre and Bolen 1994), Adaptive Harvest Management is now used to set regulations by USFWS.

Aerial view of former rice field impoundment

impoundment " ALIGN="RIGHT" BORDER="0">The impoundments of the ACE Basin study area offer ideal wintering habitat for waterfowl. Impoundments which are publicly and privately owned and managed, attract many overwintering waterfowl from the Atlantic Flyway flock.. Private lands are not available to most hunters but Wildlife Management Areas (WMA), such as Bear Island WMA and Donnelley WMA, provide hunting opportunities through the statewide lottery. Hunting for waterfowl remains heavily regulated with seasons and bag limits, as well as prohibited harvest of certain species. Studies indicate that conservative hunting regulations during years of low population numbers may prevent overharvesting of some species (Campbell 1987).

Some marked declines have been noted statewide in the number of duck hunters and harvest for the period between 1984 and 1991 (Duck hunters and harvest). Duck harvest appears to have fluctuated widely while the number of hunters has been more stable. In Colleton County, the waterfowl harvest has been variable, with the greatest estimated harvest occurring in 1995 (Waterfowl harvest). The major species of interest to hunters statewide are wood duck, mallard, and green-winged teal. Reports from band returns and surveys indicate that the primary species harvested in Colleton County, over a ten-year period, were green-winged and blue-winged teals, wood ducks, widgeons, and mallards. At Bear Island Wildlife Management Area, primary harvested species in 1996-97 were shoveler, green-winged and blue-winged teal, and widgeon (Bear Island Waterfowl), while at Donnelley Wildlife Management Area, green-winged teal and wood duck constituted >70% of the total harvest (Donnelley Island Waterfowl).

Wood duck *(Aix sponsa)*

Wood Duck

The wood duck is truly a success story in waterfowl management. Unrestricted hunting, drainage of wetlands and extensive logging nearly extinguished the species in the early 1900's. The decline of the species was of such concern that the governments of Canada and the US closed the hunting season in 1918, and it remained closed until 1941 when limited hunting was allowed. The hunting moratorium, subsequent small bag limit and habitat protection efforts contributed to restoration of wood duck populations. Because of habitat management and the wide-spread availability of man-made boxes, the population of wood duck may be at an all-time high (Simbeck 1994). The habitat requirement of cavity trees for breeding afforded a unique opportunity to restore nesting populations. The man-made boxes have been successful as substitutes for natural cavities. The statewide nest box program, funded from SC Migratory Waterfowl Hunting Stamps and administered by the SCDNR - Samworth and Santee Delta Wildlife Management Area, has contributed to the wood duck's resurgence. Boxes erected and maintained in wetlands in the ACE Basin study area have helped establish nesting populations on state-owned and private lands. Colleton County is one of the most successful in terms of duckling production. Boxes are installed in fall and early winter, prior to nesting, within one-quarter mile of wetlands with suitable brood-rearing potential. Wetlands of five acres or more are preferred because they usually have greater plant diversity and cover (Beach 1989). A total of 2,630 cooperators in the Wood Duck Nest Box Project have been issued 19,800 boxes from inception of the program through 1995. At the conclusion of the 1995 wood duck nesting season, 3,294 (61.8%) of the boxes were utilized by wood ducks. A total of 2,870 nests were reported to be successful (87.1%) with a reported 27,482 wood ducklings hatching from 42,594 eggs laid (Strange 1996).

Wood duck box

Landowners are also encouraged to enhance wood duck habitat through management of wetlands. A ratio of 50 percent open water to 50 percent vegetation is ideal for breeding. Broods require about 75% cover and presence of herbaceous emergent vegetation as well as woody growth in order to have adequate sources of invertebrates as prey for young ducklings (Beach 1989). Some bottomland hardwood habitats are managed in the ACE Basin study area by manipulating water levels. The timing of flooding and draining is important to survival and growth of mast-producing trees. Flooding is generally done in the fall with drawdown occurring before the spring growing season. Manipulation of water levels also prevents depletion of the acorn crop by other species of wildlife before arrival of waterfowl in the fall.

Wood duck are the most popular hunted waterfowl species in South Carolina. In 1995 and 1996, wood duck constituted 41.6% and 35.4% of the total bag, respectively. In Colleton County, the harvest of wood ducks remained relatively stable until 1995 when marked increases were noted.(Wood duck harvest).

American Widgeon

American widgeon or baldpate is a puddle duck that is commonly found in the ACE Basin study area. Widgeons breed in the prairie lands of Canada and arrive in fall in the ACE Basin study area to feed in fresh and brackish marshes on green vegetation (Addy 1964). Widgeon are generally present from October to April, although there have been several records of occurrences as late as June. Widgeon sometimes feed on green algae found in the intertidal zone or sea lettuce (*Ulva*) in subtidal open waters, a feeding habit that results in their strong odor and unpalatability (Potter et al. 1980, Sandifer et al. 1980).

Although widgeon constituted only 3.8% and 3.3% of the statewide harvest in 1995 and 1996, respectively, it made up 9.8% of the total bag for Bear Island Wildlife Management Area in that same period (Strange 1996). Over the last decade in Colleton County, widgeon have constituted 10.2 % of the total ducks harvested (Waterfowl Harvest).

Mallard

The mallard is another favorite of South Carolina hunters. Its large size, tendency to be attracted by decoys, and flavor make it the most highly prized species as a trophy duck and the one with which hunters would most like to fill their limit. Its diet of grain, grasses, seeds and acorns makes it more palatable than most diving ducks.

Mallards typically frequent shallow freshwater marshes and rivers. They are an overwintering species in South Carolina.

Mallard ducks flying

Although domestic mallards do nest in South Carolina, few, if any, wild mallards nest here. The southern part of the breeding range is eastern North Carolina. Canada is the mallard's primary breeding area and the condition and amount of Canadian breeding grounds greatly determines the number of mallards that inhabit the ACE Basin study area and other areas of South Carolina each winter. Land use conflicts within the Prairie-Parkland region of Canada has resulted in a struggle that threatens mallard populations and that of other waterfowl species dependent upon wetlands. Prairie potholes, which are fringed with bulrushes and cattails provide perfect nesting and foraging habitat for the mallard and its young. Unfortunately, nesting habitat is situated in a major agricultural region in which drainage of potholes and farming of the Prairie-Parkland region continues at the expense of waterfowl habitat. The mallard has managed to adapt in the face of man-made and climatic disruptions within its Canadian breeding grounds. The duck is expanding its breeding range into territory of the black duck in eastern Canada where beaver ponds are being replaced by farm ponds (Poland 1981).

Even though an average of nearly 89,000 mallards wintered in South Carolina between 1974 and 1981, continued destruction of northern breeding habitat is taking its toll on the number wintering in the state. Although the severity of northern winters and lack of rainfall can also affect the number wintering here, the northern breeding population, which has been declining for a number of years, is the determining factor. It is a good indicator of waterfowl population status in general, as the mallard population mirrors that of other species. Although the population of mallards does vary from season to season, abundance has not yet dropped to alarming levels.

Although mallards are targeted in the ACE Basin study area by hunters, it is an inland duck and prefers inland freshwater impoundments to saltwater marshes. Preferred mallard wintering habitat occurs in nearby Beaufort County, as well as in counties in the vicinity of the Santee Wildlife Refuge. Harvest of mallards in Colleton County has been highly variable over time with a marked decline occurring in 1995 (Mallard harvest).

Teal

The green-winged and blue-winged teal are common winter residents in the ACE Basin study area. They rank next to mallards in the flyway in numbers and harvest. The green-winged teal breeds in the northern prairies of Canada and occurs from October-April in South Carolina. It generally arrives later and departs earlier than the blue-winged teal but outnumbers the latter.

Green-winged teal prefer freshwater habitats but may be found in salt marshes and tidal rivers. The diet of green-wings is

Green-winged teal (*Anas crecca*)

mostly plant material with seeds of panic grasses, widgeon grass, pondweeds and bulrush constituting a large portion. Occasional insects and mollusks are also consumed. Green-wings search for food on mudflats and shallow water areas. They feed in impounded marshes of intermediate salinity where natural foods are abundant and readily available.

Blue-winged teal have been reported in the state during every season (Sprunt and Chamberlain 1970). Although they generally arrive in South Carolina in September, a small number of blue-wings may overwinter in the state during mild winters, but numbers generally diminish rapidly during October (McKenzie et al. 1980). Blue-wings utilize similar habitats as green-winged teal and feed in shallow water on floating and shallowly submerged vegetation. Common foods include duckweeds, widgeon grass, pondweeds, sedges, smartweeds and wild millet. Approximately 30% of the diet is animal matter with snails, insects, crustaceans, beetles, and insect larvae being consumed (Sprunt and Chamberlain 1970).

Harvest of teal in Colleton County has been highly variable over time with peak harvests noted for green-winged in 1989 and 1995 (1989-1995 Green-winged teal harvest) and for undifferentiated teals in 1996 (1996 Unidentified teal harvest).

Back to Top

Alligator

Overview

American alligator
(*Alligator mississippiensis*)

The American alligator (*Alligator mississippiensis*) has been a part of South Carolina's ambience for thousands of years, and records of early explorers mentioned the presence of alligators (Ashe 1682, Lawson 1718, Catesby 1743, Drayton 1802). During the Civil War, soldiers harvested alligators for food and used their hide as shoe leather.

- Harvest
- Management
- Monitoring
- Threats to Alligator Populations

Much of what we know about alligators in South Carolina was learned from research projects conducted in the ACE Basin study area. Nest and spotlight surveys were completed and factors such as movements, nesting ecology, and growth were studied (Bara 1976, Murphy and Coker 1984, Wilkinson 1983, Wilkinson and Rhodes 1992, Wilkinson and Rhodes 1997).

The range of the alligator in South Carolina extends south and east of the Fall Line, which runs approximately from North Augusta through Columbia to just north of Bennettsville. Highest population densities are found in the coastal counties of Beaufort, Berkeley, Charleston, Colleton, Georgetown, and Jasper. Population densities gradually decline further inland (Murphy and Coker 1984, W.E. Rhodes, unpub. data).

Harvest

As a result of increased alligator populations on private lands, a limited alligator season was established in 1995. Prior to this time, many landowners viewed alligators as a problem and shot them in response to their abundance. With an alligator hunting season, property owners could realize an economic benefit by harvesting and selling alligator products. With the alligator now having some value, landowners were more apt to conserve not only the alligator population but also the wetland habitat that supports them, which would benefit other wetland-dependent wildlife species.

The number of alligators harvested from private lands during the 30-day season averages just under 150 alligators annually. Average length of alligators harvested is 212 cm (7 ft) (Alligator harvest). Both alligator meat and hides are sold (Alligator meat and hides). An average of 1,500 kg (3,200 lbs) of alligator meat and an average of 300 meters (1,000 ft) of hide have been produced over the last four years. Prices for hides range from $49-$115/meter ($15-35/ft) and meat averages $10/kg ($4.50/lb)

Management

Harvesting of alligators went unregulated in South Carolina until the 1950s. It is impossible to estimate population size then but alligators were likely common and abundant. The ACE Basin study area was a major area for alligator hunting. One of the first laws to protect alligators, although originally enacted to protect deer, was the prohibition of night shooting in 1955. By 1962, alligator trappers were required to possess licenses and tags for taking alligators, and enforcement of this law helped reduce poaching.

In spite of these initial regulations, public concern about low alligator densities resulted in closure of the South Carolina alligator season in 1964. At the federal level, first protection came when the alligator was included in the Endangered Species Protection Act of 1966. Later, the law was changed to the Endangered Species Conservation Act in 1969. Despite state and federal laws, established interstate poaching networks remained active.

It was not until 1970 that legislation was passed which contributed significantly to recovery of the alligator. The Lacey Act of 1900, which prohibited the transportation of illegally harvested game (birds and mammals) across state lines, was amended to include alligators. This law gave officials the means to effectively end poaching, and alligator populations began their impressive comeback.

The Endangered Species Act of 1973 continued to enhance the alligator's recovery and provided research funding to determine its status and investigate certain biological questions. Creation of the Convention on International Trade in Endangered Species (C.I.T.E.S.) has also contributed to the recovery by regulating the export of alligator hides, meat, and parts.

During the 1970s and early 1980s, the alligator was federally listed as threatened on the coast and as endangered elsewhere in South Carolina. The alligator was added to the state endangered species list in 1979 because of the animal's low reproduction rate and slow recovery potential. In June 1987, the U.S. Fish and Wildlife Service reclassified the American alligator from endangered or threatened to a category of "threatened due to similarity of appearance" throughout its range (Fed. Register 52(107), 4 June 1987). Reclassification was based on evidence that the species was no longer biologically endangered or threatened but continued federal controls were necessary to regulate taking and commerce in order to provide protection of the American crocodile (*Crocodylus acutus*) in the United States and other endangered crocodilians in foreign countries.

Monitoring

Monitoring the population trends of alligators in South Carolina is done by annual aerial nest surveys (when funding permits) and night-light surveys. Nest and night-light surveys have shown that alligator populations statewide are stable. Nest and population densities are equal, and in some cases, exceed levels reported in more traditional areas of the alligator's range (i.e., Florida and Louisiana).

Beginning in 1988, the Nuisance Alligator Program was established to handle alligator complaints received from the public. Four Alligator Control Agents are contracted by the SCDNR to remove nuisance alligators at the department's discretion. Approximately 750 complaints are received statewide, and roughly 250 animals are harvested annually. In the ACE Basin study area, most nuisance complaints originate from lower Charleston County and near Beaufort. Alligators harvested under the nuisance program are skinned and butchered by the trapper. Hides are sold to hide brokers in Florida and most meat is sold to local restaurants.

Threats to Alligator Populations

Other than coastal habitat conversion from rural to urban, few threats to the alligator population exist. There is limited information on for environmental contaminants in South Carolina alligators (W. Rhodes. SCDNR. pers. comm. 1998). Wood (1994) found that average PCB concentrations in alligator eggs from Bear Island WMA in the ACE Basin study area (0.39 µg/g) were lower than PCB concentrations from Yawkey Wildlife Center near Georgetown (2.3 µg/g). Further, more highly-chlorinated PCBs were present in the Yawkey sample than the Bear Island sample. Researchers working at either location have not noticed any abnormalities in alligator reproduction or hatching.

Mercury, a naturally-occurring element often associated with oligotrophic waters of low pH, has been shown to affect growth and development, metabolism, and reproduction in fish, wildlife, and humans (Eisler 1987, Ruckel 1993). Rhodes and Cobb (unpub. data) noted mercury presence in all 15 samples analyzed from alligators, with concentrations averaging 0.694 ppm (range=0.049-3.44 ppm).

The U. S. Food and Drug Administration (FDA) action level for fish flesh consumption was 1 ppm, but no action level has been established for alligator meat. Mercury concentrations noted in the state do not appear to be negatively affecting the alligator population, however, human consumption of alligator meat does occur, albeit on a limited basis. Thus, monitoring for mercury would seem prudent for public health concerns.

Back to Top

The Future of Hunting

One of the most striking changes that has occurred with hunting in the ACE Basin study area and other parts of South Carolina has been the transition from small-game, such as squirrels and rabbits, to big-game hunting for white-tailed deer and wild turkey. Squirrel hunting was once the most popular hunting activity in South Carolina but, today, squirrels are among the most under-hunted game animals. Rabbit hunting has also declined in popularity. The shift from small game to deer and turkey has increased demand for available hunting land. Hunting has become big business with lease rights to hunt on private property drawing large sums (Casada 1998). A score of hunting clubs that are tightly managed have been formed in the ACE Basin study area and are a popular means of gaining access to private land. This shift places a heavy demand on available hunting land and forces those who ca not afford access to private clubs and leased land to depend heavily on public lands.

Individuals dependent on public land as a place to hunt are finding that its availability is also decreasing. Holdings in the SCDNR Wildlife Management Area (WMA) Program began to decline in 1978 largely due to loss of corporate participants. Withdrawal of public hunting lands is largely due to economics and the irresponsible behavior of some hunters. Corporations view lands, with their abundance of game, as an opportunity for profit through lease of large tracts to private hunting clubs at a much higher fee than the amount received as a WMA participant (Poland 1985a). Along with the economic attraction, landowners view hunt clubs as a means to limit and control the hunting pressure that occurs on their property. While many landholders still feel that public stewardship of land is important and view their participation in the WMA program as positive public relations, there is increasing concern over abuses by irresponsible hunters.

One solution to the loss of public lands has been purchase of lands by the State of South Carolina. With passage of the Heritage Trust Fund Act, appropriations are available to acquire land deemed to be significant natural resources under the Act. Increased user fees and other sources of revenue appear to be viable means of increasing state ownership of lands as a means to guarantee public access (Poland 1985b).

Another major factor affecting the future of hunting is the public's attitude. As the rural face of the landscape changes from burgeoning population growth, fewer individuals are viewing hunting as an acceptable tradition. It thus becomes incumbent on hunters to practice ethical hunting and utilize proper wildlife management techniques in the enjoyment of their sport (Casada 1998). Finally, strict enforcement of hunting laws and regulations EXIT along with an education effort that focuses on hunter ethics, safety, and game management will help preserve the hunting heritage in the ACE Basin study area.

NEXT SECTION: Tourism

Author

E. Wenner, SCDNR Marine Resources Research Institute

W. Rhodes, SCDNR Wildlife and Freshwater Fisheries Division

References

Addy, C. E. 1964. Atlantic flyway. *In*: J. P. Linduska (ed.). Waterfowl tomorrow. U.S. Fish and Wildlife Service, Washington, DC.

Ashe, T. 1682. Carolina, or a description of the present state of that country. *In*: A. S. Salley, Jr. (ed.). Narratives of early Carolina, 1650-1708. Scribner and Sons, New York, NY.

Baker, O. E. III and D. B Carmichael, Jr. 1991. South Carolina's furbearers. SC Department of Natural Resources, Columbia, SC.

Baldassarre, G. A. and E. G. Bolen. 1994. Waterfowl ecology and management. John Wiley and Sons Inc., New York, NY.

Bara, M. O. 1976. American alligator investigations. Final Study Report SC Wildlife and Marine Resources Department, Columbia, SC.

Baumann, D. 1987. Bronze bird of the southland. South Carolina Wildlife 34(2):6-10.

Baumann, D. P., Jr., L. D. Vangilder, C. Taylor, R. Engel-Wilson, R. O. Kimmel, and G. A. Wunz. 1990. Expenditures for wild turkey hunting. *In* W.M. Healy and G.B. Georgette (eds). Proceedings of the Sixth National Wild Turkey Symposium, March 1990, Charleston, SC. National Wild Turkey Federation, Edgefield, SC.

Beach, V. 1989. Carolina's duck. South Carolina Wildlife 36(6):27-35.

Beasley, B. R., W. D. Marshall, A. H. Miglarese, J. D. Scurry, and C. E.Vanden Houten. 1996. Managing resources for a sustainable future: The Edisto River Basin Project Report No. 12. SC Department of Natural Resources, Water Resources Division, Charleston, SC.

Campbell, B. 1975. Gawd loves a gunnerman. *In*: J. Culler (ed.). Carolina's hunting heritage. South Carolina Wildlife 22(6):26-31.

Campbell, B. 1987. A time of reckoning: Waterfowl 1987. South Carolina Wildlife 34(6):22-29.

Campbell, B. 1990. Big bucks for ducks. South Carolina Wildlife 37(4):45-49.

Casada, J. 1998. The changing face of hunting. South Carolina Wildlife 45(1):18-23.

Catesby, M. 1743. The natural history of Carolina, Florida, and the Bahamas Islands. (Revised by Edwards). Beehive Press, Savannah, GA.

Carmichael, B. and C. Thompson. 1994. Can quail make a comeback? South Carolina Wildlife 41:40-45.

Culler, John. 1978. History. p. 170-173. *In*: J. Culler (ed.). Carolina's hunting heritage. South Carolina Wildlife, Columbia, SC.

Dolton, D. D. and G. W. Smith. 1998. Mourning dove breeding population status, 1998. U.S. Fish and Wildlife Service, Office of Migratory Bird Management, Laurel, MD.

Drayton, J. 1802. A view of South Carolina, as respects her natural and civil concerns. W. P. Young, Charleston, SC.

Eisler, R. 1987. Mercury hazards to fish, wildlife, and invertebrates: A synoptic review. U.S. Department of the Interior, Fish and Wildlife Service Biological Report 85(1.10).

Elliot, W. 1859. Carolina sports by land and water. Derby and Jackson, New York, NY.

Gurnell, J. 1987. The natural history of squirrels. Facts on File Inc., New York, NY.

Jacobson, H. A. and D. C. Guynn, Jr. 1995. A primer. p. 81-102. *In*: K. V. Miller and R. L. Marchinton (eds.). Quality whitetails: The why and how of quality deer management. Stackpole Books, Mechanicsburg, PA.

Kammermeyer, K. E. and R. Thackson. 1995. Habitat management and supplemental feeding, p. 129-154. *In*: K. V. Miller and R. L. Marchinton (eds.). Quality whitetails: The why and how of quality deer management. Stackpole Books, Mechanicsburg, PA.

Keeler, J. E. 1977. Mourning dove. p. 275-300. *In*: G. C. Sanderson (ed.). Management of migratory shore and upland game birds in North America. International Association of Fish and Wildlife Agencies, Washington, DC.

Landers, J. L. and B. S. Mueller. 1992. Bobwhite quail management: A habitat approach. Tall Timbers Research Station, Tallahassee, FL and Quail Unlimited Inc., Augusta, GA.

Laurie, P. 1977. The wild turkey: A management success. South Carolina Wildlife 24: 10-11. Columbia, SC.

Laurie, P. 1978. The truth about trapping. South Carolina Wildlife 25(1):40-47.

Lawson, J. 1718. The history of Carolina: Containing the exact description and natural history of the country. T. Warner, London, UK.

Linder, S. C. 1995. Historical atlas of the rice plantations of the ACE River Basin - 1860. SC Department of Archives and History.

Lucas, G. 1991. Fleet foot. South Carolina Wildlife 38(6):6-10.

Mahan, W. E. 1992. Bobwhite quail. South Carolina Wildlife and Marine Resources Department.

Mayer, L. 1973. Cottonfield cottontails. South Carolina Wildlife 20(1):33-35.

McKenzie, M. D., J. V. Miglarese, B. S. Anderson, and L. A. Barclay (eds.). 1980. Biological characterization of the Sea Island coastal region of South Carolina and Georgia. Vol II: Socioeconomic features of the characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-79/41.

Miller, K. V. and R. L. Marchinton. 1995. Quality whitetails: The why and how of quality deer management. Stackpole Books, Mechanicsburg, PA.

Miller, K. V., R. L. Marchinton, and J. J. Ozoga. 1995. Deer sociobiology. p.118-128. *In*: K. V. Miller and R. L. Marchinton (eds.). Quality whitetails: The why and how of quality deer management. Stackpole Books, Mechanicsburg, PA.

Moore, G. 1978. Natural history. p. 174-175. *In*: J. Culler (ed.). Carolina's hunting heritage. South Carolina Wildlife, Columbia, SC.

Murphy, T. M. and J. W. Coker. 1984. American alligator population studies in South Carolina. Study Compilation Report to the SC Wildlife and Marine Resources Department, Columbia, SC.

Poland, T. 1981. The continental duck. South Carolina Wildlife 28(6):28-35.

Poland, T. 1985a. Game management areas. Part I: The crisis at hand. South Carolina

Wildlife 32(5):28-31.

Poland, T. 1985b. Game management areas. Part II: A plan for the future. South Carolina Wildlife 132(6):12-15.

Potter, E. F., J. F. Parnell, and R. P. Teulings. 1980. Birds of the Carolinas. The University of North Carolina Press, Chapel Hill, NC.

Reid, V. H. and P. D. Goodrum. 1979. Winter feeding habits of quail in longleaf-slash pine habitat. U.S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report - Wildlife No. 220, Washington, DC.

Renshaw, L. 1992. Ringtail. South Carolina Wildlife 39(5):6-10.

Richardson, C. L., G. K. Yarrow, and W. M. Smoathers, Jr. 1996. Economic impact of hunting on rural communities. Quality whitetails 3(2):5-8.

Rhodes, W. 1997. Tops for doves. South Carolina Wildlife 44(5):37-41.

Rhodes, W. E. and J. W. Lang. 1995. Sex ratios of naturally-incubated alligator hatchlings: Field techniques and initial results. Proceeding of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 49:640-646.

Ruckel, S. W. 1993. Mercury concentrations in alligator meat in Georgia. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 47:287-291.

Sandifer, P. A., J. V. Miglarese, D. R. Calder, J. J. Manzi, and L. A. Barclay. 1980. Ecological characterization of the Sea Island coastal region of South Carolina and Georgia. Vol. III: Biological features of the characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-79/42.

Shipes, D. A. 1993. The utilization of wildlife resources by hunters licensed to hunt in South Carolina during 1991-92 as determined by a postal survey. SC Wildlife and Marine Resources Department, Columbia, SC.

Simbeck, R. 1994. For wildlife watchers: Wood ducks. South Carolina Wildlife 41(6):48-49.

Simbeck, R. 1995. For wildlife watchers: Grey fox. South Carolina Wildlife 42(1):48-49.

Simbeck, R. 1997. For wildlife watchers: Opossum. South Carolina Wildlife 44(2):42-43.

Sprunt, A. Jr. and E. B. Chamberlain. 1970. South Carolina bird life. University of South Carolina Press, Columbia, SC.

Strange, T. 1996. Waterfowl status report 1995-96. SC Department of Natural Resources.

South Carolina Department of Natural Resources. 1996. Furbearer Project 1995-96. South Carolina commercial furbearer harvest summary. South Carolina Department of Natural Resources, Columbia, SC.

Teaford, J. W. 1986. Eastern gray squirrel (*Sciurus carolinensis*). Wildlife Resources Management Manual, Technical Report EL-86-6. U.S. Army Corps of Engineers,Waterways Experiment Station, Vicksburg, MS.

Tomlinson, R. E., D. D. Dolton, R. R. George, and R. E. Mirarchi. 1994. Mourning dove. p.

5-28. *In*: T. C. Tacha and C. E. Braun (eds.). Migratory shore and upland game bird management in North America. International Association of Fish and Wildlife Agencies, Washington, DC.

U.S. Fish and Wildlife Service. 1996. 1996 National survey of fishing, hunting and wildlife-associated recreation, State Overview. Washington, DC.

Wilkinson, P. M. 1983. Nesting ecology of the American alligator in coastal South Carolina. Study Compilation Report for the SC Wildlife and Marine Resources Department, Columbia, SC.

Wilkinson, P. M. and W. E. Rhodes. 1997. Growth rates of American alligators in coastal South Carolina. Journal of Wildlife Management 61:397-402.

Wilkinson, P. M. and W. E. Rhodes. 1992. Nesting habitat of American alligators in coastal South Carolina. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 46:260-265.

Wood, P. D. 1994. Determination of PCBs in eggs and chorioallantoic membranes of Loggerhead sea turtles (*Caretta caretta*) and American alligators (*Alligator mississippiensis*): Assessment of CAM as an indicator tissue in reptiles. M.S. Thesis. Clemson University, Clemson, SC.

M
E
N
U

Economic Impact of Tourism

Types of Tourism

Tourism in Rural Areas

Tourism in the ACE Basin

The ACE Basin's Tourism Assets

ACE Basin Discovery Complex

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Tourism

Economic Impact of Tourism

U.S. and World

It is well established that tourism is of great economic significance worldwide. The demand for places in which to spend tourism dollars is high and shows no signs of slowing down. Domestic and international travel generates numerous jobs, great amounts of wealth, and increased tax revenues. Indeed, tourism is the world’s fastest growing industry. It will ultimately generate over $2 trillion to the global economy annually (Mathieson and Wall 1982). Travelers, both domestic and foreign, spent $705 billion in 1993 in the United States and forecasts by the World Travel and Tourism Council suggests that this figure will climb further in coming years. A record number of Americans traveled in 1994, up 7% over 1993, according to the U.S. Travel Data Center (Rafool 1998).

South Carolina

Tourism is a significant economic force in South Carolina and has grown recently from a $4.8 billion industry in 1992 to a $6.6 billion industry in 1996. These expenditures were for dining and drinking ($2.0 billion), accommodations ($1.6 billion), auto transportation ($1.0 billion), public transportation ($0.7 billion), general retail ($0.8 billion), and entertainment and recreation ($0.5 billion) (SCPRT 1997a).

Capital investments in tourism-related facilities in South Carolina were reported at $979 million in 1997, a 21.8% increase over 1996. Additionally, these new developments and business expansions created 7,381 jobs with associated wages of nearly $100 million. The prolonged U.S. economic growth in the 1990s has generated more jobs, higher rates of new companies formed, and significant industry investment across the country in nearly every industry.

The South Carolina coast claims a significant portion of the state’s tourism. In 1996, the coastal area accounted for 56% of the state’s visitors. These visitors spent $747 million in 1996, up 20% from 1992. When asked to list activities enjoyed on their trip to the region, the most popular response was going to the beach, followed by shopping, playing golf or tennis, and hiking/fishing/hunting. In fact, hiking, fishing and hunting were mentioned by 20% of the respondents. However, when asked what the purpose of their trip was, only 23% stated outdoor recreation. Visitors to the Lowcountry came from across the country, but mostly the east coast, including other parts of South Carolina (18%), Atlanta (11%), New York (9%), Washington DC (6%), Cleveland (6%) and Augusta, GA (4%) (SCPRT 1997a).

ACE Basin

Tourism is an important component of the economy in the ACE Basin. Tourism and entertainment in Colleton County (calculated as those working in restaurants, hotels, and recreational services) accounted for 8.6% of the businesses and 11.8% of the jobs in 1995. Tourism-derived income increased by 38% in the last 10 years, much of it in growth from restaurants and cafes and hotels.

The ACE Basin derives economic benefit from tourists passing through the area on Interstate 95 and Hwy. 17 and from visitors with vacation destinations in the ACE Basin. The town of Walterboro particularly benefits from its proximity to I-95 and also draws visitors to its Artisans' Center and other cultural attractions. [insert photo: Artisan Center ace-rec/artisan.bmp] The most popular vacation destinations in the ACE Basin are the resort town of Edisto Beach and several state parks in or near the ACE Basin: Edisto Beach and Colleton, (Colleton County), Hunting Island (Beaufort County) and Givhans (Dorchester County) State Parks The Edisto Canoe and Kayak Trail, encompassing a 50-mile stretch of the Edisto River, also attracts visitors to the area. With the region's commitment to fostering nature-based tourism, new bed & breakfast inns, outdoor outfitters, and nature tours have emerged in the last several years to capitalize on the area's natural assets.

Types of Tourism

There are several categories of tourism, and many different names and definitions to differentiate various types within each category. The broadest set of divisions can be classified as business-related tourism, through-travel tourism (people on their way from one place to another stopping at an intermediate point), and direct leisure tourism, which includes traditional as well as heritage- and nature-based tourism.

Business Tourism

The primary goal of a business tourist's visit is to conduct business and any leisure activities are secondary. Most often the visitors travel alone or are part of a large conference or group. Business travelers often expect a higher level of accommodations and amenities than most leisure travelers do. In addition, they usually do not stay for extended periods of time (Gunn 1994).

Through-tourism

Through-tourism refers to tourists who stop on route to somewhere else (note that this definition is not exclusive of the above definition of a business traveler). As with business tourism, a through-tourist's stay in the place under study is secondary to his main purpose. Many through-travelers demand less in accommodations than business travelers do and less in terms of local amenities than leisure travelers. Their activities are usually very limited and their stay is very short. The challenge for communities with many through travelers is to encourage them to stay an extra day or two so that their economic impact is greater. For through travelers, easy access to sites, access to information, and attractiveness are all key to encouraging a longer stay.

Leisure Tourism

When the primary purpose of traveling is recreation or entertainment, it can be referred to as leisure tourism. This category encompasses a wide range of tourism -- from the mass-market, consumer-driven experiences typical of such destinations as Myrtle Beach or Disneyland to the resource-dependent, low-impact experiences associated with nature- and heritage-based tourism. Categories of leisure include mass tourism, adventure tourism, heritage tourism and nature-based tourism (France 1997).

Mass Tourism – Large numbers of visitors characterize mass tourism (e.g., Disney World). The impacts of this type of tourism are significant -- the positive economic impacts are enormous, as are the negative social and environmental impacts, simply because the number of people involved is so great. Resort tourism, a specific type of mass tourism, is characterized by intensive development that

- requires extensive infrastructure (including water/sewer, transportation, communications, safety);
- depends on large concentrations of people; and
- frequently places a heavy burden on the natural environment.

Heritage Tourism – The National Trust for Historic Preservation (NTHP) (1993) defines heritage tourism as "traveling to historic and cultural attractions to learn about the past in an enjoyable way." Where ecotourism tends to focus on the natural environment and cultural tourism refers to the lifestyles and livelihoods of past and present community residents, heritage tourism focuses on an area's historical features. Because the emphasis is on an area's history -- its past events and historic structures – future growth and economic development through this form of tourism is heavily dependent on a community's ability to plan and implement a sustainable heritage tourism initiative.

Christ Church (established 1835)

A sustainable program is one that conserves and preserves the area's defining historical assets, along with a quality of life that contributes to the area's uniqueness and perceived value. The relationship between heritage tourism and sustainable development lies in a community's efforts to combine the promotion of tourist attractions with the preservation and protection of these attractions. Heritage tourism planning and project implementation must be done right if it is to preserve the very assets and quality of life that make an area unique and loved. The NTHP has established five principles for developing a sustainable heritage tourism program: (1) focus on the authenticity and quality of experience; (2) preserve and protect resources; (3) make sites come alive; (4) find the fit between a community or region and tourism; and (5) collaborate for success.

Heritage tourism is one of the fastest growing sectors of the tourism industry. With heritage tourism programs, communities can generate outside income, community pride, locally produced goods and services, new employment, and improved economic stability.

The ACE Basin, with nearly 300 species of birds, is a popular spot for birdwatchers

Nature-Based Tourism - The South Carolina Nature-Based Tourism Association (SCNBTA) defines nature-based tourism as "responsible travel to natural areas which conserves the environment and improves the welfare of the people." This is also the same definition that the Ecotourism Society has used to define ecotourism. Although nature-based tourism and ecotourism have the same definition, ecotourism can be perceived to exclude hunters and fishermen. Because hunters and fishermen have traditionally been large contributors to the tourism industry in many rural coastal areas including the ACE Basin, the term ‘nature-based tourism’ is preferred by those in the S.C. nature-based tourism industry (Bacon and Kibler 1996).

Nature-based tourism can be divided into business-based tourism or ‘organized tourism’ and visitation or ‘casual tourism’. Organized tourism employs guides to take a group into an area, such as the ACE Basin, for either day trips or extended trips. Most sustainable tourism plans are based on developing this type of tourism. Casual tourism includes visitors who use a natural area to fish, bird watch or any other outdoor recreation activity, but who do not go with a guide to the area, generally do not stay overnight, and may not even plan their trip. These unstructured trips still have an impact on the resources or the economy of an area because casual visitors to an area may purchase food, local crafts, bait or other miscellaneous items. Adventure tourism is a form of nature-based tourism that usually involves some physical rigor.

Nature-based tourism increased dramatically between 1994 and 1995 – nearly doubling from 7.5 percent to 13.5 percent of the traveling public. In 1995, 34 million Americans had previously booked a nature-based trip or were planning to do so on their next trip (Plog Research Inc. 1995). Nature-based tourism is one of the strongest growth sectors of the tourism industry and is estimated to be a $200 billion per year industry (Freedman 1995). Peoples’ desire to see unusual, untouched places, and their willingness to pay for such experiences, has fueled the rapid growth of this niche market.

Tourism in Rural Areas

The overall strength of the tourism market and consumers’ continuing demand for travel experiences suggests that smaller and rural communities examine this industry’s potential as an impetus for local economic development. Many rural communities and less developed regions, such as the ACE Basin, however, are typically unable (or unwilling) to support traditional, consumer-driven tourism. As a result, less developed areas must consider specialized niche markets, such as nature- and heritage-based tourism. Generally, these niche areas are, when compared to traditional consumer-driven tourism, more consistent with rural areas' capacity for development, and better aligned with an area's natural and cultural character.

Additionally, nature- and heritage-based tourism are often more compatible than traditional industrial recruitment as a long-term economic development path for smaller and rural communities. The strength of nature- and heritage-based tourism over traditional tourism or even industrial development in smaller or rural communities is that this type tourism:

- often builds upon natural beauty or historical assets abundantly available in many rural communities;
- produces less industrial waste than manufacturing;
- requires less time and capital outlay to start up (stores, hotels, restaurants and cafes, tour guide operations, etc) than manufacturing operations; and
- typically does not produce jobs that require highly technical skills, which in turn creates employment opportunities that are within reach of much of the community.

Tourism can be a strong contributor to economic development in rural areas. The Southern Growth Policies Board identified tourism as one of the top three growth factors for rural areas in the South between 1977 and 1984 (Rosenfeld and Bergman 1989). In addition, the 15 fastest-growing counties in the South all benefited from either direct tourism trade or spillover trade from nearby urban communities.

Low-impact, low-density tourism is most consistent with nature- and heritage-based tourism. In fact, nature- and heritage-based tourism is dependent upon maintaining the integrity of a destination's cultural, natural, and historic features and resources over the long-term. To this end, sustainable development is critical to the establishment and long-term management of visitor destinations centered on nature- and/or heritage-based tourism.

Tourism in the ACE Basin

History

Aerial view of former rice field impoundment

Tourism has been an integral part of the history of the ACE Basin. Prior to the Civil War, much of the Basin and the surrounding areas were large, privately owned properties maintained for agriculture. Following the Civil War, the nature of agriculture in the ACE Basin changed, and many of the plantations were sold. Many of the new plantation owners maintained these properties in their original condition, preserving important historical and natural resources. Impounded wetlands, formerly used for rice culture, were maintained for the purpose of enhancing waterfowl habitat and hunting opportunities. Prominent people often travelled to these plantations to hunt a variety of game animals, especially waterfowl, as well as to enjoy the relatively cool air temperatures of those plantations situated near the ocean.

In the late 1800s, the ACE Basin became a popular summer retreat. Many leaders of the state used small communities such as Eddingsville, near Edisto Beach, as sites for summer residences. These people were drawn to the area for its beauty and natural resources. Eddingsville was seen, as were many coastal communities as a "healthy" area where sea breezes kept away malaria-carrying mosquitoes and the summer heat.

The first facilities for public access were built in the ACE Basin in the 1930s by the Civilian Conservation Corps (CCC). Four state parks in and around the ACE Basin were built by CCC labor in the 1930s. Two coastal parks, Edisto Beach and Hunting Island provided access to the beach, while Givhans Ferry and Colleton state parks offered access to the Edisto River above the ACE Basin. In the late 1950s, the Bear Island Wildlife Management Area (WMA) was created, enhancing the protection of the area's natural resources (see Protected Lands) and providing hunting opportunities to the public.

Recent Direction

The advent of land protection efforts in the ACE Basin gave the area national exposure during the 1980s, when it was included in the North American Waterfowl Management Plan. Under the direction of the ACE Basin Task Force, several properties were obtained during the 1980s and 1990s to protect wildlife habitats. The Bear Island Wildlife Management Area (WMA) was expanded and two public access properties were created: the Donnelley WMA , managed by the South Carolina Department of Natural Resources , and the ACE Basin National Wildlife Refuge (NWR), managed by the US Fish and Wildlife Service (USFWS). Other properties were obtained for inclusion in the ACE Basin National Estuarine Research Reserve (NERR). In addition, the ACE Basin Task Force has been very successful in securing conservation easements on private properties to enhance wildlife habitat and preserve the rural character of the area (see Protected Lands).

What began as a concerted effort to achieve a single goal (waterfowl management) has, because of its success, evolved into a more comprehensive initiative. Not only do ongoing efforts continue to protect the Basin, there is now an interest in deriving a measure of economic benefit from the area. Land and properties once valued only for their seclusion and private recreational purposes are now also valued for the potential they can return to private sector investors and the local tax base.

As part of the process of securing and protecting wildlife management areas in the ACE Basin, management professionals have, inadvertently, created and preserved natural areas that provide access to an area characterized by ecological integrity, scenic vistas, and solitude. This combination of natural qualities is a magnet for outdoor enthusiasts, and an excellent foundation for the growth and development of

Osprey *(Pandion haliaetus)*

nature- and heritage-based tourism. The ACE Basin was recently featured in the national magazine *Outside* (Putterbaugh 1998).

Mainly through efforts by the South Carolina Department of Parks, Recreation, and Tourism (SCPRT), the commercial nature-based tourism industry in South Carolina began to rapidly develop in the late 1980s. In 1988, the Edisto River Canoe and Kayak Trail opened to provide guided and self-guided trips along the Edisto River. This trail was developed through cooperative efforts of SCPRT, the Water Resources Division of SCDNR, and the local community. Volunteers currently maintain and generate interest in the trail. The development of the Edisto River Canoe and Kayak Trail encouraged the establishment of other canoe and kayak delivery operators and the opening of this trail is seen as a key step in the advancement of organized nature-based tourism in the state. In 1995, the South Carolina Nature Based Tourism Association was created to promote sustainable development in the industry, promote voluntary self-regulation, and provide quality assurance through education.

Community Response

During the 1995-1996 strategic planning process for the ACE Basin community (ACE Basin Economic Forum 1996), residents enthusiastically supported nature and heritage tourism as an economic development path towards which to channel efforts and funds. Residents felt that tourism could be economically beneficial to the region while also generating fewer detrimental effects on the environment than other economic activities. Three important community sentiments were revealed during the forum:

- Residents want to keep the area pristine. Both in interviews and at the retreat, members of the community made it clear that they wish to preserve the natural beauty of the ACE. Some even suggested ways of using a proposed visitors center to monitor and thus limit access to particularly sensitive portions of the ACE. Residents want tourism that will not harm the natural resources.
- Residents want to maintain traditional ways of life, traditional ways of earning a living, and the close, small town feel of local communities. To the extreme, some have noted that the area is resistant to change.
- The region is suspicious of government. Residents were initially very wary of the establishment of the ACE's protected areas, fearing increased federal and state limits on what they could do with their land. In discussions on tourism initiatives, this issue was raised again, as a few people reinforced desires to receive government funding as long as it does not come with additional regulations.

The tourism task force developed several specific recommendations as part of increasing the profile of the ACE Basin:

- Develop a visitor/interpretive center near U.S. Highway 17. Plans for a center were drawn up and then shelved, but 1998 has seen the renewal of interest in the visitors center concept.
- Support the Scenic Parkway Concept Plan and designation effort.
- Develop a consistent ACE Basin graphic identity that would apply to all brochures, maps and other visitor materials
- Develop primary and secondary environmental and heritage education programs.
- Create a recreational river corridor by developing additional recreation opportunities along the Edisto River, that might include additional campsites, a series of inns near some parts of the river, a canoe livery, and additional landings.

Since 1995, efforts have been slow to follow through on the task force recommendations. After a couple of false starts, plans are underway to develop an interpretive center on I-95. Private companies in the tourism industry are increasing their advertising and promotion of activities in the ACE Basin.

Status of Nature-based Tourism

Out building at Grove Plantation

Major progress has been made on conserving the area based on unique partnerships between landowners, conservation organizations, and government agencies. This conservation effort has led to recognition of the ACE Basin, nationally and internationally, as a "world class" ecosystem. While some progress has been made, the region has yet to make full use of the comparative economic advantage offered by the ACE Basin's unique environmental, historical, and cultural heritage.

A study prepared by the South Carolina Department of Natural Resources (SCDNR 1999), *Nature-Based Tourism Opportunities & Related Infrastructure: South Carolina's ACE Basin,* states that while there are a limited number of good visitor services for nature-based visitors, they generally do not measure up to the caliber and "visitor value" of the resource. The study found that,

- several outfitters offer water-based experiences that are exceptional;

- there is a need for more outfitters offering guided land-based experiences;

- appreciating the Basin's historic and cultural heritage is severely limited by the difficulty of placing the available historic evidence into a broader context;

- publicly managed properties are excellent in terms of accessing a variety of habitats and viewing wildlife, but offer little or no interpretive services; and

- other opportunities and visitor features – food, lodging, entertainment – are serviceable, but probably not of outstanding or memorable quality.

In general, the available opportunities to fully appreciate the ACE Basin's beauty, ecological complexity, wild qualities and cultural heritage, do not measure up to the quality of the resource and its ability to attract enthusiasts for high-quality natural and cultural experiences that are authentic to the area. For example, even though the ACE Basin receives national recognition in a number of popular birding and nature magazines, there have not been serious efforts to promote bird watching group trips to the area. And although bird walks are offered at state parks, and occasionally by the National Estuarine Research Reserve (NERR) and U.S. Fish and Wildlife Service on their managed properties, few, if any commercial birding trips are organized within the area.


Wildlife watching at Grove Plantation rice fields

A profile of visitors to the ACE Basin NERR revealed that although most were from South Carolina, over one-third of the visitors were from other states. Most were on an overnight trip, staying within the ACE Basin, and indicated that the ACE Basin NERR was their primary destination. The visitors were interested in such activities as beach combing, swimming, picnicking and fishing. Only 10% indicated that they had participated in a guided excursion or tour. Additionally, many had visited an historic site while on their trip and were interested in learning about South Carolina's history (Martin et al. 1998). Based on the findings from this survey, there appears to be additional opportunities for outfitters in the region to enhance the existing visitor product.

Additional information on the issues and management concerns surrounding tourism in the ACE Basin may be found in the Land Use Module and the Management section.

The ACE Basin's Tourism Assets

- Location
- Public Access
- Water-based Activities
- State Parks
- Other Protected Areas
- Historic Homes and Attractions
- Festivals
- Lodging
- South Carolina Heritage Corridor

Location

In addition to its rich and diverse base of natural and cultural resources, the ACE Basin also enjoys a strategic physical location. The Basin is bisected by two major North-South arteries, Interstate 95 and U.S. Highway 17 and located between two of South Carolina's primary visitor destinations: Charleston and Beaufort-Hilton Head. In 1996, Hilton Head hosted 1.8 million visitors, drawn to its 12 miles of coastline, four main resort communities, and championship golf courses. Charleston, meanwhile, is the state's major cultural and heritage tourism site. In 1996, 5.4 million tourists visited Charleston. Over 35% of the city's visitors visited a museum or historic site, the most popular activity surveyed. As the physical bridge between these destinations along the Highway 17 corridor, the ACE Basin offers recreational and cultural experiences that are different from the experiences currently available in Charleston, Beaufort and Hilton Head. Moreover, nature-based visitor profiles indicate that visitors traveling to Charleston and Beaufort share many of the same interests of nature-based visitors.

Public Access

Westvaco nature trail

Although much of the ACE Basin is in private ownership, the public may access the natural and historic resources of the Basin by boat, roadways, and from a number of public lands, including state parks. Boating, paddling a canoe or kayak along one of the ACE Basin's three rivers and many tributaries offers one of the best ways to observe wildlife and the areas's abundant natural beauty and cultural heritage. Boating is allowed throughout the ACE Basin and several public access ramps are available. The islands of the NERR, accessed only by boat, are open to camping by permit from SCDNR.

A number of scenic parts of the ACE are accessible by car via S.C. Secondary Highway 26 (Bennett's Point Road) and Secondary Highways 161 and 162, all off U.S. Highway 17, and by hiking. Hiking trails and overlooks are placed throughout the ACE Basin and maintained by the SCDNR, SCPRT, and Westvaco. These trails are open at a variety of times throughout the year and represent excellent opportunities for bird watching and learning about the ecosystems and culture of the area.

Water-Based Activities

The three rivers, abundant salt marshes and open water of the ACE Basin make it a perfect area for water-based tourism activities such as paddlesports, sailing, motor boat tours, and fishing. Businesses that have been successful in the ACE Basin have often used the water as a draw.

Abundant bird life, variable habitats, and old scenic rice fields await paddlers along the rivers of the ACE Basin making it truly attractive to commercial operators. Commercial vendors operate on all three rivers and each offers unique viewing opportunities. The

Edisto may be the most visited because of access at two state parks, Givhans Ferry and Colleton, and presence of the Edisto River Canoe and Kayak Trail. Occasionally commercial operations organize paddling trips to brackish and saltwater areas.

The open waters of St. Helena Sound are more conducive to kayaks or larger boats than canoes. Sailing and power boat operators, although few in number, have been fairly successful in operating trips in the lower ACE Basin, particularly out of Edisto Beach. There is a great variety in the content and duration of these trips and the routes that they follow. See the South Carolina Nature Based Tourism Association web site for more information.

State Parks

Presently, the most popular visitor destinations within the ACE Basin are the two coastal state parks, Hunting Island State Park and Edisto Beach State Park, which together hosted more than 800,000 visitors in 1996-1997 (SCPRT 1997a, 1997b).

Hunting Island lighthouse

Hunting Island State Park anchors the southernmost edge of the ACE Basin region. Located in Beaufort County, Hunting Island is accessible by car via the town of Beaufort, (27 km or 17 miles away). The park can also be accessed via two public boat landings. Hunting Island, which encompasses 2024 hectares (5,000 acres), is the largest of the Basin’s coastal parks. It has fifteen cabins for overnight stays, 200 campsites, and primitive camping for up to 100 tents. There is also a visitor’s center (with brochures and exhibits), the only South Carolina lighthouse open to the public, a park store (souvenirs and snacks), a beach shop open April to October, nature trails, a boardwalk, a fishing pier, boat ramps, 3 sheltered picnic shelters, and beaches for ocean swimming. In addition, the park offers clinics, nature series, kayaking and canoeing, and walks almost daily.

For fiscal year 1996-97, Hunting Island Park attracted 645,509 visitors, 30%of whom were from out-of-state. The park is the second-most visited state park in South Carolina, after Myrtle Beach. Nearly 16% of the park’s visitors were campers (104,626) while 508,484 were day visitors and 4,013 visitors were fishermen.

The second coastal State Park in the ACE Basin is Edisto Beach State Park. Edisto Beach Park encompasses 508 hectares (1,255 acres), including 2.4 km (1.5 miles) of beach, and provides a range of visitor facilities, including five vacation cabins, 102 campsites, a primitive camping area for organized groups of up to 80 people, 2 picnic shelters, a boat ramp, a hiking trail, playground equipment, and beach access for ocean swimming.

During fiscal year 1996-97 Edisto Beach State Park hosted 179,654 visitors, 30% of whom were from out-of-state. Thirty-five percent of the park’s visitors camped at the park. A significant number of visitors (134,815) were picnickers. The park had few fishermen (360).

Other Protected Lands

Public lands within the boundaries of the ACE Basin account for approximately 20,235 hectares (50,000 acres). These properties represent an excellent resource base for developing and promoting nature-based tourism in and around the Basin. Complementing the two premier coastal parks, the ACE Basin is also home to other state and federal public properties, including the Donnelley WMA, Bear Island WMA, ACE Basin NERR, and ACE Basin NWR (see Protected Lands). In addition, Westvaco Corporation maintains the Edisto Nature Trail (2.4 km, 1.5 miles) and Bluff Trail (0.8 km, 0.5 miles).

The Grove Plantation, part of the ACE Basin NWR and operated by the U.S. Fish and Wildlife Service, is also open to the public and is occasionally utilized both by organized groups and casual visitors. The Grove Plantation is notable not only for its natural resources but also for its historic value.

The ACE Basin offers some of the best bird watching in South Carolina. Public lands provide many opportunities to view the 265 species of resident and migrant birds reported in the area, including endangered and threatened species such as the bald eagle and wood stork. Both Bear Island and Donnelley WMAs offer miles of roads and dike trails for observing waterfowl and wading birds. In addition, two observation platforms are located in the Bear Island WMA. Bear Island WMA hosts a high concentration of nesting eagles.

Hunting is another aspect of tourism in the ACE Basin. Access is provided through hunting clubs and through public land holdings. Although hunting has declined slightly in recent years, there are still guides operating in the ACE Basin. Donnelley WMA, Bear Island WMA, and a number of private plantations are managed for wildlife, with hunting used as a wildlife management strategy.

Historic Homes and Attractions

The Basin area is rich in historically and architecturally significant homes and buildings. The structures range in age from those developed at the time of the Revolutionary War, to rice plantations established during the early-to-mid nineteenth century, to the more recent construction of Frank Lloyd Wright's *Auldbrass*. During the second weekend in October, a local historic preservation group provides tours of the historic homes, plantations, churches, ruins, and cemeteries.

Festivals

The ACE Basin is host to several festivals throughout the year that celebrate the culture and diversity of the area. In addition to the tour of historic homes, there are festivals that celebrate the local industry and local arts. The largest is the Rice Festival, held in mid-April and tied to the region's long history of rice culture. Other festivals that celebrate the area's heritage include the Edisto Beach Bazaar (May 1st), the Edisto Fishing Tournament (Memorial Day), and the Edisto Riverfest (mid-June). The *Nature-Based Tourism Opportunities & Related Infrastructure: South Carolina's ACE Basin*, noted that "Generally, the events [festivals] are centered around the locale's heritage or in some way highlight a community's natural and/or cultural attributes. While the events are probably not "destination quality" -- of such significance that visitors build a trip around the event – they do provide a valuable "window" into the character of the community. From that standpoint, the events are likely to be of interest to nature-based visitors" (SCDNR 1999).

Lodging

Within the ACE Basin, there is a mix of lodging and overnight accommodations – from national motel chains located along I-95, to a condominium beach/golf resort, Farifield Ocean Ridge at Edisto Beach, to several unique overnight properties that reflect the area's historic and natural character. Six unique lodging properties in the ACE Basin that most likely meet the baseline expectations of nature-based visitors are Bonnie Doone Plantation, Broxton Bridge Plantation, Mt. Carmel Farm B & B, Old Academy B & B, Seaside B & B, and Whitehall Plantation (SCDNR 1999). Generally, these properties are either historic – at least 75 years old – or provide an overnight experience that, because of location, highlights the natural qualities of the area.

South Carolina Heritage Corridor

The ACE Basin is located within South Carolina's National Heritage Corridor – a Congressionally designated national heritage area, one of only 16 in the country. As the state's first comprehensive initiative to develop and promote heritage tourism, the Corridor is 386 km (240 miles) in length and includes 14 counties, including two within the ACE Basin, Charleston and Colleton.

South Carolina's Heritage Corridor program is designed to use natural, cultural, and historic assets for tourism development. At the height of its operation, the program expects to attract upwards of 700,000 visitors and $83.5 million in tourism revenue each year. To deliver the expected results, the program has outlined four major goals:

1. Preserve the diverse types of historic resources that portray the range of settings and activities that have been significant to the entire corridor and to its individual communities;
2. Educate residents and visitors about the history of the Heritage Corridor and its regions, building appreciation for the special qualities of its man-made and natural landscape as well as its culture and people;
3. Facilitate expanded recreational and cultural tourism by South Carolinians and out-of-state visitors, capitalizing on the corridor's rich historical, natural, and human resources; and
4. Define programs and projects which can achieve economic benefits from increased tourism throughout the corridor.

Within the framework of the program's goals, the plan calls for the development of new visitor products with which to attract heritage tourists. There are a variety of proposed products, each to be place/history specific. The product mix will include: Regional Discovery Centers, as well as the Discovery Route and the Nature Route which direct visitors interested in history- and/or nature-intensive experiences. Additionally, "specialty trails", focusing on the region's military history, birds, local arts and crafts, cotton history, and the state's African-American heritage, are also planned. Without question, the ACE Basin is a repository of historic and natural features that are consistent with the goals and plans of heritage tourism and, more specifically, South Carolina's Heritage Corridor.

The *Report on Heritage Travel and Tourism in South Carolina* outlines the defining characteristics and value of heritage tourism (SCPRT 1999). The report evidences that heritage tourism holds significant value for the State of South Carolina, as well as for the economic development of the ACE Basin and the surrounding area. Similar to nature-based visitors, heritage visitors' interests and characteristics are highly complementary to the special needs of environmentally fragile and historically rich locations. Heritage visitors are more educated, more environmentally aware and more sensitive to unique and fragile community cultures. They are interested in the authentic, real, and natural experiences.

Also, like seekers of nature-based tourism, heritage tourists comprise a sizeable share and are among the most desirable segment of the tourism market. According to the Travel Industry Association of America (1998):

- over one-fourth of U.S. adults (53.6 million) took at least one trip in the previous year to visit an historic place or museum;

- reasons for historic trips are – personal enjoyment, personal education and the education of children;

- children are more often included on historic site visits than on cultural site visits;

- most historic travelers are on a pleasure trip, although about 16 percent visit historic sites in conjunction with business travel;

- 91 percent of historic travelers are likely to include overnight stays, versus 82 percent of travelers overall;

- on average, historic travelers spend nearly double ($688) the amount per trip than non-historic travelers ($373), and 20 percent of historic trips have expenditures of $1,000 or more; and

- more than a third of the nation's historic visitors are from the South, and 40 percent of the nation's historic visitors elect to experience the South's heritage.

The nature of heritage tourism – the emphasis on authenticity, history, nature, and vanishing lifestyles; and the scale of heritage tourism in South Carolina (2.7 million visitors annually who spend $581 million and support 13,570 jobs) -- dovetails with the characteristics and unique qualities, as well as economic needs of South Carolina's ACE Basin. For this region, a place characterized as economically disadvantaged, with a rich historic and cultural past, and an exceptional natural resource base, heritage tourism offers a solid development opportunity for enhanced economic growth and resource protection.

ACE Basin Discovery Complex

The Economic Forum report prepared for Colleton County, with input from the community, articulates the significant natural and cultural attributes of the ACE

Exploring the old rice fields at Grove Plantation

Basin as a defining feature within Colleton County, and recommends an economic development path that includes nature- and history-based tourism (ACE Basin Economic Forum 1996).

Since the report's publication, the community, in conjunction with the ACE Basin Task Force, has developed a conceptual plan for a proposed visitor educational center, the ACE Basin Discovery Complex. The Complex is envisioned as incorporating complementary sites that, together, introduce visitors to the natural and cultural diversity of the Basin.

The overarching goals for the development of the ACE Basin Discovery Complex are to:

- develop and implement a long-term resource management strategy that relies on educating visitors and residents alike to appreciate the environmental and ecological significance, natural fragility and cultural uniqueness of the ACE Basin, so that they in turn become stewards of the resource and ultimately ensure its long-term protection; and
- provide a catalyst for economic development based on managed tourism. Establishing an "address" for the ACE Basin is the first step toward developing and shaping the area as a premier visitor destination for high-end nature- and heritage-based tourism.

The educational goal is for visitors to recognize and appreciate the significance of the ACE Basin and its various elements, and further understand it as a complex, interrelated ecological system. Through passive and interactive learning – an exhibit gallery, a discovery lab, and several miles of interpretive trails – visitors will be introduced to specific aspects of the ACE Basin, as well as challenged to appreciate the complex interplay of biological systems and their environments. (See related section: Research and Monitoring.)

NEXT CHAPTER: Resource Management

Authors

D. Clones, Corporation for Enterprise Development

A. Kirkley, Kirkley and Associates

W. McMillian, SCDNR Marine Resources Research Institute

E. Wenner, SCDNR Marine Resources Research Institute

References

ACE Basin Economic Forum. 1996. Health economy, healthy environment. ACE Basin Economic Forum, Walterboro, SC.

Bacon R.H. and T. Kibler. 1996. Nature based tourism development in South Carolina. *In* M.L. Miller, J. Auyong, N.P. Hadley (eds). Proceedings of the 1996 World Congress on Coastal Marine Tourism, 19-22 June, Honolulu, Hawaii. Washington Sea Grant Program, University of Washington, Seattle, WA.

France, L.A. (ed.). 1997. Earthscan reader in sustainable tourism. Earthscan Publications Ltd., London, U.K.

Freedman, A. 1995. Eco-topia. National Review 47.

Gunn, C. 1994. Tourism Planning. Third Edition. Taylor and Francis, Philadelphia, PA.

Martin, B.S., W.C. Norman, T. McClinton, S. Ross, J. Krout, and W. McMillan. 1998. A profile of visitors to National Estuarine Research Reserves: Implications for interpretive programs. South Carolina Department of Natural Resources, Charleston, SC.

Mathieson, A. and G. Wall. 1982. Tourism. Longman House, London, U.K. and New York, N.Y.

National Trust for Historic Preservation. 1993. Getting started: How to succeed in heritage tourism. Washington, DC.

Plog Research Inc. 1995. American Traveler Survey, 1995-96. Plog Research Inc., Reseda, CA.

Putterbaugh, P. 1998. Ace is the place. Outside (November).

Rafool, M. 1998. State tourism taxes. Travel and Tourism, A Partnership Series, No. 2. National Conference of State Legislators (July 1998), Denver, CO.

Rosenfeld, S. and E. Bergman. 1989. Making connections: After the factories revisited. Southern Growth Policies Board, Research Triangle Park, NC.

[SCDNR] South Carolina Department of Natural Resources. 1999. Nature-based tourism opportunities and related infrastructure: South Carolina's ACE Basin. Columbia, SC.

[SCPRT] South Carolina Department of Parks, Recreation, and Tourism. 1997a. The tourism industry in South Carolina. Annual Report for 1996. Columbia, SC.

[SCPRT] South Carolina Department of Parks, Recreation, and Tourism. 1997b. The tourism industry in South Carolina. Annual Report for 1997. Columbia, SC.

[SCPRT] South Carolina Department of Parks, Recreation, and Tourism. 1999. Report on Heritage Travel and Tourism in South Carolina. Columbia, SC.

Travel Industry Association of America. 1998. The Adventure Travel Report, 1997. Travel Industry Association of America, Washington, DC.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Resource Management

Introduction

The 182,115 hectares (450,000 acres) making up the ACE Basin study area support more than 1,500 plant and animal species (not including insects) within six distinct ecosystem habitats. The ecosystems of the ACE Basin are not untouched considering that some level of anthropogenic impact has occurred for the last 6,000 years; however, the ecological integrity of the ACE Basin has been maintained through conscious management and sustainable use of its resources. The management of natural resources involves a number of different aspects including both the resource itself (i.e., a fish species) and the habitat the resource occupies (i.e., providing riparian zones as fish habitat). The following management sections discuss management issues and goals presently in use and needed in the future to maintain the unique nature of the Basin:

These sections also include in depth discussions about preservation of resources, wildlife habitats, and cultural resources, as well as development of nature-based tourism. The research and education section describes ongoing research, monitoring, and education within the ACE Basin National Estuarine Research Reserve as well as educational programs throughout the Basin. The ACE contacts section presents all of the federal, regional, state, and local agencies and organizations mentioned in the Characterization. The regulations section describes the pertinent federal and state regulations governing activities in the ACE Basin.

All aspects of the cultural, historical, physical, chemical, biological, and sociological environment affect the strategy of resource management in the ACE Basin. Therefore, the reader is referred to sections on History and Cultural Resources, Environmental Conditions, Biological Resources, Traditional and Current Resource Use, and Socio-Economic Assessment of this Characterization for further information on these topics as they relate to the Resource Management component.

Next Section: Assessment of Management Issues and Goals

Author

M. McKenzie, SCDNR Marine Resources Division

M
E
N
U

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Resource Management

Regulations

The purpose of this section is to provide a summary of most state and federal environmental regulations relating to natural resources and natural resource management in the ACE Basin.

SC State Laws
US Federal Laws

Included are most state regulations regarding natural resources and natural resource management. All others are excluded. These summaries are for informational purposes only and are not intended to replace the original language of the laws. These summaries are based on regulations that were current as of May 1999. Users of this characterization should check the appropriate source for changes to these laws since that time. Laws are listed in alphabetical order. The primary source of this information is the World Wide Web version of the U.S. Code, held by Cornell University and the South Carolina Code of Laws, 1997. Links are provided to the complete regulation, most of which are located at the Cornell University web page or South Carolina General Assembly-LPITR page. These links will cause you to exit the ACE Basin Characterization.

For more information see:

- FindLaw.com EXIT
- Cornell Law Library EXIT
- South Carolina General Assembly-LPITR EXIT
- Environmental Permitting in South Carolina EXIT

Next Chapter: Synthesis Modules

Authors

A. Sievert, NOAA Coastal Services Center

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Synthesis Modules

Water Quality Module | Land Use Module

Introduction

Two modules are included in this ACE Basin Characterization that attempt to synthesize information relevant to two of the most important issues facing the ACE Basin, water quality and land use. The goal of each module is to provide a summary of the ecological, socio-economic, and management aspects of these issues. Land use and water quality were identified as important issues during a workshop held for ACE Basin Project stakeholders. The ecological and socio-economic aspects of these issues are discussed in the context of their importance at national, regional, and ACE Basin-specific levels. Information on management options to mediate problems associated with poor water quality and land use is also included.

The water quality of our nation's streams, rivers, creeks, estuaries, and oceans is environmentally significant. Good water quality is critical to the health and survival of most plant and animal species including humans. Water quality can be altered by numerous factors such as nutrient enrichment, sediment loadings, and chemical pollution. The Water Quality Synthesis Module discusses relevant legislation, watersheds in the ACE Basin study area, and the issues pertinent to water quality. Seven water quality issues discussed in this module include eutrophication, turbidity and sedimentation, hypoxia, biopollutants, toxic pollutants in the water column, sediment contaminants, and salinity alterations/saltwater encroachment.

The Land Use Synthesis Module discusses current land use policies, agencies that affect land use decisions, land use planning in and around the ACE Basin, land use issues, alternative approaches to development, and stakeholders. Six land use issues discussed in this module include traditional land uses, forestry, agriculture, mining, aquaculture, and urbanization. Economic considerations, ecological considerations, and management practices are described for each land use issue. In addition, the Land Use Synthesis Module provides an extensive summary of stewardship development practices and describes the South Carolina Stewardship Development Program.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

MENU

Importance of Water Quality

Water Quality Legislation

Watersheds in the ACE Basin

Water Quality Issues

Summary

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Water Quality Module

Eutrophication
Turbidity and Sedimentation
Sediment Loading Model
Hypoxia
Biopollutants
Toxic Pollutants
Sediment Contaminants
Salinity Alterations and Saltwater Encroachment

Importance of Water Quality

Water resources in the ACE Basin include rivers, streams, estuaries, wetland impoundments, and ground water. We use these waters for different purposes such as swimming, fishing, drinking, agriculture and industry. The quality of the water resources is affected by natural events and human activities. Natural events include the timing, duration and intensity of rainfall and major storms, while human influences include runoff from urban and agricultural land, failing septic systems, and point source discharges, such as sewage outfalls. All waters in the United States are required by law to be designated for "beneficial uses." These uses establish a level of quality that is monitored and evaluated through various water quality management mechanisms. Waters classified for support of aquatic life and contact recreation should be usable for fishing and swimming. Some waters are designated as public water supplies, which are used for drinking and bathing.

Wastewater treatment plant

Poor water quality can limit the extent to which we use surface waters for drinking and harvesting fish and shellfish. Reducing the risk of drinking contaminated water is a goal of the Environmental Protection Agency (EPA) and state health agencies, such as the South Carolina Department of Health and Environmental Control (SCDHEC). Consumption of contaminated fish and shellfish due to poor water or sediment quality can pose significant risk to human health. Chemical concentrations in fish/shellfish tissues can bioaccumulate to levels much greater than found in surrounding water or sediments. Bacterial contamination can also be a factor in closure of beaches in order to prevent outbreak or spread of disease from contact recreation (EPA 1996).

Good water quality is critical to the health and survival of most plant and animal species. Aquatic habitats can become impaired, causing a decline or even extinction in local populations of many species. The structure and function of biological communities can be valuable indicators of stressors in a waterbody. Although conditions might appear suitable for aquatic life, the absence of healthy and diverse communities may indicate the existence of water quality problems that have not been detected (EPA 1996).

In this synthesis of water quality issues, we present each in the context of its importance nationally, regionally, and in the ACE Basin. We also discuss the relationship of water quality issues to the ACE ecosystem, and possible mechanisms to mediate the problems. These issues are discussed in detail in the following subsections.

Back to Top

Water Quality Legislation

The advent of industrialization and rapidly increasing human population has increased the demand for water and necessitated higher water quality standards. The history of legislation dealing with water quality standards dates to the 1899 Rivers and Harbors Act and the 1924 Oil Pollution Act. The first Water Pollution Control Act was enacted in 1948 in light of concerns over water-born diseases such as typhoid and dysentery and their effects on beaches and shellfish beds. In the mid-1950's, and again in the mid-1960's, Congress passed amendments to the Water Pollution Control Act. In 1972, Congress passed the Federal Water Pollution Control Act, which strengthened federal water pollution controls. The 1972 amendments created a national permitting program that required discharges to navigable waters to have a federal-or state-approved permit. Through further substantive amendments in 1977 and 1987, the Clean Water Act and the Water Quality Act included protecting and restoring coastal resources. A discussion of the key sections of the law may be found in *Coastal Challenges: A Guide to Coastal and Marine Issues* (Environmental Health Center 1998).

The Clean Water Act assigns primary authority to the states to set their own standards but requires that all states comply with the " fishable and swimmable" goal of the Act through establishment of beneficial uses and water quality criteria. The EPA recommends that states include the following beneficial uses:

1. **Aquatic life support** in which there is suitable habitat for survival and reproduction of shellfish, fishes, and other aquatic organisms;
2. **Fish consumption** in which the waterbody supports a population of fishes that is free from contamination and does not pose a health risk to consumers;
3. **Shellfish harvesting** is permissible because shellfish growing waters and populations are free from toxicants and pathogens that could pose a health risk to consumers;
4. **Drinking water supply** is safe with conventional treatment;
5. **Primary contact recreation--swimming** can occur without adverse human health effects;
6. **Secondary contact recreation** that encompasses activities on the water that can occur without risk of adverse human effects from contact with the water;
7. **Agriculture** practices such as irrigation and watering livestock can occur due to adequate water quality.

The SCDHEC classifies waters to reflect both existing and intended uses. Criteria stringent enough to protect those uses are assigned to each class. SCDHEC routinely evaluates ambient water quality data against these criteria to summarize the degree to which surface waters support the designated uses overall. This assessment is submitted to EPA every two years. Data from the reports of each state are aggregated to form the National Water Quality Inventory Report to Congress which portrays the status of the nation's waters assessed during the reporting period (EPA 1996).

Back to Top

Watersheds in the ACE Basin

A watershed is defined as a geographic area into which the surrounding waters, sediments, and dissolved materials drain, and whose boundaries extend along surrounding topographic ridges (SCDHEC 1997). The South Carolina Department of Health and Environmental Control grouped the state's watersheds into eight major basins and is charged with managing surface and groundwater quality throughout these basins (See DHEC watersheds). Each basin is subdivided into management units that are regularly monitored by SCDHEC. A Watershed Water Quality Management Strategy has been created for each of the five major drainage basins. The ACE Basin is included within the Salkehatchie and the Edisto drainage basins, which comprise approximately 4 million acres. (See related sections: SCDHEC Water Quality Assessment, Surface Water.)

The southern two-thirds of the ACE Basin is in the Salkehatchie water management area (See Edisto and Salkehatchie watersheds). This drainage basin covers much of the southwestern corner of South Carolina. Most of the subwatersheds in the study area lie within this water management area. The Salkehatchie River basin originates in the Sandhills region and joins with the Little Salkehatchie to form the Combahee River which empties into St. Helena Sound and the Atlantic Ocean. This basin also contains drainages for the Ashepoo, Coosawhatchie, Broad and New Rivers (SCDHEC 1997).

The northern third of the ACE Basin is in the Edisto Basin watershed management area, which is completely contained within South Carolina. The Edisto River Basin originates in the Sandhills and forms the South Edisto and North Edisto Rivers which drain into the Atlantic.

Back to Top

Water Quality Issues

At least 37% of the population in the US is located within 100 km of major estuaries or the oceans (Cohen et al. 1997). Most coastal water-quality problems result from waste associated with concentration of the human population along the coasts and from land-use practices in coastal watersheds. The upward trend in population growth within coastal areas is expected to continue well into the future (National Research Council 1993). (See related section: Land Use Module.)

In an effort to manage waste along the coast, more than 1400 municipal wastewater treatment plants are in operation nationally and discharge approximately 39 billion liters (10 billion gallons) of treated effluent per day. About 85% of this effluent is discharged into bays and estuaries (EPA 1992). In addition to this municipal discharge, industrial facilities discharge about 42.8 billion liters per day (11.3 billion gallons per day) of treated industrial wastewater and cooling water to marine systems. In the ACE Basin, industrial development is minimal with NPDES permits issued for 16 facilities. Municipal wastewater treatment plants that discharge into ACE Basin waters include the Walterboro plant on the Ashepoo River and the Yemassee plant on the Combahee River. The Walterboro publicly owned treatment works (POTW) is permitted to discharge up to 9.99 million liters per day (mld) [2.64 million gallons per day (mgd)], while the Yemassee POTW has a permitted discharge of 0.91 mld (0.24 mgd). There are also four, community-owned, domestic wastewater treatment systems located within the study area. Two of these facilities discharge into the Ashepoo River, one into the Combahee River and one into St. Helena Sound. These facilities have a combined maximum discharge of less than 0.15 mld (0.04 mgd).

Discharges from these municipal and industrial facilities constitute only a portion of the total pollutant input to the ACE Basin ecosystem. Runoff from urban, industrial and agricultural activities, either in the Basin or from areas upstream, is a significant source of pollution. Because the volume of runoff with its associated contaminants increases with increasing urbanization, the ACE Basin has not experienced the degree of water quality degradation that other areas of South Carolina's coast, such as Charleston Harbor, have experienced. Unfortunately, deposition of pollutants from the atmosphere is of increasing concern nationally and within relatively pristine areas such as the ACE Basin. Structural interventions in the natural hydrological cycle through diversion of water among drainage basins and the over-pumping of aquifers can also lead to problems with water quality, such as salinization.

Although most water quality degradation is due to anthropogenic influences, there are natural events, such as hurricanes and torrential rainfall, that can impact water and sediment quality. The effect of these natural events on water and sediment quality are often aggravated by man's activities, such as deforestation that results in soil erosion during heavy rainfall events.

Based on an assessment by EPA of the coastal states, the most common causes of not achieving designated uses in the Nation's estuaries are nutrients, pathogenic organisms, organic enrichment and resulting low levels of dissolved oxygen and siltation (EPA 1990). Non-attainment of designated uses are common around urban and agricultural areas due to runoff containing metals and synthetic organic pollutants which may accumulate in sediments and be resuspended or released into the water column during disturbances. Metals and synthetic organic chemicals have been demonstrated to bioaccumulate in biota and produce health threats to the ecosystem and to humans. In an assessment of water resources of the Edisto River Basin, nonpoint source pollution was determined to pose the greatest threat to water quality (Beasley et al. 1996).

Back to Top

Summary

Water quality in the ACE Basin has not experienced many of the problems found in other more populated areas of the country. With expansion of South Carolina's coastal population, it is likely that deterioration of water quality will occur. Water quality problems of eutrophication, hypoxia, sedimentation, contaminant loadings, and salinity alteration presented in this module are influenced by a number of activities that occur in the ACE Basin, including urbanization, forestry practices, and agricultural development. Thus, it is important that a basic understanding of the potential effects from population and economic growth be achieved so that resource managers can capitalize on beneficial changes and prevent or minimize harmful ones.

Although water quality has improved nationwide since passage of the Clean Water Act, it is important that all levels of government, as well as public and private groups, work together to maintain or improve water quality in the ACE Basin and other coastal areas. The linkage between science and policy needs to be strengthened. Merely gathering and reporting scientific information does not guarantee its use in addressing concerns of society about water quality problems. Water quality problems should be couched in terms of human health and welfare, as well as ecosystem health and sustainability. A greater understanding of water quality issues with emphasis on educating the public about the linkages between personal action and water quality is imperative if the ACE Basin is to remain a relatively pristine ecosystem. This synthesis module has summarized many of these linkages with the goal that the public will take the steps necessary to protect the water resources and aquatic habitats of the ACE Basin.

NEXT SECTION: Land Use Module

Authors

E. Wenner, SCDNR Marine Resources Research Institute

M. Thompson, SCDNR Marine Resources Research Institute

References

Beasley, B. R., W. D. Marshall, A. H. Miglarese, J. D. Scurry, and C. E. Vanden Houten. 1996. Managing resources for a sustainable future: the Edisto River Basin project report, No. 12. SC Department of Natural Resources, Water Resources Division, Columbia, SC.

Cohen, J. E., C. Small, A. Mellinger, J. Gallup, and J. Sachs. 1997. Estimates of coastal populations. Science 278:1211-1212.

Environmental Health Center. 1998. Coastal challenges: A guide to coastal and marine issues. National Safety Council, Washington, DC.

[EPA] Environmental Protection Agency. 1990. The quality of our nations water: a summary of the 1988 National Water Quality Inventory. EPA 440/4/90-005. Office of Water, Environmental Protection Agency, Washington, D.C.

[EPA] Environmental Protection Agency. 1992. National Water Quality Inventory: 1990 Report to Congress. EPA 503/99-92-006. Office of Water, Environmental Protection Agency, Washington, D.C.

[EPA] Environmental Protection Agency. 1996. Environmental indicators of water quality in the United States. EPA 841-R-96-002. Office of Water, Environmental Protection Agency, Washington, D.C.

National Research Council. 1993. Managing wastewater in coastal urban areas. National Academy of Science Press. Washington, D.C.

South Carolina Department of Health and Environmental Control. 1997. Watershed water quality management strategy: Savannah and Salkehatchie River basins. Bureau of Water, SC Department of Health and Environmental Control, Columbia, SC. Technical report No. 003-

97.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

MENU

Introduction

Current Land Use Management Goals

Current Land Use Policies

Agencies Affecting Land Use Decisions

Land Use Planning in and around the ACE Basin

Land Use Issues

Conclusion

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Land Use Module

[Forestry Land Uses](#)
[Agriculture Land Uses](#)
[Mining Land Uses](#)
[Aquaculture Land Uses](#)
[Tourism](#)
[Urbanization Land Uses](#)
[Alternative Approaches to Development](#)

Introduction

Former intertidal swamp modified by human activity for use as rice fields

Humans are a terrestrial species, yet the impacts of their activities have spread to each environmental media adjacent to their habitat. Land use patterns and characteristics created by human enterprise have affected surface and groundwater quality, air quality, wildlife habitat availability and quality, climate, and ecosystem structure. These impacts are becoming more significant as the human population grows and the ability to exploit natural resources has been refined. Man now has the capability to completely reshape the entire face of this planet in a very small amount of time. The rate of natural resource consumption and production of human waste products is now so great that the health of all ecosystems on this planet is affected. The way in which man uses the land on which he lives affects the very future of the world.

The ACE Basin Characterization study area is thought of as a large expanse of minimally developed land, yet its relatively undeveloped condition does not mean the land has been unaltered by man. Surely every acre of the study area has been affected in some way by anthropogenic influences. The historical and present use of the area's land has had a significant influence on the economic and ecological conditions of the region.

Early Land Use Impacts

The ACE Basin was one of the first areas along the coast of North America which attracted the interest of European settlers. The original native inhabitants of the area had been impacting the land use structure for thousands of years prior to European influence, yet their exploitation habits were different than those of the Europeans. Europeans looked upon the land as an area to be exploited for profit, while the native peoples could be described as subsistence or sustainable users of the land. St. Helena Sound is one of the largest sounds along the East Coast south of the Chesapeake Bay (NOAA 1990), and thus attracted early Spanish, French and English settlements. The earliest Europeans concentrated on finding resources to export, e.g. timber, gold, exotic plants and animals. Once European settlements began to develop, agricultural exports were a primary focus of their efforts. Lands within the ACE Basin were cleared for timber products, agriculture and homesites. Cattle, hogs, horses, and other livestock were raised to supply food for these settlers and for export. The Native American custom of burning woodlands to improve forage for deer also benefited livestock in the area. (See related section: History.)

The early European influence in the ACE Basin changed the landscape forever. The original forests were cleared, wetlands were filled, and forested land tracts were converted to agriculture. The ecology and economy of the ACE Basin became linked to large plantations shaped by the use of slave labor to clear cypress and tupelo swamps and tidal wetlands. The plantation was the major unit of land ownership in the study area during the 1700's and 1800's. The ACE Basin was a working landscape where humans derived all their needs from the resources of the area. The land use patterns associated with this economy changed water quality, habitat abundance and quality, and wildlife abundance. Wolves, buffalo and bear were extirpated and aquatic resources such as oysters and finfish were reduced to a fraction of those described by the first Europeans arriving in the area (Goode 1884, Pearson 1972, Beasley et al. 1996). Establishment of rice culture by the 1700's influenced every aspect of the region for over a century. Rice was planted on the large plantations and harvested to be processed and transported to the ports of Savannah and Charleston. Many sustenance crops were also grown in the sandy soils of the area. On the sea islands, where rice culture was not possible due to the saline waters, crops of indigo and long staple cotton were established. Most of the original woodlands disappeared; roads were built; ferry services established; and canals, dikes and channels were dug and dredged.

When the plantation economy collapsed after the Civil War, plantations were divided or sold to wealthy businessmen. Many of the plantations were converted to working game reserves. The abandoned rice fields were managed to attract waterfowl for hunters, while corn, soybeans, and wheat were grown as cash crops. Timber harvesting again became one of the primary industries within the ACE in the 1800's, with railroads being built and small settlements forming around sawmills. Throughout the history of the ACE Basin, fisheries have been an important resource along with agriculture and forestry. As fishery equipment became more efficient and refrigeration became available, commercial fishers in the ACE Basin began to distribute their products nationally year round, becoming an important part of the ACE Basin economy.

Current Land Use and Management Goals

To date, the ACE Basin has remained primarily rural, with natural resource industries as an important economic force in the area. Currently about half of the land within the study area is forested, while about 12% is cropland, 17% is wetlands and 2% is urbanized (See Change in areal extent of forested land). The natural habitats which existed before Europeans arrived have been changed, yet the great extent of undeveloped land makes the area a prime candidate for preservation.

Although traditional uses of agriculture and forestry continue to dominate the landscape patterns within the ACE Basin, the ability to exploit the available natural resources has progressed with technological evolution. The ACE Basin Task Force, consisting of government, private landowners and non-profit organizations, was formed out of recognition that the abundance of natural resources still present in the ACE are of great conservation value. The ACE Basin Task Force has initiated protection for over 52,611 hectares (130,000 acres) of land through government purchases from willing sellers, and conservation easements granted to organizations by private landowners. The best of modern conservation practices within the ACE Basin consider the interaction of all parts of the natural and man-made community to arrive at a holistic resource management plan which will balance economic growth with habitat conservation goals. The traditional land uses of forestry, agriculture, hunting and fishing have been recognized and encouraged in the management goals put forth by the ACE Basin Initiative, while industrial and resort development is discouraged. The goals set forth by the group include:

- maintaining the natural character of the basin by promoting wise resource management on private lands and protection of strategic tracts by conservation agencies;
- continue traditional uses such as hunting, commercial and recreational fishing, forest management, and agriculture;
- acquire land or easements only from willing sellers and participants. No condemnation procedures will be undertaken;
- provide assistance in wildlife management to improve habitat; and
- maintain or improve public access.

The adoption of these goals has led to broad-based public support for the ACE Basin Initiative, including the endorsement of over 70 citizens groups. Success of the Initiative is based upon the willingness of current landowners to protect the area. Private ownership which protects and enhances habitat is an essential element of the ACE Basin Initiative.

Sustainable development is a key concept within the ACE Basin Initiative and attempts to maintain the quality of life, allow well-planned growth, eliminate the pressures which drive development of land tracts, and pace resource utilization to assure a continuous supply in the future. Sustainable forestry practices attempt to assure a continued supply of timber products by developing a forest management plan which takes into account future needs and provides real time economic and ecological returns. Sustainable agriculture uses best management practices to assure a continuing supply of food resources while minimizing detrimental impacts to the environment.

Projected Changes in Land Use

South Carolina and Georgia have the greatest expanses of undeveloped coastlines remaining along the eastern United States, and this fact is now being exploited by realtors and developers. Over the next decade, there will be a 50% increase in the number of Americans in the 45-55 age range, which has a disproportionate share of disposable income and leisure time (Howe et al. 1997). Studies have shown that baby boomers stand to inherit some $10.4 trillion in stock market gains and real estate assets from their parents. Armed with these resources, boomers are expected to double the demand for seaside, marshside, and island retreats built for investment, rental, and as second or third homes (Howe et al. 1997). Most often, local governments see development as a beneficial expansion of their tax base, yet each new house brings additional demands on the community infrastructure. Residential development of farmland and undeveloped land outside a town's core has been shown to nearly always result in a revenue shortfall for the community. A study by the U. S, Department of Agriculture and the American Farmland Trust concluded that for every dollar of tax revenue collected from residential land uses, local governments spend an average of $1.36 dollars in services (Howe et al. 1997).


Development on barrier island

Urbanization can be defined as the conversion of rural lands into high and moderate density residential and commercial (urban) land use patterns. Rural lands may originally be forested, agricultural, rural residential, wetlands, grasslands, waterbodies or combinations of these. Conversion to urban land-use patterns results in an increase in the proportion of impervious land surface, decrease in diversity and abundance of habitat, fragmentation of existing habitats, loss of wildlife, an increase in erosion rates and stormwater runoff, surface water contamination, flooding, well development and aquifer drawdown, and groundwater contamination (USGS 1999). Rapid urbanization (sprawl) occurs on the fringes of business and population centers (cities) as urbanites try to escape the pressures of the city. Poorly-planned development may follow and result in the same conditions which they were initially trying to avoid. Land use planning attempts to direct growth, yet many social issues are involved. Urbanization may also take a toll on historical, cultural and traditional economic resources of a rural area. (See related section: Urban Areas.)

Areas of rapid population growth are centered within an hour’s drive north (Charleston) and south (Beaufort) of the ACE Basin study area, creating the potential for rapid urbanization within the area. People are attracted to the mild climate, rural character, affordable land prices, recreational opportunities and natural settings available in the vicinity of the ACE Basin. Yet, the very things that attract people to the area may be affected by population growth and urbanization.

The study area boundaries include over 295,000 hectares (730,000 acres) of land and water. Although the current protected portion is significant, a majority of land in the study area has no land use plan, and thus, is susceptible to changes which may seriously alter the land use patterns which exist today. Wetlands comprise 17% of the land available in the ACE Basin. With the desire to develop along waterways, oceans and marshes, impacts to wetlands is an important issue in long-term land use planning. Questions remain as to whether the current permitting process, required for projects which disturb wetlands, is actually successful at preventing loss, or whether we are still losing wetlands a few acres at a time. The debate continues on whether landholders should be compensated when permit applications are rejected. These concerns and other issues will be examined in this module.

Changes in land use patterns from those designated as traditional have been recognized as a threat to the existing natural and social community structure. The land use issues which must be addressed during these times of rapid population growth include: property values and taxes which provide incentive to subdivide and develop (urbanize) lands currently managed for traditional uses; expansion of economic infrastructure (roads, sewers, electricity, etc.); resource utilization; industrial development; protection of habitat (biodiversity) and minimization of habitat fragmentation; pollution; access to public lands; and education. The remaining sections of this module will summarize land use policies and review some of the major issues which must be addressed by citizens of the ACE Basin, resource management agencies, conservation groups, private industries, and developers which all have an interest in the area's future.

Back to Top

Current Land Use Policies

Guidelines and Regulations in Land Use Planning

Federal, state and local agencies have developed guidelines and regulations to address many of the land use issues we face today including: best management practices for forestry and agriculture; state and federal soil and water conservation districts; state and federal mining regulations; state and federal coastal zone management regulations; state water quality management plans and water use designations; the South Carolina Heritage Preserve Program; wetlands permitting requirements; federal coastal barrier island preservation acts; and local land use plans and ordinances which attempt to direct growth.

In land use decisions, the interests of industry, business, and private interest groups are considered along with the interests of social planning by government regulation. Government resource planning finds legitimacy in the premise that private enterprise and the market economy entail only short-term exploitation of an ecologically vulnerable resource (Goldstein 1981). Public policy decisions such as land use planning should ultimately be based upon ethical judgements, yet land use decisions have historically been absent of ethical arguments (Beatley 1994). The social allocation of land to uses and activities can be viewed as a problem of ethics. In addition to the water, air and land quality impacts that land use decisions have, they influence the distribution of goods and services (schools, jobs, transportation, recreation, etc.) within a society, and the distribution of undesirables such as pollution, landfills, traffic and other health risks (Beatley 1994).

The State Framework

The legal framework for land use planning and regulation in South Carolina is provided by the *South Carolina Local Government Comprehensive Planning Enabling Act of 1994* (Municipal Association of South Carolina and South Carolina Association of Counties 1994). The act sets out clear requirements to local governments on the purpose, approach, and procedures for plan preparation, approval, and enforcement. Conforming to the Act means that the local governing body must adopt, by ordinance, a comprehensive plan, with at least the seven mandatory elements, by May 3, 1999. The required plan elements are:

- population - historic trends and projections, household numbers and sizes, educational levels, and income characteristics;
- economic development - labor force characteristics, employment by place of work and residence, and analysis of the economic base;
- natural resources - coastal resources, slope characteristics, prime agricultural and forest land, plant and animal habitats, parks and recreation areas, scenic views and sites, wetland, and soil types;
- cultural resources - historic buildings and structures, commercial districts, residential districts, unique, natural, or scenic resources, archaeological, and other cultural resources;
- community facilities - transportation network, water supply, treatment, and distribution, sewage system and waste water treatment, solid waste collection and disposal, fire protection, emergency medical services, general government facilities, education facilities, libraries and other cultural facilities;
- housing - location, types, age and condition of housing, owner and renter occupancy, and affordability of housing; and

land use - existing and future land use by categories, including residential, commercial, industrial, agricultural, forestry, mining, public and quasi-public, recreation, parks, open space, and vacant or undeveloped land.

The seven required plan elements, and any other locally determined elements, may be adopted simultaneously or as separate increments. However, adoption of the land use element must precede adoption of a corresponding zoning ordinance, and adoption of the community facilities element must precede adoption of a corresponding land development or subdivision ordinance. The cumulative plan elements constitute the local comprehensive plan at any given point in time.

Comprehensive Planning at the Local Level

Historically, city planning began as American towns were mapped out for the location of streets, open space, governmental buildings, and available building lots. Early planning efforts included construction and set back requirements designed to ensure the public health, safety and general welfare of citizens. Today, modern planning is an important function of local governments. It provides both a blueprint for the future and an analysis of current land use development within the community. The following sections further explore land use planning issues.

Planning and Zoning
Stakeholders

In 1994, the General Assembly passed the South Carolina Local Government Comprehensive Planning Enabling Act, repealing prior planning enabling legislation as of May 3, 1999, and expanding the scope and substance of comprehensive plans. Although the new Act does not mandate comprehensive planning by the state's 270 municipalities and 46 counties, local planning programs, and their related land use control ordinances, must conform to the Act by that date in order to continue in effect.

Local governments must establish a planning commission to conduct their comprehensive planning. The planning commission for a county or municipality has a responsibility to develop and carry out a continuing planning program for the physical, social, economic growth, development, and redevelopment of the area within its authority. The planning commission serves as a citizen advisory group to the governing body, making recommendations for the adoption of comprehensive plan elements and plan-related ordinances. The comprehensive plan has to be designed "to promote the public health, safety, morals, convenience, prosperity, general welfare, efficiency, and economy of its area of concern." The planning commission has to prepare a comprehensive plan based on trends and projections of population and the economy, natural resources, cultural resources, community facilities, housing, and land use. It also has to prepare and recommend measures for carrying out the plan, which may include zoning ordinances, subdivision and development regulations, an official map, a landscaping ordinance, a capital improvements program, and other implementation policies and procedures. Each plan element must include, but not be limited to, an inventory of existing conditions, a statement of needs and goals, implementation strategies with time frames, and consideration of potential conflicts with adjacent jurisdictions and regional plans or issues. Each plan element must be an expression of the planning commission's recommendations for wise and efficient use of public funds, future growth, development, and redevelopment of the jurisdiction, and consideration of the fiscal impact on property owners.

The planning commission may use advisory committees, with internal or external membership, for any or all of the plan elements, and can incorporate the work of a separate board into the comprehensive plan by reference. Indeed, the planning commission must review and consider plan elements prepared by other agencies for possible inclusion. The planning commission must reevaluate the comprehensive plan elements at least every five years, and update the entire plan at least every ten years.

To implement the comprehensive plan, the planning commission has the power and duty to prepare and recommend for adoption: zoning ordinances; land development or subdivision regulations; an official map of land reserved for future public acquisition; landscape ordinances; a capital improvements program; and policies and procedures for annexation, utility extensions, public maintenance of new infrastructure, economic development incentives, etc.

Portions of Beaufort, Charleston, Hampton, Dorchester and Colleton Counties lie within the ACE Basin Ecological Characterization boundary. Beaufort and Colleton Counties are served by the Lowcountry Council of Governments, while Charleston County is a member of the Berkeley-Charleston-Dorchester Council of Governments. Since most land use decisions are made at the local government level, coordinated, comprehensive land use planning among the Basin's local and regional governments will be essential to sustainable use of this ecosystem. The South Carolina Local Government Comprehensive Planning Enabling Act of 1994 facilitates, but does not assure, this outcome.

Back to Top

Agencies Affecting Land Use Decisions

State Level

Several agencies have responsibilities for protecting the state's natural resources. The SC Department of Health and Environmental Control (SCDHEC), Ocean and Coastal Resource Management (OCRM) a division of SCDHEC, and the SC Department of Natural Resources (SCDNR) are state agencies having jurisdiction over environmental permitting and other land use decisions in South Carolina. (See related section: State Agencies Affecting Land Use Decisions .) In addition to implementing federal acts, such as Section 401 of the Clean Water Act, these state departments use permits, licenses, and certifications unique to South Carolina's ecology and landscapes to actively protect land and water quality. Because the ACE Basin is located in three coastal counties, land use issues center around the coastal environment. Consequently, OCRM plays a large role in permitting for development.

Nationwide Comparison

While most states' governmental structure is similar, they often have different approaches to land use policies. Some states, such as Michigan, California, and New York, have developed State Wetland Conservation Plans. Such plans give states a framework to protect, restore, and create wetlands by finding gaps in their current wetland protection programs. With EPA's financial support, technical assistance, and guidance, states are able to improve their current wetland protection policy. States are encouraged to interact with local governments and citizens to expand wetland management programs while taking into account economic and geographic factors. The State Wetland Conservation Plan may also incorporate cooperative actions, such as education, technical assistance, tax incentives, easements, and zoning. Through the integration of regulatory and cooperative approaches, states are more likely to attain superior wetland management.

Land use programs that have been implemented in other states include Maryland's Environmental Resource and Land Information Network that provides maps of the watershed in an electronic format available to the public. Florida's program is unique in that it contains an active land acquisition program that sets priorities for coastal land acquisition and establishes additional criteria pertaining to coastal areas for consideration by the State Conservation and Recreation Lands Program. In the state of Louisiana, eight of 19 parishes developed Local Coastal Programs, making them eligible for federal funding and giving them permitting authority.

Compared to other states, South Carolina has an excellent coastal zone management program. In fact, OCRM received the first annual federal award in 1992 for excellence in coastal zone management. NOAA has never presented the award to any other program.

Federal Level

Acts vital to the well being of our nation's lands and natural resources are set by federal agencies. Because federal agencies are not the most appropriate venue for local land-use decisions, these acts are often carried out by state and local governments. This gives federal agencies limited direct authority over land use planning decisions that impact wetlands and terrestrial ecosystems. Federal agencies maintain involvement by providing assistance in the forms of grant funds, data information, and technical assistance while retaining oversight authority. (See related section: Federal Agencies Affecting Land Use Decisions .)

Back to Top

Land Use Planning in and Around the Ace Basin

There are four local governments with planning commissions that have a direct or indirect impact on the ACE Basin. The one with the most impact is Colleton County. The others are the City of Walterboro, Beaufort County, and Charleston County. [Small portions of the study area also lie in Hampton (5%) and Dorchester (1%) counties.] Although each progressed through a process consistent with the requirements of the South Carolina Local Government Comprehensive Planning Enabling Act of 1994, their current status and scope are quite different. (See related section: County Land Use Plans.)

Implications for the ACE Basin

Over the past two or three years (1996-1999), there has been a noticeable shift in public opinion in coastal South Carolina towards the need for effective land use planning and regulation. There has been some strong resistance to increasing governmental regulation over the use of private land, both for reasons of ideology and for self-interest. This has served to slow down the planning process in Colleton County, where development pressures are for the moment less severe. In neighboring Charleston and Beaufort Counties, however, the concern over the detrimental impacts on quality of life of unplanned growth has overcome this resistance, resulting in comprehensive plans that place a high priority on protecting the natural environment and improving the quality of new development.

The unsuccessful planning process initiated by the ACE Basin Economic Forum did at least bring the issues to the public’s attention, and it remains to be seen during the summer of 1999 whether Colleton County will have an effective planning and zoning ordinance. Meanwhile, the ACE Basin is partially protected by its designation as a Resource Conservation District under the old plan. The main concern is that this provision is designed not to stop development, “but to better fuse it” into environmentally sensitive areas. A wide range of uses such as marinas and shoreline projects, residential resort complexes, and trailer and recreational vehicle parks remain, at least in theory, permissible subject to a public hearing.

Back to Top

Land Use Issues

The unique landscape of the ACE Basin has been praised nationwide for its importance ecologically and as a model effort in balancing conservation of natural resources with population growth and economic development. The diverse habitats of the ACE Basin and the animals that inhabit them will be shaped by land use decisions. The threat of increasing population growth in coastal areas nationwide and throughout the Southeast brings with it the likelihood that impacts in the ACE Basin study area will increase markedly in the years ahead. (See related section: Biological Resources.)

In the nearby coastal cities of Charleston and Beaufort, the higher value placed on shoreline locations increases the economic incentives to develop there. Increased urbanization of cities surrounding the ACE Basin can affect the environment in three major ways: by conversion of land to urban uses, by the extraction and depletion of natural resources, and by increased pollution associated with urban land use. Land conversion activities range from cutting of forests for timber or conversion to agriculture, to draining and filling of marshes and other wetlands, and constructing homes or resorts on rivers and tidal creeks. As the populace moves to the coast and cities expand, habitats such as wetlands and forests are transformed into land for housing, roads, and industry or converted to agricultural fields or clear cut to meet public needs. Natural resources are linked, so that the degradation of one resource affects not only the resource itself but also other resources in and around the impacted area. For example, deforestation contributes to a variety of indirect environmental impacts, including soil degradation, water siltation, and the loss of indigenous plant and animal species. However, since forests are a renewable resource, proper management can help mitigate the impacts.

There are a number of social and economic benefits associated with increased urbanization, yet along with the benefits come environmental and social ills. These include a diversity of problems, from lack of access to suitable drinking water, to increased pollution, and threats to aquatic and terrestrial resources. Environmental problems associated with increased urbanization can also create a range of social impacts. They may impair human health, cause economic and other social losses, or damage the ecosystems on which both urban and rural areas depend. Most urban environmental problems entail all three of these impacts, either directly or indirectly. For example, urban air pollution has a direct impact on human health, increasing the incidence of respiratory disease. Its impact on the economy is mainly indirect, arising largely from productivity losses due to ill health.

Environmental problems in a watershed such as the ACE Basin often result from the uncoordinated land use management practices of individual decision-makers that, when taken together, cause significant environmental impacts. One of the most serious threats to ecosystem health nationwide is the tremendous influx of the nutrients nitrogen and phosphorus from both urban and agricultural sources. The decline in forested land use and conversion to agriculture has affected habitat and water quality. Although the ACE Basin has not experienced widespread urban development, the threat of suburban sprawl, which causes the loss of wetlands and riparian forest cover, both of which provide important nutrient buffers and habitat, must be carefully considered in landuse planning efforts.

To properly manage environmental resources in the ACE Basin where there are large privately owned parcels, it is necessary to understand how individual land use decisions affect environmental processes across space and through time. The ACE Basin landscape must be considered as a whole, even though it may be subject to an array of dissimilar threats and under the control of many separate governments. By identifying the land use issues in the ACE study area and the possible options for addressing them, the choices for action will have a better chance of being supported by public, private and government sectors.

To the extent possible, this section of the Land Use Module concentrates on environmental issues that arise directly from urbanization and land use activities in the ACE Basin study area. Forestry and agriculture are among the most important land uses in the Basin, while mining and aquaculture have altered the landscape to a much lesser extent. The scope of impacts, the response of the ecosystems to stress, and management options are discussed. A difficulty in gauging the full impact of land uses on the natural environment lies in our incomplete understanding of complex ecological processes. Although abundant research has linked land use and pollution pressures to damage to aquatic or terrestrial life, the total impacts on ecosystems are difficult to measure. When evaluating the impacts of urban activities on human health, for instance, the endpoints can be measured in terms of illness and death rates. Few equivalent measures exist for assessing the health of ecosystems.

Back to Top

Conclusion

This module has provided information on several important concepts and issues related to land use in the ACE Basin. It is evident that public opinion will influence the path that growth and development follows in the ACE Basin, whether it be in the planning stage, implementation stage or evaluation stage. It would behoove planners to involve the public early in the planning process. Residents are the ones whose quality of life is affected by the changes that occur from stimulating growth in a community. Visitors, tourists, and recreators are all affected as well by limits of growth in recreational areas. There can be no question but that the opinions and welfare of each must be considered.

For sustainable development to become a reality, a number of changes in the way we do business will have to occur. Some of these changes have already taken place. There is growing awareness of some of the long-term impacts of growth to the environment, impacts such as global warming, sea level rise, habitat fragmentation, loss of biodiversity, and water quality degradation. We have begun to evaluate the economic and social value of the ecological services that are provided by natural areas such as wetlands and forested areas. People have begun to realize that their activities on their individual pieces of property can have an effect on local, regional and global resources. The mentality of “think globally, act locally” is a reflection of this awareness.

What lies ahead will depend largely on whether wise planning and stewardship is continued - ecological resources are conserved through techniques that support sustainable development; and it will also depend on whether we adopt new approaches to land use and management, approaches promote sustained use of our natural resources.

Next Subsection: Forestry Land Use Issues

Authors

E. Wenner, SCDNR Marine Resources Research Institute

M. Thompson, SCDNR Marine Resources Research Institute

L. Zimmerman, SCDNR Marine Resources Research Institute

M. Poole, NOAA Coastal Services Center

B. Dabson, Corporation for Enterprise Development

E. Starr, SCDNR Land, Water and Conservation Division

D. Clonis, Corporation for Enterprise Development

B. Martin, SCDNR Marine Resources Division

L. McGilvray, NOAA Ocean and Coastal Resource Management

A. Kirkley, Anne Kirkley and Associates

References

Beasley, B.R., W.D. Marshall, A.H. Miglarese, J.D. Scurry, C. Vanden Houten. 1996. Managing resources for a sustainable future: The Edisto River Basin Project. South Carolina Department of Natural Resources, Columbia, SC.

Beatley, T. 1994. Ethical land use. John Hopkins University Press, Baltimore, MD.

Goldstein, J. 1981. Environmental decision making in rural locales. Praeger Publishers, New York, NY.

Goode, G.B. 1884. The fisheries and fishery industries of the United States. Commissioner of Fisheries. Government Printing Office, Washington, DC.

Harrigan, J.J. 1989. Political change in the metropolis. Scott Foresman and Company, IL.

Hay, L. Personal Communication. Wadmalaw Island Land Use Planning Committee. 1999.

Howe, J., E. McMahon, and L. Propst. 1997. Balancing nature and commerce in gateway communities. Island Press, WA.

Municipal Association of South Carolina and South Carolina Association of Counties. 1994. Comprehensive Planning Guide for Local Governments.

National Oceanic and Atmospheric Administration. 1990. Estuaries of the United States: Vital statistics of a national resource base. U.S. Department of Commerce, National Ocean Service, Rockville, MD.

Pearson, J.C. 1972. The fish and fisheries of colonial North America: A documentary history of fishing resources of the United States and Canada. Part V: The south Atlantic states. National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Rockville, MD.

United States Geological Survey. 1999. How urbanization affects the hydrologic system. wwwga.usgs.gov/edu/uraneffects.html.

M
E
N
U

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Community Perspectives

Land Use Issues | Tourism Issues | Water Quality Issues | Biographical Sketches

The community perspectives component attempts to bring some human flavor of the ACE Basin into the product. We hope the user is able to "see" some issues in the ACE Basin through the interviewees' eyes and begin to understand the complexity of these issues faced by the ACE Basin community. The ten interviewees all have a "stake" in the ACE Basin and come from a variety of backgrounds and professional experience. They include resource managers, realtors, conservation organizations, community association members, and residents. The diversity of opinions on land use, tourism, and water quality truly reflects the diverse nature of the ACE Basin community.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Community Perspectives
Water Quality Issues

In recent years it has been determined that the greatest threat to water quality nationwide is nonpoint source pollution.

Question 1: What do you think are the greatest threats to water quality in the ACE Basin?
Question 2: What can or should be done to protect the ACE Basin's surface water quality?
Question 3: What are some of your suggestions for educating the public on water quality issues?

(Click on the answer number to hear the responses of each respondent or click on biography to review their biographical sketch.)

Debra Hernandez
Coastal Engineer Manager, DHEC Department of Ocean

and Coastal Resources
Biographical Sketch

Answer 1, **Answer 2**, **Answer 3**

Question 1 : What do you think are the greatest threats to surface water quality in the ACE Basin area?

Answer : Like most relatively undeveloped areas in coastal South Carolina, the greatest threat to water quality is from the impacts of growth and development. As land is converted from forest to urban land cover; drainage patterns change. Rainwater that use to fall in the forest and soak into the ground now travels over construction sites, parking lots, roads, and manicured lawns. This runoff picks up sediments, oils, grease, nutrients, and many other pollutants. This contaminated rainwater is called nonpoint source pollution because it comes from so many different sources. In fact, nonpoint source pollution is the leading cause of water quality violations in South Carolina and nationwide.

Another potential threat to water quality is atmospheric deposition. Contaminants in the air that either come down with the rain or which settle its dry deposition can be a significant source of pollution. The sources of pollution can be many miles away. A preliminary estimate for the Charleston Harbor, which is just north of the ACE Basin, is that 14% of the annual nitrogen load comes from atmospheric sources. This is an issue that requires more study, but which everyone should consider a significant source of pollution in the ACE Basin area.

Question 2 : What can or should be done to protect the ACE's surface water quality?

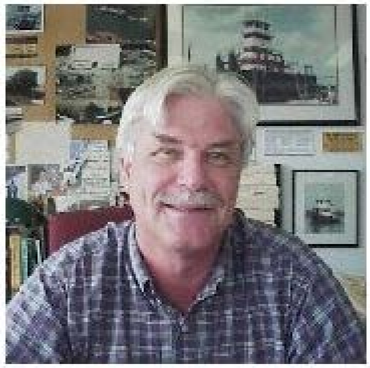
Answer : Water quality can only be protected by managing the activities on the land. The activities that occur on the land are primarily decided by the local governments. Many people believe that the Environmental Protection Agency, the Department of Health and Environmental Control, and other state and federal resource protection agencies can protect water quality. Those programs, however, have great limitations. Decisions like where roads are built, whether buffers are required, and what kinds of drainage systems are installed, are in the hands of local officials. These officials are not necessarily aware the impact that those decisions have on water quality. Therefore, comprehensive land use plans that consider the natural environment have to be developed, adopted, and enforced. These plans can prevent water quality degradation, and are much more effective than trying to correct a problem after it occurs. Additionally, we need more stringent standards than are currently required by the state to address storm water from development and to better manage septic tanks.

Question 3 : What are some of your suggestions for educating the public on water quality issue?

Answer : There are many on-going educational programs being implemented by various agencies, such as the Clemson Extension, Sea Grant, the Department of Natural Resources, and the Department of Health and Environmental Control. Local officials and the public must be educated about how the impacts of land use affects water quality. I believe they also need to be made to understand about the long term economic benefits in protecting water quality. There are many tools that can be used to estimate how development will impact the adjacent natural environment. Growth and development are inevitable. But, this growth can occur without significantly harming water quality if an educated citizenry demands proper land use planning. They only know what to demand by being educated. They also need to be convinced that by putting land use controls in place, you will not harm the economic value of land or the long term prosperity of their communities.

Answer 1, **Answer 2**, **Answer 3**

Question 1 : What do you think are the greatest threats



Gordon Locatis
Resident of Edisto Island

Biographical Sketch

to surface water quality in the ACE basin area?

Answer : I think certainly that surface water contamination of the watersheds is very important. Upstream contamination by industry or by agriculture is a primary threat to this area because its been proven that other areas that are developed or overpopulated have become real problems such as in North Carolina and other populated areas along the eastern seaboard. The ACE Basin is one of the last areas that is still clean, and we need to protect the watershed with the utmost importance.

Question 2 : What can or should be done to protect the ACE's surface water quality?

Answer : I think that it is real important that on-going research be maintained and that there is enough funding to keep technicians and biologists on the water, so they can see if there is any significant changes occurring. If a problem is detected, scientists need to figure out the cause of the problem and then find ways to correct it because the nursery of the ocean must be protected. We need to keep our waters as clean as possible.

Question 3: What are some of your suggestions for educating the public?

Answer: I think people who really care about water quality and the ACE basin are people who watch educational television. I think short programs that are funded to entertain and educate people about the ACE Basin are real important. The second most important avenue for educating the public is the newspaper. Feature articles in local papers such as Charleston, Beaufort, and Walterboro about the significant research studies occurring in the ACE Basin would enhance public awareness. Articles that include pictures of fun things going, research vessels, animals, or significant studies would serve a big purpose in teaching people how important it is to keep the ACE Basin clean and to protect it from any future threats that we see occurring all over the country.

Answer 1, **Answer 2**, **Answer 3**

Nancy Vinson
South Carolina Coastal Conservation League

Biographical Sketch

Question 1 : What do you think is the greatest threat to surface water quality in the ACE Basin area?

Answer : I think there are two main threats to water quality in the ACE Basin. The first is runoff, or nonpoint source pollution (NPS), from any nearby uncontrolled development. The second is stormwater runoff from poorly-run forestry or agricultural operations on lands within the ACE Basin. Nonpoint source pollution, or stormwater runoff from streets, yards, roof tops, parking lots, and farm fields is the main source of water pollution in America today. It contains oil, grease, pesticides, fertilizers, and bacteria from animal wastes.

As development occurs in areas surrounding the ACE Basin, we must be sure that unplanned haphazard development is not allowed to generate contaminated runoff problems for the ACE Basin. Within the ACE Basin, how the rural protected lands are managed is the key issue in protecting clean water. Farm and forestry operations must use best management practices to prevent contaminated runoff.

Question 2 :What can or should be done to protect the ACE's surface water quality?

Answer : To protect the high quality waters in the ACE Basin's tidal creek marshes and tidal marshes, it is very important to protect the remaining lands within the ACE Basin boundaries from any large-scale development, either through purchase or conservation easements. We must also work closely with local government leaders in communities surrounding the basin to ensure that sound land use plans are adopted which will protect water quality within the ACE Basin. The land owners within the ACE Basin must be educated and kept up to date in the use of best management practices for farming and forestry operations to prevent pesticides, fertilizers, and excessive sediments from harming the nearby waters in the ACE Basin.

Question 3 : What are some of your suggestions for educating the public on water quality issues?

Answer : Some suggestions for educating the public on water quality issues would be that we educate local government leaders and citizens in the communities surrounding the ACE Basin of the importance on this wonderful natural area and what is needed to protect it.

We could provide educational tours, slide shows, talks for the general public and for civic groups and businesses groups, and local government leaders. We also need to work with the news media whenever possible to generate news coverage at the local and state levels so that everyone will develop a greater appreciation for enjoying and protecting the ACE Basin.

Priscilla Wendt
Environmental Evaluations, SCDNR Marine Resources Division

[**Biographical Sketch**]

Answer 1, **Answer 2**, **Answer 3**

Question 1 : What do you think are the greatest threats to surface water quality in the ACE Basin area?

Answer : First of all, it is impossible to talk about water quality without talking about adjacent land uses because these topics are so closely related. Considering the existing rural character of the ACE Basin and the relatively small number of point-source discharges, the greatest threat to surface water quality in the ACE Basin is clearly from nonpoint source pollution. Currently, more than half of the land cover within the ACE Basin is forested, with 40% of the forested land devoted to silviculture. Agricultural lands compromise only 12%, while urban areas account for a mere 2% of existing land uses. With increasing development pressures, however, urbanization is expected to escalate. While all three of the land uses, which are agriculture, forestry, and urbanization development, are potential contributors to nonpoint source pollution, the specter of uncontrolled growth, or urban sprawl, around existing population centers may well pose an existing threat to water quality in and around the ACE Basin. Due to the implementation of best management practices (BMP) by the forestry industry and to the net conversion to agricultural lands to timberlands and natural cover, nutrient loading to water bodies in the ACE Basin have decreased over the past decade. With the increasing urbanization however, it is projected that this decreasing trend will soon be reversed. It is most likely that the frequency and duration of hypoxic events, that is the occasions when dissolved oxygen falls below the potentially lethal level of 2 mg/L, will increase with increased urbanization as well. We have also seen an increasing trend in fecal coliform concentrations in certain water bodies in the ACE Basin, primarily in areas of human development where septic systems are the primary mode of domestic waste water treatment and other sources of urban runoff are found.

Question 2 : What can or should be done to protect the ACE's surface water quality?

Answer : There are several things that can be done to protect the water quality in the ACE Basin, and several of these initiatives are already underway. Perhaps most importantly, a comprehensive land use plan should be developed which encourages the maintenance of traditional land uses, such as forestry and agriculture, and discourages urban sprawl. Conservation easements and other economic incentives can be used to accomplish this goal. Establishing urban growth boundaries, or green belts, around existing population centers would also control sprawl and contribute to the maintenance of good water quality by limiting the amounts of impervious surface area and consequently the volume of stormwater runoff. In addition, faulty septic systems should be identified and repaired and in densely populated areas, replaced with sewer systems and publicly-owned wastewater treatment facilities. Finally, there are numerous best management practices (BMPs) for forestry, agricultural, livestock operations, and urban development that can and should be implemented to minimize nonpoint source pollution of our waterways. These BMPs include, among many others, establishing natural vegetated buffers adjacent to wetlands and open waterbodies, using fertilizers and pesticides sparingly, and only when needed; and disposing of waste oil and other hazardous substances properly

Question 3 : What are some of your suggestions for educating the public on water quality issues?

Answer : For those who are interested, there are several goods sources of information about nonpoint source pollution and ways to minimize it by following appropriate best management practices. To name a few, the S.C. Department of Health and Environmental Control publishes a quarterly newsletter entitled, *Turning the Tide on Nonpoint Source Pollution*. It contains a lot of useful information for the average citizen, as well as foresters, farmers, and environmental managers. The Clemson Extension has produced numerous informational brochures and two excellent risk assessment guides for protecting water quality. One of these guides is intended for the small farmers and is based on The National Farm Assist Program. The other guide entitled *SC Home A Syst*, is a self assessment manual that teaches citizens how to help protect the quality of surface and ground water near their homes and throughout their communities. The S.C. Department of Natural Resources and the U.S. Department of Agriculture, in cooperation with several other agencies and institutions, have also published an excellent handbook of agricultural and conservationist practices entitled, *Farming for Clean Water in South Carolina*. Last but not least, the S.C. Forestry Commission has published a very informative booklet entitled, *South Carolina's Best Management Practices for Forestry*, which gives forest landowners and professional foresters guidelines to follow for practicing good stewardship of our valuable forest land which in turn will protect our nearby waterbodies. Of course, it is also important that we educate our children about water quality issues and attempt to instill in them an environmental ethic that will undoubtedly serve them and their community well into the future.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

MENU

Joseph Hamilton

Calvert Huffines

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Community Perspectives
Land Use Issues

Question 1: What do you think are the greatest barriers to land use planning in the ACE Basin?
Question 2: What is your vision for the use of the ACE Basin over the next 50 years?
Question 3: Would you support a land use plan for Colleton County?

Joseph Hamilton
Resident of Greenpond

Biographical Sketch

Answer 1, Answer 2, Answer 3,

Question 1 : What do you think are the greatest barrier to land use planning in the ACE Basin?

Answer : There are several barriers, but primary is the thought or belief that a land use plan will dictate how home owners and land owners use their properties. Land owners seem distressing of anyone advocating a land use plan. Therefore, an aggressive educating or awareness program needs to be in place.

Question 2 : What is your vision over the use of the ACE Basin in the next fifty years?

Answer : I hope or envision a visitor/interpretative center in Green Pond or elsewhere on the ACE Basin Parkway. Also, I would like to see an aggressive education program for local schools to involve more students on environmental issues and just how to be good stewards of nature.

Question 3 : Would you support a land use plan for Colleton County?

Answer : Yes. I applied for the position for the Colleton County Planning Commission and I feel that my experience with GIS (Geographic Information System) and working currently with the Public Works Planning in developing a comprehensive master plan, we could not only develop a comprehensive master plan for the ACE Basin but for Colleton County as a whole.

Calvert Huffines
Realtor in Walterboro

Biographical Sketch

Answer 1, **Answer 2**, **Answer 3**

Question 1 : What do you think are the greatest barriers to land use planning in the ACE Basin?

Answer : The greatest barriers are the uneducated and misinformed people who are making the decisions about land use planning in the ACE Basin. Our surrounding counties, Charleston County and Beaufort County both have passed important, sensitive and comprehensive land use plans that will encourage good development in their counties but protect the natural resources. In Colleton County we are finding that the preliminary land use plans that are being developed do not take into account long-term goals, but rather the short-term goals to promote development at any cost. Politically, this is something that the citizens who live in and around the ACE Basin need to get involved with, and to make sure that their voices are heard and that it is not a political process, but rather a process in which all input is listened to and decisions are made which will benefit the area for the long term rather than the short term.

Question 2 : What is your vision for the use of the ACE Basin over the next fifty years?

Answer : It is my hope that the ACE Basin will remain very much like it is today. One of the greatest tools we found in protecting the ACE Basin is the conservation easement, where much of the land is privately held are then sold or passed on to heirs, but are protected in perpetuity from development. This tool has already saved 150,000 acres of land in the 350,000 acre ACE Basin. By putting conservation easements on their properties, not only are the current owners doing something for their property that gives them so much over the past few years, but it is also protecting a very important aspect of the water quality and estuary system for all of us who live in the ACE Basin.

Question 3 : Would you support a land use plan for Colleton County?

Answer : It is very important that Colleton County develop a good land use plan that is somewhat in step with the surrounding counties of Charleston and Beaufort counties, so that as they turn away bad development, our land use plan will not encourage this bad development to end up in Colleton County. A bad land use plan is almost worse than no land use plan at all. Colleton County should be forceful and provide the strength necessary to develop a good, effective land use plan which will protect the natural resources, yet encourage good development in certain areas.

Long term thinking is necessary.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

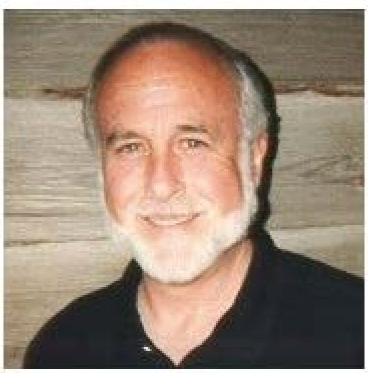
M E N U

- Joe Hamilton
- Ann Kirkley
- Danner Neal
- Rob Achenberg

Community Perspectives
Tourism Issues

The ACE Basin Economic Forum has listed tourism as a potential for economic growth in the area. A few economic benefits of the ACE Basin include nature-based tourism and wildlife-oriented recreation.

Question 1: Do you feel it will help the Colleton County economy?
Question 2: Do you think it will improve the overall standard of living for Colleton County's citizens?
Question 3: Do you think nature-based tourism will help or hurt the ACE Basin region?
Question 4: What can be done to encourage nature-based tourism in the ACE Basin in a way that has minimal negative impact on the environment?



Joe Hamilton
Ducks Unlimited, Inc.
Biographical Sketch

Answer 1 and 2, Answer 3, Answer 4

Question 1 : Do you feel it will help the Colleton County economy ?

Question 2 : Do you think it will improve the overall standard of living for Colleton County' s citizens ?

Answer : Thousands of acres of undeveloped land in the western part of Colleton County produce agricultural and forestry products, both are extremely important to the local economy. The ACE Basin in the eastern portion of Colleton County encompasses 350,000 acres - this is the largest undeveloped wetland on the coast. These lands from eastern and western part of Colleton County, produce a second crop each year. Hunting, fishing, and wildlife observation would be that crop. Last year South Carolina received revenues totaling 1.5 billion dollars from the combined activities of hunting, fishing, and wildlife observation. With its bounty of natural resources, you can bet that Colleton County receives a higher than average share of these revenues. Therefore ecotourism is a burgeoning industry for Colleton County. Especially considering the loss of natural habitats to development in other coastal areas.

Question 3 : Do you think nature- based tourism will help or hurt the ACE Basin region?

Answer : Ecotourism related to hunting, fishing and wildlife observation is an environmentally sound approach towards utilizing the county's bounty of renewable natural resources.

Question 4 : What can be done to encourage nature-based tourism the ACE Basin in a way that has minimal negative impact on the environment?

Answer : Governmental agencies from the local level, all the way up to the national scope should develop a public relations program to enhance the public awareness of nature-based activities; while at the same time provide maps, tour guides, and other supportive information for the ones who enjoy the bounty of nature in this county

---

Ann Kirkley
Principal of Ann Kirkley & Associates, LLC
Biographical Sketch

Answer 1, **Answer 2**, **Answer 3**, **Answer 4**

Question 1 : Do you feel it will help the Colleton County economy?

Answer : Colleton County enjoys the distinction of embracing more than 60% of the area identified as the ACE Basin. This area represents about 75% of the total area within the boundaries of the county. Because of the basin's dominance within the county and its environmental sensitivity, Colleton County is challenged to identify and develop economic development strategies that complement traditional development. An area of economic development that is consistent with the county's environmentally sensitive properties is nature-based tourism. Because of proximity to two of the state's leading tourism destinations, which are Charleston and Beaufort, and the exceptional quality of the natural resource base that defines a large percentage of the county, nature-based tourism is believed to have the potential to be a positive force on Colleton County's economy.

Question 2 : Do you think it will improve the overall standard of living of Colleton County's citizens?

Answer : Nature-based tourism is among the most fastest growing segments of the tourism industry, with an annual growth rate pegged at about 15 to 25 percent versus 2 to 4 percent for more traditional tourism. This area has promising driver for economic growth. Nature-based tourism is by its very nature, a community-based development path that relies heavily on the participation of the local population. While capital infusion may come from inside and outside the community, the local people are typically an integral force in the development/growth of the tourism sector. Generally, nature-based tourism does not have an immediate impact, but its benefits are revealed over time. It is grounded in a locale's authentic features, its natural and cultural resources, and it is founded in the fabric of the local community. Because it's so integral to the community, it depends heavily on local population. I believe nature-based tourism can positively impact the county's overall standard of living, by creating job opportunities, nurturing local entrepreneurs, and encouraging cottage industries that previously had no commercial outlet.

Question 3 : Do you think nature- based tourism will help or hurt the ACE Basin region?

Answer : Nature-based tourism if carefully developed and managed has the potential to help the ACE Basin. Nature-based tourism can raise the basin's public profile and help it achieve higher recognition as a unique and valuable resource. Nature-based tourism can, by defining the basin's various visitors' experiences and placing the resource in a larger context, help more people understand the basin's value and appreciate its significance. Greater familiarity with the resource, especially its unique features and exceptional quality, can become the foundation for a constituency of supporters who will work tirelessly to ensure that the environmental and cultural integrity of the basin remains intact for future generations.

Question 4 : What can be done to encourage nature-based tourism in the ACE Basin in a way that has minimal negative impact on the environment?

Answer : To encourage nature-based tourism that will have a minimal negative impact on the environment, a comprehensive land use plan and attendant regulations should be implemented. The area needs a strong land use plan that takes into consideration the need for sustainable development in a fragile environment. A plan can affect the intensity, the type, and location of development in such a way as to create a setting that is environmentally sensitive and esthetically pleasing.

Answer 1, Answer 2, Answer 3, Answer 4

Question 1 : Do you feel it will help the Colleton County economy?

Answer : As the Chamber of Commerce Director for Edisto Island, I only speak to a portion of Colleton County. But most definitely, nature-based tourism

Danner Neal
Edisto Beach Chamber of Commerce

Biographical Sketch

and wildlife orientated recreation will be a positive economic influence on Colleton County. The increased need for nature-interpretive tours and the complimentary services required from increased visitors will bring more dollars to this area. With Edisto being an anchor to the ACE Basin, it follows that visitors will find their accommodations and dine and shop on Edisto. Currently, the tourist season is mainly summer visitors. Visitors interested in the ACE Basin as a nature-based tourist destination are not necessarily summer visitors. Therefore, this may expand the visitors season which would again impact the economic benefits as promoting Edisto as a place to stay while exploring the ACE Basin.

Question 2 : Do you think it will improve the overall standard of living for Colleton County's citizens?

Answer : The impact to the citizens of Colleton County will depend on the types of jobs created to interpret the ACE Basin. An example is the Center for Excellence or the interpretive center planned for Edisto. It is critical to me that the managers of this facility look to the locals of Edisto for not only functional, low paying, operational tasks, such as ground maintenance. Local individuals perceive this to be a potential future career opportunity as an interpreter or in the field of conservation and wildlife management. This will take intentionality on the part of the center's management to not only provide job opportunities, but also provide educational opportunities for local citizens to learn more about the resources in their backyards. Anytime educational level increases the overall standard of living of the citizens improves. Long-term, this is not only an asset to the community economically but complements the goal of conservation management.

Question 3 : Do you think nature-based tourism will help or hurt the ACE Basin?

Answer : I am not a conservationist. Therefore, it is very difficult for me to answer this question from that perspective. I do believe that conservation must include education of the general public. Therefore, nature-based tourism as it relates to educating the public can only be helpful to the ACE Basin region.

Question 4 : What can be done to encourage nature-based tourism in the ACE Basin in a way that has minimal negative impact on the environment?

Answer : Again my answer deals with education. Such education must expand beyond just those involved with conservation, such as resource management employees. From the perspective of the Chamber of Commerce, there must be a community understanding that the ACE Basin is our economic resource and therefore it must be maintained in order to continue to have this resource. Our area being Edisto should be marketed as the gateway to this beautiful pristine ecosystem. This is important to me that the community be given the concept and the appropriate verbiage to understand the importance of maintaining the beauty and consequently the resources of the ACE Basin. For this to happen education must not only include our tour guide, but also the accommodation staff, restaurant workers, shop clerks, and the local citizens. I commend The Nature Conservancy and DNR who are beginning this method relative to the sea turtles in the community involvement in the process of understanding the importance of the citizens being invested in resource management. This could be done in a larger scale for the ACE Basin. Again, education! Education! Education!

Rob Achenberg
Superintendent of Edisto Beach

Answer 1, Answer 2, Answer 3, Answer 4

Question 1 : Do you feel it will help the Colleton County economy?

Answer: The development of nature-based tourism will help boost the economy of Colleton County. The public demands for quality, nature-based tourism has increased over the last few years. The pristine nature of the ACE Basins salt marshes and maritime forest represents the types of quality resources that visitors want to experience. These same visitors are willing to pay a premium price to experience this environmentally sensitive area. Visitors

State Park

Biographical Sketch

will require outfitters who are well educated about the ACE Basin to provide a quality interpretive program about the resources . These visitors will also require other quality accommodations to include lodging, restaurants and entertainment. There are many opportunities for Colleton County to benefit from the development of nature-based tourism in the ACE Basin.

Question 2 : Do you think it will improve the overall standard of living for Colleton County's citizens?

Answer : The standard of living of the Colleton County's citizens will improve the development of nature-based tourism in the ACE Basin. The attraction of visitors to this resource will provide jobs for the local residents and increase the tax base for local governments. The quality of life for the citizens of Colleton County is closely related to the quality of resources within the ACE Basin. Most people who live in the area enjoy and respect the environment. The development of nature-based tourism activities in the ACE Basin will attract visitors who share that view to Colleton County. With wise managers, visitors and local citizens alike will be able to enjoy the ACE Basin for many generations to come.

Question 3 : Do you think nature- based tourism will help or hurt the ACE Basin region?

Answer : Any type of development in an environmentally sensitive area such as the ACE Basin needs to be managed wisely and with the utmost respect for the resource. The quality of the natural environment is the main focus for the visitors searching for a nature-based tourism experience. If development that degrades the resource is allowed, not only will the visitors stop coming, but the quality of the resource may be compromised for generations to come. The wise management of the nature-based tourism development in the ACE Basin will help the visitor develop a stronger appreciation and respect for the fragile resource. With this stronger understanding of the ACE Basin individuals will be more conscious of environmental issues that affect this region and be more willing to help protect it.

Question 4 : What can be done to encourage nature-based tourism in the ACE Basin in a way that has minimal negative impact on the environment?

Answer : The job of minimizing impacts of nature-based tourism and development begin with the managers and owners of the properties that make up the ACE Basin. You need to know the types of resources you have on your property and what kind of condition those resources are in. Once this inventory is complete and you have a bench mark to refer back to once your able to allow nature-based tourism in your area. If you see evidence that the resource is beginning to be degraded, then that activity can be cut back and the resource allowed to recover. An inventory is vital to the development of the carrying capacity because if you do not know what you have on your property, you cannot protect it. Once this inventory is complete the next step is the recruitment of qualified, trained outfitters who have an understanding and respect for the environment. These individuals should be educated on the various ecosystems within the ACE Basin and be willing to put those resources above financial gain. An outfitter can be financially successful without compromising the resource if the operation is managed wisely. The development standards regarding training, educational content, and required equipment are other ways to minimize the environmental impact of nature-based tourism.

M
E
N
U

Rob Achenberg

Joe Hamilton

Joseph Hamilton

Debra Hernandez

Calvert Huffines

Ann Kirkley

Gordon Locatis

Danner Neal

Nancy Vinson

Priscilla Wendt

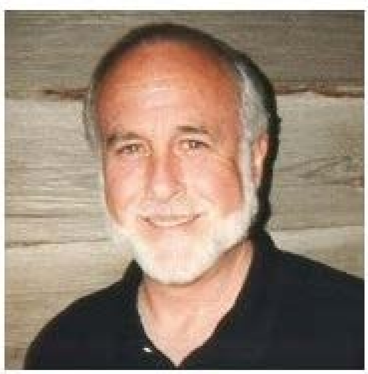
General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Community Perspectives
Biographical Sketches

Robert Achenberg, *Superintendent of Edisto Beach State Park, SC Department of Recreation and Tourism*

As Superintendent of Edisto Beach State Park, Robert is responsible for the protection and management of the 1,255 acre state park, which is located in the ACE Basin.

Robert has lived in the Lowcountry for the past five years. He enjoys the ACE Basin for "the peace and serenity of the natural environment."



Joe Hamilton, *Ducks Unlimited, Inc.*

Joe Hamilton has been a citizen of the ACE Basin for the past 14 years. His involvement with the Lowcountry Initiative within Ducks Unlimited has helped to protect and enhance the area through the formation of conservation easements and by providing technical assistance to land owners and other organizations involved in land protection. Hamilton admires most about the ACE Basin the "natural integrity of the Basin and the involvement in traditional uses of the land."

"It is of paramount importance that the ideals of the ACE Basin Project are fostered in other areas of South Carolina and its neighboring states. Land conservation efforts in other Focus Areas with an emphasis on partnerships is the model for success in protecting our heritage for future generations."

Joseph Hamilton, *Chairman of the ACE Basin Economic Forum*

As Chairman of the ACE Basin Economic Forum for Education, Joseph Hamilton has helped to create an action

agenda for compatible development, which will hopefully foster job creation and business development while protecting the area's cultural and natural assets.

Joseph was born and raised in Colleton County and currently resides in Green Pond with his wife Blanche and three children, Joseph St. Michael, Kimberly Michelle, and Jennifer Elizabeth. When asked what he likes best about the ACE Basin, Joseph responded, "I like best about the ACE Basin: I am a Christian and therefore believe that creator God is the architect of the universe, the human race, and the world. Sometimes when riding bicycle or driving one of our many rural roads, I can see the handiwork of creator God and I am truly blessed. I can see Him in the blue heron, the cattle egrets, or the black waters of the Edisto River. I can hear him in the croaking of the frogs, the hawk and the great eagle as they soar overhead. I can smell Him after a spring rain or see him in all his majesty after a storm. I hear Him when I sit on the screen porch at night. If we don't exercise care in the way we live in the ACE, then a part of my relationship with God would be destroyed."

Debra L. Hernandez, *Assistant Director of Planning, SCDHEC's Office of Ocean and Coastal Resource Management*

Debra has over 11 years of experience in coastal management and is currently Assistant Director of Planning at SCDHEC's Office of Ocean and Coastal Resource Management. Her work includes representing the agency on hazard mitigation and nonpoint source management issues at the state, regional, and federal level; managing watershed projects; organizing workshops and advising individuals and agencies on a wide variety of issues; and providing expert testimony on coastal processes, nonpoint source pollution, and related engineering and water quality issues. She is South Carolina representative to the Coastal States Organization, serving on the Executive Committee, the Hazards Committee, and as Chair of the Clean Water Committee.

Calvert W. Huffines, *The Huffines Company*

The Huffines Company was established by Calvert Huffines in 1987. His four firms have a variety of services in the appraisal, management, and brokerage area of plantation sales. His involvement in the ACE Basin effort stemmed from his love of the Lowcountry and his awareness of how unique and valuable the area is and how quickly it could be changed. His early

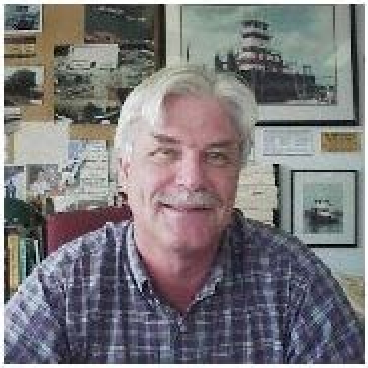
discussions with Gaylord Donnelley, owner of a number of South Carolina Lowcountry plantations created a unique vehicle to protect the ACE Basin through a coalition between the public and private sector, an effort that had never been tried before. He helped to establish a task force composed of private landowners, the South Carolina Wildlife and Marine Resources Department (now known as the Department of Natural Resources), the US Fish and Wildlife Service, the Nature Conservancy, and Ducks Unlimited. This task force has been very effective at the preservation of natural areas and has been duplicated in other areas of South Carolina, North Carolina, and Georgia.

The ACE Basin's "remarkable success provides not only interest to those of us in Beaufort, but perhaps a place for current discussion of land planning and conservation during times in which we are undergoing substantial change."

Ann Kirkley, *Principal of Ann Kirkley & Associates, LLC*

Ann Kirkley & Associates, LLC is a firm that specializes in economic development for the public sector, and business development in the private sector, providing research, strategic planning, and marketing services. Ann's firm has assisted several public and private groups working on behalf of the protection, management and economic development of the ACE Basin. The firm prepared a detailed conceptual plan for a proposed visitor center on Highway 17 on behalf of the SCDNR and The Nature Conservancy. It conducted a survey of nature-based tourism resources and opportunities in the Basin for the SCDNR and made a presentation thereon to the Chamber of Commerce and business community of Edisto Island.

Ann enjoys visiting the ACE Basin because it is "as much a state of mind as a physical place. Its unique natural and cultural features are significant not only for South Carolina, but for the entire East Coast of the US. As one of the last remaining, largely untouched estuarine environments, it is home to many natural habitats and 17 protected or endangered species; claims a history that reflects the formative years of the nation; and even today reflects the character and richness of the Gullah culture. The ACE Basin is a respite from over commercialization, intense development and artificiality -- it's a wonderful place to 'get away to' when you want to spend time alone and enjoy scenery that is more subtle than spectacular."



Gordon Locatis, *Edisto Island Community Association*

Gordon Locatis is past president and long-time member of the Board of Directors of the Edisto Island Community Association. He currently serves as an active member of the Board of Directors and delegate to the ACE Basin Citizens Advisory Committee. The Community Association has an active role in the ACE through involvement with the ACE Citizens Advisory Committee and strong interest in the educational aspects of the Basin and proposed education center.

Gordon and his wife Catherine have lived in the Lowcountry for the past 19 years and have raised their two children, Giles and Abigail, on Edisto Island. The family lives on 12 acres of woods, marsh and creek located in the ACE Basin. They enjoy exploring the ACE Basin on a regular basis with boat trips to Otter Island, kayaking the Edisto River, camping and birding. What Gordon likes best about the ACE Basin is "the fact that a diverse group of individuals and agencies have cooperated in preserving a large and vital marine ecosystem. It restores my soul to know that this initiative to preserve the natural wonders of the low country is working and will remain in place to the benefit of all things great and small."

Danner Neal, *Executive Director of the Edisto Chamber of Commerce*

As executive director of the Edisto Chamber of Commerce, Danner's role is to be the first source of information to new residents, business, and visitors. Edisto Chamber of Commerce assists new businesses and residents with relocation to Edisto Island and the Town of Edisto Beach. New residents are provided with information about the island and the town, including lists of lodging, restaurants, and recreational and cultural sites and activities.

Danner has lived in the ACE Basin for two years and enjoys the area most for its " beauty, and how residents and visitors appreciate the natural character of the area and understand the importance of maintaining and conserving the area."

Nancy Vinson, *South Carolina Coastal Conservation League*

For the past five years Nancy has worked with the South Carolina Coastal Conservation League, an advocacy organization which promotes protection of the special natural resources of the ACE Basin. As Water Quality Program Director in the Conservation League, Nancy plays a strong role

in environmental advocacy in the Lowcountry of South Carolina. She also serves on the ACE Basin Advisory Committee and represents the Conservation League.

What Nancy likes best about the ACE Basin is "the fact that a really significant, large natural ecosystem is being protected for posterity. That is so important given, South Carolina's rapid coastal development."

Priscilla H. Wendt, *Environmental Quality Manager III, SCDNR MRD, Office of Environmental Management*

Priscilla came to the Lowcountry as a benthic ecologist after completing her Masters of Arts in Marine Science at the College of William and Mary's Virginia Institute of Marine Science in Gloucester Pt., VA. She now specializes in environmental contaminants and water quality issues at SCDNR MRD, Office of Environmental Management

Priscilla enjoys the ACE Basin for its "serene, unspoiled beauty, and its striking diversity of wildlife and habitats."

1999 ACE Basin Ecological Characterization: archaeological Watershed Database coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of archaeology and Anthropology, Columbia, SC; Jim Scurry
Publication_Date: 19981100
Title:
1999 ACE Basin Ecological Characterization: archaeological Watershed Database coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Columbia, SC
Publisher: University of South Carolina

Larger_Work_Citation:

Citation_Information:

Originator:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)
Publication_Date: 19990501
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention

for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
An existing data layer of archaeological and cultural sites was formatted to represent the number of sites with the United States Geologic Survey HUC codes. The data layer does not provide the specific location of archaeological site, but the number of sites.

Purpose:
Data layer provides information on the number of known archaeological and cultural sites within each watershed. The actual number of potential sites is much larger.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19880000
Ending_Date: 19980000

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0724
East_Bounding_Coordinate: -80.1525
North_Bounding_Coordinate: 33.1211
South_Bounding_Coordinate: 32.3038

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: archaeology
Theme_Keyword: cultural resources

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: South Carolina
Place_Keyword: ACE Basin

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data. Data was collected under the assumptions of the project that collected the data. Appropriate use of this data set is the responsibility of the user. Information in data set is comprised of only known sites. Significant numbers of sites have not been uncovered.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Complete

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: South Carolina Institute of archaeology and Anthropology
Publication_Date: 19980000
Title: archaeological Database
Edition: none
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Columbia, SC
Publisher: University of South Carolina

Source_Scale_Denominator: 24000
Type_of_Source_Media: Electronic Mail System
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 198800
Ending_Date: 19980000

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: provided information for the archaeology datalayer

Process_Step:

Process_Description:
archaeological sites were initially digitized by Jim Scurry of the South Carolina Department of Natural Resources, Land, Water, and conservation Division in the early 80's. Sites were digitized from USGS topos with sites drawn on the maps. Maps are maintained by SCIAA. Data was clipped to ACE Characterization Project boundaries by Scurry and transferred to MRD.
Process_Date: 19980000
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The archaeology polygon coverage was unioned to the watershed split coverage in ArcInfo. The Info file for the unioned coverage was then exported and brought into Microsoft Excel.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The Info file of the unioned coverage was analyzed in Excel to create a new file that listed how many archaeological sites were in each watershed. The file with the number of sites per watershed was then joined with the attribute table the watershed polygon coverage.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 36

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: archaeol.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3349209.250
Range_Domain_Maximum: 166225280.000

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 13238.898
Range_Domain_Maximum: 99124.453

Attribute:

Attribute_Label: Acearch_
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2
Range_Domain_Maximum: 37

Attribute:

Attribute_Label: Acearch_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 261

Attribute:

Attribute_Label: Splitcode
Attribute_Definition:
assigned value used to split the study area based on 14 digit watersheds
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 36

Attribute:

Attribute_Label: Sitecount
Attribute_Definition: number of archaeological sites in a watershed
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 65

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no

liability for the data.

Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:44 2000

1999 ACE Basin Ecological Characterization: Deep Core coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19990601
Title: 1999 ACE Basin Ecological Characterization: Deep Core coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990601
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention

for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth.

The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin.

This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
Cores were collected from the main channel of the Ashepoo River and the adjacent salt-marsh south of Fenwick Cut for pollution history studies. This site was chosen because a thick fine-grained deposit of sediment, which best records pollutant inputs, was discovered there. Samples from these cores were analyzed by gamma spectroscopy (for Pb-210, Cs-137, and Be-7) and ICP-MS (for metals) to determine the rates of accumulation, profiles of inorganic pollutants, and historical records of pollutant input during the past several centuries.
Purpose:
Cores were taken to determine the long-term (100-y) historical record of pollutant input to the ACE Basin as recorded in channel and salt-marsh deposits, and to compare these data with similar work done in the Sapelo Island NERR and Savannah River estuary.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19950315
Ending_Date: 19950316

Currentness_Reference: Final Report submitted - 19951004

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.4132
East_Bounding_Coordinate: -80.4088

North_Bounding_Coordinate: 32.5253
South_Bounding_Coordinate: 32.5236

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: geochronology
Theme_Keyword: x-radiography
Theme_Keyword: sedimentology
Theme_Keyword: pollution history
Theme_Keyword: metals
Theme_Keyword: Pb-210
Theme_Keyword: Be-7

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: Ashepoo River
Place_Keyword: Fenwick Island
Place_Keyword: ACE Basin
Place_Keyword: Fenwick Cut

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: ArcView version 3.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: Post processing in ArcInfo shows polygon topology.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator:
Dr. Clark Alexander, Skidaway Institute of Oceanography, 10 Ocean Science Circle, Savannah, GA 31411
Publication_Date:
Title:
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place:
Publisher:

Source_Scale_Denominator: 24000
Type_of_Source_Media: paper, map, final report
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19950315
Ending_Date: 19950316

Source_Currentness_Reference: none

Source_Citation_Abbreviation: none
Source_Contribution:
provided information for the creation of the deep core data layer

Process_Step:

Process_Description:
The points were digitized by hand based on the coordinates given in the report.
Process_Date: 19980900
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 2

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: deepcore.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Id
Attribute_Definition: an arbitrary number used to identify the station
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 2

Attribute:

Attribute_Label: Station
Attribute_Definition: the name of the station where data was collected
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Location
Attribute_Definition:
where in the tidal zone data was collected - subtidal, intertidal
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.

City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at
<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:59 2000

1999 ACE Basin Ecological Characterization: 1989 Unrevised National Wetlands Inventory

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Jeff Trudnak
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: 1989 Unrevised National Wetlands Inventory
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE

Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

This 1:24000 coverage contains wetland location and classification as defined by the U.S. Fish and Wildlife Service. The digital data as well as the hardcopy maps that were used as a source of the digital data are produced and distributed by the U.S. Fish & Wildlife Service's National Wetlands Inventory project. The data set covers the ACE ecological characterization area. This metadata record is for 1989nwi1, 1989nwi2, and 1989nwi3.

Purpose:

The data provide consultants, planners, and resource managers with information on wetland location and type. The data were collected to meet U.S. Fish & Wildlife Service's mandate to map the wetland and deepwater habitats of the United States.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19890301
Ending_Date: 19900130

Currentness_Reference: Ground Condition

Status:

Progress: Complete
Maintenance_and_Update_Frequency: continually

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0723
East_Bounding_Coordinate: -80.3599
North_Bounding_Coordinate: 33.0257
South_Bounding_Coordinate: 32.3067

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: land use/land type
Theme_Keyword: wetland
Theme_Keyword: coast
Theme_Keyword: national wetland inventory

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: South Carolina
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: Ace Basin

Access_Constraints: None
Use_Constraints:
Not for use at scales greater than 1:24000. Federal, State, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner that used in this inventory. The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info version 7.2.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator:
South Carolina Water Resource Commission Fish and Wildlife Service - National Wetlands Inventory
Publication_Date: 19900100
Title: 1989-1990 National Wetlands Inventory
Edition: 1989-1990
Geospatial_Data_Presentation_Form: map
Other_Citation_Details: none

Source_Scale_Denominator: 24000
Type_of_Source_Media: magnetic tape
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19890101
Ending_Date: 19950000

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: provided NWI datalayers for use in ACE characterization

Process_Step:

Process_Description:
The NWI coverage was created by map-joining coverages for individual USGS Quads and then clipping the coverage to the ACE Boundary (This step was completed by SCDNR - Land, Water, and Conservation Division in Columbia, SC). The mapjoined coverage was then

divided into three coverages using the ArcInfo "split" command.
Process_Date: 19981201
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 9397

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000

False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: nwi89_a.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1.37612
Range_Domain_Maximum: 31018519.70196

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 7.04160
Range_Domain_Maximum: 195705.46010

Attribute:

Attribute_Label: Ace89nwis2
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Ace89nwis2
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Nwimajor1
Attribute_Definition: NWI attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 109

Attribute:

Attribute_Label: Nwiminor1
Attribute_Definition: NWI attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 0

Attribute:

Attribute_Label: Habitat_89
Attribute_Definition: NWI attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Lucode
Attribute_Definition: land use code
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Landuse
Attribute_Definition: land use type
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at
[<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>](http://www.csc.noaa.gov/clearinghouse/prodreq_form.html)

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:59 2000

1999 ACE Basin Ecological Characterization: 1994 National Wetlands Inventory

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Jeff Trudnak
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: 1994 National Wetlands Inventory
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE

Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

This 1:24000 coverage contains wetland location and classification as defined by the U.S. Fish and Wildlife Service. The digital data as well as the hardcopy maps that were used as a source of the digital data are produced and distributed by the U.S. Fish & Wildlife Service's National Wetlands Inventory project. The data set covers the ACE ecological characterization area. This metadata record is for 1994nwi1, 1994nwi2, and 1994nwi3.

Purpose:

The data provide consultants, planners, and resource managers with information on wetland location and type. The data were collected to meet U.S. Fish & Wildlife Service's mandate to map the wetland and deepwater habitats of the United States.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19890301
Ending_Date: 19900130

Currentness_Reference: Ground Condition

Status:

Progress: Complete
Maintenance_and_Update_Frequency: Unknown

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0723
East_Bounding_Coordinate: -80.3599
North_Bounding_Coordinate: 33.0257
South_Bounding_Coordinate: 32.3067

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: land use/land type
Theme_Keyword: wetland
Theme_Keyword: coast
Theme_Keyword: national wetland inventory

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: South Carolina
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: Ace Basin

Access_Constraints: None
Use_Constraints:
Not for use at scales greater than 1:24000. Federal, State, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner that used in this inventory. The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info version 7.2.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator:
South Carolina Water Resource Commission Fish and Wildlife Service - National Wetlands Inventory
Publication_Date: 19950100
Title: 1994 National Wetlands Inventory
Edition: 1994
Geospatial_Data_Presentation_Form: map
Other_Citation_Details: none

Source_Scale_Denominator: 24000
Type_of_Source_Media: magnetic tape
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19940101
Ending_Date: 19950000

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: provided NWI datalayers for use in ACE characterization

Process_Step:

Process_Description:
The NWI coverage was created by map-joining coverages for individual USGS Quads and then clipping the coverage to the ACE Boundary (This step was completed by SCDNR - Land, Water, and Conservation Division in Columbia, SC). The mapjoined coverage was then

divided into three coverages using the ArcInfo "split" command.
Process_Date: 19981201
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 8997

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000

False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: nwi94_a.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1.37612
Range_Domain_Maximum: 31018519.70196

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 7.04160
Range_Domain_Maximum: 195705.46010

Attribute:

Attribute_Label: nwi2_
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: nwi2_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Nwimajor1
Attribute_Definition: NWI attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 109

Attribute:

Attribute_Label: Nwiminor1
Attribute_Definition: NWI attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 0

Attribute:

Attribute_Label: Habitat_94
Attribute_Definition: NWI attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Lucode
Attribute_Definition: land use code
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Landuse
Attribute_Definition: land use type
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at [<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>](http://www.csc.noaa.gov/clearinghouse/prodreq_form.html)

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:02 2000

1999 ACE Basin Ecological Characterization: ACE Basin Soils coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: ACE Basin Soils coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention

for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

This data set was supplied by the South Carolina Department of Natural Resources, Water Resources Division. The source data is unrectified 1:20000-scale black and white county soil survey maps. These data were geometrically corrected using a zoom transfer scope (ZTS) and re-drafted and digitized at 1:24000 scale, by the SCDNR Water Resources Division. Although the data are not an official National Resources Conservation Service (NRCS) product, the local NRCS office provided quality assurance review of the ZTS product prior to digitization. As of 1/6/1994 all data were being transferred to the NRCS for incorporation into their national database. There are an additional 21 data tables linked to the attribute table for this coverage. The attributes in these tables were not included in the entity and attribute section of this metadata record because they are not actually part of the coverage. For more information on these attributes, please search the STATSGO and SSURGO online services at [<http://www.ftw.nrcs.usda.gov/stat_data.html>](http://www.ftw.nrcs.usda.gov/stat_data.html) and [<http://www.ftw.nrcs.usda.gov/ssur_data.html.>](http://www.ftw.nrcs.usda.gov/ssur_data.html) This metadata record is for Acesoil1, Acesoil2 and Acesoil3.

Purpose:

This data set is used to classify and identify soil polygons by using NRCS soil mapping units. This effort is part of the National Cooperative Soil Survey Program. Soils are mapped and classified for soil interpretations and general land use planning purposes.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19960315
Ending_Date: 19960315

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0724
East_Bounding_Coordinate: -80.1525
North_Bounding_Coordinate: 33.1211
South_Bounding_Coordinate: 32.3038

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: soils
Theme_Keyword: geology
Theme_Keyword: Soil Conservation Service
Theme_Keyword: Natural Resource Conservation Service

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator:
USDA, NRCS; through the South Carolina Department of Natural Resources - Water Resources Division
Publication_Date: 19990600
Title: County Soil Survey: Bennetts Point Quad
Edition: none
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: none
Publisher: none

Source_Scale_Denominator: 24000
Type_of_Source_Media: magnetic media
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19960315
Ending_Date: 19960315

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: Data provided information for the soil data layers.

Process_Step:

Process_Description:
The soils coverage was created by map-joining coverages for individual USGS Quads and then clipping the coverage to the ACE Boundary (This step was completed by SCDNR - Land, Water, and Conservation Division in Columbia, SC). The mapjoined coverage was then divided into three coverages using the ArcInfo "split" command.
Process_Date: 19981201
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service:
Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time 8:30-5:00 M-F

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 5241

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator

Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: soils_a.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1.61866
Range_Domain_Maximum: 80422771.29440

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 6.00332
Range_Domain_Maximum: 252379.41921

Attribute:

Attribute_Label: Ace80sls2_
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Ace80sls2_
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Slsmajor1
Attribute_Definition:
NRCS attribute definition For a description of attributes see Soil Surveys for; Charleston County, South Carolina USDA NRCS 1991; Colleton County, South Carolina USDA NRCS 1982; and Beaufort and Jasper Counties, South Carolina USDA NRCS 1980.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 49

Attribute:

Attribute_Label: Slsminor1
Attribute_Definition:
NRCS attribute definition For a description of attributes see Soil Surveys for; Charleston County, South Carolina USDA NRCS 1991; Colleton County, South Carolina USDA NRCS 1982; and Beaufort and Jasper Counties, South Carolina USDA NRCS 1980.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 75

Attribute:

Attribute_Label: Slsmajor2
Attribute_Definition:
NRCS attribute definiton. For a description of attributes see Soil Surveys for; Charleston County, South Carolina USDA NRCS 1991; Colleton County, South Carolina USDA NRCS 1982; and Beaufort and Jasper Counties, South Carolina USDA NRCS 1980.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 95

Attribute:

Attribute_Label: Slsminor2
Attribute_Definition:
NRCS attribute definition For a description of attributes see Soil Surveys for; Charleston County, South Carolina USDA NRCS 1991; Colleton County, South Carolina USDA NRCS 1982; and Beaufort and Jasper Counties, South Carolina USDA NRCS 1980.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 0

Attribute:

Attribute_Label: Slscode
Attribute_Definition:
NRCS County Soil Code For a description of attributes see Soil Surveys for; Charleston County, South Carolina USDA NRCS 1991; Colleton County, South Carolina USDA NRCS 1982; and Beaufort and Jasper Counties, South Carolina USDA NRCS 1980.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Slsname
Attribute_Definition:
NRCS County Soil Name For a description of attributes see Soil Surveys for; Charleston County, South Carolina USDA NRCS 1991; Colleton County, South Carolina USDA NRCS 1982; and Beaufort and Jasper Counties, South Carolina USDA NRCS 1980.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Slstype
Attribute_Definition:
NRCS County Soil Type For a description of attributes see Soil Surveys for; Charleston County, South Carolina USDA NRCS 1991; Colleton County, South Carolina USDA NRCS 1982; and Beaufort and Jasper Counties, South Carolina USDA NRCS 1980.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Slope
Attribute_Definition:
NRCS County Soil Slope Category For a description of attributes see Soil Surveys for; Charleston County, South Carolina USDA NRCS 1991; Colleton County, South Carolina USDA NRCS 1982; and Beaufort and Jasper Counties, South Carolina USDA NRCS 1980.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Slscty
Attribute_Definition:
County Identification This item gives the county where soil-mapping units are located.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Muid
Attribute_Definition:
Map Unit Identification This number is used to link to NRCS Identification tables in info. The series of tables are based on STATSGO.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:04 2000

1999 ACE Basin Ecological Characterization: Coastal Change Analysis Program coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19990427
Title:
1999 ACE Basin Ecological Characterization: Coastal Change Analysis Program coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention

for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

The ACE Basin C-CAP Data was clipped from the South Carolina Land Cover and Change Assessment developed by NOAA-CSC. This metadata is for the acemosai0.tif, acemosai1.tif, and acematrix.tif files. The acemosai0.tif is the 1990 image. The acemosai1.tifis the 1995 image. The acematrix is the landchange analyis. The remainder of the abstract is taken from the C-CAP documentation. The Coastal Change Analysis Program was established to inventory coastal submersed habitats, wetland habitats, and adjacent uplands and monitors changes in these habitats on a one- to five-year cycle (Dobson, et. al., 1995). The C-CAP classification scheme is a product of a national panel of research scientists and resources managers, each ensuring that the unique features of their region are represented and that the system meets their specific information requirements. The system is derived from established land cover mapping systems. Uplands are adopted from the top levels of the U.S. Geological Survey Land Use/Land Cover Classification System (Anderson et al., 1976) while marine and wetland environments come from the U.S. Fish and Wildlife Service Wetland Classification System (Cowardin et. al., 1979). The C-CAP classification system is based on these systems, but not unconditionally correspondent. The classes are specifically derived to label features that are identifiable and pertinent to earth cover change and trend analysis. One notable difference between Anderson and C-CAP is that C-CAP exclusively classifies land cover and does not attempt to designate land use. There are three primary factors responsible for the development of the C-CAP classification system. The need for 1. upland, wetland, and submersed aquatic mapping compatibility, 2. a national database flexible enough to meet the challenges of regionally diverse coastal environments, 3. that is standardized for change detection exercises. The C-CAP classification system is hierarchical. It divides the cover of the land in a top-down approach beginning with general differentiation, more specific characteristics are identified at each successive classification level. The uppermost level, "the superclass," distinguishes land cover based on it's hydrological regime, upland, wetland, and water and submerged land. Beyond this, logical divisions are base on land cover type for uplands, and land cover type plus hydrology/salinity for wetland and marine classes. Before beginning any land cover mapping exercise, it is wise to select an appropriate classification system and identify the land cover categories that you will expect to find in a given study area. C-CAP is dedicated to mapping specific land cover features. These are underlined in the following classification scheme. An important clarification of the required classes should be made. The classes noted in the protocol include Developed Land, Cultivated Land, Grassland, Woody Land, Bare Land, Estuarine Emergent Wetland, Estuarine Woody Wetland, Palustrine Emergent Wetland, Palustrine Woody Wetland, and Water. The attached classification scheme has been adjusted to reflect the current coastal change analysis information requirements. Within each of the woody classes it will also be required that the subclass' Forest and Scrub/Shrub be identified (where

they exist). Upland Woody Scrub/Shrub is required. It is not, however, necessary to distinguish between deciduous, evergreen, and mixed scrub/shrub for each of the woody classes. It is not necessary to distinguish between deciduous, evergreen, and mixed palustrine or estuarine forest. For coastal change analysis studies in South Carolina, the following categories were selected. The following discussion of these classes comes directly from the C-CAP protocol chapter 2 and appendix 3. South Carolina Coastal Change Analysis Land Cover Categories: 1. Developed-High Intensity 2. Developed-Low Intensity 3. Cultivated Land 4. Grassland 5. Deciduous Forest 6. Evergreen Forest 7. Mixed Forest 8. Scrub/Shrub 9. Palustrine Forest 10. Palustrine Scrub/Shrub 11. Palustrine Emergent Wetland 12. Estuarine Emergent Wetland 13. Unconsolidated Shore 14. Bare Land 15. Water Developed-High Intensity High Intensity, Developed Land includes heavily built-up urban centers and large constructed surfaces in suburban and rural areas with a variety of different land uses. The High Intensity category contains areas in which a significant land area is covered by concrete and asphalt or other constructed materials. Vegetation, if present, occupies < 20 per cent of the landscape. Examples of such areas include apartment buildings, skyscrapers, shopping centers, factories, industrial complexes, large barns, airport runways, and interstate highways. Developed-Low Intensity Low Intensity, Developed Land includes areas with a mixture of constructed materials (eg. roofing, metal, concrete, asphalt) and vegetation or other cover. Constructed materials account for 50 to 79 per cent of total area. These areas commonly include single-family housing areas, especially in suburban neighborhoods, but may include scattered surfaces associated with all types of land use. As the percentage of constructed material cover decreases, this category grades into Cultivated, Grassland, Woody, and other land cover classes. A large building surrounded by several acres of grass, for example, might appear as one or more pixels of High Intensity Developed Land, one or more pixels of Low Intensity Developed Land and many pixels of Grassland. Cultivated Land Cultivated Land includes herbaceous (cropland) and woody (orchards, nurseries, vineyards, etc.) cultivated lands. Seasonal spectral signatures, geometric field patterns and road network patterns may help identify this land cover type. Always associated with agricultural land use, cultivated land is used for the production of food and fiber. Grassland Grassland includes managed and unmanaged grass. Unmanaged Grasslands are dominated by naturally occurring grasses and forbs which are not fertilized, cut, tilled or planted regularly. Managed Grasslands are maintained by human activity such as fertilization and irrigation, are distinguished by enhanced biomass productivity, and can be recognized through vegetative indices based on spectral characteristics. Examples of such areas include lawns, golf courses, forest or shrub areas converted to grassland, or areas of permanent grassland with altered species composition. This category includes managed pastures and pastures with vegetation that grows vigorously as fallow. Managed Grasslands are used for grazing or for growing and harvesting hay and straw for animal feed. Deciduous Forest The Deciduous Forest subclass includes all forest areas having a predominance of trees that lose their leaves or needles at the end of the frost-free season or at the beginning of a dry season. This category contains greater than two-thirds deciduous trees and shrubs. Deciduous Forest includes areas dominated by single stemmed, woody vegetation unbranched 2-3' above the ground having a height > 6 m. Deciduous forest areas have a tree-crown areal density (crown closure percentage) of > 10 percent, are stocked with trees capable of producing timber or other wood products, and exert an influence on the climate or water regime. Evergreen Forest The Evergreen Forest subclass contains trees that do not lose their leaves or needles at the end of a frost-free season or at the beginning of a dry season. Evergreen Forest includes areas in which > 67 % of the trees remain green throughout the year. Both coniferous and broad-leaved evergreens are included in this category. Coniferous evergreens predominate, except in tropical regions where broad-leaved evergreens are indigenous. Mixed Forest The Mixed Forest class includes all forest areas where both evergreen and deciduous trees grow and neither predominates. When evergreen and deciduous species each respectively occupy > 33 % of an area, the land it is classified as Mixed Forest. Scrub/Shrub This category contains vegetation that is < 6 meters in height. The species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. True shrubs are those woody stemmed species that exhibit several erect, spreading or prostrate stems and a general bushy appearance. Shrub Lands may represent a successional stage leading to forests or they may be relatively stable communities. Forest regrowth composed of young trees < 6 m tall is also included in this category. Bare Land Bare Land is composed of bare rock, sand, silt, gravel, or other earthen material with little or no vegetation regardless of its inherent ability to support life. Vegetation, if present, is more widely spaced and scrubby than that in the vegetated categories. Unusual conditions, such as a heavy rainfall, occasionally may result in a short-lived, luxuriant plant cover. Wet, nonvegetated exposed lands are included in the wetland categories. Categories of Bare Land include dry salt flats, beaches, sandy areas other than beaches, bare exposed rock, strip mines, quarries, gravel pits, transitional areas, and mixed barren land. Palustrine System The Palustrine System includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5%. The Palustrine System is bounded by upland or by any of the other four Systems. The Palustrine System was developed to group the vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie pothole, which are found throughout the United States. It also includes small, shallow, permanent or intermittent water bodies often called ponds (except in New England and New York where the term pond often refers to substantial lakes). Palustrine wetlands may be situated shoreward of lakes, river channels, or estuaries; on river floodplains; in isolated catchments; or on slopes. They may also occur as islands in lakes or rivers. The erosive forces of wind and water are of minor importance except during severe floods. Estuarine System The Estuarine System consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land. The salinity may be periodically increased above that of the open ocean by evaporation. Along some low-energy coastlines there is appreciable dilution of sea water. Offshore areas with typical estuarine plants and animals, such as red mangroves (Rhizophora mangle) and eastern oysters (Crassostrea virginica), are also included in the Estuarine System. The Estuarine System extends (1) upstream and landward to where ocean-derived salts measure < 0.5% during the period of average annual low flow; (2) to an imaginary line closing the mouth of a river, bay, or sound; and (3) to the seaward limit of wetland emergents, shrubs, or trees where they extend beyond the river mouth defined by (2). The Estuarine System also includes offshore areas of continuously diluted sea water. Water Cowardin et al. (1979) define deepwater habitats as permanently flooded lands lying below the deepwater boundary of wetlands. Deepwater habitats include environments where surface water is permanent and often deep, so that water, rather than air, is the principal medium within which the dominant organisms live, whether or not they are attached to the substrate. As in wetlands, the dominant plants are hydrophytes. However, the substrates are considered nonsoil because the water is too deep to support emergent vegetation. The class Water includes Marine/Estuarine, Lacustrine, Palustrine, and Riverine Deepwater subclasses as defined by Cowardin et al. (1979). References Cited Anderson, J.R., E.E. Hardy, J.R. Roach, and R.E. Witmer. 1976. A land cover and land use classification system for use with remote sensor data., U.S. Geological Survey. Professional Paper, 964 P. Cowardin, L.M., V. Cater, F.C., Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31. Dobson, JE, EA Bright, RL Ferguson, DW Field, LL Wood, KD Haddad, JR Jensen, H. Iredale, VV Klemas, RJ Orth, and JP Thomas. 1995. NOAA Coastal Change Analysis Program (C-CAP): Guidance for regional implementation. NOAA Technical Report NMFS/123.

Purpose:

Show land cover and change from 1990 to 1995 for the ACE Basin Ecological Characterization Study Area.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19901209
Ending_Date: 19950105

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency:

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0721
East_Bounding_Coordinate: -80.1521
North_Bounding_Coordinate: 33.1228
South_Bounding_Coordinate: 32.3054

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: land change
Theme_Keyword: landuse
Theme_Keyword: satellite
Theme_Keyword: imagery
Theme_Keyword: CCAP

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Edisto
Place_Keyword: Ashepoo
Place_Keyword: Colleton
Place_Keyword: Beaufort
Place_Keyword: Southeast
Place_Keyword: estuary
Place_Keyword: South Carolina
Place_Keyword: Combahee
Place_Keyword: Charleston

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data. Imagine/ArcInfo k:\acefinal\images\acemtrx.tif

---

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report:

Logical_Consistency_Report:
Completeness_Report: complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report:

Lineage:

Process_Step:

Process_Description:
The 1990, 1995, and land change analysis (matrix) were all processed the same way for the ACE Basin. The imagegrid command was used in ArcInfo to convert the imagine files provided by NOAA-CSC to grids. The gridclip command was then used to clip the grids of the entire SC Coastal zone to the ACE Basin Characterization boundary. The ArcInfo gridimage command was then used to convert the clipped grids back to a TIFF image.
Process_Date: 19990427
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Raster

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050

Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:15 2000

1999 ACE Basin Ecological Characterization: 14 - Digit Hydrologic Unit Outlet Locations coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: South Carolina Department of Natural Resources
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: 14 - Digit Hydrologic Unit Outlet Locations coverage
Edition: 1st
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National

Geophysical Data Center, and the Corporation for Enterprise Development.

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Description:

Abstract:
This data layer was created by using data provided by the US Department of the Interior USGS to show outlet locations on the 14 - digit hydrologic units.
Purpose:
To show outlet locations of water in the 14 - digit hydrologic units

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Currentness_Reference: Publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: As needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.1141
East_Bounding_Coordinate: -80.2562
North_Bounding_Coordinate: 33.1087
South_Bounding_Coordinate: 32.4988

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: 14 - digit hydrologic unit codes
Theme_Keyword: outlet locations

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina department of natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no repsonsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: ArcView version 3.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Data set is complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: US Department of the Interior USGS
Publication_Date: 19990200
Title: Development of a 14-digit Hydrologic Unit Code Numbering System
Edition: 1st
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Columbia, SC
Publisher: US Department of the Interior, US Geologic Survey

Other_Citation_Details: none to report
Larger_Work_Citation:

Citation_Information:

Originator: US Department of the Interior, US Geologic Survey
Publication_Date: 19990200
Title:
Development of a 14-Digit Hydrologic Unit Code Numbering System for South Carolina
Publication_Information:

Publication_Place: Columbia, SC
Publisher: US Department of the Interior, US Geologic Survey

Source_Scale_Denominator: 24000
Type_of_Source_Media: cd-rom
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: provided data contributing to data layer

Process_Step:

Process_Description:
The original data was obtained from the US Department of the Interior USGS in PDF format. The table was copied and pasted into Microsoft Excel. The columns were then formatted. This table was then added to an Arcview project using the add table option. The table was used to create a shapefile by using the add event theme option. This point layer was then converted to a shapefile. This shapefile was then clipped to the 14-digit hydrologic unit coverage using the geoprocessing extension available with Arcview Version 3.1. This clipped shapefile was then converted to an ArcInfo coverage using the shapearc command in ArcInfo Version 7.2.1. This coverage was then converted from a geographic projection to a UTM projection by using the project command. The converted coverage was then converted back to a shapefile.
Process_Date: 19990215
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 46

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -81.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4000000
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: flow_pts.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Huc
Attribute_Definition: 14-digit hydrologic unit code number
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3050202050020
Range_Domain_Maximum: 3050208090020

Attribute:

Attribute_Label: Lon_deg

Attribute_Definition: longitude degrees
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 80
Range_Domain_Maximum: 81

Attribute:

Attribute_Label: Lon_min
Attribute_Definition: longitude minutes
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2
Range_Domain_Maximum: 59

Attribute:

Attribute_Label: Lon_sec
Attribute_Definition: longitude seconds
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 56

Attribute:

Attribute_Label: Lon_dd
Attribute_Definition: longitude decimal degrees
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -81
Range_Domain_Maximum: -80

Attribute:

Attribute_Label: Lat_deg
Attribute_Definition: latitude degrees
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 32
Range_Domain_Maximum: 33

Attribute:

Attribute_Label: Lat_min
Attribute_Definition: latitude minutes
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 59

Attribute:

Attribute_Label: Lat_sec
Attribute_Definition: latitude seconds
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 59

Attribute:

Attribute_Label: Lat_dd
Attribute_Definition: latitude decimal degrees
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 32.5000
Range_Domain_Maximum: 33.1083

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at
<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:06 2000

Freshwater - Saltwater Boundary Metadata

Metadata:

- Identification_Information
- Data_Quality_Information
- Spatial_Data_Organization_Information
- Spatial_Reference_Information
- Entity_and_Attribute_Information
- Distribution_Information
- Distribution_Information
- Metadata_Reference_Information

Identification_Information:

Citation:

Citation_Information:

Originator: South Carolina Department of Natural Resources
Publication_Date: 19990500
Title: Freshwater - Saltwater Boundary Metadata
Edition: 1st
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.
Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Description:

Abstract:
This data layer was cerated to show the accepted division between freshwater and saltwater on the three ACE rivers. One point is shown on the Ashepoo, Combahee, and Edisto rivers. The layer was created based on section 5017-30 of the Coastal Fisheries Laws.
Purpose:
To show the Saltwater-freshwater dividing lines within the ACE characterization area.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Currentness_Reference: Publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: Continually

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.6832
East_Bounding_Coordinate: -80.4459
North_Bounding_Coordinate: 32.7642
South_Bounding_Coordinate: 32.6510

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: Freshwater-saltwater dividing line

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River

Place_Keyword: Edisto River
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina department of natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no repsonsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: ArcView version 3.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: unknown

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Data set is complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report: unknown

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: SCDNR
Publication_Date: 19990500
Title: Freshwater - saltwater dividing line
Edition: 1st
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center

Other_Citation_Details: none
Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Source_Scale_Denominator: 24000
Type_of_Source_Media: cd-rom
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: provided data contributing to data layer

Process_Step:

Process_Description:
Data layer was digitized based on section 50-17-30 of the Coastal Fisheries Laws. The point data layer was limited to a single point on each of the three ACE rivers.
Process_Date: 19990115
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 3

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -81.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4000000
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: frshsalt.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Desc
Attribute_Definition: describes what point data represents
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character Field

Attribute:

Attribute_Label: Rivname
Attribute_Definition: name of river
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character Field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:07 2000

1999 ACE Basin Ecological Characterization: United States Geological Survey 8-Digit Hydrologic Unit Coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Jeff Trudnak
Publication_Date: 19970901
Title:
1999 ACE Basin Ecological Characterization: United States Geological Survey 8-Digit Hydrologic Unit Coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration- Coastal Services Center

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA_CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse

ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin.

Description:

Abstract:

The Unites States Geological Survey (USGS) delineates watersheds of different scales. Watersheds or hydrologic units are coded as a basin, at an 8 digit level, an 11 digit level, and a 14 digit level (smallest basin area). For the ACE Basin Characterization these coverages were obtained from South Carolina Department of Health and Environmental Control. The only available ArcInfo coverage for the 14 digit hydrologic units was the preliminary coverage that was in development at the time this project started. The preliminary 14 digit hydrologic unit coverage was used to delineate the study boundary and to split the study are into thirty-six separate polygons (based on watershed) when needed.

Purpose:

To delineate watersheds (hydrologic units) of varying scales at the regional and local levels.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970601
Ending_Date: 19990501

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.5063
East_Bounding_Coordinate: -80.0265
North_Bounding_Coordinate: 33.4271
South_Bounding_Coordinate: 32.0350

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: hydrologic unit coverage
Theme_Keyword: watershed
Theme_Keyword: 8-digit

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1

indicate that arc and node topology exist.

Completeness_Report: complete

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none to report

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: Jeannie Eidson
Publication_Date: 19970000
Title: Hydrologic Unit Coverages
Edition: 1997
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Columbia, SC
Publisher: DHEC-Bureau of Water Pollution Control

Source_Scale_Denominator: 24000
Type_of_Source_Media: cd-rom
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970000
Ending_Date: 19970000

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: provided data used to create coverage

Process_Step:

Process_Description:
8-digit watershed coverages of the Savannah-Salkehatchie basin and the Saluda-Edisto basin were joined to form a single coverage in ArcInfo using the union command. The ACE characterization boundary was then overlaid on top of this coverage in ArcView. Any hucs found within the boundary or intersecting the boundary were selected. A new field was added to the attribute table in which these hucs were labeled "1". All other hucs were labeled "0". This new field was used in conjunction with the reselect command in ArcInfo to create a new

coverage in ArcView showing only those hucswithin or intersecting the ACE boundary.
Process_Date: 19981110
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 3

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000

False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: Huc_8.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2235689216.000
Range_Domain_Maximum: 5799640064.000

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 321034.750
Range_Domain_Maximum: 527801.813

Attribute:

Attribute_Label: Hucs8_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Hucode8
Attribute_Definition: 8-digit hydrologic unit code number for polygon
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:09 2000

1999 ACE Basin Ecological Characterization: United States Geological Survey 11-Digit Hydrologic Unit Coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Jeff Trudnak
Publication_Date: 19970901
Title:
1999 ACE Basin Ecological Characterization: United States Geological Survey 11-Digit Hydrologic Unit Coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-

Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

The Unites States Geological Survey (USGS) delineates watersheds of different scales. Watersheds or hydrologic units are coded as a basin at an 8 digit level, an 11 digit level, and a 14 digit level (smallest basin area). For the ACE Basin Characterization these coverages were obtained from the South Carolina Department of Health and Environmental Control. The only available ArcInfo coverage for the 14 digit hydrologic units was the preliminary coverage that was in development at the time this project started. The preliminary 14 digit hydrologic unit coverage was used to delineate the study boundary and to split the study are into thirty-six separate polygons (based on watershed) when needed.

Purpose:

To delineate watersheds (hydrologic units) of varying scales at the regional and local levels.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970601
Ending_Date: 19990501

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.3648
East_Bounding_Coordinate: -80.0289

North_Bounding_Coordinate: 33.2086
South_Bounding_Coordinate: 32.2263

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: watershed
Theme_Keyword: 11-digit
Theme_Keyword: hydrologic unit coverage (huc)

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: Savannah-Salkehatchie basin
Place_Keyword: Saluda-Edisto basin

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none to report

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: Jeannie Eidson
Publication_Date: 19970000
Title: Hydrologic Unit Coverages
Edition: 1997
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Columbia, SC
Publisher: DHEC-Bureau of Water Pollution Control

Source_Scale_Denominator: 24000
Type_of_Source_Media: cd-rom
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970000
Ending_Date: 19970000

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: provided data from which coverage was created

Process_Step:

Process_Description:

11-digit watershed coverages of the Savannah-Salkehatchie basin and the Saluda-Edisto basin were joined to form a single coverage in ArcInfo using the union command. The ACE characterization boundary was then overlaid on top of this coverage in ArcView. Any hydrologic unit coverages (hucs) found within the boundary or intersecting the boundary in any way were selected. A new field was added to the attribute table in which these hucs were labeled "1". All other hucs were labeled "0". This new field was used in conjunction with the reselect command in ArcInfo to create a new coverage in ArcView showing only the hucs within or intersecting the ACE boundary.

Process_Date: 19981110
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 16

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator

Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: Huc_11.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 151689392.000
Range_Domain_Maximum: 1129439744.000

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 68547.391
Range_Domain_Maximum: 224439.734

Attribute:

Attribute_Label: Hucs11_id
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Huc11
Attribute_Definition: 11-digit hydrologic unit code for polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC

Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:07 2000

1999 ACE Basin Ecological Characterization: United States Geological Survey 14-Digit Hydrologic Unit Coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Jeff Trudnak
Publication_Date: 19970901
Title:
1999 ACE Basin Ecological Characterization: United States Geological Survey 14-Digit Hydrologic Unit Coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990501
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Other_Citation_Details:

The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

The Unites States Geological Survey (USGS) delineates watersheds of different scales. Watersheds or hydrologic units are coded as a basin at an 8 digit level, an 11 digit level, and a 14 digit level (smallest basin area). For the ACE Basin Characterization these coverages were obtained from the South Carolina Department of Health and Environmental Control. The only available ArcInfo coverage for the 14 digit hydrologic units was the preliminary coverage that was in development at the time this project started. The preliminary 14 digit hydrologic unit coverage was used to delineate the study boundary and to split the study are into thirty-six separate polygons (based on watershed) when needed.

Purpose:

To delineate watersheds (hydrologic units) of varying scales at the regional and local levels.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970601
Ending_Date: 19990501

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0724
East_Bounding_Coordinate: -80.1896
North_Bounding_Coordinate: 33.1228
South_Bounding_Coordinate: 32.2479

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: watershed
Theme_Keyword: 14-digit
Theme_Keyword: hydrologic unit coverage (huc)

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: Savannah-Salkehatchie basin
Place_Keyword: Saluda-Edisto basin

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none to report

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: DHEC
Publication_Date: 19970000
Title: Hydrologic Unit Coverages
Edition: 1997
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Columbia, SC
Publisher: DHEC-Bureau of Water Pollution Control

Source_Scale_Denominator: 24000
Type_of_Source_Media: cd-rom
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970000
Ending_Date: 19970000

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: provided data which contributed to creation of the coverage

Process_Step:

Process_Description:
14-digit watershed coverages of the Savannah-Salkehatchie basin and the Saluda-Edisto basin were joined to form a single coverage in ArcInfo using the union command. The ACE characterization boundary was then overlaid on top of this coverage in ArcView. Any hydrologic unit coverages (hucs) found within the boundary or intersecting the boundary in any way were selected. A new field was added to the attribute table in which these hucs were labeled "1". All other hucs were labeled "0". This new field was used in conjunction with the reselect command in ArcInfo to create a new coverage in ArcView showing only the hucs within or intersecting the ACE boundary.
Process_Date: 19981110

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 34

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: Huc_14.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 15421827.000
Range_Domain_Maximum: 225737328.000

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 25766.787
Range_Domain_Maximum: 99124.453

Attribute:

Attribute_Label: Hucs14_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 377
Range_Domain_Maximum: 458

Attribute:

Attribute_Label: Hucode

Attribute_Definition: 14-digit hydrologic unit code for polygon
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: character field

Attribute:

Attribute_Label: Acres
Attribute_Definition: acres covered by each huc
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3810
Range_Domain_Maximum: 55780

Attribute:

Attribute_Label: Sq_mi
Attribute_Definition: square miles covered by each huc
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 5.95
Range_Domain_Maximum: 87.16

Attribute:

Attribute_Label: Basin
Attribute_Definition: USGS defined basin
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC

Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:08 2000

1999 ACE Basin Ecological Characterization: Revised 14 - Digit Hydrologic Units coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: South Carolina Department of Natural Resources
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Revised 14 - Digit Hydrologic Units coverage
Edition: 1st
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Description:

Abstract:
This coverage contains Hydrologic Unit boundaries and their associated 14-digit codes for the ACE characterization area watersheds delineated at a scale of 1:24,000.
Purpose:
This data set is intended as a tool for water-resource management and planning activities, particularly for site-specific and localized studies which require the amount of detail provided by a large-scale map.
Supplemental_Information: none to report

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Currentness_Reference: Publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: As needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.2333
East_Bounding_Coordinate: -79.9794
North_Bounding_Coordinate: 33.1883
South_Bounding_Coordinate: 32.2465

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: 14 - digit hydrologic unit codes

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina department of natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no repsonsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: ArcView version 3.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Data set is complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:

This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: US Department of the Interior USGS
Publication_Date: 19990200
Title: Development of a 14-digit Hydrologic Unit Code Numbering System
Edition: 1st
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Columbia, SC
Publisher: US Department of the Interior, US Geologic Survey

Other_Citation_Details: none
Larger_Work_Citation:

Citation_Information:

Originator: US Department of the Interior, US Geologic Survey
Publication_Date: 19990200
Title:
Development of a 14-Digit Hydrologic Unit Code Numbering System for South Carolina
Publication_Information:

Publication_Place: Columbia, SC
Publisher: US Department of the Interior, US Geologic Survey

Source_Scale_Denominator: 24000
Type_of_Source_Media: cd-rom
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: provided data contributing to data layer

Process_Step:

Process_Description:
The original data layer was provided by the US Department of the Interior, US Geologic Survey in ArcInfo Export format. This coverage was imported into ArcView using import 71. The coverage was then converted from a geographic projection to a UTM projection using the project command in ArcInfo Version 7.2.1. This converted coverage was clipped to the ACE characterization boundary using the geoprocessing extension available with ArcView Version 3.1. This shapefile became the revised 14-Digit HUC coverage.
Process_Date: 19990214
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 54

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -81.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4000000
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: huc_14r.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software generated
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software generated
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Nuhuc14_id
Attribute_Definition: feature identification number
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2
Range_Domain_Maximum: 55

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at [<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>](http://www.csc.noaa.gov/clearinghouse/prodreq_form.html)

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:08 2000

1999 ACE Basin Ecological Characterization: United States Geological Survey Arc hydrography coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: United States Geological Survey Arc hydrography coverage
Edition: none
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center

in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Description:

Abstract:
This 1:24,000 scale coverage contains hydrography data as identified in USGS DLGs. The data set covers the ACE ecological characterization area. Hydrography includes streams and other surface water channels and features. This metadata record is for archyd01, archyd02, and archyd03.

Purpose:
DLGs depict information about geographic features on or near the surface of the Earth, terrain, and political and administrative units. These data were collected as a part of the National Mapping Program.

Supplemental_Information: none

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: Continually

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0711
East_Bounding_Coordinate: -80.3988
North_Bounding_Coordinate: 33.0230
South_Bounding_Coordinate: 32.3136

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: hydrography
Theme_Keyword: rivers
Theme_Keyword: streams

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: southeast SC

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: ArcView version 3.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this set are topologically consistent. Post processing in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: data set is complete

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: National Mapping Division US Geological Survey
Publication_Date: Unknown
Title: Hydrography derived from 1:24000 Usgs DLGs
Edition: none
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Reston, VA
Publisher: US Geological Survey

Other_Citation_Details: none

Source_Scale_Denominator: 24000
Type_of_Source_Media: magnetic tape
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: Unknown
Ending_Date: Unknown

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: provided DLG data layers for ACE characterization

Process_Step:

Process_Description:
Mapjoined dlg coverages using ArcInfo. Mapjoined coverages were then clipped to the ACE Basin boundary. Larger dlg coverages were then split into three basins.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Complete Chain
Point_and_Vector_Object_Count: 13700

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -81.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4000000
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: hydroa_a.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Fnode_
Attribute_Definition: From-node identifier of linear feature
Attribute_Definition_Source: Software generated
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Tnode_
Attribute_Definition: To-node identifier of linear feature
Attribute_Definition_Source: Software generated
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Length
Attribute_Definition: Length of line
Attribute_Definition_Source: Software generated
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Arc88hyd2_

Attribute_Definition: internal feature number
Attribute_Definition_Source: software computed
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Arc88hyd2_
Attribute_Definition: internal feature number
Attribute_Definition_Source: software computed
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Hydmajor1
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 50
Range_Domain_Maximum: 50

Attribute:

Attribute_Label: Hydminor1
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 200
Range_Domain_Maximum: 606

Attribute:

Attribute_Label: Hydmajor2
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 59

Attribute:

Attribute_Label: Hydminor2
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 618

Attribute:

Attribute_Label: Hydmajor3
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 59

Attribute:

Attribute_Label: Hydminor3
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 610

Attribute:

Attribute_Label: Hydmajor4
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hydminor4
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hydmajor5
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hydminor5
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hydname
Attribute_Definition: name of hydrography feature
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character Field

Attribute:

Attribute_Label: Hydtype
Attribute_Definition: type of hydrography feature
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character Field

Attribute:

Attribute_Label: Mdir
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: E
Enumerated_Domain_Value_Definition: east
Enumerated_Domain_Value_Definition_Source: USGS

Enumerated_Domain:

Enumerated_Domain_Value: N
Enumerated_Domain_Value_Definition: north
Enumerated_Domain_Value_Definition_Source: USGS

Enumerated_Domain:

Enumerated_Domain_Value: S
Enumerated_Domain_Value_Definition: south
Enumerated_Domain_Value_Definition_Source: USGS

Enumerated_Domain:

Enumerated_Domain_Value: W
Enumerated_Domain_Value_Definition: west
Enumerated_Domain_Value_Definition_Source: USGS

Attribute:

Attribute_Label: Mdist
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 228

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.

Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing

Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:09 2000

1999 ACE Basin Ecological Characterization: United States Geological Survey Polygon Hydrography coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: United States Geological Survey Polygon Hydrography coverage
Edition: none
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can

use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Description:

Abstract:
This 1:24,000 scale coverage contains hydrography data as identified in USGS DLGs. The data set covers the ACE ecological characterization area. Hydrography includes streams and other surface water channels and features. This metadata record is for polyhyd1, polyhyd2, and polyhyd3.

Purpose:
DLGs depict information about geographic features on or near the surface of the Earth, terrain, and political and administrative units. These data were collected as a part of the National Mapping Program.

Supplemental_Information: none to report

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0723
East_Bounding_Coordinate: -80.3599
North_Bounding_Coordinate: 33.0257
South_Bounding_Coordinate: 32.3067

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: hydrography
Theme_Keyword: rivers
Theme_Keyword: streams

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: southeast SC

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: ArcView version 3.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this set are topologically consistent. Post processing in ArcInfo Version 7.2.1 indicate that arc

and node topology exist.
Completeness_Report: data set is complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: National Mapping Division US Geological Survey
Publication_Date: Unknown
Title: Hydrography derived from 1:24000 Usgs DLGs
Edition: none
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Reston, VA
Publisher: US Geological Survey

Source_Scale_Denominator: 24000
Type_of_Source_Media: magnetic tape
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: Unknown
Ending_Date: Unknown

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: provided DLG data layers for ACE characterization

Process_Step:

Process_Description:
Mapjoined dlg coverages using ArcInfo. Mapjoined coverages were then clipped to the ACE Basin boundary. Larger dlg coverages were then split into three basins.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 3285

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -81.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4000000
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: hydrop_a.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software generated
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software generated
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Poly88hyd2
Attribute_Definition: feature identification number
Attribute_Definition_Source: software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software computed

Attribute:

Attribute_Label: Poly88hyd2

Attribute_Definition: internal feature number
Attribute_Definition_Source: software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software computed

Attribute:

Attribute_Label: Hypmajor1
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 50

Attribute:

Attribute_Label: Hypminor1
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 423

Attribute:

Attribute_Label: Hypmajor2
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 59

Attribute:

Attribute_Label: Hypminor2
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 628

Attribute:

Attribute_Label: Hypmajor3
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 52

Attribute:

Attribute_Label: Hypminor3
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 625

Attribute:

Attribute_Label: Hypmajor4
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 52

Attribute:

Attribute_Label: Hypminor4
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 29

Attribute:

Attribute_Label: Hypmajor5
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999

Range_Domain_Maximum: 50

Attribute:

Attribute_Label: Hypminor5
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Numeric field

Attribute:

Attribute_Label: Hypmajor6
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Numeric field

Attribute:

Attribute_Label: Hypminor6
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Numeric field

Attribute:

Attribute_Label: Hypname
Attribute_Definition: name of hydrography feature
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character Field

Attribute:

Attribute_Label: Hyptype
Attribute_Definition: type of hydrography feature
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character Field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at
<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:11 2000

1999 ACE Basin Ecological Characterization: United States Geological Survey Hypsography coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Jeff Trudnak
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: United States Geological Survey Hypsography coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention

for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
This 1:24000 scale coverage contains Hypsography data as identified in USGS DLGs.

Purpose:
DLGs depict information about geographic features on or near the surface of the Earth, terrain, and political and administrative units. These data were collected as part of the National Mapping Program.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Currentness_Reference: Publication Date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0713
East_Bounding_Coordinate: -80.3706
North_Bounding_Coordinate: 33.0231
South_Bounding_Coordinate: 32.3275

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: hydrography
Theme_Keyword: rivers
Theme_Keyword: hypsography
Theme_Keyword: streams

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: South Carolina Coast
Place_Keyword: Southeast Coast
Place_Keyword: Atlantic Coast

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data. Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info version 7.2.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Data set is complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: NONE

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator:
National Mapping Division U.S. Geological Survey
Publication_Date: Unknown
Title: Hydrography derived from 1:24000 USGS DLGs
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Reston, VA
Publisher: U.S. Geological Survey

Source_Scale_Denominator: 24000
Type_of_Source_Media: magnetic tape
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: Unknown
Ending_Date: Unknown

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: Provided dlg data layers for ACE characterization

Process_Step:

Process_Description:
Mapjoined dlg coverages using ArcInfo. Mapjoined coverages were then clipped to the ACE Basin boundary. Larger dlg coverages were then split into three basins.

Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Complete Chain
Point_and_Vector_Object_Count: 5182

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000

False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: hypsog_a.dbf
Entity_Type_Definition: Arc Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Fnode_
Attribute_Definition: From-node identifier of linear feature
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1900
Range_Domain_Maximum: 22574

Attribute:

Attribute_Label: Tnode_
Attribute_Definition: To-node identifier of linear feature
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1900
Range_Domain_Maximum: 22577

Attribute:

Attribute_Label: Length
Attribute_Definition: Length of line
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 9.09180
Range_Domain_Maximum: 16643.12650

Attribute:

Attribute_Label: Bn2hyp_
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Bn2hyp_id_
Attribute_Definition: Feature identification number
Attribute_Definition_Source: Software generated
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Hypmajor1
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 20

Attribute:

Attribute_Label: Hypminor1
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 201

Attribute:

Attribute_Label: Hypmajor2
Attribute_Definition: USGS attribute

Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 24

Attribute:

Attribute_Label: Hypminor2
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 95

Attribute:

Attribute_Label: Hypmajor3
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 24

Attribute:

Attribute_Label: Hypminor3
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 612

Attribute:

Attribute_Label: Hypmajor4
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 20

Attribute:

Attribute_Label: Hypminor4
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 611

Attribute:

Attribute_Label: Hypmajor5
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 20

Attribute:

Attribute_Label: Hypminor5
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 605

Attribute:

Attribute_Label: Hypmajor6
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hypminor6
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hypmajor7
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hypminor7
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hypmajor8
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hypminor8
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hypmajor9
Attribute_Definition: USGS attribute

Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hypminor9
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hypmajor10
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hypminor10
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hypmajor11
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hypminor11
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hypmajor12
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hypminor12
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hypmajor13
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hypminor13
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Hyptype
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Hypunits
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Contour_ft
Attribute_Definition: contour in feet
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -9999.99
Range_Domain_Maximum: 123.04

Attribute:

Attribute_Label: Contour_m
Attribute_Definition: contour in meters
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -9999.99
Range_Domain_Maximum: 37.50

Attribute:

Attribute_Label: Carry_ft
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -9999.99

Range_Domain_Maximum: 124.68

Attribute:

Attribute_Label: Carry_m
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -9999.99
Range_Domain_Maximum: 38.00

Attribute:

Attribute_Label: Descriptio
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:13 2000

1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Breeding Bird Survey coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19970901
Title:
1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Breeding Bird Survey coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:

The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

The Breeding Bird Survey is a large-scale survey of North American birds. It is a roadside survey covering the continental United States and southern Canada. The survey was started in 1966 and currently over 3500 routes are surveyed each June by experienced birders, during the peak of nesting season. Each route is 39.42 km long, with a total of fifty stops located at 0.81-km intervals along the route. A three-minute point count is conducted at each stop. The observer records all birds heard or seen within 0.40 km of the stop. In the ACE Basin, the Breeding Bird Survey route is surveyed yearly near Walterboro, SC by volunteers for the United States Geologic Survey. The Walterboro census began in 1970 and the data set included in this CD contains data through 1996. However, no data was collected for the years 1982-1985 and 1989. The observer traveled along the designated route, stopping every 0.81-km to record observations. Over the 26-year period, a total of 1167 different species have been observed. The total number of species has ranged between 51 and 61. The total number of individual birds counted has ranged between 497 and 878.

Purpose:

The purpose of the survey is to estimate population changes among songbirds. However, the data have many potential uses, and investigators have used the data to address a variety of research and management objectives.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19700000
Ending_Date: 19960000

Currentness_Reference: publication date

Status:

Progress: Complete

Maintenance_and_Update_Frequency: yearly

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.6515
East_Bounding_Coordinate: -80.5150
North_Bounding_Coordinate: 32.9829
South_Bounding_Coordinate: 32.7872

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: Breeding Bird Survey

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: Walterboro
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: Kieth Pardieck
Publication_Date: Unpublished material
Title: Breeding Bird Survey USGS Protection Wildlife Resource Center
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: none
Publisher: none

Source_Scale_Denominator: 24000
Type_of_Source_Media: paper
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19700000
Ending_Date: 19960000

Source_Currentness_Reference: most recent version

Source_Citation_Abbreviation: none
Source_Contribution: Data provided tables for the GIS data layer.

Process_Step:

Process_Description:
Data was received from Kieth Pardieck and then the data sets were reformatted for use in Excel.
Process_Date: 19980700
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
This coverage was created by using ARCView to digitize on screen the line for the breeding bird survey. The survey path follows existing roads. Once the survey path was digitized, the tabular data was linked.
Process_Date: 19980800
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Complete Chain
Point_and_Vector_Object_Count: 1

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate Pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: bredbird.dbf
Entity_Type_Definition: Arc Attribute Table
Entity_Type_Definition_Source: none

Attribute:

Attribute_Label: Id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Route
Attribute_Definition: the name of the route that observations were made along
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Detailed_Description:

Entity_Type:

Entity_Type_Label: bird2lnk.dbf
Entity_Type_Definition: Link Table
Entity_Type_Definition_Source: none

Attribute:

Attribute_Label: Name
Attribute_Definition: The common name assigned to birds.
Attribute_Definition_Source: User defined.
Attribute_Domain_Values:

Unrepresentable_Domain: Character Set

Attribute:

Attribute_Label: Year
Attribute_Definition: Year in which count occurred.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1970
Range_Domain_Maximum: 1996

Attribute:

Attribute_Label: Number_obs
Attribute_Definition: Number of observations that were counted in a given year.
Attribute_Definition_Source: User defined.
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 497
Range_Domain_Maximum: 878

Detailed_Description:

Entity_Type:

Entity_Type_Label: bird1lnk.dbf
Entity_Type_Definition: Link Table
Entity_Type_Definition_Source: none

Attribute:

Attribute_Label: Route
Attribute_Definition: Name of route.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character Set

Attribute:

Attribute_Label: Latitude
Attribute_Definition: Latitude of route location.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Unrepresentable_Domain: Numeric field (only one value)

Attribute:

Attribute_Label: Longitude
Attribute_Definition: Longitude of route location.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Unrepresentable_Domain: Numeric field (only one value)

Attribute:

Attribute_Label: Year
Attribute_Definition: Year of survey.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1970
Range_Domain_Maximum: 1996

Attribute:

Attribute_Label: Date
Attribute_Definition: Date of survey.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Start_Temp
Attribute_Definition: starting temperature- Fahrenheit
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 65
Range_Domain_Maximum: 81

Attribute:

Attribute_Label: End_Temp
Attribute_Definition: ending temperature -Fahrenheit
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 68
Range_Domain_Maximum: 93

Attribute:

Attribute_Label: Start_Time
Attribute_Definition: starting time
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0541
Range_Domain_Maximum: 0553

Attribute:

Attribute_Label: End_Time
Attribute_Definition: ending time
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0907
Range_Domain_Maximum: 0945

Attribute:

Attribute_Label: Start_Wind
Attribute_Definition:
starting wind (Beaufort scale): 0=<1mph; 1=1-3mph; 2=4-7mph; 3=8-12mph; 4=13-18mph; 5=19-24mph
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: <1 mph
Range_Domain_Maximum: 4-7 mph

Attribute:

Attribute_Label: End_Wind
Attribute_Definition:
ending wind (Beaufort scale): 0=<1mph; 1=1-3mph; 2=4-7mph; 3=8-12mph; 4=13-18mph; 5=19-24mph
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: <1 mph
Range_Domain_Maximum: 8-12 mph

Attribute:

Attribute_Label: Start_Sky
Attribute_Definition: starting sky condition
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: clear
Enumerated_Domain_Value_Definition: clear skies
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: partly cloudy
Enumerated_Domain_Value_Definition: partly cloudy skies
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: cloudy
Enumerated_Domain_Value_Definition: cloudy skies

Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: fog
Enumerated_Domain_Value_Definition: fog
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: drizzle
Enumerated_Domain_Value_Definition: drizzle
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: snow
Enumerated_Domain_Value_Definition: snow
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: showers
Enumerated_Domain_Value_Definition: showers
Enumerated_Domain_Value_Definition_Source: User Defined

Attribute:

Attribute_Label: End_Sky
Attribute_Definition: ending sky condition
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: clear
Enumerated_Domain_Value_Definition: clear skies
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: partly cloudy
Enumerated_Domain_Value_Definition: partly cloudy skies
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: cloudy
Enumerated_Domain_Value_Definition: cloudy skies
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: fog
Enumerated_Domain_Value_Definition: fog
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: drizzle
Enumerated_Domain_Value_Definition: drizzle
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: snow
Enumerated_Domain_Value_Definition: snow
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: showers
Enumerated_Domain_Value_Definition: showers
Enumerated_Domain_Value_Definition_Source: User Defined

Attribute:

Attribute_Label: Total_Spe
Attribute_Definition: Total number of species observed
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 51
Range_Domain_Maximum: 61

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager

Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:44 2000

1999 ACE Basin Ecological Characterization: Colonial Waterbird Colony Survey coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Jeff Trudnak
Publication_Date: 19970901
Title:
1999 ACE Basin Ecological Characterization: Colonial Waterbird Colony Survey coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990501
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE

Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

Data set summarizes current and past colonial waterbird nesting locations in the ACE Basin. Locations and attributes were developed by SCDNR staff. Extensive ground surveys were done in 1987,1988,1994, and 1996. Other less extensive ground and aerial surveys were done intermittantly. Data attatched to the data layer include colony site code, species, date of survey, number of nests by species, and method of survey.

Purpose:

Data set provides information on location of current and past colonial wading bird sites. In addition, the data gives species and number of nests by species to characterize nesting activity at each location.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19641231
Ending_Date: 19971231

Currentness_Reference: ground condition

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.7232
East_Bounding_Coordinate: -80.1966
North_Bounding_Coordinate: 32.6248
South_Bounding_Coordinate: 32.3347

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: colonial wading bird
Theme_Keyword: nest
Theme_Keyword: nesting activity

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: St Helena Sound
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exists.
Completeness_Report: complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none to report

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: Thomas Murphy, SCDNR; Heritage Trust, Greenpond, SC
Publication_Date:
Title: Bird Nesting Coordinate Locations and Other Attributes
Edition: 1995
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Greenpond, SC
Publisher: SCDNR

Source_Scale_Denominator: 24000
Type_of_Source_Media: 3.5 inch disk
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19641231
Ending_Date: 19971231

Source_Currentness_Reference: Ground Condition

Source_Citation_Abbreviation: htr
Source_Contribution:
The source provided lat/long locations for bird nests/observations

Process_Step:

Process_Description:
converted latitudes and longitudes from degrees minutes seconds to decimal degrees
Process_Date: 19980501
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
converted colonial waterbird data from dBase IV to MS Access 97. Includes date of survey, station information, species, number of nests, survey method.
Process_Date: 19981001
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 68

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: cwbnests.dbf

Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Acecolonia
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 68

Attribute:

Attribute_Label: Colonialut
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 8
Range_Domain_Maximum: 122

Attribute:

Attribute_Label: Sitenumber
Attribute_Definition:
code for colony site. First two letters indicate the state, second two the county, last are consecutive sites, and a hyphen follows the sitenumber.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Sitename
Attribute_Definition: name of the colony
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Lat_dd
Attribute_Definition: latitude in decimal degrees
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 32.2508
Range_Domain_Maximum: 33.1750

Attribute:

Attribute_Label: Long_dd
Attribute_Definition: longitude in decimal degrees
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -81.1250
Range_Domain_Maximum: -80.1400

Detailed_Description:

Entity_Type:

Entity_Type_Label: cwb2lnk.dbf
Entity_Type_Definition: link table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: SITE_NUM
Attribute_Definition:
code for colony site. First two letters indicate the state, second two the county, last are consecutive sites, and a hyphen follows the sitenumber.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: SITE_NAME
Attribute_Definition: name of the colony
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: USGS_QUAD
Attribute_Definition: Name of USGS Quad on which the colony occurs
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: TOWN
Attribute_Definition: closest town

Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: LAT_DD
Attribute_Definition: latitude in decimal degrees
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 32.3230
Range_Domain_Maximum: 32.9847

Attribute:

Attribute_Label: LON_DD
Attribute_Definition: longitude in decimal degrees
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -81.0103
Range_Domain_Maximum: -80.1783

Detailed_Description:

Entity_Type:

Entity_Type_Label: cwb1lnk.dbf
Entity_Type_Definition: link table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: SITE_NUM
Attribute_Definition:
code for colony site. First two letters indicate the state, second two the county, last are consecutive sites, and a hyphen follows the sitenumber.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: DATE
Attribute_Definition: date of survey
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: COM_NAME
Attribute_Definition: common name of species surveyed
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: NUM_NESTS
Attribute_Definition: number of nests counted by date and species
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 12410

Attribute:

Attribute_Label: CENSUS_MET
Attribute_Definition: method of survey
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: aerial photographic count
Enumerated_Domain_Value_Definition:
a photo of a rookery is taken then projected on a screen and all occupied nests are counted.
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: aerial visual count
Enumerated_Domain_Value_Definition: two observers make a nest count while observing from a plane
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: partial count and proj.
Enumerated_Domain_Value_Definition:
a nest count is made while travelling along a transect of the rookery. The total number is then extrapolated from this count.
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: perimeter count
Enumerated_Domain_Value_Definition:

Observers travel along the perimeter of the rookery and look within to make a nest count.
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: total ground count
Enumerated_Domain_Value_Definition:
The entire rookery is surveyed while an exhaustive nest count is made.
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: Unknown census method
Enumerated_Domain_Value_Definition: method for nest count was not recorded and is unkown.
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: visual total estimate
Enumerated_Domain_Value_Definition: a total estimate is made by extrapolations from aerial counts
Enumerated_Domain_Value_Definition_Source: User Defined

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at [<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>](http://www.csc.noaa.gov/clearinghouse/prodreq_form.html)

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC

Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:45 2000

1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Bald Eagle Survey coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19970901
Title:
1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Bald Eagle Survey coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:

The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

Monitoring of bald eagle nesting began in 1977. At this time, there were a total of 13 occupied nests in South Carolina. Of these, 6 nests were located in the ACE Basin area. During 1998, a total of 129 nests were known throughout the state. Of these 129, 30 occupied nests were in the ACE Basin. Because large portions of the State were reoccupied by nesting eagles, the percentage of nests in the ACE has declined over the years. However, use of manmade inland reservoirs has resulted in the creation of additional habitat for eagles that has extended the inland range. The total number of nests within the Ace has continued to climb and the Basin continues to support one of the highest nesting densities in the State. Bald eagle nests average 2 meters across the top and are 1-3 m top to bottom. Eagles use the same nests for many years enlarging the nest each year. Eagles select large trees with open lateral access to the nest and are generally adjacent to aquatic feeding areas. Most eagle nests are in pine trees and average 30 meters above the ground. Eagle nesting surveys are conducted from single engine, wing over cockpit aircraft flown at an altitude of 60-180 meters to locate nests. Two surveys are made of each nest each year. One survey determines the reproductive status of the territory for the year and the second documents the number of young produced. On average, an occupied nest produces 1.21 young per year. About 75% of nesting attempts successfully fledge young in an average year. Of these successful nests, 48% fledge 1 young and 48% fledge produce 2. The remaining 4% produce 3 young. Eagles nest during the winter months in the Basin, because water is at its clearest, there are abundant waterbirds wintering here and fish spawning runs will occur when eagle chicks reach their maximum demand for food. The peak in egg laying is December 31, but may occur as from early November to late March. The eggs require 35 days to hatch and the chicks require 10-12 weeks to grow and fledge from the nest. Chicks are as large as the adults when they leave the nest and are fed by the adults for an additional 6-8 weeks as they develop their flying skills. Including courtship and nest construction or repair, the reproductive cycle may require 8 months to complete if successful in raising young. There is additional information about the eagle nest sites located in the table eagl.fin which is attached to the eagle attribute table in the project.

Purpose:

The bald eagle nest monitoring program has been conducted in order to determine the status of eagles in the state. It also enables scientists to the monitor the effects of management activities, to provide location data for permit reviews, to provide data for regional and national monitoring and to gather basic biological data on the species.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19900000
Ending_Date: 19980000

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: yearly

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.4580
East_Bounding_Coordinate: -80.1948
North_Bounding_Coordinate: 32.5703
South_Bounding_Coordinate: 32.3303

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: Bald Eagle
Theme_Keyword: Bald Eagle nests
Theme_Keyword: Endangered Species

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: South Carolina
Place_Keyword: Charleston

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.

Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Process_Step:

Process_Description:
Imported eagle dbf into ArcView Version 3.1. Used add event theme tool to create a visual representation of the point location of the endangered species. Converted this coverage to a shapefile. Used geoprocessing extension to clip the shapefile to the DHEC basins coverage which displays the 36 different watersheds found within the ACE characterization area. This clipped shapefile was then converted to an ArcInfo coverage by using the shapearc command in ArcInfo Version 7.2.1. The identity command was then used to compute the geometric intersection of the clipped point coverage and the polygon watershed coverage. This new coverage was then brought into ArcView Version 3.1. Using the field calculate tool, sums of bald eagle nests within each of the 36 watersheds was calculated. A new field was then added to the polygon attribute table to display the eagle nest count found within each of the 36 watersheds.

Process_Date: 19980900
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Complete Chain
Point_and_Vector_Object_Count: 36

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000

False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: eagles.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: none

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3349209.250
Range_Domain_Maximum: 166225280.000

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 13238.898
Range_Domain_Maximum: 99124.453

Attribute:

Attribute_Label: Row_id
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2
Range_Domain_Maximum: 37

Attribute:

Attribute_Label: Eagle_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 261

Attribute:

Attribute_Label: Hucode
Attribute_Definition: 14-digit number assigned to the watershed by the USGS
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Acres
Attribute_Definition: amount of land in acres
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 37573

Attribute:

Attribute_Label: Sq_mi
Attribute_Definition: amount of land in sq.mi
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 58.71

Attribute:

Attribute_Label: Splitcode
Attribute_Definition:
Field used in ACE Characterization to divide data layers based on 14 digit hydrologic units
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 36

Attribute:

Attribute_Label: Count_nest
Attribute_Definition: Number of nests counted in a particular sector
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 9

Detailed_Description:

Entity_Type:

Entity_Type_Label: eaglelnk.dbf
Entity_Type_Definition: Link Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: YEAR
Attribute_Definition: Year in which count occurred.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1990
Range_Domain_Maximum: 1998

Attribute:

Attribute_Label: STATUS
Attribute_Definition: Status of nest - Active, occupied, not active, adult.
Attribute_Definition_Source: User defined.
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: Active
Enumerated_Domain_Value_Definition: Active
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: Occupied
Enumerated_Domain_Value_Definition: Occupied
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: Not active
Enumerated_Domain_Value_Definition: Not active
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: Adult
Enumerated_Domain_Value_Definition: Adult
Enumerated_Domain_Value_Definition_Source: User Defined

Attribute:

Attribute_Label: PROD
Attribute_Definition: Number of chicks produced.
Attribute_Definition_Source: User defined.
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 3

Attribute:

Attribute_Label: TER_N
Attribute_Definition: Numeric code given to territory name.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 191

Attribute:

Attribute_Label: NEST
Attribute_Definition: Numeric code given to nest site.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 377

Attribute:

Attribute_Label: HUCODE
Attribute_Definition: 14-digit number assigned to the watershed by the USGS
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: SPLITCODE
Attribute_Definition:
Field used in ACE Characterization to divide data layers based on 14 digit hydrologic units
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 11
Range_Domain_Maximum: 33

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at [<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>](http://www.csc.noaa.gov/clearinghouse/prodreq_form.html)

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110

Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:45 2000

1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Epifauna Survey coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: SCDNR-MRD
Publication_Date: 19981117
Title:
1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Epifauna Survey coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse

ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

Benthic invertebrates fulfill an important economic and ecological role in both marine and freshwater ecosystems. Infaunal benthic invertebrates are the primary food source for many commercially important fish and crustaceans. Epifaunal benthic invertebrates provide food and shelter for a variety of organisms and some are commercially important (e.g. oysters and crabs). Both infaunal and epifaunal benthic surveys have been conducted in the ACE Basin using a variety of methods. Data from Van Dolah et al. (1991), Calder and Booth (1977), Van Dolah et al. (1979), and Calder et al. (1977) were condensed and summarized in tabular form. The infaunal benthic invertebrate summary table contains a list of dominant species (species with an overall abundance > 50 individuals/m^2 across all stations) in the ACE Basin and the abundance of these dominants at each station sampled in the ACE Basin. This table also includes salinity and sediment characteristics of each station. The epifaunal table contains a list of all species collected in the ACE Basin and the stations at which each species was found. This table also includes the salinity characteristics of each station. One hundred eighty-six species of epifauna were identified from the 25 stations sampled and 76 species of dominant infauna species were identified from the 26 stations sampled.

Purpose:

The benthic invertebrate datasets were created from existing SC Department of Natural Resources data to characterize the infaunal and epifaunal invertebrate community in the ACE Basin.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19730700
Ending_Date: 19950000

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.7435
East_Bounding_Coordinate: -80.1896
North_Bounding_Coordinate: 32.6840
South_Bounding_Coordinate: 32.4895

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: epifaunal
Theme_Keyword: macrobenthos
Theme_Keyword: qualitative sampling
Theme_Keyword: dredging
Theme_Keyword: EMAP
Theme_Keyword: quantitative sampling

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: North Edisto River
Place_Keyword: South Ediston River
Place_Keyword: Dawho River
Place_Keyword: St. Helena Sound
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment:
Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: Van Dolah, R.F.
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization - Benthic Section
Edition: first
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC.

Source_Scale_Denominator: 24000
Type_of_Source_Media: CD-ROM
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19730700
Ending_Date: 19950000

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: Excel Files and information for GIS data layers.

Process_Step:

Process_Description:
Epifaunal: A summary list of all species identified in all stations was created. The presence (+) or absence (blank) of each species at each station was recorded in tabular form. The number of occurrences of each species across all stations was recorded. Additionally, at each station the total number of species and the salinity range was recorded.
Process_Date: 19980800
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
Data was reorganized in Excel spreadsheets so they could be imported into a GIS data layer. Some stations did not contain data for epifauna. These stations were removed from their respective shapefile.
Process_Date: 19981008
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The points were digitized on screen using maps from existing reports and ArcView 3.1.
Process_Date: 19981000
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 25

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: epifauna.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Epifauna
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 25

Attribute:

Attribute_Label: Statname
Attribute_Definition:
The identification name given to the station where sampling occurred.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: C_sapidus
Attribute_Definition: Scientific name - Callinectes sapidus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: M_manhatt
Attribute_Definition: Scientific name - Molgula manhattensis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: E_dumorti
Attribute_Definition: Scientific name - Ectopleura dumortieri
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_setiger
Attribute_Definition: Scientific name - Aeverrillia setigera
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: S_vulgari
Attribute_Definition: Scientific name - Sabellaria vulgaris
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_palmata
Attribute_Definition: Scientific name - Anguinella palmata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: M_tenuis
Attribute_Definition: Scientific name - Membranipora tenuis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: O_bidenta
Attribute_Definition: Scientific name - Obelia bidentata
Attribute_Definition_Source:

Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: B_improvi
Attribute_Definition: Scientific name - Balanus improvisus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_setifer
Attribute_Definition: Scientific name - Penaeus setiferus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_distans
Attribute_Definition: Scientific name - Amathia distans
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: B_gracili
Attribute_Definition: Scientific name - Bowerbankia gracilis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: E_monosta
Attribute_Definition: Scientific name - Electra monostachys
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_kincaid
Attribute_Definition: Scientific name - Clytia kincaidi
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: L_virgula
Attribute_Definition: Scientific name - Leptogorgia virgulata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_herbsti
Attribute_Definition: Scientific name - Panopeus herbstii
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: B_rugosa
Attribute_Definition: Scientific name - Bougainvillia rugosa
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: G_francis
Attribute_Definition: Scientific name - Garveia franciscana
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: S_stookey
Attribute_Definition: Scientific name - Sertularia stookeyi
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: M_prolife
Attribute_Definition: Scientific name - Microciona prolifera
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_hauffi
Attribute_Definition: Scientific name - Alcyonidium hauffi

Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Campanulin
Attribute_Definition: Scientific name - Campanulina sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_polyoum
Attribute_Definition: Scientific name - Alcyonidium polyoum
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_tenuiss
Attribute_Definition: Scientific name - Conopeum tenuissimum
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: E_carneum
Attribute_Definition: Scientific name - Eudendrium carneum
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: O_dichoto
Attribute_Definition: Scientific name - Obelia dichotoma
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: N_succinea
Attribute_Definition: Scientific name - Nereis succinea
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: T_orbicul
Attribute_Definition: Scientific name - Tanystylum orbiculare
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_viridis
Attribute_Definition: Scientific name - Perophora viridis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.

Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: T_nutricu
Attribute_Definition: Scientific name - Turritopis nutricula
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: O_angulat
Attribute_Definition: Scientific name - Ophiothrix angulata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: L_sublevi
Attribute_Definition: Scientific name - Lepidonotus sublevis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: M_arbores
Attribute_Definition: Scientific name - Membranipora arborescens
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: B_laxa
Attribute_Definition: Scientific name - Barentsia laxa
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: N_sayi
Attribute_Definition: Scientific name - Neopanope sayi
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_tenuis
Attribute_Definition: Scientific name - Paracaprella tenuis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_mammill
Attribute_Definition: Scientific name - Alcyonidium mammillatum
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: S_errata
Attribute_Definition: Scientific name - Schizoporella errata
Attribute_Definition_Source:

Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Pandeidae_
Attribute_Definition: Scientific name - Pandeidae (undet.)
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: S_tenella
Attribute_Definition: Scientific name - Schizotricha tenella
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Cliona_sp_
Attribute_Definition: Scientific name - Cliona sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: H_dianthu
Attribute_Definition: Scientific name - Hydroides dianthus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_nitida
Attribute_Definition: Scientific name - Parasmittina nitida
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: G_loveni
Attribute_Definition: Scientific name - Gonothyraea loveni
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: H_scanden
Attribute_Definition: Scientific name - Hebella scandens
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: O_hyalina
Attribute_Definition: Scientific name - Obelia hyalina
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: B_niveus
Attribute_Definition: Scientific name - Balanus amphitrite niveus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_ornatus
Attribute_Definition: Scientific name - Callinectes ornatus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Caprellida
Attribute_Definition: Scientific name - Caprellidae (undet.)
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: H_angusti
Attribute_Definition: Scientific name - Hexapanopeus angustifrons
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: M_mercena
Attribute_Definition: Scientific name - Menippe mercenaria

Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_longica
Attribute_Definition: Scientific name - Pagurus longicarpus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_cylindr
Attribute_Definition: Scientific name - Clytia cylindrica
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: D_cornici
Attribute_Definition: Scientific name - Dynamena cornicina
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_florida
Attribute_Definition: Scientific name - Plumularia floridana
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: H_elongat
Attribute_Definition: Scientific name - Hemipholis elongata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: B_exustus
Attribute_Definition: Scientific name - Brachidontes exustus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_laminar
Attribute_Definition: Scientific name - Craniella laminaris
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_normann
Attribute_Definition: Scientific name - Alpheus normanni
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.

Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_breviro
Attribute_Definition: Scientific name - Callipallene brevirostrum
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_patula
Attribute_Definition: Scientific name - Chelonibia patula
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_planica
Attribute_Definition: Scientific name - Cleantis planicauda
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: E_brasili
Attribute_Definition: Scientific name - Erichthonius brasiliensis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Libinia_sp
Attribute_Definition: Scientific name - Libinia sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: M_appendi
Attribute_Definition: Scientific name - Melita appendiculata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_aztecus
Attribute_Definition: Scientific name - Penaeus aztecus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: T_constri
Attribute_Definition: Scientific name - Trachypenaeus constrictus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Actiniaria
Attribute_Definition: Scientific name - Actiniaria (undet.)
Attribute_Definition_Source:

Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: L_gracili
Attribute_Definition: Scientific name - Lovenella gracilis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: L_carolin
Attribute_Definition: Scientific name - Lissodendoryx carolinensis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Sabellidae
Attribute_Definition: Scientific name - Sabellidae (undet.)
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: B_galeatu
Attribute_Definition: Scientific name - Balanus galeatus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Corophium_
Attribute_Definition: Scientific name - Corophium sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: E_depress
Attribute_Definition: Scientific name - Eurypanopeus depressus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: G_daiberi
Attribute_Definition: Scientific name - Gammarus daiberi
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: L_webster
Attribute_Definition: Scientific name - Lembos websteri
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: L_spinica
Attribute_Definition: Scientific name - Leucothoe spinicarpa
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: L_polyphe
Attribute_Definition: Scientific name - Limulus polyphemus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_vulgari
Attribute_Definition: Scientific name - Palaemonetes vulgaris
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: S_empusa
Attribute_Definition: Scientific name - Squilla empusa
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_armata
Attribute_Definition: Scientific name - Aeverrillia armata

Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: M_ciliata
Attribute_Definition: Scientific name - Microporella ciliata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: D_leucole
Attribute_Definition: Scientific name - Diadumene leucolena
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_forbesi
Attribute_Definition: Scientific name - Asterias forbesi
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_humilis
Attribute_Definition: Scientific name - Cuspidella humilis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_transve
Attribute_Definition: Scientific name - Anadara transversa
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_virgini
Attribute_Definition: Scientific name - Crassostrea virginica
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: D_obscura
Attribute_Definition: Scientific name - Doridella obscura
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: E_caudata
Attribute_Definition: Scientific name - Eupleura caudata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.

Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: O_equestr
Attribute_Definition: Scientific name - Ostrea equestris
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: S_uniplic
Attribute_Definition: Scientific name - Simnia uniplicata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: S_ellipti
Attribute_Definition: Scientific name - Stylochus ellipticus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_armilla
Attribute_Definition: Scientific name - Alpheus armillatus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: B_eburneu
Attribute_Definition: Scientific name - Balanus eburneus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: B_cathari
Attribute_Definition: Scientific name - Batea catharinensis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_equilib
Attribute_Definition: Scientific name - Caprella equilibra
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_vittatu
Attribute_Definition: Scientific name - Clibanarius vittatus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: E_levis
Attribute_Definition: Scientific name - Elasmopus levis
Attribute_Definition_Source:

Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: M_nitida
Attribute_Definition: Scientific name - Melita nitida
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_duoraru
Attribute_Definition: Scientific name - Penaeus duorarum
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: B_neritin
Attribute_Definition: Scientific name - Bugula neritina
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: N_stipata
Attribute_Definition: Scientific name - Nolella stipata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_dinema
Attribute_Definition: Scientific name - Amphinema dinema
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_capilla
Attribute_Definition: Scientific name - Cyanea capillata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: L_agassiz
Attribute_Definition: Scientific name - Linvillea agassizi
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: R_renifor
Attribute_Definition: Scientific name - Renilla reniformis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: L_clathra
Attribute_Definition: Scientific name - Luidia clathrata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_cernua
Attribute_Definition: Scientific name - Pedicellina cernua
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_pilosa
Attribute_Definition: Scientific name - Acanthodoris pilosa
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_simplex
Attribute_Definition: Scientific name - Anomia simplex
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: B_canalic
Attribute_Definition: Scientific name - Busycon canaliculatum

Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: B_carica
Attribute_Definition: Scientific name - Busycon carica
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_plana
Attribute_Definition: Scientific name - Crepidula plana
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: I_obsolet
Attribute_Definition: Scientific name - Illyanassa obsoleta
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: M_lunata
Attribute_Definition: Scientific name - Mitrella lunata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: N_uniplic
Attribute_Definition: Scientific name - Neosimnia uniplicata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: G_dibranc
Attribute_Definition: Scientific name - Glycera dibranchiata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_heteroc
Attribute_Definition: Scientific name - Alpheus heterochaelis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_lentus
Attribute_Definition: Scientific name - Anoplodactylus lentus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.

Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Microproto
Attribute_Definition: Scientific name - Microprotopus sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: N_duodors
Attribute_Definition: Scientific name - Nymphopsis duodorsospinosa
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: O_ocellat
Attribute_Definition: Scientific name - Ovalipes ocellatus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_pollica
Attribute_Definition: Scientific name - Pagurus pollicaris
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_aestuar
Attribute_Definition: Scientific name - Parapleustes aestuarius
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: S_breviro
Attribute_Definition: Scientific name - Sicyonia brevirostris
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: S_minuta
Attribute_Definition: Scientific name - Stenothoe minuta
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: X_kroyeri
Attribute_Definition: Scientific name - Xiphopenaeus kroyeri
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_danae
Attribute_Definition: Scientific name - Astrangia danae
Attribute_Definition_Source:

Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: G_humilis
Attribute_Definition: Scientific name - Garveia humilis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: H_luciae
Attribute_Definition: Scientific name - Haliplanella luciae
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Obelia_sp_
Attribute_Definition: Scientific name - Obelia sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: S_margina
Attribute_Definition: Scientific name - Sertularia marginata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Loxosomell
Attribute_Definition: Scientific name - Loxosomella sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_avara
Attribute_Definition: Scientific name - Anachis avara
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_fornica
Attribute_Definition: Scientific name - Crepidula fornicata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: M_america
Attribute_Definition: Scientific name - Modiolus americanus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Opisthobra
Attribute_Definition: Scientific name - Opisthobranch (undet.)
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: B_candida
Attribute_Definition: Scientific name - Bdelloura candida
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: H_bowerba
Attribute_Definition: Scientific name - Halichondria bowerbanki
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: A_iricolo
Attribute_Definition: Scientific name - Arabella iricolor
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: G_asymmet
Attribute_Definition: Scientific name - Glycera asymmetrica

Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Oligochaet
Attribute_Definition: Scientific name - Oligochaeta (undet.)
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: B_venustu
Attribute_Definition: Scientific name - Balanus venustus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_irrorat
Attribute_Definition: Scientific name - Cancer irroratus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_tubular
Attribute_Definition: Scientific name - Cerapus tubularis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_lacustr
Attribute_Definition: Scientific name - Corophium lacustre
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_richmon
Attribute_Definition: Scientific name - Crangonyx richmondensis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: G_mucrona
Attribute_Definition: Scientific name - Gammarus mucronatus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: H_ephelit
Attribute_Definition: Scientific name - Hepatus epheliticus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.

Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: L_emargin
Attribute_Definition: Scientific name - Libinia emarginata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: L_alba
Attribute_Definition: Scientific name - Lysianassa alba
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: L_wurdema
Attribute_Definition: Scientific name - Lysmata wurdemanni
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: M_dentata
Attribute_Definition: Scientific name - Melita dentata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Microdeuto
Attribute_Definition: Scientific name - Microdeutopus sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: N_beaufor
Attribute_Definition: Scientific name - Neopontonides beaufortensis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: O_limicol
Attribute_Definition: Scientific name - Ogyrides limicola
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_pugio
Attribute_Definition: Scientific name - Palaemonetes pugio
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_longica
Attribute_Definition: Scientific name - Periclimenes longicaudatus
Attribute_Definition_Source:

Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_gibbesi
Attribute_Definition: Scientific name - Portunus gibbesii
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_spinima
Attribute_Definition: Scientific name - Portunus spinimanus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: U_serrata
Attribute_Definition: Scientific name - Unciola serrata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_pallasi
Attribute_Definition: Scientific name - Cryptosula pallasiana
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: T_elongat
Attribute_Definition: Scientific name - Triticella elongata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Ascidiacea
Attribute_Definition: Scientific name - Ascidiacea (undet.)
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Campanopsi
Attribute_Definition: Scientific name - Campanopsis sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_quinque
Attribute_Definition: Scientific name - Chrysaora quinquecirrha
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_paulens
Attribute_Definition: Scientific name - Clytia paulensis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: E_album
Attribute_Definition: Scientific name - Eudendrium album
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: H_echinat
Attribute_Definition: Scientific name - Hydractinia echinata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_rapifor
Attribute_Definition: Scientific name - Paranthus rapiformis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: T_crocea
Attribute_Definition: Scientific name - Tubularia crocea

Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Z_costata
Attribute_Definition: Scientific name - Zanclea costata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_penicil
Attribute_Definition: Scientific name - Ciocalypta penicillus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: H_pearsei
Attribute_Definition: Scientific name - Hemectyon pearsei
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: M_quinque
Attribute_Definition: Scientific name - Mellita quinquesperforata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: O_brevisp
Attribute_Definition: Scientific name - Ophioderma brevispinum
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_emerson
Attribute_Definition: Scientific name - Cerithiopsis emersoni
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_apicula
Attribute_Definition: Scientific name - Chaetopleura apiculata
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: D_cayenen
Attribute_Definition: Scientific name - Diodora cayenensis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.

Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: H_arctica
Attribute_Definition: Scientific name - Hiatella arctica
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: N_obsolet
Attribute_Definition: Scientific name - Nassarius obsoletus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: N_vibex
Attribute_Definition: Scientific name - Nassarius vibex
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: P_duplica
Attribute_Definition: Scientific name - Polinices duplicatus
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: U_cinerea
Attribute_Definition: Scientific name - Urosalpinx cinerea
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: C_mutabil
Attribute_Definition: Scientific name - Coronadena mutabilis
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Nemertine_
Attribute_Definition: Scientific name - Nemertine (undet.)
Attribute_Definition_Source:
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Species is present.
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: No_of_spe
Attribute_Definition: The number of species obtained in the collection
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2
Range_Domain_Maximum: 81

Attribute:

Attribute_Label: Salinity_r
Attribute_Definition: The salinity range during the collection
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210

Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:47 2000

1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Fur Bearer Survey coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources-Marine Resources Division
Publication_Date: 19990501
Title:
1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Fur Bearer Survey coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990501
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-

Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth.

The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a Geographic: information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin.

This CD-ROM was produced by the National Oceanic and Atmospheric Administration's Coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

The Wildlife and Freshwater Fisheries division of the SCDNR established a terrestrial furbearer survey in 1984. Furbearer data is collected from over 160 locations throughout the state between September 24 and October 24 of every year. Four lines occur with the ACE Characterization project area. Target species include gray fox, red fox, bobcat, raccoon, and coyote. Incidental information on free-ranging dogs is also collected. Data through the 1996 sampling season was received from WWF by the South Carolina Department of Natural Resources Marine Resource Division. ACE Project staff formatted and summarized the data for inclusion in the final product. The data set contains census data on a selection of furbearers using scent stations along a transect to attract animals. Species are identified by tracks left in the ground around each station. The data set includes the location of the transect, the date, observer's name, wind velocity (Beaufort Scale), temperature, cloud cover, and total number indivuduals by species. Due to the one-to-many relationship between the sites and the data collected, the fursurv point coverage is to be linked with the furlink.dbf file using the ID's in each file. The index for each species is computed by counting the number of animals (by species) present at each station on the transect, dividing by the number of operational stations, and multiplying by 1000.

Purpose:

The data is used to monitor furbearer populations throughout the state. In addition, the data is collected in partial fulfillment of annual US Fish and Wildlife Service requirements for approval of federal export of bobcat pelts.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 1968
Ending_Date: 1996

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.6863
East_Bounding_Coordinate: -80.2864
North_Bounding_Coordinate: 32.8517
South_Bounding_Coordinate: 32.5865

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: Fur
Theme_Keyword: game
Theme_Keyword: hunting
Theme_Keyword: bobcat
Theme_Keyword: coyote
Theme_Keyword: fox
Theme_Keyword: cat
Theme_Keyword: raccoon

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE
Place_Keyword: Ashepoo
Place_Keyword: Combahee
Place_Keyword: Edisto
Place_Keyword: South Carolina
Place_Keyword: Southeast
Place_Keyword: Atlantic Coast

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.1.1 indicate that arc and node topology exist.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
The data was digitized on-screen using NWI data and roads data as reference.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: None to report.

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: SCDNR-MRD
Publication_Date: 19980331
Title: SCDNR WFF Furbearer Survey
Edition: none
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Charleston, SC
Publisher: SCDNR-MRD

Source_Scale_Denominator: 24000

Type_of_Source_Media: paper
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19680000
Ending_Date: 19960000

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: Excel Files and maps

Process_Step:

Process_Description:
Furbearer data set was received as hardcopy from W. Dukes with the SCDNR WFF section. Values were hand entered in Excel 7.0 for initial formatting. Data entry was double checked for accuracy. Data was used to develop some of the tables accessed through the body of the characterization text.
Process_Date: 19980201
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The survey lines were hand-drawn on copies of topo maps. Using 1989 NWI (landuse) data as background and the roads data from the Environmental Sensitivity Index for South Carolina as a reference, the arcs composing this data set were created as shapefiles using ArcView.
Process_Date: 19980300

Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
After the survey lines were digitized and checked for accuracy the rc Shapefiles were converted o ArcInfo line coverages using the ArcInfo shapearc command.
Process_Date: 19980300
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Complete Chain
Point_and_Vector_Object_Count: 9

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: fursurvy.dbf
Entity_Type_Definition: Arc Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Length
Attribute_Definition: Length of line
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2504.666
Range_Domain_Maximum: 5401.280

Attribute:

Attribute_Label: Furbearer
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 9

Attribute:

Attribute_Label: lin_numb
Attribute_Definition: survey line number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 63
Range_Domain_Maximum: 114

Detailed_Description:

Entity_Type:

Entity_Type_Label: furlink.dbf
Entity_Type_Definition: Link table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: lin_numb
Attribute_Definition: survey line number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 63
Range_Domain_Maximum: 114

Attribute:

Attribute_Label: county
Attribute_Definition: county where survey line is located
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Species
Attribute_Definition: common name of species present
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: index68
Attribute_Definition: Data for 1968
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -999
Range_Domain_Maximum: 100

Attribute:

Attribute_Label: index84
Attribute_Definition: Data for 1984
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -999
Range_Domain_Maximum: 400

Attribute:

Attribute_Label: index85
Attribute_Definition: Data for 1985
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -999

Range_Domain_Maximum: 600

Attribute:

Attribute_Label: index86
Attribute_Definition: Data for 1986
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -999
Range_Domain_Maximum: 600

Attribute:

Attribute_Label: index87
Attribute_Definition: Data for 1987
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -999
Range_Domain_Maximum: 800

Attribute:

Attribute_Label: index88
Attribute_Definition: Data for 1988
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 1000

Attribute:

Attribute_Label: index89
Attribute_Definition: Data for 1989
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 800

Attribute:

Attribute_Label: index90
Attribute_Definition: Data for 1990
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 1000

Attribute:

Attribute_Label: index91
Attribute_Definition: Data for 1991
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 600

Attribute:

Attribute_Label: index92
Attribute_Definition: Data for 1992
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -999
Range_Domain_Maximum: 900

Attribute:

Attribute_Label: index93
Attribute_Definition: Data for 1993
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 556

Attribute:

Attribute_Label: index94
Attribute_Definition: Data for 1994
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -999
Range_Domain_Maximum: 556

Attribute:

Attribute_Label: index95
Attribute_Definition: Data for 1995
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 700

Attribute:

Attribute_Label: index96
Attribute_Definition: Data for 1996
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 700

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at [<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>](http://www.csc.noaa.gov/clearinghouse/prodreq_form.html)

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:47 2000

1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Freshwater Benthos Survey coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resource Division (SCDNR-MRD)
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Freshwater Benthos Survey coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-

Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

Macrobenthos data was collected by the SCDHEC Aquatic Biology Section Macroinvertebrate Team from freshwater locations in the ACE Basin. Only those species with number of specimens collected greater than 5 were included. Data was provided by SCDHEC, Bureau of Water, Aquatic Biology Section (unpublished data). Values represent results of qualitative sampling using multiple gear. The data was collected between 1980 and 1996.

Purpose:

The Aquatic Biology Section collects aquatic macroinvertebrates as part of their yearly ambient monitoring effort. This allows them to evaluate the streams and assign a water quality rating. The evaluation, but none of the data, can be found in the "Watershed Water Quality Management Strategy" documents.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19800218
Ending_Date: 19960315

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.8710
East_Bounding_Coordinate: -80.5299

North_Bounding_Coordinate: 32.9851
South_Bounding_Coordinate: 32.7690

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: freshwater benthos
Theme_Keyword: station
Theme_Keyword: species

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Walterboro
Place_Keyword: Colleton

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: ArcView version 3.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none to report

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: SCDHEC Aquatic Biology Section Macroinvertebrate Team
Publication_Date: Unpublished material
Title: "Watershed Water Quality Management Strategy"
Edition: none
Geospatial_Data_Presentation_Form: map

Source_Scale_Denominator: 24000
Type_of_Source_Media: paper
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19800218
Ending_Date: 19960315

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: Provided data for the freshwater benthos datalayer.

Process_Step:

Process_Description:
A new datalayer for the station locations was created. The stations were added as a point theme. A table containing information about when collections occurred, what species were collected, and the number of species collected at each station was added to the datalayer. This table was joined with the attribute table to create a look-up table.
Process_Date: 19981113
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
Species counts were summed for all stations and only the dominant species were included. Dominant species were considered those which had an abundance greater than 5 when all stations were summed. The total abundance was calculated by summing all species counts for each station. The abundance of dominants was calculated by summing the species counts of the dominants for each station. % abundance of dominants for each station was calculated by dividing the abundance of dominants by the total abundance and multiplying by 100.
Process_Date: 19980700
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us

Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The points were digitized on screen using maps from existing reports and ArcView 3.1.
Process_Date: 19981000
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 12

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17

Transverse_Mercator:

Scale_Factor_at_Central_Meridian: .9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: fwbnthos.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Id
Attribute_Definition:
numeric value assigned to station name for ease of identification
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 12

Attribute:

Attribute_Label: Station
Attribute_Definition: the name of the station where sampling occurred
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Sample_dat
Attribute_Definition: the date that the sample was collected
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 19800218
Range_Domain_Maximum: 19960315

Attribute:

Attribute_Label: Leptophleb
Attribute_Definition:
name of species - Arthropoda Hexapoda Ephemeroptera Leptophlebia sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 147

Attribute:

Attribute_Label: Crangonyx_
Attribute_Definition: name of species - Arthropoda Crustacea Amphipoda Crangonyx sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 88

Attribute:

Attribute_Label: Asellus_sp
Attribute_Definition: name of species - Arthropoda Crustacea Isopoda Asellus sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2
Range_Domain_Maximum: 64

Attribute:

Attribute_Label: Hydroporus
Attribute_Definition: name of species - Arthropoda Hexapoda Coleoptera Hydroporus sp.
Attribute_Definition_Source: User Defined

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 39

Attribute:

Attribute_Label: Enallagma_
Attribute_Definition: name of species - Arthropoda Hexapoda Odonata Enallagma sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 44

Attribute:

Attribute_Label: Hydropsych
Attribute_Definition:
name of species - Arthropoda Hexapoda Trichoptera Hydropsyche sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 119

Attribute:

Attribute_Label: Stenonema_
Attribute_Definition:
name of species - Arthropoda Hexapoda Ephemeroptera Stenonema Modestum
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 43

Attribute:

Attribute_Label: Cambaridae
Attribute_Definition: name of species - Arthropoda Crustacea Decapoda Cambaridae
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3
Range_Domain_Maximum: 17

Attribute:

Attribute_Label: Simulium_s
Attribute_Definition: name of species - Arthropoda Hexapoda Diptera Simulium sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 44

Attribute:

Attribute_Label: Hydropsych
Attribute_Definition:
name of species - Arthropoda Hexapoda Trichoptera Hydropsyche decalda
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 54

Attribute:

Attribute_Label: Palaemonet
Attribute_Definition: name of species - Arthropoda Crustacea Decapoda Palaemonetes sp
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 34

Attribute:

Attribute_Label: Gyrinus_sp
Attribute_Definition: name of species - Arthropoda Hexapoda Coleoptera Gyrinus sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 72

Attribute:

Attribute_Label: Chimarra_s
Attribute_Definition: name of species - Arthropoda Hexapoda Trichoptera Chimarra sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 89

Attribute:

Attribute_Label: Labiobaeti
Attribute_Definition:
name of species - Arthropoda Hexapoda Ephemeroptera Labiobaetis frondalis
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 86

Attribute:

Attribute_Label: Perithemis
Attribute_Definition: name of species - Arthropoda Hexapoda Odonata Perithemis sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 86

Attribute:

Attribute_Label: Peltodytes
Attribute_Definition:
name of species - Arthropoda Hexapoda Coleoptera Peltodytes oppositus
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 45

Attribute:

Attribute_Label: Conchapelo
Attribute_Definition:
name of species - Arthropoda Hexapoda Diptera Conchapelopia Group
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 30

Attribute:

Attribute_Label: Baetidae
Attribute_Definition: name of species - Arthropoda Hexapoda Ephemeroptera Baetidae
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 74

Attribute:

Attribute_Label: Lirceus_sp
Attribute_Definition: name of species - Arthropoda Crustacea Isopoda Lirceus sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 29

Attribute:

Attribute_Label: Cyphon_sp_
Attribute_Definition: name of species - Arthropoda Hexapoda Coleoptera Cyphon sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 41

Attribute:

Attribute_Label: Dineutus_s
Attribute_Definition: name of species - Arthropoda Hexapoda Coleoptera Dineutus sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 29

Attribute:

Attribute_Label: Triaenodes
Attribute_Definition:
name of species - Arthropoda Hexapoda Trichoptera Triaenodes ochraceus
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 27

Attribute:

Attribute_Label: Calopteryx
Attribute_Definition: name of species - Arthropoda Hexapoda Odonata Calopteryx sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 22

Attribute:

Attribute_Label: Eurylophel
Attribute_Definition:
name of species - Arthropoda Hexapoda Ephemeroptera Eurylophella sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 19

Attribute:

Attribute_Label: Corixidae
Attribute_Definition: name of species - Arthropoda Hexapoda Heteroptera Corixidae
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 35

Attribute:

Attribute_Label: Polypedilu
Attribute_Definition:
name of species - Arthropoda Hexapoda Diptera Polypedilum convictum
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 41

Attribute:

Attribute_Label: Baetis_sp_
Attribute_Definition: name of species - Arthropoda Hexapoda Ephemeroptera Baetis sp
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 27

Attribute:

Attribute_Label: Nasiaeschn
Attribute_Definition:
name of species - Arthropoda Hexapoda Odonata Nasiaeschna pentacantha
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 19

Attribute:

Attribute_Label: Cheumatops
Attribute_Definition:
name of species - Arthropoda Hexapoda Trichoptera Cheumatopsyche sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 22

Attribute:

Attribute_Label: Oligochaet
Attribute_Definition: name of species - Arthropoda Oligochaeta NA Oligochaeta
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 12

Attribute:

Attribute_Label: Stenonema_
Attribute_Definition:
name of species - Arthropoda Hexapoda Ephemeroptera Stenonema integrum
Attribute_Definition_Source: User Defined

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 25

Attribute:

Attribute_Label: Coptotomus
Attribute_Definition: name of species - Arthropoda Hexapoda Coleoptera Coptotomus sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 32

Attribute:

Attribute_Label: Tanytarsus
Attribute_Definition: name of species - Arthropoda Hexapoda Diptera Tanytarsus sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 23

Attribute:

Attribute_Label: Gammarus_s
Attribute_Definition: name of species - Arthropoda Crustacea Amphipoda Gammarus sp
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 15

Attribute:

Attribute_Label: Hyallela_a
Attribute_Definition:
name of species - Arthropoda Crustacea Amphipoda Hyallela azteca
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 23

Attribute:

Attribute_Label: Ramphocori
Attribute_Definition:
name of species - Arthropoda Hexapoda Heteroptera Ramphocorixa sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 28

Attribute:

Attribute_Label: Libellulid
Attribute_Definition: name of species - Arthropoda Hexapoda Odonata Libellulidae
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 28

Attribute:

Attribute_Label: Coptotomus
Attribute_Definition:
name of species - Arthropoda Hexapoda Coleoptera Coptotomus interrogatus
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 25

Attribute:

Attribute_Label: Tribelos_s
Attribute_Definition: name of species - Arthropoda Hexapoda Diptera Tribelos sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 24

Attribute:

Attribute_Label: Belostomat
Attribute_Definition:
name of species - Arthropoda Hexapoda Heteroptera Belostomatidae
Attribute_Definition_Source: User Defined

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 26

Attribute:

Attribute_Label: Boyeria_vi
Attribute_Definition: name of species - Arthropoda Hexapoda Odonata Boyeria vinosa
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 12

Attribute:

Attribute_Label: Stenelmis_
Attribute_Definition: name of species - Arthropoda exapoda Coleoptera Stenelmis sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 13

Attribute:

Attribute_Label: Tropistern
Attribute_Definition:
name of species - Arthropoda Hexapoda Coleoptera Tropisternus sp
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 14

Attribute:

Attribute_Label: Ischnura_a
Attribute_Definition:
name of species - Arthropoda Hexapoda Odonata Ischnura/Anomalagrion
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 13

Attribute:

Attribute_Label: Sperchopsi
Attribute_Definition:
name of species - Arthropoda Hexapoda Coleoptera Sperchopsis tessellatus
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 15

Attribute:

Attribute_Label: Polypedilu
Attribute_Definition:
name of species - Arthropoda Hexapoda Diptera Polypedilum illinoense
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 8

Attribute:

Attribute_Label: Macromia_s
Attribute_Definition: name of species - Arthropoda Hexapoda Odonata Macromia sp
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 11

Attribute:

Attribute_Label: Pychnopsych
Attribute_Definition:
name of species - Arthropoda Hexapoda Trichoptera Pycnopsyche antica/guttifer
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 15

Attribute:

Attribute_Label: Nyctiophyl
Attribute_Definition:

name of species - Arthropoda Hexapoda Trichoptera Nyctiophylax sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 15

Attribute:

Attribute_Label: Hirudinea
Attribute_Definition: name of species - Arthropoda Hirudinea NA Hirudinea
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 11

Attribute:

Attribute_Label: Hydrovatus
Attribute_Definition: name of species - Arthropoda Hexapoda Coleoptera Hydrovatus sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 8

Attribute:

Attribute_Label: Dicrotendi
Attribute_Definition: name of species - Arthropoda Hexapoda Diptera Dicrotendipes sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 8

Attribute:

Attribute_Label: Stenochiro
Attribute_Definition:
name of species - Arthropoda Hexapoda Diptera Stenochironomus sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0

Range_Domain_Maximum: 10

Attribute:

Attribute_Label: Stenonema_
Attribute_Definition:
name of species - Arthropoda Hexapoda Ephemeroptera Stenonema sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 11

Attribute:

Attribute_Label: Microcyllo
Attribute_Definition:
name of species - Arthropoda Hexapoda Coleoptera Microcylloepus pusillus
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 9

Attribute:

Attribute_Label: Hydroptila
Attribute_Definition:
name of species - Arthropoda Hexapoda Trichoptera Hydroptila sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 13

Attribute:

Attribute_Label: Ironoquia_
Attribute_Definition: name of species - Arthropoda Hexapoda Trichoptera Ironoquia sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 11

Attribute:

Attribute_Label: Chironomus

Attribute_Definition: name of species - Arthropoda Hexapoda Diptera Chironomus sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 9

Attribute:

Attribute_Label: Synurella_
Attribute_Definition: name of species - Arthropoda Crustacea Amphipoda Synurella sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 9

Attribute:

Attribute_Label: Hydrochus_
Attribute_Definition: name of species - Arthropoda Hexapoda Coleoptera Hydrochus sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 10

Attribute:

Attribute_Label: Ablabesmyi
Attribute_Definition:
name of species - Arthropoda Hexapoda Diptera Ablabesmyia parajanta/janata
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 11

Attribute:

Attribute_Label: Libellula_
Attribute_Definition: name of species - Arthropoda Hexapoda Odonata Libellula sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0

Range_Domain_Maximum: 5

Attribute:

Attribute_Label: Tropistern
Attribute_Definition:
name of species - Arthropoda Hexapoda Coleoptera Tropisternus glaber
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 6

Attribute:

Attribute_Label: Clinotanyp
Attribute_Definition:
name of species - Arthropoda Hexapoda Diptera Clinotanypus pinguis
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 7

Attribute:

Attribute_Label: Isoperla_t
Attribute_Definition:
name of species - Arthropoda Hexapoda Plecoptera Isoperla transmarina
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 10

Attribute:

Attribute_Label: Ablabesmyi
Attribute_Definition:
name of species - Arthropoda Hexapoda Diptera Ablabesmyia mallochi
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 3

Attribute:

Attribute_Label: Chironomid
Attribute_Definition: name of species - Arthropoda Hexapoda Diptera Chironomidae
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 5

Attribute:

Attribute_Label: Rheotanyta
Attribute_Definition:
name of species - Arthropoda Hexapoda Diptera Rheotanytarsus sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 6

Attribute:

Attribute_Label: Belostoma
Attribute_Definition: name of species - Arthropoda Hexapoda Heteroptera Belostoma sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 6

Attribute:

Attribute_Label: Ranatra_bu
Attribute_Definition:
name of species - Arthropoda Hexapoda Heteroptera Ranatra buenoi
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 6

Attribute:

Attribute_Label: Sialis_sp_
Attribute_Definition: name of species - Arthropoda Hexapoda Megaloptera Sialis sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 6

Attribute:

Attribute_Label: Sisyra_vic
Attribute_Definition: name of species - Arthropoda Hexapoda Neuroptera Sisyra vicaria
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 5

Attribute:

Attribute_Label: Calopteryx
Attribute_Definition:
name of species - Arthropoda Hexapoda Odonata Calopteryx maculata
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 5

Attribute:

Attribute_Label: Pachydipla
Attribute_Definition:
name of species - Arthropoda Hexapoda Odonata Pachydiplax longipennis
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 4

Attribute:

Attribute_Label: Gomphus_sp
Attribute_Definition: name of species - Arthropoda Hexapoda Odonata Gomphus sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 3

Attribute:

Attribute_Label: Erythemis_
Attribute_Definition: name of species - Arthropoda Hexapoda Odonata Erythemis sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 8

Attribute:

Attribute_Label: Unionidae
Attribute_Definition: name of species - Arthropoda Pelecypoda Unionoida Unionidae
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 8

Attribute:

Attribute_Label: Tanypodina
Attribute_Definition: name of species - Arthropoda Hexapoda Diptera Tanypodinae
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 7

Attribute:

Attribute_Label: Limnoporus
Attribute_Definition: name of species - Arthropoda Hexapoda Heteroptera Limnoporus sp
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 6

Attribute:

Attribute_Label: Somatochlo
Attribute_Definition: name of species - Arthropoda Hexapoda Odonata Somatochlora sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0

Range_Domain_Maximum: 6

Attribute:

Attribute_Label: Tetragoneu
Attribute_Definition: name of species - Arthropoda Hexapoda Odonata Tetragoneuria sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 3

Attribute:

Attribute_Label: Pycnopsych
Attribute_Definition:
name of species - Arthropoda Hexapoda Trichoptera Pycnopsyche sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 6

Attribute:

Attribute_Label: Molanna_bl
Attribute_Definition:
name of species - Arthropoda Hexapoda Trichoptera Molanna blenda
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 5

Attribute:

Attribute_Label: Crictopus
Attribute_Definition:
name of species - Arthropoda Hexapoda Diptera Cricotopus/Orthocladius
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 6

Attribute:

Attribute_Label: Polybedilu

Attribute_Definition: name of species - Arthropoda Hexapoda Diptera Polypedilum sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 4

Attribute:

Attribute_Label: Uranotaeni
Attribute_Definition: name of species - Arthropoda Hexapoda Diptera Uranotaenia sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 5

Attribute:

Attribute_Label: Argia_sp_
Attribute_Definition: name of species - Arthropoda Hexapoda Odonata Argia sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 3

Attribute:

Attribute_Label: Ischnura_s
Attribute_Definition: name of species - Arthropoda Hexapoda Odonata Ischnura sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 6

Attribute:

Attribute_Label: Polycentro
Attribute_Definition:
name of species - Arthropoda Hexapoda Trichoptera Polycentropus sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0

Range_Domain_Maximum: 6

Attribute:

Attribute_Label: Procambaru
Attribute_Definition: name of species - Arthropoda Crustacea Decapoda Procambarus sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 2

Attribute:

Attribute_Label: Ablabesmyi
Attribute_Definition: name of species - Arthropoda Hexapoda Diptera Ablabesmyia sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 4

Attribute:

Attribute_Label: Cryptochir
Attribute_Definition:
name of species - Arthropoda Hexapoda Diptera Cryptochironomus sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 2

Attribute:

Attribute_Label: Anopheles_
Attribute_Definition: name of species - Arthropoda Hexapoda Diptera Anopheles sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 3

Attribute:

Attribute_Label: Trichocori
Attribute_Definition:
name of species - Arthropoda Hexapoda Heteroptera Trichocorixa sp.

Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 5

Attribute:

Attribute_Label: Nigronia_s
Attribute_Definition:
name of species - Arthropoda Hexapoda Megaloptera Nigronia serricornis
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 4

Attribute:

Attribute_Label: Anisocentr
Attribute_Definition:
name of species - Arthropoda Hexapoda Trichoptera Anisocentropus pyraloides
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 4

Attribute:

Attribute_Label: Oecetis_ge
Attribute_Definition:
name of species - Arthropoda Hexapoda Trichoptera Oecetis georgia
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 5

Attribute:

Attribute_Label: Ptilostomi
Attribute_Definition:
name of species - Arthropoda Hexapoda Trichoptera Ptilostomis sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 3

Attribute:

Attribute_Label: Campeloma_
Attribute_Definition:
name of species - Arthropoda Gastropoda Mesogastropoda Campeloma sp.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 5

Attribute:

Attribute_Label: Adundance_
Attribute_Definition: total number of dominant species in the collection
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 110
Range_Domain_Maximum: 714

Attribute:

Attribute_Label: Total_abun
Attribute_Definition: total number of the species collected
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 119
Range_Domain_Maximum: 740

Attribute:

Attribute_Label: Z_abundanc
Attribute_Definition: the percent of dominants in total abundance
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 92
Range_Domain_Maximum: 98

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:

Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.

Custom_Order_Process:

Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:48 2000

1999 ACE Basin Ecological Characterization: Benthic Infauna coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: SCDNR-MRD
Publication_Date: 19981117
Title:
1999 ACE Basin Ecological Characterization: Benthic Infauna coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE

Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

Benthic invertebrates fulfill an important economic and ecological role in both marine and freshwater ecosystems. Infaunal benthic invertebrates are the primary food source for many commercially important fish and crustaceans. Infaunal benthic surveys have been conducted in the ACE Basin using a variety of methods. Data from Van Dolah et al. (1991), Calder and Booth (1977), Van Dolah et al. (1979), and Calder et al. (1977) were condensed and summarized in tabular form. The infaunal benthic invertebrate summary table contains a list of dominant species (species with an overall abundance > 50 individuals/m^2 across all stations) in the ACE Basin and the abundance of these dominants at each station sampled in the ACE Basin. This table also includes salinity and sediment characteristics of each station. tions at which each species was found. This table also includes the salinity characteristics of each station. 76 species of dominant infauna species were identified from the 26 stations sampled.

Purpose:

The benthic invertebrate data sets were created from existing SC Department of Natural Resources data to characterize the infaunal invertebrate community in the ACE Basin.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19730700
Ending_Date: 19950000

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.5483

East_Bounding_Coordinate: -80.1632
North_Bounding_Coordinate: 32.6834
South_Bounding_Coordinate: 32.5106

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: infaunal
Theme_Keyword: macrobenthos
Theme_Keyword: qualitative sampling
Theme_Keyword: dredging
Theme_Keyword: EMAP
Theme_Keyword: quantitative sampling

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: North Edisto River
Place_Keyword: South Ediston River
Place_Keyword: Dawho River
Place_Keyword: St. Helena Sound
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: Van Dolah, R.F.
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization- Benthic Section
Edition: first
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Source_Scale_Denominator: 24000
Type_of_Source_Media: CD-ROM
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19730700
Ending_Date: 19950000

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: Excel Files and information for GIS data layers.

Process_Step:

Process_Description:
Infaunal: Benthic abundance for each species at each station was converted to number/m^2. Mean benthic abundance was calculated by averaging all replicate and seasonal abundances for each species at each station. A table was created which listed each species and its average abundance at each station. Initially this table included only those species at each station which made up greater than 90% of the total abundance at that station. However, this table was determined to be too detailed and it was further summarized by including only those species which had an overall abundance across all stations of greater than 50/m^2. Mean total abundance per m^2 was determined for each station by averaging all seasonal and replicate values. Abundance of dominants at each station was calculated by adding all abundances for the dominant species. Percent abundance of the dominant species was determined by dividing the abundance of dominants by the mean total abundance. Number of species/grab was determined by dividing the number of species found at each station by the number of replicate or seasonal samples taken. The mean species diversity (H') was calculated by averaging the species diversities reported for each station. The benthic index value was reported for each EMAP station. The benthic index value is an indication of the environmental condition of a site. A index value of less than 3 indicates the site may be degraded. The sediment characteristics were reported from each station. Stations with <20% muds were considered sandy, stations with 20-80% muds were considered mixed and stations with >80% muds were considered muddy. Muds indicates the percent by weight of the sample which could pass through a 0.5 mm sieve. Salinity characteristics at each station were reported using the Venice system: Oligohaline (0.5-5 ppt), Mesohaline (5-18 ppt), Polyhaline (18-30 ppt), Euhaline (30-40 ppt).
Process_Date: 19980800
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:

Data was reorganized in Excel spreadsheets so they could be imported into a GIS data layer. Some stations did not contain data for epifauna and infauna. These stations were removed from their respective shapefile.

Process_Date: 19981008

Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager

Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The point data was digitized on-screen using previously existing reports and ArcView 3.1 to create a shapefile. The tabular data was then joined to the point data. The shapefile was then converted to an ArcInfo point coverage using the shapearc command in ArcInfo 7.2.1.

Process_Date: 19981000

Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager

Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service:
Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time 8:30am - 5:00 pm EST

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 23

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: infauna.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Infauna_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 25

Attribute:

Attribute_Label: Statname
Attribute_Definition: station name
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: S_perkins
Attribute_Definition: Scientific name - Sphaerosyllis perkinsi
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 13

Attribute:

Attribute_Label: T_killari
Attribute_Definition: Scientific name - Tharyx killariensis
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 0

Attribute:

Attribute_Label: Ampelisca_
Attribute_Definition: Scientific name - Ampelisca sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 5488

Attribute:

Attribute_Label: P_pinnata
Attribute_Definition: Scientific name - Paraprionospio pinnata
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 1468

Attribute:

Attribute_Label: Oligochaet
Attribute_Definition: Scientific name - Oligochaeta
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 538

Attribute:

Attribute_Label: A_vadorum
Attribute_Definition: Scientific name - Ampelisca vadorum
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 2000

Attribute:

Attribute_Label: S_vulgari
Attribute_Definition: Scientific name - Sabellaria vulgaris
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 838

Attribute:

Attribute_Label: S_benedic
Attribute_Definition: Scientific name - Streblospio benedicti
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 304

Attribute:

Attribute_Label: P_palmata
Attribute_Definition: Scientific name - Pista palmata
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 1263

Attribute:

Attribute_Label: P_longici
Attribute_Definition: Scientific name - Parapionosyllis longicirrata
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 138

Attribute:

Attribute_Label: Anthozoa_
Attribute_Definition: Scientific name - Anthozoa (undet)
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 825

Attribute:

Attribute_Label: Polychaeta

Attribute_Definition: Scientific name - Polychaeta (undet)
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 224

Attribute:

Attribute_Label: B_cathari
Attribute_Definition: Scientific name - Batea catharinensis
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 305

Attribute:

Attribute_Label: A_marioni
Attribute_Definition: Scientific name - Aphelochaeta marioni
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 675

Attribute:

Attribute_Label: C_lacustr
Attribute_Definition: Scientific name - Corophium lacustre
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 577

Attribute:

Attribute_Label: Nemertina
Attribute_Definition: Scientific name - Nemertina
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 213

Attribute:

Attribute_Label: S_tenuis
Attribute_Definition: Scientific name - Scoletoma tenuis
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 650

Attribute:

Attribute_Label: E_dispar
Attribute_Definition: Scientific name - Exogone dispar
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 525

Attribute:

Attribute_Label: A_millsi
Attribute_Definition: Scientific name - Acanthohaustorius millsi
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 538

Attribute:

Attribute_Label: E_brasili
Attribute_Definition: Scientific name - Erichthonius brasiliensis
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 406

Attribute:

Attribute_Label: M_nitida
Attribute_Definition: Scientific name - Melita nitida
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 237

Attribute:

Attribute_Label: C_equilib
Attribute_Definition: Scientific name - Caprella equilibra
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 226

Attribute:

Attribute_Label: Odontosyll
Attribute_Definition: Scientific name - Odontosyllis sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 350

Attribute:

Attribute_Label: D_cauller
Attribute_Definition: Scientific name - Dipolydora caulleryi
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 338

Attribute:

Attribute_Label: U_serrata
Attribute_Definition: Scientific name - Unciola serrata
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 118

Attribute:

Attribute_Label: Mediomastu

Attribute_Definition: Scientific name - Mediomastus sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 313

Attribute:

Attribute_Label: Syllidae
Attribute_Definition: Scientific name - Syllidae (undet)
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 163

Attribute:

Attribute_Label: Actinaria
Attribute_Definition: Scientific name - Actinaria
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 88

Attribute:

Attribute_Label: C_burbank
Attribute_Definition: Scientific name - Cyathura burbanki
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 238

Attribute:

Attribute_Label: N_succine
Attribute_Definition: Scientific name - Nereis succinea
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 132

Attribute:

Attribute_Label: M_lateral
Attribute_Definition: Scientific name - Mulinia lateralis
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 127

Attribute:

Attribute_Label: P_tenuis
Attribute_Definition: Scientific name - Paracaprella tenuis
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 125

Attribute:

Attribute_Label: S_oculatu
Attribute_Definition: Scientific name - Spiochaetopterus cost. Oculatus
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 225

Attribute:

Attribute_Label: N_hemipod
Attribute_Definition: Scientific name - Notomastus hemipodus
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 107

Attribute:

Attribute_Label: H_elongat
Attribute_Definition: Scientific name - Hemipholis elongata
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 167

Attribute:

Attribute_Label: T_setiger
Attribute_Definition: Scientific name - Tharyx setigera
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 117

Attribute:

Attribute_Label: H_filifor
Attribute_Definition: Scientific name - Heteromastus filiformis
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 48

Attribute:

Attribute_Label: Haustoriid
Attribute_Definition: Scientific name - Haustoriidae (undet)
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 116

Attribute:

Attribute_Label: C_tubular
Attribute_Definition: Scientific name - Cerapus tubularis
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 83

Attribute:

Attribute_Label: P_cristat

Attribute_Definition: Scientific name - Pista cristata
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 107

Attribute:

Attribute_Label: O_limicol
Attribute_Definition: Scientific name - Ogyrides limicola
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 52

Attribute:

Attribute_Label: L_webster
Attribute_Definition: Scientific name - Lembos websteri
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 86

Attribute:

Attribute_Label: Poecilocha
Attribute_Definition: Scientific name - Poecilochaetus sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 119

Attribute:

Attribute_Label: L_dytiscu
Attribute_Definition: Scientific name - Lepidactylus dytiscus
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 98

Attribute:

Attribute_Label: C_coeca
Attribute_Definition: Scientific name - Chiridotea coeca
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 113

Attribute:

Attribute_Label: S_bombyx
Attribute_Definition: Scientific name - Spiophanes bombyx
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 52

Attribute:

Attribute_Label: P_ligni
Attribute_Definition: Scientific name - Polydora ligni
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 56

Attribute:

Attribute_Label: Hemichorda
Attribute_Definition: Scientific name - Hemichordata (undet)
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 107

Attribute:

Attribute_Label: A_aequali
Attribute_Definition: Scientific name - Abra aequalis
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 85

Attribute:

Attribute_Label: P_archite
Attribute_Definition: Scientific name - Phoronis architecta
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 97

Attribute:

Attribute_Label: Pelecypoda
Attribute_Definition: Scientific name - Pelecypoda
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 36

Attribute:

Attribute_Label: Notomastus
Attribute_Definition: Scientific name - Notomastus sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 51

Attribute:

Attribute_Label: Autolytus_
Attribute_Definition: Scientific name - Autolytus sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 62

Attribute:

Attribute_Label: M_califor

Attribute_Definition: Scientific name - Mediomastus californiensis
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 49

Attribute:

Attribute_Label: Orbiniidae
Attribute_Definition: Scientific name - Orbiniidae (undet)
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 56

Attribute:

Attribute_Label: P_obscura
Attribute_Definition: Scientific name - Podarke obscura
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 75

Attribute:

Attribute_Label: Chiridotea
Attribute_Definition: Scientific name - Chiridotea sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 38

Attribute:

Attribute_Label: Cirriformi
Attribute_Definition: Scientific name - Cirriformia sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 63

Attribute:

Attribute_Label: Ophiuroide
Attribute_Definition: Scientific name - Ophiuroidea (undet)
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 69

Attribute:

Attribute_Label: Sipunculid
Attribute_Definition: Scientific name - Sipunculida (undet)
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 46

Attribute:

Attribute_Label: Spionidae_
Attribute_Definition: Scientific name - Spionidae (undet)
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 55

Attribute:

Attribute_Label: M_fragili
Attribute_Definition: Scientific name - Microphthalmus fragilis
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 63

Attribute:

Attribute_Label: D_cuprea
Attribute_Definition: Scientific name - Diopatra cuprea
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 42

Attribute:

Attribute_Label: A_america
Attribute_Definition: Scientific name - Ampharete americana
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 29

Attribute:

Attribute_Label: C_acherus
Attribute_Definition: Scientific name - Corophium acherusicum
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 58

Attribute:

Attribute_Label: Corophium_
Attribute_Definition: Scientific name - Corophium sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 22

Attribute:

Attribute_Label: Tellinidae
Attribute_Definition: Scientific name - Tellinidae sp
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 32

Attribute:

Attribute_Label: Tellina_sp

Attribute_Definition: Scientific name - Tellina sp.
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 35

Attribute:

Attribute_Label: Nereidae
Attribute_Definition: Scientific name - Nereidae
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 31

Attribute:

Attribute_Label: Hesionidae
Attribute_Definition: Scientific name - Hesionidae (undet)
Attribute_Definition_Source:
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 50

Attribute:

Attribute_Label: Abundance_
Attribute_Definition:
Abundance of dominants. Any species that collected that numbered 50/sq. meter or more was considered a dominant species.
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 168
Range_Domain_Maximum: 14425

Attribute:

Attribute_Label: Mean_total
Attribute_Definition: Average number of animals collected at each site.
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 212
Range_Domain_Maximum: 15613

Attribute:

Attribute_Label: Mean_no_s
Attribute_Definition: Average number of species collected per sample.
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2
Range_Domain_Maximum: 49

Attribute:

Attribute_Label: Mean_h_
Attribute_Definition: Species diversity index
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.75
Range_Domain_Maximum: 4.14

Attribute:

Attribute_Label: Benthic_in
Attribute_Definition:
Benthic index of how degraded or undegraded an environment is. Based on EMAP definitions.
Attribute_Definition_Source: EMAP
Attribute_Domain_Values:

Unrepresentable_Domain: Not all are applicable.

Attribute:

Attribute_Label: Sed_type_
Attribute_Definition: Based on the composition of the sediment.
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: S
Enumerated_Domain_Value_Definition: Predominantly sand
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: Mx
Enumerated_Domain_Value_Definition: Mixture of Sand and Mud
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: M
Enumerated_Domain_Value_Definition: Predominantly mud
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: Sh
Enumerated_Domain_Value_Definition: Predominantly shell
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: C
Enumerated_Domain_Value_Definition: Predominantly clay
Enumerated_Domain_Value_Definition_Source: User Defined

Attribute:

Attribute_Label: Salinity_
Attribute_Definition: Salinity based on the Venus system.
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: EH
Enumerated_Domain_Value_Definition: Euhaline(32-40 ppt)
Enumerated_Domain_Value_Definition_Source: Venus System

Enumerated_Domain:

Enumerated_Domain_Value: PH
Enumerated_Domain_Value_Definition: Polyhaline(25-32 ppt)
Enumerated_Domain_Value_Definition_Source: Venus System

Enumerated_Domain:

Enumerated_Domain_Value: MH
Enumerated_Domain_Value_Definition: Mesohaline(18-25)
Enumerated_Domain_Value_Definition_Source: Venus System

Enumerated_Domain:

Enumerated_Domain_Value: OH
Enumerated_Domain_Value_Definition: Oligohaline (5-18 ppt)
Enumerated_Domain_Value_Definition_Source: Venus System

Attribute:

Attribute_Label: Z_abundanc
Attribute_Definition:
Percent of dominant species at each site. How much of the abundance consists of dominants.
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 58
Range_Domain_Maximum: 96

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405

Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:49 2000

1999 ACE Basin Ecological Characterization: Plant Communities coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Plant Communities coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Resource Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse

ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

The Nature Conservancy plant community survey focused on the identification and classification of natural plant communities. Survey sites were selected based upon the potential for containing high quality natural communities. Aerial photo interpretation and aerial reconnaissance were used to identify specific sites. At the sites, survey teams recorded individual community occurrancesm respective plant composition and any rare plant species encountered. All information was collected and managed using the standard methods designed by the Nature Conservancy(White and Aulbach-Smith, 1993). Scientific nomenclature generally followed that of Radford and others(1968) and Godfrey and Wooten (1979,1981). Community classification followed the Southeastern Regional Ecological Community Classification developed by the Nature Conservancy (Allard,1990, Weakley et al. 1998). Allard, D.J. 1990. Southeastern United States Ecological Community Classification, Interim reprt Version 1.2. The Nature Conservancy, Southeast Regional Office, Chapel Hill, North Carolina. Godfrey, R.K. and J.W. Wooten. 1979. Aquatic and Wetland Plants of Southeastern United States: Monocotyledons. University of Georgia Press, Athens. Godfrey, R.K. and J.W. Wooten. 1981. Aquatic and Wetland Plants of Southeastern United States: Dicotyledons. University of Georgia Press, Athens. Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the Vascular Flora of the Carolinas. University of North Carolina Press, Chapel Hill. Weakley, A.S., K.D. Patterson, S. Landaal, and M. Pyne(eds). International Classification of Ecological Communities: Terrestial Vegetation of Southeastern United States. Working Draft of March 1998. The Nature Conservancy and Natural Heritage Programs of the Southeastern United States. White, J. and C. Aulbach-Smith. 1993. Edisto River Basin Natural Area Inventory: Survey Standards and Guidelines. Report for the Nature Conservancy, Chapel Hill, North Carolins and by the South Carolina Water Resources Commission, Columbia, South Carolina. May 1993 edition.

Purpose:

The plant community survey was conducted to provide detailed, site-specifc information on the occurrence of and species composition of natural communities. The purpose of the plant community inventory is to provide information needed by the private and public landowners to design management plans.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19900601
Ending_Date: 19920831

Currentness_Reference: published data

Status:

Progress: Complete
Maintenance_and_Update_Frequency:
The plant community database will be updated as new plant communities are catalogued or when standard nomenclature of communities and plant species change.

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.9994
East_Bounding_Coordinate: -80.3361
North_Bounding_Coordinate: 32.9132
South_Bounding_Coordinate: 32.3337

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: plant community

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: South Carolina
Place_Keyword: Beaufort County
Place_Keyword: Charleston County
Place_Keyword: Colleton County
Place_Keyword: ACE Basin Characterization Study Area
Place_Keyword: ACE Basin Habitat and Protection Project Area
Place_Keyword: ACE Basin National Esturaine Research Reserve
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Salkehatchie River
Place_Keyword: South Edisto River
Place_Keyword: St. Helena Sound

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none to report

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: Cindy Aulbach-Smith
Publication_Date: 19930000
Title: ACE Basin Biological Inventory Report, 1990-1992
Edition: 1993
Geospatial_Data_Presentation_Form: paper
Publication_Information:

Publication_Place: Chapel-Hill, North Carolina
Publisher: The Nature Conservancy, Southeast Regional Office

Source_Scale_Denominator: 24000
Type_of_Source_Media: report
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19900601
Ending_Date: 19900831

Source_Currentness_Reference: report

Source_Citation_Abbreviation: none
Source_Contribution: Provided data for the plantcomm data layer

Process_Step:

Process_Description: Several common community names were changed
Process_Date: 19990401
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
One transcription error was corrected: one record for UPCOM02 survey site was accidentally recorded as and UPCOM01 survey site
Process_Date: 19990401

Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service:
Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time M-F 8:30am - 5:00pm EST

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 460

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000

False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: Plantcom.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 458.73893
Range_Domain_Maximum: 80140904.21300

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 78.53542
Range_Domain_Maximum: 167237.51736

Attribute:

Attribute_Label: Acebio_id
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2
Range_Domain_Maximum: 461

Attribute:

Attribute_Label: Polygonid
Attribute_Definition: name of the plant community found within the polygon
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Detailed_Description:

Entity_Type:

Entity_Type_Label: Plantlnk.dbf
Entity_Type_Definition: link table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: POLYGONID
Attribute_Definition: name of the plant community found within the polygon
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: SITE
Attribute_Definition: properties where survey areas are located
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: COMMUNITY
Attribute_Definition: names of plant communities on survey areas
Attribute_Definition_Source:
common plant community names generated by TNC and ACE Basin NERR staff to represent the respective plant associations
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: FAMILY
Attribute_Definition:
family names that the plants belong to; a family is defined as a taxonomic group consisting of related genera
Attribute_Definition_Source:
Holmes, S. 1979. Henderson's Dictionary of Biological Terms. Longman Scientific and Technical, Longman Group Limited
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: GENUS
Attribute_Definition:
genus names of plants; a genus refers to a taxonomic group consisting of closely related soecies
Attribute_Definition_Source:
Holmes, S. 1979. Henderson's Dictionary of Biological Terms. Longman Scientific and Technical, Longman Group Limited
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: SPECIES
Attribute_Definition:
species names of plants; a species is defined as a taxonomic group of interbreeding individuals
Attribute_Definition_Source:
Holmes, S. 1979. Henderson's Dictionary of Biological Terms. Longman Scientific and Technical, Longman Group Limited
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: DOMINANCE
Attribute_Definition:
qualitative estimate of the abundance of each plant species in an association
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: ALLIANCE_C
Attribute_Definition:
these are numerical codes that represent plant alliances; a plant alliance represents the first floristic level of the Vegetation Classification System developed by TNC; an alliance is

generally defined as a group of plant associations (see next definition)that share one or more plant species that, as a rule, are in the top canopy of the association type.
Attribute_Definition_Source: Weakley et al., 1998
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: ASSOC_CODE
Attribute_Definition:
these are numerical codes that represent plant alliances; a plant alliance represents the first floristic level of the Vegetation Classification System developed by TNC; a plant association generally is defined by TNC "as a plant community of definite floristic composition, presenting a uniform physiognomy and growing in uniform habitat conditions"
Attribute_Definition_Source: Weakley et al., 1998
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: ASSOC_SCI
Attribute_Definition: scientific names of plants in an association
Attribute_Definition_Source: Weakley et al., 1998
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: ASSOC_COMM
Attribute_Definition: common names of plants in an association
Attribute_Definition_Source: Weakley et al., 1998
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: ALLIANCE_S
Attribute_Definition: South Carolina's scientific names of plants in an alliance
Attribute_Definition_Source: Weakley et al., 1998
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: CONSERVE_S
Attribute_Definition:
these rankings represent the relative rarity of the plant associations within their respective geographic ranges
Attribute_Definition_Source:
Please consult Weakley et al., 1998 for definitions of rankings

Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:50 2000

1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Trammel Data coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19970901
Title:
1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Trammel Data coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:

The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

The Inshore Sportfish Research Section of SCDNR, Marine Resources Research Institute sampled shallow water fish populations in the ACE Basin designated area from January through July 1991 and again from January through 1997. Samples were made with trammel nets, set during all tide stages during the 1991 and during high and ebb tides during the later years. The nets were cast along the edge of the marsh or bank. The enclosed area was "beaten" to encourage any enclosed fish to entangle in the gear and the net was then immediately retrieved. Selected site and basic hydrographic data were collected at each location upon retrieval of the gear. Target species included Red Drum (Sciaenops ocellatus), Spotted Seatrout (Cynoscion nebulosus), Black Drum (Pogonias cromis), Sheepshead (Archisargus probatocephalus), and Southern Flounder (Paralichthys lethostigma). Selected measurements were taken on all fish species collected: on all specimens of target species and on up to a subsample of twenty-five specimens of non-target species. More detailed information about the conditions during the trawl and the characteristics of the specimans caught have been attached to the attribute table and are explained further in the metadata.

Purpose:

The data were collected as part of a larger survey of Inshore Sport Fishes in coastal South Carolina. Data were used to monitor stocks and year class strength of Red Drum, as well as to provide size at age data on selected species.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19910100
Ending_Date: 19970000

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.5219
East_Bounding_Coordinate: -80.3438
North_Bounding_Coordinate: 32.5387
South_Bounding_Coordinate: 32.4828

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: Finfish
Theme_Keyword: Red Drum
Theme_Keyword: Southern Flounder
Theme_Keyword: Spotted Sea Trout
Theme_Keyword: Mullet

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110

Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Process_Step:

Process_Description:
Data was converted from Access into Excel spreadsheets. The field Tide Stage was converted from numeric code to text description. Errors found in the database were corrected.
Process_Date: 19980700
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us

Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The point data was digitized on screen using existing maps and ArcView 3.0a. The shapefile was then converted to an ArcInfo point coverage using the shapearc command in ArcInfo 7.2.1.
Process_Date: 19980900
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 62

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: trammel.shp
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Trammel_id
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 63

Attribute:

Attribute_Label: Station
Attribute_Definition: station name
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Prefix
Attribute_Definition: code used in station name for identification purposes
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Detailed_Description:

Entity_Type:

Entity_Type_Label: tramcoll.dbf
Entity_Type_Definition: Link Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Month
Attribute_Definition: Month in which the collection occurred.
Attribute_Definition_Source: User defined.
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 12

Attribute:

Attribute_Label: Day
Attribute_Definition: Day on which collection took place.
Attribute_Definition_Source: User defined.
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2
Range_Domain_Maximum: 31

Attribute:

Attribute_Label: Station
Attribute_Definition:
The identification assigned to the site where the collection took place.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field.

Attribute:

Attribute_Label: Waterdepth
Attribute_Definition: The depth of the water in meters at the collection site.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.1
Range_Domain_Maximum: 3.0

Attribute:

Attribute_Label: Airtemp_oc
Attribute_Definition:
Temperature of the air in degrees Celsius at the time of Collection using a stem thermometer.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 4.0
Range_Domain_Maximum: 33.0

Attribute:

Attribute_Label: Watertemp
Attribute_Definition:
Temperature of the water in degrees Celsius at the time of collection using a stem thermometer.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 6.0
Range_Domain_Maximum: 32.0

Attribute:

Attribute_Label: Salinity_p
Attribute_Definition:
The salinity of the water in parts per thousand at the time of collection. A water sample was brought to the lab for analysis in a refractometer.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1.8
Range_Domain_Maximum: 35.0

Attribute:

Attribute_Label: Starttime
Attribute_Definition: The time the collection began in military time.

Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0835
Range_Domain_Maximum: 1745

Attribute:

Attribute_Label: Tidestage
Attribute_Definition: The state of the tide at the time of collection.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: Early Ebb
Enumerated_Domain_Value_Definition: approximately the first two hours of the approaching low tide
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: Early Flood
Enumerated_Domain_Value_Definition: approximately the first two hours of the approaching high tide
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: High
Enumerated_Domain_Value_Definition: peak high tide
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: Late Ebb
Enumerated_Domain_Value_Definition: approximately the last two hours of the approaching low tide
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: Late Flood
Enumerated_Domain_Value_Definition: approximately the last two hours of the approaching high tide
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: Low
Enumerated_Domain_Value_Definition: peak low tide
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: Mid Ebb
Enumerated_Domain_Value_Definition: approximately the middle two hours of the approaching low tide
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: Mid Flood
Enumerated_Domain_Value_Definition: approximately the middle two hours of the approaching high tide
Enumerated_Domain_Value_Definition_Source: User Defined

Attribute:

Attribute_Label: Duration_m
Attribute_Definition: The amount of time between set and finishing net retrieval.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 10
Range_Domain_Maximum: 140

Detailed_Description:

Entity_Type:

Entity_Type_Label: tramsum.dbf
Entity_Type_Definition: link table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Collection
Attribute_Definition:
The six-digit number assigned to the collection for identification purposes.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 910013
Range_Domain_Maximum: 971152

Attribute:

Attribute_Label: Station
Attribute_Definition:
The identification assigned to the site where the collection took place.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: River
Attribute_Definition: The name of the river where collection took place.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Month
Attribute_Definition: The month during which collection took place.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 12

Attribute:

Attribute_Label: Scientific
Attribute_Definition:
The Latin name assigned to the fish by the scientist who discovers/describes the fish.
Attribute_Definition_Source:
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Common
Attribute_Definition: The name assigned to fish by the American Fisheries Society.
Attribute_Definition_Source: American Fisheries Society
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Total#
Attribute_Definition: The total number of fish collected.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 581

Attribute:

Attribute_Label: Total-weig
Attribute_Definition: The total weight, in grams, of all fish collected.

Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3
Range_Domain_Maximum: 160000

Attribute:

Attribute_Label: #lengths
Attribute_Definition: The number of fish that were measured from the collection.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 196

Attribute:

Attribute_Label: Ave-length
Attribute_Definition: The average length, in millimeters, of all fish collected.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 44
Range_Domain_Maximum: 1500

Attribute:

Attribute_Label: Max-length
Attribute_Definition: The maximum length, in millimeters, of fish collected.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 44
Range_Domain_Maximum: 1500

Attribute:

Attribute_Label: Min-length
Attribute_Definition: The minimum length, in millimeters, of fish collected.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 44
Range_Domain_Maximum: 1500

Attribute:

Attribute_Label: Lengthtype
Attribute_Definition: SL - standard length; TL - total length
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.

City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at
[<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>](http://www.csc.noaa.gov/clearinghouse/prodreq_form.html)

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:51 2000

1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Trawl Survey coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division
Publication_Date: 19990601
Title:
1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Trawl Survey coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information,

data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

Data set contains trawl data from 12 stations in the National Estuarine Research Reserve. One, 10 minute, trawl tow is made monthly at each station. Trawl is made during flood tide, during the day and towed against the current. Data on water temperature, salinity, depth, species composition, number of individuals, and weight are recorded. Meteorological data is also recorded for each trawl. There are three tables included in this data - trawldata.dbf, trawlsum.dbf, and trawl.pat. All three tables are linked together using the "Station" field. Attributes for these tables are listed later in the metadata.

Purpose:

Survey is designed to evaluate long term changes in abundance of a variety of species at each of the 12 stations.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19930801
Ending_Date: 19971216

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.4580
East_Bounding_Coordinate: -80.1948
North_Bounding_Coordinate: 32.5703
South_Bounding_Coordinate: 32.3303

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: trawl
Theme_Keyword: decapod community
Theme_Keyword: fish community

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: South Carolina
Place_Keyword: USA

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: SCDNR-MRD
Publication_Date:
Title: ACE Basin Trawl Survey
Edition: none
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: none
Publisher: none

Source_Scale_Denominator: 24000
Type_of_Source_Media: 3.5" disk
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19930801
Ending_Date: 19971216

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: Excel Files and maps

Process_Step:

Process_Description:

Data was collected by NERR staff and maintained and manipulated in SAS. Information was taken into MS Access 7. Primary data tables and reference tables were constructed, indexed, and primary keys were established. Required fields were then exported to MS Excel 7.0 to attach data to point coverage.

Process_Date: 19980301

Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager

Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
Excel files were converted to text and then joined to point data

Process_Date: 19981112

Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager

Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service:
Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time 8:30am - 5:00 p.m. EST

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 12

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: trawls.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Trawl_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 12

Attribute:

Attribute_Label: River
Attribute_Definition: name of river where sampling
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Station
Attribute_Definition: name of sampling site
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Num_ind
Attribute_Definition: number of individuals
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 842
Range_Domain_Maximum: 11108

Attribute:

Attribute_Label: Num_spec

Attribute_Definition: number of species
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 23
Range_Domain_Maximum: 68

Attribute:

Attribute_Label: Diversity
Attribute_Definition: the number of species in a community
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1.8813
Range_Domain_Maximum: 4.0275

Attribute:

Attribute_Label: Evenness
Attribute_Definition: how many individuals there are among the different species
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.3489
Range_Domain_Maximum: 0.6616

Attribute:

Attribute_Label: Richness
Attribute_Definition: a measure of the ratio between total species and total numbers
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3.2661
Range_Domain_Maximum: 8.8821

Detailed_Description:

Entity_Type:

Entity_Type_Label: trwlcoll.dbf
Entity_Type_Definition: Link Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Collection

Attribute_Definition: Unique number assigned to trawl event
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 930001
Range_Domain_Maximum: 970636

Attribute:

Attribute_Label: Station_na
Attribute_Definition: descriptive station name
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Month
Attribute_Definition: month sample was taken
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 12

Attribute:

Attribute_Label: Day
Attribute_Definition: calendar day sample was taken
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 31

Attribute:

Attribute_Label: Year
Attribute_Definition: year sample was taken
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 19930000
Range_Domain_Maximum: 19970000

Attribute:

Attribute_Label: Light_desc
Attribute_Definition: description of the daylight during the trawl
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: day
Enumerated_Domain_Value_Definition: in between dawn and dusk
Enumerated_Domain_Value_Definition_Source: User Defined

Attribute:

Attribute_Label: Cloud_cove
Attribute_Definition: percentage of sky covered by clouds
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: clear
Enumerated_Domain_Value_Definition: clear skies
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: 25
Enumerated_Domain_Value_Definition: mostly sunny
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: 50
Enumerated_Domain_Value_Definition: cloudy skies
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: 75
Enumerated_Domain_Value_Definition: mostly cloudy
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: 100
Enumerated_Domain_Value_Definition: no sun, rainy
Enumerated_Domain_Value_Definition_Source: User Defined

Attribute:

Attribute_Label: Precipitat
Attribute_Definition: description of the type of precipition during a collection
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Wind_direc
Attribute_Definition: direction of wind relative to magnetic north
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 360

Attribute:

Attribute_Label: Wind_speed
Attribute_Definition: speed in knots using hand-held electronic wind speed indicator
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 70

Attribute:

Attribute_Label: Air_temp
Attribute_Definition:
air temperature in degrees Celsius measured with alcohol thermometer
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1.1
Range_Domain_Maximum: 100

Attribute:

Attribute_Label: Tide_stage
Attribute_Definition: stage of tide at time of sample
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: early flood
Enumerated_Domain_Value_Definition: low to mid-low tide
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: late flood
Enumerated_Domain_Value_Definition: mid-low to high tide
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: max. flood
Enumerated_Domain_Value_Definition: maximum high tide
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: in between tides
Enumerated_Domain_Value_Definition: fog
Enumerated_Domain_Value_Definition_Source: User Defined

Attribute:

Attribute_Label: Water_dept
Attribute_Definition:
water depth in meters, measured by electronic depth censor
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.3
Range_Domain_Maximum: 9.8

Attribute:

Attribute_Label: Water_temp
Attribute_Definition: water temperature in degrees Celsius
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3.5
Range_Domain_Maximum: 32.0

Attribute:

Attribute_Label: Salinity
Attribute_Definition:
salinity at water surface. measured with optical refractometer in field.
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 38.0

Attribute:

Attribute_Label: Trawl_star
Attribute_Definition: time when trawl starts
Attribute_Definition_Source: user defined

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0700
Range_Domain_Maximum: 1739

Detailed_Description:

Entity_Type:

Entity_Type_Label: trawlsum.dbf
Entity_Type_Definition: Link Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Collection
Attribute_Definition: unique number assigned to trawl event
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 930001
Range_Domain_Maximum: 970636

Attribute:

Attribute_Label: Station
Attribute_Definition:
unique code assigned to a particular position. First letter indicates river, following three numerals indicate number of units.
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Station_na
Attribute_Definition: descriptive station name
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Month
Attribute_Definition: month sample was taken
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 12

Attribute:

Attribute_Label: Year
Attribute_Definition: year sample was taken
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 93
Range_Domain_Maximum: 97

Attribute:

Attribute_Label: Scientific
Attribute_Definition: scientific name of species
Attribute_Definition_Source: defined by the scientist that discovered it
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Common_nam
Attribute_Definition: common name of species
Attribute_Definition_Source: American Fisheries Society standard
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Total_numb
Attribute_Definition:
total number of individuals caught in trawl. Actual count except for collection number 930011 where Penaeus setiferus numbers were based on counting and weighing 1000 individuals and extrapolating total number by total weight.
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 4010

Attribute:

Attribute_Label: Total_weig
Attribute_Definition:
total weight of number of individuals in grams, measured with electronic balance
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 14.989

Attribute:

Attribute_Label: Number_of_
Attribute_Definition: total number of lengths measured per station
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 48

Attribute:

Attribute_Label: Average_le
Attribute_Definition:
mean length in millimeters by species collection. Length not measured for all species. Length is total length, except for those species with fork lengths in which case, length is fork length.
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3
Range_Domain_Maximum: 835

Attribute:

Attribute_Label: Maximum_le
Attribute_Definition: upper value of size range in millimeters
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3
Range_Domain_Maximum: 880

Attribute:

Attribute_Label: Minimum_le
Attribute_Definition: lower value of size range in millimeters
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3
Range_Domain_Maximum: 790

Attribute:

Attribute_Label: Standard_d
Attribute_Definition: standard deviation of mean length
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 401

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at
<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:51 2000

1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Christmas Bird Survey coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19970901
Title:
1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Christmas Bird Survey coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:

The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

The Christmas Bird Count is the oldest and largest wildlife survey in the world. It began in 1900 and includes over 1500 survey sites. Today, the National Audubon Society sponsors the survey and publishes the results. Volunteers conduct a survey of the number of species and estimates of total number of individuals over one calendar day (from midnight to midnight), within a well-defined geographic region. The survey takes place in the early winter. Volunteers participate in about 1500 counts held during a two and one-half week period. Each bird count is conducted in a circle 15 miles in diameter, total area approximately 458.43 km^2 (177 mi^2). Bird counters try to cover as much of the circle as possible within the 24-hour period. They record each individual bird and species they see or hear in their designated sector of the circle. Representatives from each group meet at the end of the day to compile a master list and minimize double counting of birds. Bird feeders within the circle are also censured. The Christmas Bird Data is collected yearly at the SCDNR field station at Bennett's Point within the ACE Basin boundary. The Bennett's Point census began in 1990 and this data set includes data through the 1996 census. The total number of volunteers has ranged between 18 and 47. The total number of species seen has ranged between 129 and 146. These species include birds that had been seen prior to the day of the count, but not seen on the count day. These species are indicated by a value of negative one in the count field. Total number of individuals counted has ranged between 17381 and 89139.

Purpose:

The Christmas Bird Count is a valuable resource for two primary reasons. First, birds are an indicator of the overall health of our environment. Therefore, the Christmas Bird Count data over time in any given area can provide valuable insights into the long-term health of bird populations and the environment. Second, the Christmas Bird Count has evolved into the largest and longest-running wildlife survey ever undertaken. It provides almost 100 years of data. This data is very helpful in showing long term trends in populations.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19900000
Ending_Date: 19960000

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: yearly

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.4580
East_Bounding_Coordinate: -80.1948
North_Bounding_Coordinate: 32.5703
South_Bounding_Coordinate: 32.3303

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: Christmas Bird Count
Theme_Keyword: Audubon Society

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: South Carolina
Place_Keyword: Bennett's Point

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.

Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston

State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: John Shipman
Publication_Date: 19980804
Title: CBC database distribution
Edition: 5.10
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place:
Publisher: Audobon Society

Source_Scale_Denominator: 24000
Type_of_Source_Media: internet
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970728
Ending_Date: 19980804

Source_Currentness_Reference: most recent version

Source_Citation_Abbreviation: none
Source_Contribution: Data provided tables for the GIS data layer.

Process_Step:

Process_Description:
Data, including South Carolina census data, latitude and longitude data, effort data, and species lists, were downloaded from the web. The data sets were reformatted for use in Excel.
Process_Date: 19980800
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
A hardcopy map of the generalized landuse/landcover was produced using the 1989 NWI data. Lines were then draw on the hardcopy map to mark the beaches that were surveyed for sea turtle nests. The lines marking the surveys were then digitized on screen using ARCView 3.0a and linked to the tabluar data.
Process_Date: 19980900
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Complete Chain
Point_and_Vector_Object_Count: 1

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate Pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: xmasbird.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: none

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 455060352.00
Range_Domain_Maximum: 455060352.00

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 75716.695
Range_Domain_Maximum: 75716.695

Detailed_Description:

Entity_Type:

Entity_Type_Label: xmaslnk.dbf
Entity_Type_Definition: Link Table
Entity_Type_Definition_Source: none

Attribute:

Attribute_Label: Station
Attribute_Definition: Number assigned to station
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 1

Attribute:

Attribute_Label: Year
Attribute_Definition: Year that observation occurred in.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1990
Range_Domain_Maximum: 1996

Attribute:

Attribute_Label: Common_nam
Attribute_Definition: The name commonly assigned to birds.
Attribute_Definition_Source:
As defined by John Shipman, <ftp://ftp.nmt.edu/pub/people/john/cbc>
Attribute_Domain_Values:

Unrepresentable_Domain: character field giving common names of bird species.

Attribute:

Attribute_Label: Count
Attribute_Definition: The total number of observations for each individual species.
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -1
Range_Domain_Maximum: 40710

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:52 2000

1999 ACE Basin Ecological Characterization: 1990 Census Block Groups coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: 1990 Census Block Groups coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse

ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
These are polygon coverages built from the TIGER/LINE 1995 data that shows 1990 Census Statistics at the County, Census Tract/Block Numbering Area, and Blockgroup levels for the ACE Basin Ecological Characterization. The data joined to the polygons has been extracted from Census Bureau Summary Tape File 1 (STF1) and Summary Tape File 2 (STF2).

Purpose:
The Census Bureau's TIGER (Topographicically Integrated Geographic Encoding and Referencing) System automates the mapping and related geographic activities required to support the deccenial census and sample survey programs of the deccenial census.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19900000
Ending_Date: 19970000

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: continually

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.2371
East_Bounding_Coordinate: -79.9331
North_Bounding_Coordinate: 33.1829
South_Bounding_Coordinate: 32.1603

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: census
Theme_Keyword: population
Theme_Keyword: income
Theme_Keyword: housing
Theme_Keyword: race
Theme_Keyword: TIGER/Line files

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE basin
Place_Keyword: Colleton
Place_Keyword: Beaufort
Place_Keyword: Charleston
Place_Keyword: Dorchester
Place_Keyword: Hampton
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
Post processing in ArcInfo 7.2.1 shows that polygon topology exists.
Completeness_Report: complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none to report

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: U.S.Census Bureau
Publication_Date: 19950000
Title: 1995 TIGER/Line Files, Summary Tape File 1, Summary Tape File 2
Edition: 1997
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Washington, DC
Publisher: US Census Bureau

Source_Scale_Denominator: 100000
Type_of_Source_Media: cd-rom
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 1990000
Ending_Date: 19970000

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: none
Source_Contribution:
TIGER/Line is the spatial data from which boundaries were defined. Summary Tape Files provided statistical data.

Process_Step:

Process_Description:
TIGER files for Beaufort, Charleston, Colleton, Dorchester, and Hampton counties were imported into ArcInfo and mapjoined.
Process_Date: 19980200
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The mapjoined coverage was then dissolved to derive the county boundaries (cnty), the census tract (ctbna) boundaries, and the blockgroup (bckgrp) boundaries.
Process_Date: 19980200
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422

Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
At each level only polygons that were entirely within or partially within the ACE Basin Characterization Boundary were reselected to create the polygon coverages for the ACE and the hierarchical order (cnty, ctbna, blckgrp) added to the attribute tables at the different levels. The hierarchical order was then used to create an ID that was unique to each polygon.
Process_Date: 19980200
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The data for each county at the different levels was extracted from Summary Tape File 1 (STF1) and Summary Tape File 3 (STF3) and place in a MS Access database. Queries were performed to create tables with the necessarry attributes and the hierarchical order (cnty, ctbna, blckgrp) was used to create a unique ID.
Process_Date: 19980200
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:

South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The tables were then exported to MS Excel and the names of the attributes changed, some calculations made, and some columns were reformatted. The MS Excel files were then converted to a text file and mapjoined with the polygon coverage using the unique id.
Process_Date: 19980200
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 63

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: .9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: Acebgrps.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 581734.95858
Range_Domain_Maximum: 383432154.88350

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3645.19698
Range_Domain_Maximum: 155524.68480

Attribute:

Attribute_Label: Bgrps90_id
Attribute_Definition: Internal feature ID
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Cnty_name
Attribute_Definition: county name
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Cnty
Attribute_Definition: US Census County Code
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: 13
Enumerated_Domain_Value_Definition: Beaufort County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 19

Enumerated_Domain_Value_Definition: Charleston County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 29
Enumerated_Domain_Value_Definition: Colleton County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 35
Enumerated_Domain_Value_Definition: Dorchester County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 49
Enumerated_Domain_Value_Definition: Hampton County
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Ctbna
Attribute_Definition: Census Tract\Block Numbering Area
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 100
Range_Domain_Maximum: 980300

Attribute:

Attribute_Label: Blkgrp
Attribute_Definition: Internal Feature Number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 7

Attribute:

Attribute_Label: Pop100
Attribute_Definition: population within 100% of block group
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 2425

Attribute:

Attribute_Label: Area_sq_ml
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.20
Range_Domain_Maximum: 148.00

Attribute:

Attribute_Label: Pop_densit
Attribute_Definition: population density
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 2507

Attribute:

Attribute_Label: White
Attribute_Definition: percent of population that is white
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 1.00

Attribute:

Attribute_Label: Black
Attribute_Definition: percent of population that is black
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.92

Attribute:

Attribute_Label: Hispanic
Attribute_Definition: percent of population that is hispanic
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.05

Attribute:

Attribute_Label: Pci_white
Attribute_Definition: Per Capita Income for whites
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 39855

Attribute:

Attribute_Label: Pci_black
Attribute_Definition: Per Capita Income for blacks
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 8882

Attribute:

Attribute_Label: Pci_other
Attribute_Definition: Per Capita Income for other races
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 12327

Attribute:

Attribute_Label: Perc_pov
Attribute_Definition: percent in poverty
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.50

Attribute:

Attribute_Label: Hholds

Attribute_Definition: number of households
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 908

Attribute:

Attribute_Label: Med_hh_inc
Attribute_Definition: median household income
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 57158

Attribute:

Attribute_Label: Hh_white
Attribute_Definition: percent of householders that are white
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 1.00

Attribute:

Attribute_Label: Hh_black
Attribute_Definition: percent of householders that are black
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.91

Attribute:

Attribute_Label: Hh_other
Attribute_Definition: percent of householders that are another race
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.07

Attribute:

Attribute_Label: House_unit
Attribute_Definition: number of housing units
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 1622

Attribute:

Attribute_Label: Med_value_
Attribute_Definition: median value of owner occupied housing units
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 275000

Attribute:

Attribute_Label: Agg_value_
Attribute_Definition: aggregate value of owner occupied housing units
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 76235000

Attribute:

Attribute_Label: Builtb4_19
Attribute_Definition: number of houses built before 1939
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 176

Attribute:

Attribute_Label: hu_occ
Attribute_Definition: percent of houses that are owner occupied
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.95

Attribute:

Attribute_Label: Vac_searec
Attribute_Definition:
percentage of housing units that are for seasonal or recreational use
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.96

Attribute:

Attribute_Label: Mobile_tra
Attribute_Definition: number of mobile homes
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 506

Attribute:

Attribute_Label: Ed_9
Attribute_Definition: percent of people with less than a ninth grade education
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .21

Attribute:

Attribute_Label: Ed_9to12
Attribute_Definition: percent of people with a ninth to twelfth grade education
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .23

Attribute:

Attribute_Label: Ed_hsgrad
Attribute_Definition: percent of people with a high school education
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .39

Attribute:

Attribute_Label: Ed_somecol
Attribute_Definition: percent of people with some college education
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .27

Attribute:

Attribute_Label: Ed_associa
Attribute_Definition: percent of people with an associate's degree
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .14

Attribute:

Attribute_Label: Ed_bachelo
Attribute_Definition: percent of people with a bachelor's degree
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .31

Attribute:

Attribute_Label: Ind_agforf
Attribute_Definition: percent of people employed in agriculture or fisheries
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0

Range_Domain_Maximum: .20

Attribute:

Attribute_Label: Ind_mining
Attribute_Definition: percent of people employed in mining
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .02

Attribute:

Attribute_Label: Ind_const
Attribute_Definition: percent of people employed in constuction
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .14

Attribute:

Attribute_Label: Ind_nondur
Attribute_Definition: percent of people employed in manufacturing nondurable goods
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .17

Attribute:

Attribute_Label: Ind_durabl
Attribute_Definition: percent of people employed in manufacturing durable goods
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .13

Attribute:

Attribute_Label: Ind_retail
Attribute_Definition: apercent of people employed in retail
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .14

Attribute:

Attribute_Label: Ind_person
Attribute_Definition: percent of people employed in personal services
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .11

Attribute:

Attribute_Label: Ind_entrec
Attribute_Definition:
percent of people employed in entertainment and recreational services
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .06

Attribute:

Attribute_Label: Ind_health
Attribute_Definition: percent of people employed in health services
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .07

Attribute:

Attribute_Label: Ind_edu
Attribute_Definition: percent of people employed in education
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .09

Attribute:

Attribute_Label: Self_empl
Attribute_Definition: percent of people employed in Self-employed
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .08

Attribute:

Attribute_Label: Unpaid_fam
Attribute_Definition: percent of people as unpaid family workers
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .04

Attribute:

Attribute_Label: H2O_pub_pr
Attribute_Definition: percent of households with water from public or private utility
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 1.00

Attribute:

Attribute_Label: H20_well
Attribute_Definition: percent of households with water from a well
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 1.00

Attribute:

Attribute_Label: Pub_sewer
Attribute_Definition: percent of households with public sewer
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.59

Attribute:

Attribute_Label: Septic_ces
Attribute_Definition: percent of households with cesspools
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 1.00

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:56 2000

1999 ACE Basin Ecological Characterization: 1990 Census Tract/Block Numbering Areas coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: 1990 Census Tract/Block Numbering Areas coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-

Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
These are polygon coverages built from the TIGER/LINE 1995 data that shows 1990 Census Statistics at the County, Census Tract/Block Numbering Area, and Blockgroup levels for the ACE Basin Ecological Characterization. The data joined to the polygons has been extracted from Census Bureau Summary Tape File 1 (STF1) and Summary Tape File 2 (STF2).

Purpose:
The Census Bureau's TIGER (Topographicically Integrated Geographic Encoding and Referencing) Sytem automates the mapping and relatred geographic activities required to support the deccenid census and sample survey programs of the deccenid census.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19900000
Ending_Date: 19970000

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: continually

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.2371
East_Bounding_Coordinate: -79.9331
North_Bounding_Coordinate: 33.1829
South_Bounding_Coordinate: 32.1603

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: census
Theme_Keyword: population
Theme_Keyword: income
Theme_Keyword: housing
Theme_Keyword: race
Theme_Keyword: TIGER/Line files

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE basin
Place_Keyword: Colleton
Place_Keyword: Beaufort
Place_Keyword: Charleston
Place_Keyword: Dorchester
Place_Keyword: Hampton
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibilty and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
Post processing in ArcInfo 7.2.1 shows that polygon topology exists.
Completeness_Report: complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none to report

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: U.S.Census Bureau
Publication_Date: 19950000
Title: 1995 TIGER/Line Files, Summary Tape File 1, Summary Tape File 2
Edition: 1997
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Washington, DC
Publisher: US Census Bureau

Source_Scale_Denominator: 100000
Type_of_Source_Media: cd-rom
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 1990000
Ending_Date: 19970000

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: none
Source_Contribution:
TIGER/Line is the spatial data from which boundaries were defined. Summary Tape Files provided statistical data.

Process_Step:

Process_Description:
TIGER files for Beaufort, Charleston, Colleton, Dorchester, and Hampton counties were imported into ArcInfo and mapjoined.
Process_Date: 19980200
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The mapjoined coverage was then dissolved to derive the county boundaries (cnty), the census tract (ctbna) boundaries, and the blockgroup (bckgrp) boundaries.
Process_Date: 19980200
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422

Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
At each level only polygons that were entirely within or partially within the ACE Basin Characterization Boundary were reselected to create the polygon coverages for the ACE and the hierarchical order (cnty, ctbna, blckgrp) added to the attribute tables at the different levels. The hierarchical order was then used to create an ID that was unique to each polygon.
Process_Date: 19980200
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The data for each county at the different levels was extracted from Summary Tape File 1 (STF1) and Summary Tape File 3 (STF3) and placed in an MS Access database. Queries were performed to create tables with the necessarry attributes and the hierarchical order (cnty, ctbna, blckgrp) was used to create a unique ID.
Process_Date: 19980200
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:

South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The tables were then exported to MS Excel and the names of the attributes changed, some calculations were made, and some columns were reformatted. The MS Excel files were then converted to a text file and mapjoined with the polygon coverage using the unique id.
Process_Date: 19980200
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 23

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: .9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: Acectbna.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 13414421.14
Range_Domain_Maximum: 805042650.77

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 20733.51
Range_Domain_Maximum: 213325.76

Attribute:

Attribute_Label: Ctbna90_id
Attribute_Definition: Internal feature ID
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 23

Attribute:

Attribute_Label: Cnty_name
Attribute_Definition: county name
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Cnty
Attribute_Definition: US Census County Code
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: 13
Enumerated_Domain_Value_Definition: Beaufort County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 19
Enumerated_Domain_Value_Definition: Charleston County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 29
Enumerated_Domain_Value_Definition: Colleton County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 35
Enumerated_Domain_Value_Definition: Dorchester County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 49
Enumerated_Domain_Value_Definition: Hampton County
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Ctbna
Attribute_Definition: Census Tract\Block Numbering Area
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 100
Range_Domain_Maximum: 980300

Attribute:

Attribute_Label: Pop100
Attribute_Definition: population within 100% of ctbna
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 11
Range_Domain_Maximum: 7877

Attribute:

Attribute_Label: Area_sq_ml
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 5.18
Range_Domain_Maximum: 310.83

Attribute:

Attribute_Label: Pop_densit
Attribute_Definition: population density
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1.20
Range_Domain_Maximum: 1039.50

Attribute:

Attribute_Label: White
Attribute_Definition: percent of population that is white
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.20
Range_Domain_Maximum: 1.00

Attribute:

Attribute_Label: Black
Attribute_Definition: percent of population that is black
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.80

Attribute:

Attribute_Label: Hispanic
Attribute_Definition: percent of population that is hispanic
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.03

Attribute:

Attribute_Label: Pci_white
Attribute_Definition: Per Capita Income for whites

Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 31501

Attribute:

Attribute_Label: Pci_black
Attribute_Definition: Per Capita Income for blacks
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 8328

Attribute:

Attribute_Label: Pci_other
Attribute_Definition: Per Capita Income for other races
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 23933

Attribute:

Attribute_Label: Perc_pov
Attribute_Definition: percent in poverty
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.39

Attribute:

Attribute_Label: Hholds
Attribute_Definition: number of households
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 4
Range_Domain_Maximum: 2929

Attribute:

Attribute_Label: Med_hh_inc
Attribute_Definition: median household income
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 40196

Attribute:

Attribute_Label: Hh_white
Attribute_Definition: percent of householders that are white
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.21
Range_Domain_Maximum: 1.00

Attribute:

Attribute_Label: Hh_black
Attribute_Definition: percent of householders that are black
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.78

Attribute:

Attribute_Label: Hh_other
Attribute_Definition: percent of householders that are another race
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.06

Attribute:

Attribute_Label: House_unit
Attribute_Definition: number of housing units
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 9
Range_Domain_Maximum: 4607

Attribute:

Attribute_Label: Med_value_
Attribute_Definition: median value of owner occupied housing units
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 36500
Range_Domain_Maximum: 275000

Attribute:

Attribute_Label: Agg_value_
Attribute_Definition: aggregate value of owner occupied housing units
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 275000
Range_Domain_Maximum: 202406500

Attribute:

Attribute_Label: Builtb4_19
Attribute_Definition: number of houses built before 1939
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 479

Attribute:

Attribute_Label: Hu_occ
Attribute_Definition: percent of houses that are owner occupied
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.33
Range_Domain_Maximum: 0.95

Attribute:

Attribute_Label: Vac-searec
Attribute_Definition:

percentage of housing units that are for seasonal or recreational use
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.87

Attribute:

Attribute_Label: Mobile_tra
Attribute_Definition: number of mobile homes
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 1192

Attribute:

Attribute_Label: Ed_9
Attribute_Definition: percent of people with less than a ninth grade education
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .18

Attribute:

Attribute_Label: Ed_9to12
Attribute_Definition: percent of people with a ninth to twelfth grade education
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .19

Attribute:

Attribute_Label: Ed_hsgrad
Attribute_Definition: percent of people with a high school education
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .28

Attribute:

Attribute_Label: Ed_somecol
Attribute_Definition: percent of people with some college education
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .25

Attribute:

Attribute_Label: Ed_associa
Attribute_Definition: percent of people with an associate's degree
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .08

Attribute:

Attribute_Label: Ed_bachelo
Attribute_Definition: percent of people with a bachelor's degree
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .20

Attribute:

Attribute_Label: Ind_agforf
Attribute_Definition: percent of people employed in agriculture or fisheries
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .07

Attribute:

Attribute_Label: Ind_mining
Attribute_Definition: percent of people employed in mining
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 0

Attribute:

Attribute_Label: Ind_const
Attribute_Definition: percent of people employed in construction
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .09

Attribute:

Attribute_Label: Ind_nondur
Attribute_Definition: percent of people employed in manufacturing nondurable goods
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .13

Attribute:

Attribute_Label: Ind_durabl
Attribute_Definition: percent of people employed in manufacturing durable goods
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .07

Attribute:

Attribute_Label: Ind_retail
Attribute_Definition: percent of people employed in retail
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .10

Attribute:

Attribute_Label: Ind_person

Attribute_Definition: percent of people employed in personal services
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .05

Attribute:

Attribute_Label: Ind_entrec
Attribute_Definition:
a percent of people employed in entertainment and recreational services
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .02

Attribute:

Attribute_Label: Ind_health
Attribute_Definition: percent of people employed in health services
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .04

Attribute:

Attribute_Label: Ind_edu
Attribute_Definition: a percent of people employed in education
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .08

Attribute:

Attribute_Label: Self_empl
Attribute_Definition: percent of people employed in Self-employed
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0

Range_Domain_Maximum: .05

Attribute:

Attribute_Label: Unpaid_fam
Attribute_Definition: percent of people as unpaid family workers
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: .01

Attribute:

Attribute_Label: H2o_pub_pr
Attribute_Definition: percent of households with water from public or private utility
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: .96

Attribute:

Attribute_Label: H20_well
Attribute_Definition: percent of households with water from a well
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.97

Attribute:

Attribute_Label: Pub_sewer
Attribute_Definition: percent of households with public sewer
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.91

Attribute:

Attribute_Label: Septic_ces
Attribute_Definition: percent of households with cesspools
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.95

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405

Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:57 2000

1999 ACE Basin Ecological Characterization: 1990 Census County Level coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: 1990 Census County Level coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse

ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
These are polygon coverages built from the TIGER/LINE 1995 data that shows 1990 Census Statistics at the County, Census Tract/Block Numbering Area, and Blockgroup levels for the ACE Basin Ecological Characterization. The data joined to the polygons has been extracted from Census Bureau Summary Tape File 1 (STF1) an Summary Tape File 2 (STF2).

Purpose:
The Census Bureau's TIGER (Topographicically Integrated Geographic Encoding and Referencing) Sytem automates the mapping and relatred geographic activities required to support the deccenial census and sample survey programs of the deccenial census.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19900000
Ending_Date: 19970000

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: continually

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.4306
East_Bounding_Coordinate: -79.2564
North_Bounding_Coordinate: 33.3347
South_Bounding_Coordinate: 32.0653

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: census
Theme_Keyword: population
Theme_Keyword: income
Theme_Keyword: housing
Theme_Keyword: race
Theme_Keyword: TIGER/Line files

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE basin
Place_Keyword: Colleton
Place_Keyword: Beaufort
Place_Keyword: Charleston
Place_Keyword: Dorchester
Place_Keyword: Hampton
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
Post processing in ArcInfo 7.2.1 shows that polygon topology exists.
Completeness_Report: complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none to report

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: U.S.Census Bureau
Publication_Date: 19950000
Title: 1995 TIGER/Line Files, Summary Tape File 1, Summary Tape File 2
Edition: 1997
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Washington, DC
Publisher: US Census Bureau

Source_Scale_Denominator: 100000
Type_of_Source_Media: cd-rom
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 1990000
Ending_Date: 19970000

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: none
Source_Contribution:
TIGER/Line is the spatial data from which boundaries were defined. Summary Tape Files provided statistical data.

Process_Step:

Process_Description:
TIGER files for Beaufort, Charleston, Colleton, Dorchester, and Hampton counties were imported into ArcInfo and mapjoined.
Process_Date: 19980200
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The mapjoined coverage was then dissolved to derive the county boundaries (cnty), the census tract (ctbna) boundaries, and the blockgroup (bckgrp) boundaries.
Process_Date: 19980200
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422

Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
At each level only polygons that were entirely within or partially within the ACE Basin Characterization Boundary were reselected to create the polygon coverages for the ACE and the hierarchical order (cnty, ctbna, blckgrp) added to the attribute tables at the different levels. The hierarchical order was then used to create an ID that was unique to each polygon.
Process_Date: 19980200
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The data for each county at the different levels was extracted from Summary Tape File 1 (STF1) and Summary Tape File 3 (STF3) and place in a MS Access database. Queries were performed to create tables with the necessarry attributes and the hierarchical order (cnty, ctbna, blckgrp) was used to create a unique ID.
Process_Date: 19980200
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:

South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The tables were then exported to MS Excel and the names of the attributes changed, some calculations were made, and some columns were reformatted. The MS Excel files were then converted to a text file and mapjoined with the polygon coverage using the unique id.
Process_Date: 19980200
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 5

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: .9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: Acecty90.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1456056999.29446
Range_Domain_Maximum: 3515735341.06465

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 217925.10938
Range_Domain_Maximum: 444277.03346

Attribute:

Attribute_Label: Cnty90_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2
Range_Domain_Maximum: 6

Attribute:

Attribute_Label: Cnty_name
Attribute_Definition: County name
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Cnty
Attribute_Definition: US Census County Code
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: 13
Enumerated_Domain_Value_Definition: Beaufort County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 19
Enumerated_Domain_Value_Definition: Charleston County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 29
Enumerated_Domain_Value_Definition: Colleton County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 35
Enumerated_Domain_Value_Definition: Dorchester County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 49
Enumerated_Domain_Value_Definition: Hampton County
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Pop100
Attribute_Definition: county population within 100% of county polygon
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 18191
Range_Domain_Maximum: 295039

Attribute:

Attribute_Label: Area_sq_ml
Attribute_Definition: Area in square miles
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 562
Range_Domain_Maximum: 1357

Attribute:

Attribute_Label: Pop_densit
Attribute_Definition: population density
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 30
Range_Domain_Maximum: 217

Attribute:

Attribute_Label: White
Attribute_Definition: percent of population that is white
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.46
Range_Domain_Maximum: 0.75

Attribute:

Attribute_Label: Black
Attribute_Definition: percent of population that is Black
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.23
Range_Domain_Maximum: 0.54

Attribute:

Attribute_Label: Hispanic
Attribute_Definition: percent of population that is Hispanic
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.03

Attribute:

Attribute_Label: Pci_white
Attribute_Definition: per capita income for whites
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 12216
Range_Domain_Maximum: 18878

Attribute:

Attribute_Label: Pci_black
Attribute_Definition: per capita income for blacks

Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 5515
Range_Domain_Maximum: 7170

Attribute:

Attribute_Label: Pci_other
Attribute_Definition: per capita income for other races
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 20433

Attribute:

Attribute_Label: Perc_pov
Attribute_Definition: percent in poverty
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.11
Range_Domain_Maximum: 0.27

Attribute:

Attribute_Label: Hholds
Attribute_Definition: number of households
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 6322
Range_Domain_Maximum: 107069

Attribute:

Attribute_Label: Med_hh_inc
Attribute_Definition: median household income
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 18615
Range_Domain_Maximum: 30764

Attribute:

Attribute_Label: Hh_white
Attribute_Definition: household income for whites
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.52
Range_Domain_Maximum: 0.78

Attribute:

Attribute_Label: Hh_black
Attribute_Definition: household income for blacks
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.20
Range_Domain_Maximum: 0.48

Attribute:

Attribute_Label: Hh_other
Attribute_Definition: household income for other races
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.02

Attribute:

Attribute_Label: House_unit
Attribute_Definition: number of housing units
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 7058
Range_Domain_Maximum: 123550

Attribute:

Attribute_Label: Med_value_
Attribute_Definition: median value of owner occupied housing units
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 43700
Range_Domain_Maximum: 112100

Attribute:

Attribute_Label: Agg_value_
Attribute_Definition: aggregate value of owner occupied housing units
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 147491500
Range_Domain_Maximum: 4847065000

Attribute:

Attribute_Label: Builtb4_19
Attribute_Definition: number of houses built before 1939
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 749
Range_Domain_Maximum: 11650

Attribute:

Attribute_Label: Hu_occ
Attribute_Definition: percent of houses that are owner occupied
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.67
Range_Domain_Maximum: 0.92

Attribute:

Attribute_Label: Vac_searec
Attribute_Definition: percent of houses that are for seasonal or recreational use
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.08
Range_Domain_Maximum: 0.43

Attribute:

Attribute_Label: Mobile_tra
Attribute_Definition: number of mobile homes and trailers

Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1627
Range_Domain_Maximum: 11296

Attribute:

Attribute_Label: Ed_9
Attribute_Definition: percent of people with less than a ninth grade education
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.04
Range_Domain_Maximum: 0.12

Attribute:

Attribute_Label: Ed_9to12
Attribute_Definition: percent of people with a ninth to twelfth grade education
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.06
Range_Domain_Maximum: 0.14

Attribute:

Attribute_Label: Ed_hsgrad
Attribute_Definition: percent of people with a high school education
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.16
Range_Domain_Maximum: 0.21

Attribute:

Attribute_Label: Ed_somecol
Attribute_Definition: percent of people with some college education
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.07
Range_Domain_Maximum: 0.14

Attribute:

Attribute_Label: Ed_associa
Attribute_Definition: percent of people with an associate's degree
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.02
Range_Domain_Maximum: 0.04

Attribute:

Attribute_Label: Ed_bachelo
Attribute_Definition: percent of people with a bachelor's degree
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.03
Range_Domain_Maximum: 0.11

Attribute:

Attribute_Label: Ind_agforf
Attribute_Definition: percent of people employed in agriculture or fisheries
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.01
Range_Domain_Maximum: 0.02

Attribute:

Attribute_Label: Ind_mining
Attribute_Definition: percent of people employed in mining
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 0

Attribute:

Attribute_Label: Ind_const
Attribute_Definition: percent of people employed in construction
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.03
Range_Domain_Maximum: 0.04

Attribute:

Attribute_Label: Ind_nondur
Attribute_Definition: percent of people employed in manufacturing nondurable goods
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.01
Range_Domain_Maximum: 0.06

Attribute:

Attribute_Label: Ind_durabl
Attribute_Definition: percent of people employed in manufacturing durable goods
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.01
Range_Domain_Maximum: 0.06

Attribute:

Attribute_Label: Ind_retail
Attribute_Definition: percent of people employed in retail
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.06
Range_Domain_Maximum: 0.09

Attribute:

Attribute_Label: Ind_person
Attribute_Definition: percent of people employed in personal services
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.01
Range_Domain_Maximum: 0.03

Attribute:

Attribute_Label: Ind_entrec
Attribute_Definition:

percent of people employed in entertainment and recreational services
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 0.01

Attribute:

Attribute_Label: Ind_health
Attribute_Definition: percent of people employed in health services
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.02
Range_Domain_Maximum: 0.05

Attribute:

Attribute_Label: Ind_edu
Attribute_Definition: percent of people employed in education
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.03
Range_Domain_Maximum: 0.04

Attribute:

Attribute_Label: Self_empl
Attribute_Definition: percent of people Self-employed
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.02
Range_Domain_Maximum: 0.03

Attribute:

Attribute_Label: Unpaid_fam
Attribute_Definition: percent of people as unpaid family workers
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 0

Attribute:

Attribute_Label: H2o_pub_pr
Attribute_Definition: percent of households with water from public or private utility
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.42
Range_Domain_Maximum: 0.92

Attribute:

Attribute_Label: H20_well
Attribute_Definition: percent of households with water from a well
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.06
Range_Domain_Maximum: 0.51

Attribute:

Attribute_Label: Pub_sewer
Attribute_Definition: percent of households with public sewer
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.23
Range_Domain_Maximum: 0.86

Attribute:

Attribute_Label: Septic_ces
Attribute_Definition: percent of households with cesspools/septic tanks
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.14
Range_Domain_Maximum: 0.72

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin

Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at
<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:58 2000

1999 ACE Basin Ecological Characterization: Recreational Beaches Survey coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Environmental Sensitivity Index Mapping
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Recreational Beaches Survey coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE

Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
We extracted the point data for beaches from the South Carolina Environmental Sensitivity Index acquired from South Carolina Department of Natural Resources.
Purpose:
The end purpose of these data is to incorporate a recreational GIS for the ACE Basin. These data will also be used as a view in the ACE Basin Ecological Characterization.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19980300
Ending_Date: 19980400

Currentness_Reference: 1998

Status:

Progress: complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.4416
East_Bounding_Coordinate: -80.3167
North_Bounding_Coordinate: 32.4890
South_Bounding_Coordinate: 32.3613

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: beaches

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: Edisto
Place_Keyword: ACE Basin
Place_Keyword: Colleton County
Place_Keyword: Beaufort County
Place_Keyword: Walterboro
Place_Keyword: Charleston County

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: Research Planning, Inc.
Publication_Date: 199606
Title: South Carolina ESI
Edition: First
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Seattle, Washington
Publisher: NOAA, Office of Ocean Resources Conservation and Assessment

Source_Scale_Denominator: 24000
Type_of_Source_Media: CD-ROM
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19950000
Ending_Date: 19990000

Source_Currentness_Reference: 19960700

Source_Citation_Abbreviation: none
Source_Contribution: Provided information for the creation of the beaches datalayer.

Process_Step:

Process_Description:
Extracted data from the South Carolina Environmental Sensitivity Index for beaches located in the ACE Basin. We did this by editing the attribute tables and deleting extraneous information.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The shapefile created by NOAA-CSC was converted to an ArcInfo point coverage using the "shapearc" command in ArcInfo 7.2.1.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 3

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: beaches.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Beaches_id
Attribute_Definition: Feature identification number

Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 3

Attribute:

Attribute_Label: X_coord
Attribute_Definition: X coordinate of beach
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 552533.33217
Range_Domain_Maximum: 564195.85165

Attribute:

Attribute_Label: Y_coord
Attribute_Definition: Y coordinate of beach
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3580691.45161
Range_Domain_Maximum: 3594780.99550

Attribute:

Attribute_Label: Name
Attribute_Definition: name of beach
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559

City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317

Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:22 2000

1999 ACE Basin Ecological Characterization: Recreational Bed and Breakfast Survey coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Recreational Bed and Breakfast Survey coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 199900500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse

ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
Using TIGER roads data, we geocoded addresses of Bed and Breakfast establishments located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department.

Purpose:
The end purpose of these data is to incorporate a recreational GIS for the ACE Basin. These data will also be used as a view in the ACE Basin Ecological Characterization.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19980300
Ending_Date: 19980400

Currentness_Reference: 1998

Status:

Progress: complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.6541
East_Bounding_Coordinate: -80.2969
North_Bounding_Coordinate: 32.8976
South_Bounding_Coordinate: 32.5146

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: Bed and Breakfasts
Theme_Keyword: Hotels
Theme_Keyword: Lodging

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: Edisto
Place_Keyword: ACE Basin
Place_Keyword: Colleton County
Place_Keyword: Beaufort County
Place_Keyword: Walterboro
Place_Keyword: Charleston County

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage
Completeness_Report: Complete

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Process_Step:

Process_Description:
Using TIGER roads data, we geocoded addresses of Bed and Breakfast establishments located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department. .
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The shapefiles created by NOAA-CSC was converted to an ArcInfo point coverage using the "shapearc" command in ArcInfo 7.2.1.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service:
Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time 8:30am - 5:00 pm EST

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 3

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: bedbreak.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: B_bs_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 3

Attribute:

Attribute_Label: Address
Attribute_Definition: address for bed and breakfast
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: City
Attribute_Definition: city bed and breakfast is in
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: State
Attribute_Definition: state bed and breakfast is in
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Zip
Attribute_Definition: zip of bed and breakfast
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 29438
Range_Domain_Maximum: 29488

Attribute:

Attribute_Label: X_coord
Attribute_Definition: X coordinate of bed and breakfast
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 532485.68750
Range_Domain_Maximum: 565759.52195

Attribute:

Attribute_Label: Y_coord
Attribute_Definition: Y coordinate of bed and breakfast
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3597690.77570
Range_Domain_Maximum: 3639991.50000

Attribute:

Attribute_Label: Name
Attribute_Definition: name of bed and breakfast
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:

Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.

Custom_Order_Process:

Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:22 2000

1999 ACE Basin Ecological Characterization: Recreational Birding Survey coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Recreational Birding Survey coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Larger_Work_Citation:

Citation_Information:

Originator:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention

for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

Using TIGER roads data, we geocoded addresses of birding sites located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department. Lastly, we incorporated data from Westvaco Corporation for locations of birding sites.

Purpose:

The end purpose of these data is to incorporate a recreational GIS for the ACE Basin. These data will also be used as a view in the ACE Basin Ecological Characterization.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19980300
Ending_Date: 19980400

Currentness_Reference: 1998

Status:

Progress: complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.8418
East_Bounding_Coordinate: -80.3849
North_Bounding_Coordinate: 32.7018
South_Bounding_Coordinate: 32.3504

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: bird
Theme_Keyword: birding
Theme_Keyword: wildlife

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: Edisto
Place_Keyword: ACE Basin
Place_Keyword: Colleton County
Place_Keyword: Beaufort County
Place_Keyword: Walterboro
Place_Keyword: Charleston County

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage
Completeness_Report: Complete

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Process_Step:

Process_Description:
Using TIGER roads data, we geocoded addresses of birding sites located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
We extracted data from the Westvaco Corporation database of protected lands for birding sites located in the ACE Basin. We did this by choosing a point in the center of the polygon to represent the birding sites on protected lands. In addition, we edited the attribute tables and deleted extraneous information.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The shapefile created by NOAA-CSC was converted to an ArcInfo point coverage using the "shapearc" command in ArcInfo 7.2.1.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 10

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: birdsite.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Birding_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 10

Attribute:

Attribute_Label: Name
Attribute_Definition: name of birding location
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Address
Attribute_Definition: address of birding location
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: City
Attribute_Definition: city birding location is in
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Zip
Attribute_Definition: zip code for birding location
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Phone
Attribute_Definition: phone number for birding location
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: X_coord
Attribute_Definition: X coordinate of birding location
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 514887.30000
Range_Domain_Maximum: 557654.66000

Attribute:

Attribute_Label: Y_coord
Attribute_Definition: Y coordinate of birding location
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3579439.88000
Range_Domain_Maximum: 3618236.13000

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at [<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>](http://www.csc.noaa.gov/clearinghouse/prodreq_form.html)

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston

State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:23 2000

1999 ACE Basin Ecological Characterization: Recreational Boat Ramp coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Recreational Boat Ramp coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention

for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
We extracted the point data for boatramps from the South Carolina Environmental Sensitivity Index acquired from South Carolina Department of Natural Resources as well as collected our own data for boatramps using a GPS. We condensed the attribute tables to include the X and Y cooridinates and the name of the boatramp. Lastly, we incorporated data from the Westvaco Corporation for locations of boatramps.

Purpose:
The end purpose of these data is to incorporate a recreational GIS for the ACE Basin. These data will also be used as a view in the ACE Basin Ecological Characterization.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19980300
Ending_Date: 19980400

Currentness_Reference: 1998

Status:

Progress: complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.6706
East_Bounding_Coordinate: -80.2920
North_Bounding_Coordinate: 32.7343
South_Bounding_Coordinate: 32.3436

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: boating
Theme_Keyword: boatramps

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: Edisto
Place_Keyword: ACE Basin
Place_Keyword: Colleton County
Place_Keyword: Beaufort County
Place_Keyword: Walterboro
Place_Keyword: Charleston County

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage

Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Process_Step:

Process_Description:
Using TIGER roads data as a base map, we collected point data for boatramps in the ACE Basin using a GPS unit.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
Extracted data from the South Carolina Environmental Sensitivity Index for boatramps located in the ACE Basin. We did this by editing the attribute tables and deleting extraneous information.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
We extracted the point data for boatramps from Westvaco Corporation. We edited the attribute tables and deleted extraneous information.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service:
Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time 8:30am - 5:00 pm EST

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 18

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: boatramp.dbf

Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Boatramp
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 18

Attribute:

Attribute_Label: X_coord
Attribute_Definition: X coordinate of boatramp
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 530997.68750
Range_Domain_Maximum: 566338.31250

Attribute:

Attribute_Label: Y_coord
Attribute_Definition: Y coordinate of boatramp
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3578737.75000
Range_Domain_Maximum: 3621881.00000

Attribute:

Attribute_Label: Id
Attribute_Definition: physical location of the boat ramp
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at

<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:23 2000

1999 ACE Basin Ecological Characterization: Recreational Campgrounds coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Environmental Management Technical Center
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Recreational Campgrounds coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE

Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

We extracted the point data for camping facilities from the South Carolina Environmental Sensitivity Index acquired from South Carolina Department of Natural Resources as well as collected our own data for camping facilities using a GPS. We condensed the attribute tables to include the X and Y cooridinates and name of the camping facility. Using TIGER roads data, we geocoded addresses of camping facilites located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department. Lastly, we incorporated data from Westvaco Corporation for locations of camping facilities.

Purpose:

The end purpose of these data is to incorporate a recreational GIS for the ACE Basin. These data will also be used as a view in the ACE Basin Ecological Characterization.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19980300
Ending_Date: 19980400

Currentness_Reference: 1998

Status:

Progress: complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.7194
East_Bounding_Coordinate: -80.2982
North_Bounding_Coordinate: 32.8815
South_Bounding_Coordinate: 32.3500

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: camping
Theme_Keyword: campgrounds
Theme_Keyword: campsites

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: Edisto
Place_Keyword: ACE Basin
Place_Keyword: Colleton County
Place_Keyword: Beaufort County
Place_Keyword: Walterboro
Place_Keyword: Charleston County

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Process_Step:

Process_Description:
Using TIGER roads data, we geocoded addresses of camping facilities located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department. Using TIGER roads data as a base map, we collected point data for camping facilities in the ACE Basin using a GPS unit.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
Extracted data from the South Carolina Environmental Sensitivity Index for camping facilities located in the ACE Basin. We did this by editing the attribute tables and deleting extraneous

information.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
We extracted data from the Westvaco Corporation database of protected lands for camping facilities located in the ACE Basin. We did this by choosing a point in the center of the polygon to represent the camping facilities available on protected lands. In addition, we edited the attribute tables and deleted extraneous information.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The shapefile created by NOAA-CSC was converted to an ArcInfo point coverage using the "shapearc" command in ArcInfo 7.2.1.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 6

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: campgrnd.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Campground
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 6

Attribute:

Attribute_Label: X
Attribute_Definition: X coordinate of campground

Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 526401
Range_Domain_Maximum: 565652

Attribute:

Attribute_Label: Y
Attribute_Definition: Y coordinate of campground
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3579440
Range_Domain_Maximum: 3638180

Attribute:

Attribute_Label: Address
Attribute_Definition: campground address
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: City
Attribute_Definition: city in which campground is located
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Zip
Attribute_Definition: zip code of campground
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Numeric field

Attribute:

Attribute_Label: Phone
Attribute_Definition: phone number of campground
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Numeric field

Attribute:

Attribute_Label: Id
Attribute_Definition: location of campground
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.

City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:24 2000

1999 ACE Basin Ecological Characterization: Recreational Cultural Resources coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Recreational Cultural Resources coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE

Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
Using TIGER roads data, we geocoded addresses of cultural sites located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department. We collected additional cultural data using a GPS unit.

Purpose:
The end purpose of these data is to incorporate a recreational GIS for the ACE Basin. These data will also be used as a view in the ACE Basin Ecological Characterization.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19980300
Ending_Date: 19980400

Currentness_Reference: 1998

Status:

Progress: complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.6669
East_Bounding_Coordinate: -80.6636
North_Bounding_Coordinate: 32.9024
South_Bounding_Coordinate: 32.9024

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: culture
Theme_Keyword: arts and crafts
Theme_Keyword: entertainment

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: Edisto
Place_Keyword: ACE Basin
Place_Keyword: Colleton County
Place_Keyword: Beaufort County
Place_Keyword: Walterboro
Place_Keyword: Charleston County

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage
Completeness_Report: Complete

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Process_Step:

Process_Description:
Using TIGER roads data, we geocoded addresses of cultural sites located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service:
Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time 8:30am - 5:00 pm EST

Process_Step:

Process_Description:
Using TIGER roads data as a base map, we collected point data for cultural sites in the ACE Basin using a GPS unit.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service:
Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time 8:30am - 5:00 pm EST

Process_Step:

Process_Description:
The shapefile created by NOAA-CSC was converted to an ArcInfo point coverage using the "shapearc" command in ArcInfo 7.2.1.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service:
Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time 8:30am - 5:00 pm EST

Spatial_Data_Organization_Information:

> *Direct_Spatial_Reference_Method:* Point
> *Point_and_Vector_Object_Information:*
>
> > *SDTS_Terms_Description:*
> >
> > > *SDTS_Point_and_Vector_Object_Type:* Point
> > > *Point_and_Vector_Object_Count:* 3

Spatial_Reference_Information:

> *Horizontal_Coordinate_System_Definition:*
>
> > *Planar:*
> >
> > > *Grid_Coordinate_System:*
> > >
> > > > *Grid_Coordinate_System_Name:* Universal Transverse Mercator
> > > > *Universal_Transverse_Mercator:*
> > > >
> > > > > *UTM_Zone_Number:* 17
> > > > > *Transverse_Mercator:*
> > > > >
> > > > > > *Scale_Factor_at_Central_Meridian:* 0.9996
> > > > > > *Longitude_of_Central_Meridian:* -81.0000
> > > > > > *Latitude_of_Projection_Origin:* 0.0000
> > > > > > *False_Easting:* 500000
> > > > > > *False_Northing:* 0.0000
> > >
> > > *Planar_Coordinate_Information:*
> > >
> > > > *Planar_Coordinate_Encoding_Method:* Row and column
> > > > *Coordinate_Representation:*
> > > >
> > > > > *Abscissa_Resolution:*
> > > > > *Ordinate_Resolution:*
> > > >
> > > > *Planar_Distance_Units:* Meters
> >
> > *Geodetic_Model:*
> >
> > > *Horizontal_Datum_Name:* North American Datum 1927
> > > *Ellipsoid_Name:* Clarke 1866
> > > *Semi-major_Axis:* 6378206.4
> > > *Denominator_of_Flattening_Ratio:* 294.98

Entity_and_Attribute_Information:

> *Detailed_Description:*
>
> > *Entity_Type:*

Entity_Type_Label: cultural.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Culture_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 4

Attribute:

Attribute_Label: Name
Attribute_Definition: name of cultural location
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Address
Attribute_Definition: address of cultural location
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: City
Attribute_Definition: city cultural location is in
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: State
Attribute_Definition: state cultural location is in
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Zip

Attribute_Definition: zip code for cultural location
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Numeric field (only one value)

Attribute:

Attribute_Label: X_coord
Attribute_Definition: X coordinate for cultural location
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 531152.56250
Range_Domain_Maximum: 531455.06250

Attribute:

Attribute_Label: Y_coord
Attribute_Definition: Y coordinate for cultural location
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3640511.75000
Range_Domain_Maximum: 3640511.75000

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:

Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.

Custom_Order_Process:

Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:

Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.

Custom_Order_Process:

Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:

South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:24 2000

1999 ACE Basin Ecological Characterization: Recreational Golf coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Recreational Golf coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE

Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
Using TIGER roads data, we geocoded addresses of golf courses located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department. We collected additional cultural data using a GPS unit.
Purpose:
The end purpose of these data is to incorporate a recreational GIS for the ACE Basin. These data will also be used as a view in the ACE Basin Ecological Characterization.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19980300
Ending_Date: 19980400

Currentness_Reference: 1998

Status:

Progress: complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.6929
East_Bounding_Coordinate: -80.3319
North_Bounding_Coordinate: 32.8742
South_Bounding_Coordinate: 32.4826

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: golf
Theme_Keyword: driving ranges

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: Edisto
Place_Keyword: ACE Basin
Place_Keyword: Colleton County
Place_Keyword: Beaufort County
Place_Keyword: Walterboro
Place_Keyword: Charleston County

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none to report

Lineage:

Process_Step:

Process_Description:
Using TIGER roads data, we geocoded addresses of golf courses located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
Using TIGER roads data as a base map, we collected point data for golf courses in the ACE Basin using a GPS unit.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:

South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service:
Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time 8:30am - 5:00 pm EST

Process_Step:

Process_Description:
The shapefile created by NOAA-CSC was converted to an ArcInfo point coverage using the "shapearc" command in ArcInfo 7.2.1.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service:
Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time 8:30am - 5:00 pm EST

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 3

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: golfcors.dbf
Entity_Type_Definition: Point Attribute Table

Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Golf_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 3

Attribute:

Attribute_Label: X
Attribute_Definition: the X coordinate of the golf course
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 528850
Range_Domain_Maximum: 562504

Attribute:

Attribute_Label: Y
Attribute_Definition: the Y coordinate of the golf course
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3594130
Range_Domain_Maximum: 3637387

Attribute:

Attribute_Label: Address
Attribute_Definition: the address of the golf course
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: City
Attribute_Definition: the city the golf course is in
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: State
Attribute_Definition: the state the golf course is in
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Phone
Attribute_Definition: phone number for the golf course
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Numeric field

Attribute:

Attribute_Label: Name
Attribute_Definition: the name of the golf course
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:

Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at
<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559

City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:25 2000

1999 ACE Basin Ecological Characterization: Hotels coverage

Metadata:

- Identification_Information
- Data_Quality_Information
- Spatial_Data_Organization_Information
- Spatial_Reference_Information
- Entity_and_Attribute_Information
- Distribution_Information
- Distribution_Information
- Metadata_Reference_Information

Identification_Information:

Citation:

Citation_Information:

Originator:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)
Publication_Date: 19990500
Title: 1999 ACE Basin Ecological Characterization: Hotels coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE

Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
Using TIGER roads data, we geocoded addresses of hotels and motels located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department.

Purpose:
The end purpose of these data is to incorporate a recreational GIS for the ACE Basin. These data will also be used as a view in the ACE Basin Ecological Characterization.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19980300
Ending_Date: 19980400

Currentness_Reference: 1998

Status:

Progress: complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.7186
East_Bounding_Coordinate: -80.4613
North_Bounding_Coordinate: 32.9258
South_Bounding_Coordinate: 32.3357

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: motels
Theme_Keyword: Hotels
Theme_Keyword: Lodging

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: Edisto
Place_Keyword: ACE Basin
Place_Keyword: Colleton County
Place_Keyword: Beaufort County
Place_Keyword: Walterboro
Place_Keyword: Charleston County

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Process_Step:

Process_Description:
Using TIGER roads data, we geocoded addresses of hotels and motels located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department. .
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The shapefile created by NOAA-CSC was converted to an ArcInfo point coverage using the "shapearc" command in ArcInfo 7.2.1.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:

South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service:
Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time 8:30am - 5:00 pm EST

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 12

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column

Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: Hotels.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Hotels_id
Attribute_Definition: software computed
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: X
Attribute_Definition: X coordinate of hotel
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 526479
Range_Domain_Maximum: 550369

Attribute:

Attribute_Label: Y
Attribute_Definition: Y coordinate of hotel
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3577769

Range_Domain_Maximum: 3643093

Attribute:

Attribute_Label: Name
Attribute_Definition: name of hotel
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Address
Attribute_Definition: hotel address
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: City
Attribute_Definition: city hotel is in
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: State
Attribute_Definition: state hotel is in
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Zip
Attribute_Definition: zip code of the hotel
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 29488
Range_Domain_Maximum: 29920

Attribute:

Attribute_Label: Phone
Attribute_Definition: the phone number for the hotel
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210

Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:25 2000

1999 ACE Basin Ecological Characterization: Recreational Marina coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
National Oceanic and Atmospheric Administration Coastal Services Center (NOAA-CSC)
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Recreational Marina coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention

for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
Using TIGER roads data as a base map, we collected the point location of a marina in the ACE Basin using a GPS unit.

Purpose:
The end purpose of these data is to incorporate a recreational GIS for the ACE Basin. These data will also be used as a view in the ACE Basin Ecological Characterization.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19980300
Ending_Date: 19980400

Currentness_Reference: 1998

Status:

Progress: complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.3400
East_Bounding_Coordinate: -80.3400
North_Bounding_Coordinate: 32.4919
South_Bounding_Coordinate: 32.4919

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: marina

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: Edisto
Place_Keyword: ACE Basin
Place_Keyword: Colleton County
Place_Keyword: Beaufort County
Place_Keyword: Walterboro
Place_Keyword: Charleston County

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Process_Step:

Process_Description:
Using TIGER roads data as a base map, we collected the point location of a marina in the ACE Basin using a GPS unit.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The shapefile created by NOAA-CSC was converted to an ArcInfo point coverage using the "shapearc" command in ArcInfo 7.2.1.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource

Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service:
Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time 8:30am - 5:00 pm EST

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 1

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: marina.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Marina_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: software computed

Attribute:

Attribute_Label: X
Attribute_Definition: the X coordinate of the marina
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Numeric Field (only one value)

Attribute:

Attribute_Label: Y
Attribute_Definition: the Y coordinate of the marina
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Numeric Field (only one value)

Attribute:

Attribute_Label: Name
Attribute_Definition: the name of the marina
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Address
Attribute_Definition: the address of the marina
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: City
Attribute_Definition: the city that the marina is in
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Zip
Attribute_Definition: the zip for the marina
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Phone
Attribute_Definition: the phone number of the marina
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC

Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:26 2000

1999 ACE Basin Ecological Characterization: Recreational Outfitters coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
National Oceanic and Atmospheric Administration Coastal Services Center (NOAA-CSC)
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Recreational Outfitters coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention

for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
Using TIGER roads data, we geocoded addresses of canoe and kayaking tours located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department. We collected additional cultural data using a GPS unit.

Purpose:
The end purpose of these data is to incorporate a recreational GIS for the ACE Basin. These data will also be used as a view in the ACE Basin Ecological Characterization.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19980300
Ending_Date: 19980400

Currentness_Reference: 1998

Status:

Progress: complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.6681
East_Bounding_Coordinate: -80.5565
North_Bounding_Coordinate: 32.8992
South_Bounding_Coordinate: 32.7418

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: canoe
Theme_Keyword: kayak
Theme_Keyword: tours

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: Edisto
Place_Keyword: ACE Basin
Place_Keyword: Colleton County
Place_Keyword: Beaufort County
Place_Keyword: Walterboro
Place_Keyword: Charleston County

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibilty and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage.
Completeness_Report: Complete

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Process_Step:

Process_Description:
Using TIGER roads data, we geocoded addresses of canoe and kayaking tours located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
Using TIGER roads data as a base map, we collected point data for canoe and kayaking tours in the ACE Basin using a GPS unit.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The shapefile created by NOAA-CSC was converted to an ArcInfo point coverage using the "shapearc" command in rcInfo 7.2.1.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 2

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: outfiter.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Outfit_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 2

Attribute:

Attribute_Label: X
Attribute_Definition: X coordinate for canoe and kayaking tours
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 531099.32
Range_Domain_Maximum: 541480.56

Attribute:

Attribute_Label: Y
Attribute_Definition: Y coordinate for canoe and kayaking tours
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3622747.80
Range_Domain_Maximum: 3640163.89

Attribute:

Attribute_Label: Id
Attribute_Definition: name of the tour group
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Address
Attribute_Definition: where the tour group is located
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: City
Attribute_Definition: what city the tour group is in
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Zip
Attribute_Definition: the zip code for the tour group
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 29446
Range_Domain_Maximum: 29488

Attribute:

Attribute_Label: Phone
Attribute_Definition: the phone number for the tour group
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.

Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing

Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:27 2000

1999 ACE Basin Ecological Characterization: Recreational Trails coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Recreational Trails coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE

Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
Using TIGER roads data, we geocoded addresses of recreational trails located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department. We collected additional cultural data using a GPS unit.

Purpose:
The end purpose of these data is to incorporate a recreational GIS for the ACE Basin. These data will also be used as a view in the ACE Basin Ecological Characterization.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19980300
Ending_Date: 19980400

Currentness_Reference: 1998

Status:

Progress: complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.7522
East_Bounding_Coordinate: -80.2995
North_Bounding_Coordinate: 32.9343
South_Bounding_Coordinate: 32.3500

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: trails
Theme_Keyword: hiking
Theme_Keyword: biking

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: Edisto
Place_Keyword: ACE Basin
Place_Keyword: Colleton County
Place_Keyword: Beaufort County
Place_Keyword: Walterboro
Place_Keyword: Charleston County

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage.
Completeness_Report: Complete

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Process_Step:

Process_Description:
Using TIGER roads data, we geocoded addresses of recreational trails located in the ACE Basin that were provided by the South Carolina Parks, Recreation, and Tourism Department.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
Using TIGER roads data as a base map, we collected point data for recreational trails in the ACE Basin using a GPS unit.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service:
Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time 8:30am - 5:00 pm EST

Process_Step:

Process_Description:
The shapefile created by the NOAA-CSC was converted to an ArcInfo point coverage using the "shapearc" command in ArcInfo 7.2.1.
Process_Date: 19981000
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:

Additional trails were digitized on screen using ArcView 3.1 and paper maps to create a shapefile. The shapefile was then converted to an Arcinfo coverage and joined to the trials coverage provided by the NOAA-CSC using the "get" command in ArcEdit.

Process_Date: 19981000
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 10

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996

Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: trails.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Trails_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 10

Attribute:

Attribute_Label: X
Attribute_Definition: X coordinate of the trail
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 565487

Attribute:

Attribute_Label: Y
Attribute_Definition: Y coordinate of the trail
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 3625607

Attribute:

Attribute_Label: Id
Attribute_Definition: where the trail is located
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Agency
Attribute_Definition: the name of the agency that manages the trail
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Address
Attribute_Definition: the address where the trail is located
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: City
Attribute_Definition: the city that the trail is in
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: County
Attribute_Definition: the county that the trail is in
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: State
Attribute_Definition: the zip code where the trail is located
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: character field

Attribute:

Attribute_Label: Length
Attribute_Definition: Length of the trail in miles
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.3
Range_Domain_Maximum: 7.0

Attribute:

Attribute_Label: Use
Attribute_Definition: recreational uses of the trail
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:27 2000

1999 ACE Basin Ecological Characterization: Corps of Engineers Permitting coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Jeff Trudnak
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Corps of Engineers Permitting coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA_CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE

Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
This data set provides locations of Army Corp of Engineers Wetlands Permits. The data provided includes the latitude, longitude, permit number, and type of work allowed by the permit. Location accuracy of the permits is not guaranteed. Any questions regarding a specific permit(s) should be addressed to the Army Corps of Engineers - Charleston District.
Purpose:
Provide location, permit number, and type of work permitted by ACOE Wetlands permits.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19980600
Ending_Date: 19980600

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.9683
East_Bounding_Coordinate: -80.1632
North_Bounding_Coordinate: 32.9272
South_Bounding_Coordinate: 32.3262

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: army corps of engineers
Theme_Keyword: wetland permits
Theme_Keyword: COE

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this set are topologically consistent. Post processing p version 7.2.1 indicated that arc and node topology exists.

Completeness_Report: This data set is complete.
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
The accuracy of this data set is based on source data which are assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none to report

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: U.S. Army Corps of Engineers
Publication_Date:
Title: none
Edition: none
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
U.S. Army Corps of Engineers, Charleston District - Regulatory Branch

Source_Scale_Denominator: 1:24000
Type_of_Source_Media: digital
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19980600
Ending_Date: 19980600

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: Provided attribute data and spatial coordinates

Process_Step:

Process_Description:
ACOE provided a MSExcel file with the permit data. A point coverage was created in ArcInfo using the coordinate data. The Ecxel files were then converted to Info files and joined to the point coverage.
Process_Date: 19980600
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The permit points were then overlayed on the 1:24,000 County boundaries coverage in ArcView 3.0a. Permits that were located in there wrong county were marked in the attribute table and later deleted in ArcInfo.
Process_Date: 19989700
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 438

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: coeprmit.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Acecoe_
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 438

Attribute:

Attribute_Label: Acecoe_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2914
Range_Domain_Maximum: 5032

Attribute:

Attribute_Label: Permitno
Attribute_Definition: permit number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Xcoord
Attribute_Definition: x coordinate
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 80166667
Range_Domain_Maximum: 80968056

Attribute:

Attribute_Label: Ycoord
Attribute_Definition: y coordinate
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 32327740
Range_Domain_Maximum: 32925833

Attribute:

Attribute_Label: Long_dd
Attribute_Definition: longitude in decimal degrees
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -80.96810
Range_Domain_Maximum: -80.16670

Attribute:

Attribute_Label: Lat_dd
Attribute_Definition: latitude in decimal degrees
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 32.32770
Range_Domain_Maximum: 32.92580

Attribute:

Attribute_Label: County
Attribute_Definition: county name
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: 13
Enumerated_Domain_Value_Definition: Beaufort County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 19
Enumerated_Domain_Value_Definition: Charleston County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 29
Enumerated_Domain_Value_Definition: Colleton County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 35
Enumerated_Domain_Value_Definition: Dorchester County
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: 49
Enumerated_Domain_Value_Definition: Hampton County
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Typework
Attribute_Definition: code(s) for permitted work
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Type1_perm
Attribute_Definition: permitted work type 1
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Type2_perm
Attribute_Definition: permitted work type 2
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Type3_perm
Attribute_Definition: permitted work type 3
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Type4_perm
Attribute_Definition: permitted work type 4
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Type5_perm
Attribute_Definition: permitted work type 5
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston

State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.

Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at [<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>](http://www.csc.noaa.gov/clearinghouse/prodreq_form.html)

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:28 2000

1999 ACE Basin Ecological Characterization: EMAP Carolinian Province Sediment Quality and Sediment Chemistry Data coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19970901
Title:
1999 ACE Basin Ecological Characterization: EMAP Carolinian Province Sediment Quality and Sediment Chemistry Data coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:

The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

A study was conducted in the Carolinian Province to identify the estuarine resources of this region and assess their condition based on a variety of synoptically measured indicators of environmental quality. The Carolinian Province, one of 12 coastal regions established under the nationwide Environmental Monitoring and Assessment Program (EMAP), extends from Cape Henry, Virginia through St. Lucie Inlet, Florida. Indicators used in this study included measures of: (1) general habitat condition (depth, physical properties of water, sediment grain-size and organic carbon content), (2) pollution exposure (sediment contaminants, sediment toxicity, low dissolved oxygen conditions), (3) biotic conditions (diversity and abundances of macroinfaunal and demersal species, pathologies in demersal biota), and (4) aesthetic quality (presence of anthropogenic debris, visible oil, noxious sediment odor, and water clarity). A stratified random sampling approach was incorporated to support probability-based estimates of the areal extent of degraded vs.undegraded resources. Estuaries were stratified into three classes based on physical dimensions: large estuaries, small estuaries, and large tidal rivers. This classification scheme resulted in the identification of 200 estuaries with an overall estimated surface area of 11,622 km^2. There were three large estuaries, three large tidal rivers, and 194 small estuaries. A total of 84 base stations and 13 supplemental stations were sampled from June 30 - August 31, 1994. Base stations were randomly selected sites that formed the core of the probability-based monitoring design. By estuarine class, base stations included 20 in large estuaries, 47 in small estuaries, and 17 in large tidal rivers. By subregion, there were 46 stations in southern Virginia, North Carolina, 20 in South Carolina, and Georgia, and 18 in Florida. Supplemental stations in suspected contaminated areas provided sites for field validation of additional ecological indicators developed during the study. Over half (54%) of the surface area of these estuaries showed no major evidence of environmental degradation based on any of the measured biotic, exposure, or aestheticindicators. Twenty percent of the province, represented by 17 stations, exhibited adverse biological conditions linked to significant pollution exposure (significant sediment toxicity, high sediment contamination in excess of reported bioeffect guidelines, or low dissolved oxygen concentrations in bottom waters). The majority (11) of these sites were in North Carolina. Most were characterized by degraded infaunal assemblages accompanied by high sediment contamination and/or significant sediment toxicity based on Microtox(r) assays. Biotic indicators based on demersal species variables were not as effective as infaunal variables in discriminating between undegraded and degraded stations (classified on the basis of exposure indicators).

Additional localized impacts not accounted for in the above estimate of degraded estuaries were detected at nonrandom supplemental sites near potential contaminant sources. A strength of the EMAP-Estuaries probability-based sampling design is its ability to support unbiased estimates of ecological condition with known confidence. Further sampling in the Carolinian Province should improve the accuracy of these estimates and provide a basis for assessing how the overall quality of these estuaries is changing with time. An ArcInfo point coverage was generated from the EMAP data. The station name, location, depth, and sediment data was attached to those points. A one to many relationship exist between the stations and the data from the chemical analysis. Because of this one to many relationship the attribute table of the point data is meant to be linked to the table containing the chemical analysis data.

Purpose:

This study was conducted as part of the estuaries component of the Environmental Monitoring and Assessment Program (EMAP-E). EMAP, initiated by the Environmental Protection Agency (EPA), is a nationwide federal program aimed at monitoring the environmental health of a variety of coastal and terrestrial ecosystems. The estuaries portion of EMAP is conducted jointly by EPA and the National Oceanic and Atmospheric Administration (NOAA) and is designed to provide a quantitative assessment of the regional extent of potential environmental problems in the nation's estuaries by measuring status and change in selected ecological indicators. A detailed program plan for EMAP-E and related efforts in other near-coastal environments is described by Holland (1990). The integrated approach to monitoring these coastal resources fulfills a key directive under the 1992 National Coastal Monitoring Act (Sec. 501 Et Seq, 33 U.S.C. 2801) for NOAA, EPA and other federal agencies to establish a comprehensive national program for consistent monitoring of the nation's coastal environments and ecosystems. In 1993, NOAA and EPA formalized an agreement to initiate a joint monitoring program in the Carolinian Province. The Carolinian Province, which is one of 12 EMAP-E regions, extends from Cape Henry, Virginia through the southern end of the Indian River Lagoon along the east coast of Florida (Figure 1-1). The estuarine resources of this region are diverse and extensive, covering an estimated 11,622 km^2. There is an increasing need for effective management of these resources given predicted influxes of people and businesses to outheastern coastal states over the next few decades and the ensuing pressures on the coastal zone of this region. Culliton et al. (1990) estimated that the coastal population of the southeastern United States will have increased by 181% (the largest in the country) from 1960 to 2010. The Carolinian monitoring program is intended to provide valuable information on the overall health of southeastern estuaries in addition to a reliable baseline for evaluating how conditions of these resources are changing with time. The program also provides an opportunity to refine methods for conducting future monitoring and assessment studies in this and other regions. An initial pilot study was conducted in the Carolinian Province in 1993 to collect background information on ranges of environmental variables and to determine appropriate indicators of environmental quality to include in subsequent monitoring efforts. Results of the pilot study are summarized by Ringwood et al. (1995a). A full province-wide monitoring effort began in 1994. This effort incorporates approaches suggested in the pilot study but is based primarily on the overall EMAP-E sampling design and protocols to ensure data comparability with other provinces. Thus far, two years of field sampling have been completed. The following report provides a summary of ecological conditions of estuaries of the Carolinian Province based on data collected during the first monitoring season (summer 1994).

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 1990808
Ending_Date: 19950731

Currentness_Reference: time period of content ending date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.5473
East_Bounding_Coordinate: -80.2367
North_Bounding_Coordinate: 32.5998
South_Bounding_Coordinate: 32.5377

Keywords:

Theme:

Theme_Keyword_Thesaurus: none
Theme_Keyword: sediment quality
Theme_Keyword: chemical contaminants
Theme_Keyword: status and trends
Theme_Keyword: estuarine
Theme_Keyword: environmental condition
Theme_Keyword: environmental monitoring

Place:

Place_Keyword_Thesaurus: none
Place_Keyword: South Carolina
Place_Keyword: ACE Basin
Place_Keyword: Edisto river

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422

Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: The data in this data is a point coverage.
Completeness_Report: complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator:
Hyland, J.L., T.J. Herrlinger, T.R. Snoots, A.H. Ringwood, R.F. Van Dolah, C.T. Hackney, G.A. Nelson, J.S. Rosen, and S.A. Kokkinakis. 1996. NOAA Technical Memorandum NOS ORCA 97. NOAA/NOS, Office of Ocean Resources Conservation and Assessment, Silver springs, MD. 102p.
Publication_Date: 19960600
Title:
Environmental Quality of Estuaries of the Carolinian Province: 1994 Annual statistical summary for the 1994 EMAP-Estuaries Demonstration Project in the Carolinian Province.
Edition: 1996
Geospatial_Data_Presentation_Form: none?
Publication_Information:

Publication_Place: Charleston, SC
Publisher: US Government Printing Office, 1996-404-445/45413

Other_Citation_Details:
Other citations include: Ringwood, A.H., A.F. Holland, R.T. Kneib, P.E. Ross.

1996. EMAP/NS&T pilot studies in the Carolinian Province: Indicator testing and evaluation in the Southeastern estuaries. NOAA Technical Memorandum NOS ORCA 102. NOAA/NOS, Office of Ocean Resources Conservation and Assessment, Silver springs, MD. 113p.

Source_Scale_Denominator: 1:24000
Type_of_Source_Media: paper, cartridge tape, PC, computer program (SAS)
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19940808
Ending_Date: 19950731

Source_Currentness_Reference: time period of content ending date

Source_Citation_Abbreviation: none
Source_Contribution: Dataset from which coverage was created and clipped.

Process_Step:

Process_Description:
Data subsetted from EMAP database using using SAS by position and date. Data transferred to Microsoft Access for manipulation.
Process_Date: 19970900
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time
Contact_Instructions: none

Process_Step:

Process_Description:
The point coverage for the EMAP Data was generated from an Excel file listing latitude and longitude. The point coverage was then projected into UTM using the ArcInfo "project" command and the attribute data added.
Process_Date: 19971207
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The point coverage for the EMAP Data was clipped to the ACE Basin Ecological Characterization Boundary in ArcInfo.
Process_Date: 19971207
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 5

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: emapseds.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Emapsed_
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 5

Attribute:

Attribute_Label: Emapsed_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 94076
Range_Domain_Maximum: 95156

Attribute:

Attribute_Label: Station
Attribute_Definition: Station Code
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Lat_dd_
Attribute_Definition: latitude of station in decimal degrees
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 32.54
Range_Domain_Maximum: 32.61

Attribute:

Attribute_Label: Lon_dd_
Attribute_Definition: longitude of station in decimal degrees
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 80.17
Range_Domain_Maximum: 80.55

Attribute:

Attribute_Label: Date
Attribute_Definition: date of sampling
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 19940808
Range_Domain_Maximum: 19950731

Attribute:

Attribute_Label: Depth_m_
Attribute_Definition: water depth at mean low tide
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 4.20
Range_Domain_Maximum: 9.66

Attribute:

Attribute_Label: Zsand
Attribute_Definition: percent sand fraction of sediment
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 22.62
Range_Domain_Maximum: 97.62

Attribute:

Attribute_Label: Zsiltclay
Attribute_Definition: percent silt and clay fraction of sediment
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2.38
Range_Domain_Maximum: 77.38

Attribute:

Attribute_Label: Zmoisture
Attribute_Definition: percent moisture
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 26.31
Range_Domain_Maximum: 72.65

Attribute:

Attribute_Label: Ztoc
Attribute_Definition: percent total organic carbon
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.18
Range_Domain_Maximum: 3.32

Attribute:

Attribute_Label: Station_na
Attribute_Definition: sampling station name
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Detailed_Description:

Entity_Type:

Entity_Type_Label: emaplnk.dbf
Entity_Type_Definition: Link Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Station
Attribute_Definition: Station Code
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Analyte_na

Attribute_Definition: name of analyte
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Conc
Attribute_Definition: Concentration of analyte
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 529013.70

Attribute:

Attribute_Label: Unit
Attribute_Definition: units for concentration
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Sig_Fig
Attribute_Definition: number of significant figures
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 3

Attribute:

Attribute_Label: Detect_Lim
Attribute_Definition: detection limit of analysis method
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 10000

Attribute:

Attribute_Label: Qualify
Attribute_Definition:
ND = not detected, J = just barely detected, but present value not to be considered accurate

Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Analysis_m
Attribute_Definition: method of analysis for detecting analyte
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: GFAA
Enumerated_Domain_Value_Definition: Graphite Furnace Atomic Absorption
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: CVAA
Enumerated_Domain_Value_Definition: Cold Vapor Atomic Absorption
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: FAA
Enumerated_Domain_Value_Definition: Flame Atomic Absorption
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: GC/MS
Enumerated_Domain_Value_Definition: Gas Chromatography/Mass Spectrometry
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: GC/ECD
Enumerated_Domain_Value_Definition: Gas Chromatography/Electron Capture Detection
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: GC/FPD
Enumerated_Domain_Value_Definition: Gas Chromatography/Flame Photometric Detection
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: NAA
Enumerated_Domain_Value_Definition: Neutron Activation Analysis
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: GC/FID
Enumerated_Domain_Value_Definition: Gas Chromatography/Flame Ionization Detection
Enumerated_Domain_Value_Definition_Source: User defined.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC

Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.

Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at [<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>](http://www.csc.noaa.gov/clearinghouse/prodreq_form.html)

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by [mp](#) version 2.2.4 on Fri Mar 17 16:06:28 2000

1999 ACE Basin Ecological Characterization: Endangered Species coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Philip Weinbach
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Endangered Species coverage
Edition: none
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Description:

Abstract:
Endangered species are located throughout the ACE characterization area. It is important to note their locations and make efforts to ensure their future survival.
Purpose:
This data layer serves to display the general locations of endangered species within the ACE characterization area. Although specific coordinate locations existed in the original data layer, these specific sites were not included to prevent any misuse of the data and to protect the plant and animal species.
Supplemental_Information: none

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: Continually

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0724
East_Bounding_Coordinate: -80.1525
North_Bounding_Coordinate: 33.1228
South_Bounding_Coordinate: 32.3055

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: endangered species

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: southeast SC

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: ArcView version 3.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this set are topologically consistent. Post processing in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: data set is complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: South Carolina Heritage Trust
Publication_Date: 19971100
Title: South Carolina Heritage Trust Endangered Species Database
Edition: none
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Columbia, SC
Publisher: SC Heritage Trust

Other_Citation_Details: none to report
Larger_Work_Citation:

Citation_Information:

Originator:
Publication_Date:
Title:
Publication_Information:

Publication_Place:
Publisher:

Source_Scale_Denominator: 24000
Type_of_Source_Media: none
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: provided Endangered species data in dbf format

Process_Step:

Process_Description:
Imported endangered species dbf into ArcView Version 3.1. Used add event theme tool to create a visual representation of the point location of the endangered species. Converted this coverage to a shapefile. Used geoprocessing extension to clip the shapefile to the DHEC basins coverage which displays the 36 different watersheds found within the ACE characterization area. This clipped shapefile was then converted to an ArcInfo coverage by using the shapearc command in ArcInfo Version 7.2.1. The identity command was then used to compute the geometric intersection of the clipped point coverage and the polygon watershed coverage. This new coverage was then brought into ArcView Version 3.1. Using the field calculate tool, sums of endangered species within each of the 36 watersheds was calculated. A new field was then added to the polygon attribute table to display the endangered species count found within each of the 36 watersheds.
Process_Date: 19990115
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 36

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -81.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4000000
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: endangrd.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software generated
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon

Attribute_Definition_Source: Software generated
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Endangrd3_
Attribute_Definition: internal feature number
Attribute_Definition_Source: software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2
Range_Domain_Maximum: 37

Attribute:

Attribute_Label: Hucode
Attribute_Definition: 14-digit hydrologic unit code
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character Field

Attribute:

Attribute_Label: Acres
Attribute_Definition: acres of watershed
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 37573

Attribute:

Attribute_Label: Sq_mi
Attribute_Definition: square miles of watershed
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 59

Attribute:

Attribute_Label: Basin
Attribute_Definition: basin watershed is located in
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character Field

Attribute:

Attribute_Label: Splitcode
Attribute_Definition: number assigned to watersheds
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 36

Attribute:

Attribute_Label: Count_enda
Attribute_Definition: number of endangered species found within each watershed
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 26

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:

Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at [<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>](http://www.csc.noaa.gov/clearinghouse/prodreq_form.html)

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559

City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:29 2000

1999 ACE Basin Ecological Characterization: Erosion coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Jeff Trudnak
Publication_Date: 19990500
Title: 1999 ACE Basin Ecological Characterization: Erosion coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin

Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
The coverage consists of SCDHEC-OCRM beach survey benchmarks, or monuments, located in the South Carolina State Plane Coordinate System (NAD '83). There is a corresponding benchmark elevation and shoreline erosion rate (in feet per year) for each benchmark.

Purpose:
To measure erosion and/or accretion rates along the South Carolina coastline.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: continually

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.4536
East_Bounding_Coordinate: -80.2779
North_Bounding_Coordinate: 32.5177
South_Bounding_Coordinate: 32.3232

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: monument

Theme_Keyword: erosion
Theme_Keyword: accretion
Theme_Keyword: benchmark

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: South Carolina coastline

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this set are topologically consistent. Post processing performed in ArcInfo version 7.2.1 indicated that arc and node topology exists.
Completeness_Report: This data set is complete.

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none to report

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: Bill Eiser
Publication_Date:
Title: none
Edition: none
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Charleston
Publisher: SCDHEC-OCRM

Source_Scale_Denominator: 1:24000
Type_of_Source_Media: digital
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19880000
Ending_Date: 19900000

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution:
source contributed monument datalayers which were later clipped to ACE boundary

Process_Step:

Process_Description:
The monument.e00 file was created by the PC ArcInfo export utility.
Process_Date: 19980000
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
Monument datalayer was converted from stateplane to UTM 1927 in ArcInfo. The coverage was then clipped to the ACE boundary using the clip command in ArcInfo.
Process_Date: 19981112
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 69

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: Erosion.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Aceerosion
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Number
Attribute_Definition: number corresponding to data collection point
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Year
Attribute_Definition: year data collected
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Zone
Attribute_Definition: Zone classification of site
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: IS
Enumerated_Domain_Value_Definition: stabilized inlet zone
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: IU
Enumerated_Domain_Value_Definition: Unstabilized inlet zone
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: IU/S
Enumerated_Domain_Value_Definition:
portions are Unstabilized inlet zone and portions are standard zone
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: S

Enumerated_Domain_Value_Definition: Standard zone
Enumerated_Domain_Value_Definition_Source: User defined.

Attribute:

Attribute_Label: Acret_rate
Attribute_Definition: accretion rate
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -15.500
Range_Domain_Maximum: 0.000

Attribute:

Attribute_Label: Elevation
Attribute_Definition: elevation above sea level
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 3.710
Range_Domain_Maximum: 21.711

Attribute:

Attribute_Label: X_coord
Attribute_Definition: geospatial x-coordinate
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2168789.000
Range_Domain_Maximum: 2222583.000

Attribute:

Attribute_Label: Y_coord
Attribute_Definition: geospatial y-coordinate
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 178985.000
Range_Domain_Maximum: 249438.000

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.

Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:30 2000

1999 ACE Basin Ecological Characterization: Critical Horseshoe Crab Spawning Habitat coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Jeff Trudnak
Publication_Date: 19990501
Title:
1999 ACE Basin Ecological Characterization: Critical Horseshoe Crab Spawning Habitat coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA_CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention

for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin.

Description:

Abstract:
Identifies some of the most likely horseshoe crab spawning areas within the ACE Basin study area. These areas were identified during a study done in 1997, whose goal was to predict spawning habitat within South Carolina. The spawning habitats consist of well aerated sandy beaches, which resist erosion during the spring spawning months and which are adjacent to intertidal sand flat areas which serve as juvenile nursery habitat.

Purpose:
The identification of critical spawning habitat helps fishery and coastal zone managers to assess the value of these habitats in the role of conserving this species of ecological and economic/medical importance.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19980301
Ending_Date: 19980801

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.4803
East_Bounding_Coordinate: -80.1712
North_Bounding_Coordinate: 32.5910
South_Bounding_Coordinate: 32.3925

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: horseshoe crab
Theme_Keyword: spawning habitat

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: Otter Island
Place_Keyword: Edisto Island
Place_Keyword: Pine Island
Place_Keyword: Deveaux Banks
Place_Keyword: Coffin Point
Place_Keyword: Harbor Island

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that ars and node topology exist.
Completeness_Report: This data set is complete.
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none to report

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: Mark Thompson
Publication_Date: 19990501
Title:
Assessments of the population biology and critical habitat for the horseshoe crab in South Carolina
Edition: 1999
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Source_Scale_Denominator: 1:24000
Type_of_Source_Media: digital
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970101
Ending_Date: 20000101

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution:
provided hardcopy map depicting the polygons which represent critical horseshoe crab spawning habitat.

Process_Step:

Process_Description:
The data was digitized onto a view in ArcView GIS Version 3.1. Labels were placed on areas where critical horseshoe crab spawning habitat was observed.
Process_Date: 1998112398
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
areas identified as used by horseshoe crabs for spawning within the ACE Basin during spring mating activity.
Process_Date: 19970000
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 7

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: hrshocrb.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 43.750
Range_Domain_Maximum: 803096.188

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 37.794
Range_Domain_Maximum: 4270.786

Attribute:

Attribute_Label: Horsecrab
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2
Range_Domain_Maximum: 9

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:31 2000

1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources National Pollutant Discharge Elimination System Permit coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources National Pollutant Discharge Elimination System Permit coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:

The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

Permit Compliant Sysytem is a national computerized management information system that automates entry, updating, and retrieval of National Pollutant Discharge Elimination System (NPDES) data and tracks permit issuance, permit limits and monitoring data, and other data pertaining to facilities regulated under NPDES. PCS records water-discharge permit data on more than 75,000 facilities nationwide. The NPDES permit program regulates direct discharges from municipal and industrial wastewater treatment facilities that discharge into the navigable waters of the United States. Wastewater treatment facilities (also called "point sources") are issued NPDES permits regulating their discharge.

Purpose:

To meet the informational needs of the National Pollutant Discharge Elimination System (NPDES) program under the Clean Water Act, PCS was developed for tracking permit, compliance, and enforcement status. PCS is a dynamic system that supports the NPDES program at the state, regional and national levels. The system has been enhanced over the years to better support the diverse needs of its users. Within the 10 EPA regional offices and 38 NPDES states, PCS supports over 600 state/regional/headquarters users. These users are made up of enforcement, permit, data processing and planning personnel, and program managers. With its flexible reporting features, PCS supports requests for information from Congress and state legislatures, as well as Freedom of Information requests submitted by the public.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970700
Ending_Date: 19970700

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0724
East_Bounding_Coordinate: -80.1525
North_Bounding_Coordinate: 33.1211
South_Bounding_Coordinate: 32.3038

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: NPDES
Theme_Keyword: National Pollution Discharge Elimination System
Theme_Keyword: Pollutants
Theme_Keyword: Discharge

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: South Carolina
Place_Keyword: ACE Basin
Place_Keyword: Charleston
Place_Keyword: Dorchester
Place_Keyword: Hampton
Place_Keyword: Colleton
Place_Keyword: Beaufort

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston

State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: Post processing in ArcInfo shows polygon topology.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none to report

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: USEPA Envirofacts Warehouse
Publication_Date: 19980722
Title: Water Discharge Permits
Edition: none
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Internet
Publisher: http//www.epa.gov/enviro/index_java.html

Source_Scale_Denominator: 24000
Type_of_Source_Media: web page
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970700
Ending_Date: 19970700

Source_Currentness_Reference: 19980722

Source_Citation_Abbreviation: none
Source_Contribution:
Provided latitude and longitude data for the creation of the NPDES theme.

Process_Step:

Process_Description:
The data was brought into Excel, and generated a shapefile in ARC/View 3.0a. The ARC/Info coverage was generated using the shapearc command in ARC/Info.
Process_Date: 19981000
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 66

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: npdespmt.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Acenpdesid
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 66

Attribute:

Attribute_Label: Id
Attribute_Definition: the code used to identify different facilities
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Fac_id
Attribute_Definition: The 12-digit code assigned to facilities by the EPA
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Facility_n
Attribute_Definition: The name of the facility that holds the permit
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Latitude
Attribute_Definition: the latitude of the facility location
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.000000
Range_Domain_Maximum: 32.950833

Attribute:

Attribute_Label: Longitude
Attribute_Definition: the longitude of the facility location
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -80.950000
Range_Domain_Maximum: 0.000000

Attribute:

Attribute_Label: Y-coord
Attribute_Definition: the Y coordinate for the facility

Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1147989.232704
Range_Domain_Maximum: 1213801.792549

Attribute:

Attribute_Label: X-coord
Attribute_Definition: the X coordinate for the facility
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1396072.442052
Range_Domain_Maximum: 1457441.687711

Attribute:

Attribute_Label: Albers_src
Attribute_Definition:
Description of the organization that the permit was issued under
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:

Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.

Custom_Order_Process:

Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:

Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.

Custom_Order_Process:

Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:

South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:31 2000

1999 ACE Basin Ecological Characterization: ACE Protected Lands coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19981110
Title:
1999 ACE Basin Ecological Characterization: ACE Protected Lands coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse

ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

This data was collected by the U.S. Fish and Wildlife Service SC Coastal Ecosystems Program. It is intended to aid in conservation efforts in South Carolina. This project is a work in progress and data will continue to be collected. The data included in this project are from a variety of sources and covers the South Carolina coastal plain - roughly east of I-95 with some exceptions. Some polygon boundaries in this data set were brought together from various sources of existing digital data. Data not delivered in UTM meters, Zone 17, NAD27 were projected to that projection. Some boundaries were screen digitized by SCCEP with USGS DLG 1:100K roads and hydrology in the background using hand-drawn boundaries on 1:100K or 1:24K topos provided by the organizations. Some boundaries were transferred to topos by SCCEP based on information provided by the organizations. The attribute data were developed by SCCEP based on information provided by organizations and individuals about the properties. Some properties will have more than 1 polygon due to waterways, roads or parcel boundaries.

Purpose:

We are collecting the data to assist our partners in the coastal Focus Areas with their land conservation efforts. In addition, the data will be used to develop a statewide coverage to be used in the Gap Analysis Project.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19960000
Ending_Date: 19981000

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.8528
East_Bounding_Coordinate: -80.1613
North_Bounding_Coordinate: 32.8885
South_Bounding_Coordinate: 32.3380

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: South Carolina Wildlife Management Area
Theme_Keyword: Easement
Theme_Keyword: National Wildlife Refuge
Theme_Keyword: South Carolina State Park
Theme_Keyword: South Carolina County Park
Theme_Keyword: Preserve

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Beaufort
Place_Keyword: Charleston
Place_Keyword: Colleton
Place_Keyword: Dorchester
Place_Keyword: Hampton

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000

Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: BJ Richardson
Publication_Date:
Title:
unpublished Protected Lands Coverage U.S. Fish and Wildlife Service SC Coastal Ecosystems Program
Edition:
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place:
Publisher:

Source_Scale_Denominator: 1:24000
Type_of_Source_Media: paper
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19960000
Ending_Date: 19981000

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: Data provided tables for the GIS data layer.

Process_Step:

Process_Description:
The protected lands coverage (USFWS) for coastal South Carolina was clipped in ArcInfo to the ACE Basin Ecological Characterization.
Process_Date: 19981000
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 50

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: protlnds.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 10755.145
Range_Domain_Maximum: 48675296.000

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 490.092
Range_Domain_Maximum: 56694.184

Attribute:

Attribute_Label: Row_id
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 2
Range_Domain_Maximum: 52

Attribute:

Attribute_Label: Protlands
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 756
Range_Domain_Maximum: 867

Attribute:

Attribute_Label: Fwsrefno
Attribute_Definition:
5 digit integer with 1st digit indicating fed, state, priv, easement,etc - polygons sequentially numbered in each category
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 10028
Range_Domain_Maximum: 40089

Attribute:

Attribute_Label: Name
Attribute_Definition: Name of property
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Type
Attribute_Definition:
Easement, Fee Simple, Preserve, SC State Park, National Wildlife Refuge, SC Wildlife Management Area, National Forest, Mitigation Bank, County Park
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Owner
Attribute_Definition:
The name of the person/organization that owns the property. For eaxmple, SC Dept of Natural Resources; U.S. Fish and Wildlife Service; SC Dept of Transportation; SC Dept of Parks; Lowcountry Open Land Trust; Ducks Unlimited; The Nature Conservancy; Edisto Island Open Land Trust, Beaufort Open Land Trust; Charleston Cty Parks & Rec Comm
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Manager
Attribute_Definition: The name of the person/organization that manages the property.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Grantee
Attribute_Definition:
If an easement - holder of easement: The Nature Conservancy, Ducks Unlimited, Lowcountry Open Land Trust, Beaufort Open Land Trust, Lord Berkeley Conserv. Trust; Edisto Island Open Land Trust
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Grantee2
Attribute_Definition: Secondary holder of easement - same list as above
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Acres
Attribute_Definition: The number of acres that the property occupies.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 12021.00

Attribute:

Attribute_Label: Calcacres
Attribute_Definition: As calculated by A/I
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 4.38
Range_Domain_Maximum: 12022.80

Attribute:

Attribute_Label: County
Attribute_Definition: The name of the county in which the property is located.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Focusarea
Attribute_Definition: Focus area protected land falls within
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Quad
Attribute_Definition:
USGS 1:24,000 topographic quadrangle(s) that main area of property appears on
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Source

Attribute_Definition:
Source of polygon data. The name of the organization that provided the polygon data.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Closedate
Attribute_Definition:
Execution (signing) of easement or closing of purchase. Date that the execution of easement or closing of purchase occured
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:
Attribute_Domain_Values:

Unrepresentable_Domain: Numeric field

Attribute:

Attribute_Label: Wetacres
Attribute_Definition:
The number of acres that are inundated with water at some point in time during the day.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 1.03

Attribute:

Attribute_Label: Upacres
Attribute_Definition:
The number of acres that are not inundated with water at some point during the day.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.00
Range_Domain_Maximum: 2.98

Attribute:

Attribute_Label: Lastupdate
Attribute_Definition: The date that the data was last updated.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Numeric field

Attribute:

Attribute_Label: Contact
Attribute_Definition:
The name of the person/organization that should be contacted if questions arise about the property.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Telephone
Attribute_Definition: The telephone number for the contact person/organization.
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Prottype
Attribute_Definition: Protected land classification
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.

Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing

Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:32 2000

1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Turtle Survey coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19970901
Title:
1999 ACE Basin Ecological Characterization: South Carolina Department of Natural Resources Turtle Survey coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:

The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

The Recovery Plan for Marine Turtles (Hopkins and Richardson, 1984) and the Recovery Plan for the U.S. Population of Loggerhead Turtles (USFWS an NWFS, 1991) contain priority tasks to count nests and determine productivity. These data for the Ace Basin were derived from individual nest protection projects carried out by private groups or state personnel from 1981 - 1997. Not all projects were active during this entire time. Project leaders were required to submit annual reports on the numbers of nests laid and the number of hatchlings produced. These should be viewed as minimum numbers. Only projects with consistent coverages were used.

Purpose:

The purpose of these studies was to determine the number of loggerhead turtle nests and hatchlings. The loggerhead turtle is an endangered species and efforts are being made to help the population grow. In order to do this, baseline line numbers must be obtained. Additionally, it will be easier to follow population trends to determine if the efforts are working.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19810000
Ending_Date: 19970000

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: yearly

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.4580
East_Bounding_Coordinate: -80.1948
North_Bounding_Coordinate: 32.5703
South_Bounding_Coordinate: 32.3303

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: Seaturtles
Theme_Keyword: nesting
Theme_Keyword: barrier island
Theme_Keyword: Caretta caretta
Theme_Keyword: Loggerhead turtle

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: Charlotte Hope/Sally Murphy
Publication_Date:
Title:
A History of Research and Management of the Loggerhead Turtle on the South Carolina Coast - Final report to the US Fish and Wildlife Service (in prep)
Edition:
Geospatial_Data_Presentation_Form: none
Publication_Information:

Publication_Place:
Publisher:

Source_Scale_Denominator: 1:24000
Type_of_Source_Media: datasets
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19810519
Ending_Date: 19971017

Source_Currentness_Reference: most recent version

Source_Citation_Abbreviation: none

Source_Contribution: Data provided tables for the GIS data layer.

Process_Step:

Process_Description:
Data was received from Charlotte Hope and the valid effort column was converted from numeric values to text.
Process_Date: 19980828
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
A hardcopy map of the generalized landuse/landcover was produced using the 1989 NWI data. Lines were then draw on the hardcopy map to mark the beaches that were surveyed for sea turtle nests. The lines marking the surveys were then digitized on screen using ARCView 3.0a and linked to the tabluar data.
Process_Date: 19980900
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing

Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Complete chain
Point_and_Vector_Object_Count: 10

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate Pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927

Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: seaturtl.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: none

Attribute:

Attribute_Label: Id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 10

Attribute:

Attribute_Label: Beach_name
Attribute_Definition: Name of beach surveyed
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at [<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>](http://www.csc.noaa.gov/clearinghouse/prodreq_form.html)

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:33 2000

1999 ACE Basin Ecological Characterization: South Carolina Shellfish Permits within the ACE Basin Project Area

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19970901
Title:
1999 ACE Basin Ecological Characterization: South Carolina Shellfish Permits within the ACE Basin Project Area
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:

The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

Shellfish resource surveys have been conducted by the South Carolina Department of Natural Resources (SCDNR), Marine Resources Division (MRD) since 1980. The base maps were USGS 1:24,000-scale quad sheets photo- enlarged to approximately 1:12,000-scale and printed on Mylar. These maps are roughly equivalent to one quarter of a 1:24,000-scale USGS quadrant (i.e. quarter quad). During field surveys, the shellfish resource was mapped by hand onto paper copies of the base maps. After returning to the office, the data were then transferred by hand onto Mylar base maps. Multiple surveys were needed to cover many of the quarter quads, which resulted in multiple resource maps corresponding to the same Geographic area. These maps were condensed into a single base map per quarter quad that contains all of the most recent surveys. Shellfish resources have been mapped in 115 quarter quads along the South Carolina coast. Because these resources have been mapped onto photo-enlarged 1:12,000-scale basemaps, two errors to the data must be compensated for. One error is with the photo-enlargement process which introduces a small amount of distortion to the maps. Although the Mylar base maps were intended to be 1:12,000-scale, this distortion introduces uncertainty to their scale. Secondly, three corners of the enlarged map have coordinates; the three corner positions relate only to how the original negative was divided into quarters. All corner coordinates were identified and labeled before subsequent digitization by the vendor. The Shellfish resource base maps contain data for both shellfish habitat and permit boundaries. Habitat codes identify the type of shellfish habitat(i.e. polygon). A unique collection number is also assigned to each shellfish polygon per quarter quad. This collection number is used to attach additional information that pertains to each individual shellfish habitat polygon. The permit type identifies the type of permit boundary and also includes a permit number as a numeric component. LAW Engineering and Environmental Services completed all digitizing of the base maps. LAW developed and implemented a procedure for data management which is proven successful in efficiently handling large volumes of data and streamlining the overall GIS development process. All of the quarter quads had been previously mapjoined in ArcInfo to create a coverage for the entire state of South Carolina. The data layer for the ACE Basin Project was clipped from the State-wide data layer. To remove any artificial polygon boundaries resulting from map joining and clipping, the ACE Basin coverage was dissolved into two coverages. The first coverage was made by dissolving based on the permit type, the second coverage by dissolving based on the permit number. These two coverages were then joined together. The Shellfish Permit Types are encoded as follows: M =

Mariculture S = State R = Recreational G = Grant C = Culture U = undetermined It should be noted that the shellfish permits issued by SCDNR are continuously changing. The permit boundaries as well as the permit types can change anually or daily.

Purpose:

The shellfish permits and habitat digital datasets were created with the end goal of implementing an automated GIS System at the SCDNR-MRD. The shellfish database will be accessed by SCDNR Shellfish Management Program on a daily basis or as need arise. The digital database will replace the 1:12,000 Mylar base maps. The decision to develop a digital database of shellfish resources was entered in a MOA, effective October 23, 1995, between SCDNR and SCDHEC. The MOA stipulates that DNR will provide DHEC current maps depicting shellfish resource boundaries and management category designations. In turn, DHEC will provide contemporary shellfish water classification to the DNR.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19800000
Ending_Date: 19970901

Currentness_Reference: time period of content ending date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: annually

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.5598
East_Bounding_Coordinate: -80.1916
North_Bounding_Coordinate: 32.6315
South_Bounding_Coordinate: 32.3338

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: shellfish
Theme_Keyword: permits
Theme_Keyword: oyster
Theme_Keyword: mariculture

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River

Place_Keyword: Low Country
Place_Keyword: South Carolina Coast
Place_Keyword: Southeast Coast
Place_Keyword: Atlantic Coast

Access_Constraints: none
Use_Constraints:
Note that the time period of content is a reflection of the shellfish survey/resurvey date. However, the time period of the shellfish data is a reflection of the date of the base map used. For example, resurveys of shellfish maps have been conducted in 1994 this is a true survey of what exists in 1994 at a particular location. The process of hand positioning the 1994 shellfish resources on dated wetlands base maps reveals positional inaccuracies by referencing outdated boundaries for streams and rivers. For these reasons, the positional accuracy may not be well reflected when overlain with more recent data depicting streams, riverbanks, etc.

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.1.1 indicate that arc and node topology exists.
Completeness_Report:
This data set was complete at the time the data layer was created. The features represented within this layer may have changed at a later date as determined by the resource managers.
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set was developed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: SCDNR-MRD
Publication_Date: 19970901
Title: South Carolina Intertidal Oyster Study
Edition: 1997
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC

Publisher: SCDNR-MRD

Source_Scale_Denominator: 12,000
Type_of_Source_Media: Mylar
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19800000
Ending_Date: 19970901

Source_Currentness_Reference: time period of information ending date

Source_Citation_Abbreviation: none
Source_Contribution: Larger data set from which this data set was clipped.

Process_Step:

Process_Description:
This data layer was created using the Arc/Info "clip" command to select the ACE Basin Area from the larger Intertidal Oyster Survey.
Process_Date: 19971202
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The coverage clipped from the South Carolina Oyster Study was then used to create two coverages using the Arc/Info "dissolve" command in order to remove artificial boundaries. One coverage was created by dissolving on the item for the permit number, the other coverage

was created by dissolving on the item for permit type. The two coverages, permit number and permit type, were then joined together using the Arc/Info "union" command to derive this coverage.

Process_Date: 19971202
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 35

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996

Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: sfpermit.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 761.66960
Range_Domain_Maximum: 117903913.38800

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 137.68592
Range_Domain_Maximum: 68267.99535

Attribute:

Attribute_Label: Sfpermitid
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software computed

Attribute:

Attribute_Label: Permnum
Attribute_Definition: shellfish permit number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 188

Attribute:

Attribute_Label: Label
Attribute_Definition: code for shellfish permit type and number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Permtype
Attribute_Definition: shellfish permit type
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: s
Enumerated_Domain_Value_Definition: State
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: r
Enumerated_Domain_Value_Definition: Recreational
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: m
Enumerated_Domain_Value_Definition: Mariculture
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: g
Enumerated_Domain_Value_Definition: grant
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: c
Enumerated_Domain_Value_Definition: Culture
Enumerated_Domain_Value_Definition_Source: User defined.

Enumerated_Domain:

Enumerated_Domain_Value: u
Enumerated_Domain_Value_Definition: Undetermined
Enumerated_Domain_Value_Definition_Source: User defined.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:34 2000

1999 ACE Basin Ecological Characterization: South Carolina Shellfish Waters within the ACE Basin Project Area

Table of Contents

IDENTIFICATION_INFORMATION

```
Citation:
  Citation_Information:
    Originator: South Carolina Department of Natural Resources - Marine
      Resources Division (SCDNR-MRD)
    Publication_Date: 19980106
    Title: 1999 ACE Basin Ecological Characterization: South Carolina
      Shellfish Waters within the ACE Basin Project Area
    Edition:
    Geospatial_Data_Presentation_Form: Map
    Publication_Information:
      Publication_Place: Charleston, SC
      Publisher: National Oceanic and Atmospheric Administration - Coastal
        Services Center (NOAA-CSC)
    Other_Citation_Details:
      The ACE Basin Ecological Characterization is a digital
      source of information, data, and management tools related
      to management of the Ashepoo-Combahee-Edisto River Basin
      region of South Carolina. The ACE Basin is a region of
      diverse ecosystems in a largely undeveloped landscape and
      has received national attention for the quality of its
      natural resources. The challenge of management in the ACE
      Basin is to balance conservation efforts with economic
      growth. The ACE Basin Ecological Characterization provides,
      in an interactive, multi-media format, an interdisciplinary
      synthesis of information about the ACE Basin, including
      physical setting, biological and socioeconomic resources,
      and important ecosystem interactions. Spatial data are
      presented in a geographic information system and may be
      explored interactively. Users of this product may rapidly
      access information about the ACE Basin and explore and
      learn by comparing different management scenarios related
      to the impacts of various land uses on the natural
      resources in the ACE Basin. This product is a tool that
      agencies, local governments, land managers, conservation
      groups, and private citizens can use to understand and
      conserve the unique character of the ACE Basin. This CD-ROM
      was produced by the National Oceanic and Atmospheric
      Administration's coastal Services Center in cooperation
      with the South Carolina Department of Natural Resources,
      NOAA's National Geophysical Data Center, and the
      Corporation for Enterprise Development.
    Online_Linkage:
    Larger_Work_Citation:
      Citation_Information:
        Originator: NOAA-CSC
        Publication_Date: 19990500
        Title: ACE Basin Ecological Characterization
```

Publication_Information:
Publication_Place: Charleston, SC
Publisher: NOAA-CSC
Online_Linkage:
Description:
Abstract:
This layer contains a polygon coverage representing the shellfish classification along the coast area of South Carolina. This coverage was generated by assigning harvest classification attributes to 1:24000 National Wetland Inventory (NWI) coverages.
Purpose:
The shellfish permits and habitat digital datasets were created with the end goal of implementing an automated GIS System at the SCDNR-MRD. The shellfish database will be accessed by SCDNR Shellfish Management Program on a daily basis or as need arise. The digital database will replace the 1:12,000 Mylar base maps. The decision to develop a digital database of shellfish resources was entered in a MOA, effective October 23, 1995, between SCDNR and SCDHEC. The MOA stipulates that DNR will provide DHEC current maps depicting shellfish resource boundaries and management category designations. In turn, DHEC will provide contemporary shellfish water classification to the DNR.
Supplemental_Information:
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 19950000
Ending_Date: 19980000
Currentness_Reference: time period of content ending date
Status:
Progress: Complete
Maintenance_and_Update_Frequency: Annually
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -80.7456
East_Bounding_Coordinate: -80.1790
North_Bounding_Coordinate: 32.7072
South_Bounding_Coordinate: 32.3233
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: shellfish
Theme_Keyword: harvetsting
Theme_Keyword: oyster
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: Ashepoo River
Place_Keyword: Edisto River
Place_Keyword: Combahee River
Place_Keyword: ACE Basin
Place_Keyword: South Carolina Coast
Place_Keyword: Atlantic Coast
Access_Constraints:
none
Use_Constraints:
Shellfish water classifications are updated annually, so classes shown here may not be indicative of current conditions.
Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: South Carolina Department of Natural Resources' Marine Resource Research Institute
Contact_Person:
Contact_Position: GIS Manager
Contact_Address:
Address_Type: mailing and physical address
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA
Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us

Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time
Native_Data_Set_Environment:
ArcView version 3.2 shapefile format
i:\lcr\acebasin\cd_gis\res_mgmt\sfwaters.shp

Top

DATA_QUALITY_INFORMATION

Attribute_Accuracy:
Attribute_Accuracy_Report:
Coverage was reviewed by SCDNR and NOAA-CSC personnel
Logical_Consistency_Report:
The data in this data set are topologically consistent.
Post processing performed in ArcInfo Version 7.1.1 indicate
that arc and node topology exists.
Completeness_Report:
This data set was complete at the time the data layer was
created. The features represented within this layer may
have changed at a later date as determined by the resource managers.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report:
This data set was developed to meet National Map Accuracy Standards.
Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report:
none
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: SCDNR-MRD
Publication_Date: 199800000
Title: Shellfisf Classifiction
Edition: 1998
Geospatial_Data_Presentation_Form: map
Publication_Information:
Publication_Place: Scharleston, SC
Publisher: SCDNR-MRD
Other_Citation_Details:
Online_Linkage:
Larger_Work_Citation:
Citation_Information:
Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Characterization
Publication_Information:
Publication_Place: Charleston, SC
Publisher: NOAA-CSC
Online_Linkage:
Source_Scale_Denominator: 24000
Type_of_Source_Media:
Source_Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 19950000
Ending_Date: 19980000
Source_Currentness_Reference: time period of content ending date
Source_Citation_Abbreviation:
Source_Contribution:
Process_Step:
Process_Description:
Source_Used_Citation_Abbreviation:
Process_Date:
Source_Produced_Citation_Abbreviation:
Process_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Organization: South Carolina Department of Natural Resources' Marine

```
        Resource Research Institute
      Contact_Person:
    Contact_Position: GIS Manager
    Contact_Address:
      Address_Type: mailing and physical address
      Address: Box 12559
      City: Charleston
      State_or_Province: SC
      Postal_Code: 29422
      Country: USA
    Contact_Voice_Telephone: 843-762-5000
    Contact_Facsimile_Telephone: 843-762-5110
    Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
    Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time
```

Top

SPATIAL_DATA_ORGANIZATION_INFORMATION

```
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
  SDTS_Terms_Description:
    SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
    Point_and_Vector_Object_Count: 126
```

Top

SPATIAL_REFERENCE_INFORMATION

```
Horizontal_Coordinate_System_Definition:
  Planar:
    Grid_Coordinate_System:
      Grid_Coordinate_System_Name: Universal Transverse Mercator
      Universal_Transverse_Mercator:
        UTM_Zone_Number:  17
        Transverse_Mercator:
          Scale_Factor_at_Central_Meridian: 0.999600
          Longitude_of_Central_Meridian: -81.000000
          Latitude_of_Projection_Origin: 0.000000
          False_Easting: 500000.000000
          False_Northing: 0.000000
    Planar_Coordinate_Information:
      Planar_Coordinate_Encoding_Method: Coordinate pair
      Coordinate_Representation:
        Abscissa_Resolution:
        Ordinate_Resolution:
      Planar_Distance_Units: Meters
  Geodetic_Model:
    Horizontal_Datum_Name: North American Datum of 1927
    Ellipsoid_Name: Clarke 1866
    Semi-major_Axis: 6378206.4000000
    Denominator_of_Flattening_Ratio: 294.98
```

Top

ENTITY_AND_ATTRIBUTE_INFORMATION

Detailed_Description:
  Entity_Type:
    Entity_Type_Label: sfwaters.dbf
    Entity_Type_Definition: Shapefile Attribute Table
    Entity_Type_Definition_Source: None
  Attribute:
    Attribute_Label: Area
    Attribute_Definition: Area of polygon
    Attribute_Definition_Source: Software generated
    Attribute_Domain_Values:
      Unrepresentable_Domain:
        Software computed
  Attribute:
    Attribute_Label: Perimeter
    Attribute_Definition: Perimeter of polygon
    Attribute_Definition_Source: Software generated
    Attribute_Domain_Values:
      Unrepresentable_Domain:
        Software computed
  Attribute:
    Attribute_Label: Sf_area
    Attribute_Definition: Area of polygon
    Attribute_Definition_Source: Software generated
    Attribute_Domain_Values:
      Unrepresentable_Domain:
        Software computed
  Attribute:
    Attribute_Label: Sfclass_
    Attribute_Definition: Internal feature number
    Attribute_Definition_Source:
    Attribute_Domain_Values:
      Range_Domain:
        Range_Domain_Minimum: 2
        Range_Domain_Maximum: 127
  Attribute:
    Attribute_Label: Sfclass_id
    Attribute_Definition: Internal feature number
    Attribute_Definition_Source:
    Attribute_Domain_Values:
      Range_Domain:
        Range_Domain_Minimum: 472
        Range_Domain_Maximum: 885
  Attribute:
    Attribute_Label: Harvest
    Attribute_Definition: DHEC water quality designation
    Attribute_Definition_Source:
    Attribute_Domain_Values:
      Enumerated_Domain:
        Enumerated_Domain_Value: no
        Enumerated_Domain_Value_Definition: water not approved for shellfishing
        Enumerated_Domain_Value_Definition_Source: user defined
        Enumerated_Domain_Value: yes
        Enumerated_Domain_Value_Definition: water approved for shellfishing
        Enumerated_Domain_Value_Definition_Source: user defined
  Attribute:
    Attribute_Label: C1995
    Attribute_Definition: shellfish harvest classfication 1995
    Attribute_Definition_Source:
    Attribute_Domain_Values:
      Enumerated_Domain:
        Enumerated_Domain_Value:
        Enumerated_Domain_Value_Definition:
        Enumerated_Domain_Value_Definition_Source:
        Enumerated_Domain_Value: A
        Enumerated_Domain_Value_Definition: approved
        Enumerated_Domain_Value_Definition_Source: user defined
        Enumerated_Domain_Value: P
        Enumerated_Domain_Value_Definition: prohibited
        Enumerated_Domain_Value_Definition_Source: user defined
        Enumerated_Domain_Value: R
        Enumerated_Domain_Value_Definition: restricted
        Enumerated_Domain_Value_Definition_Source: user defined
  Attribute:
    Attribute_Label: C1996
                          shellfish harvest classification 1996

Attribute_Definition:
Attribute_Definition_Source:
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value:
Enumerated_Domain_Value_Definition:
Enumerated_Domain_Value_Definition_Source:
Enumerated_Domain_Value: A
Enumerated_Domain_Value_Definition: approved
Enumerated_Domain_Value_Definition_Source: user defined
Enumerated_Domain_Value: P
Enumerated_Domain_Value_Definition: prohibited
Enumerated_Domain_Value_Definition_Source: user defined
Enumerated_Domain_Value: R
Enumerated_Domain_Value_Definition: restricted
Enumerated_Domain_Value_Definition_Source: user defined
Attribute:
Attribute_Label: Ud9596
Attribute_Definition: Change from 1995 to 1996
Attribute_Definition_Source:
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: C1997
Attribute_Definition: Shellfish harvest classification 1997
Attribute_Definition_Source:
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value:
Enumerated_Domain_Value_Definition:
Enumerated_Domain_Value_Definition_Source:
Enumerated_Domain_Value: A
Enumerated_Domain_Value_Definition: approved
Enumerated_Domain_Value_Definition_Source: user defined
Enumerated_Domain_Value: CA
Enumerated_Domain_Value_Definition: conditionally approved
Enumerated_Domain_Value_Definition_Source: user defined
Enumerated_Domain_Value: P
Enumerated_Domain_Value_Definition: prohibited
Enumerated_Domain_Value_Definition_Source: user defined
Enumerated_Domain_Value: R
Enumerated_Domain_Value_Definition: restricted
Enumerated_Domain_Value_Definition_Source: user defined
Attribute:
Attribute_Label: Ud9697
Attribute_Definition: change from 1996 to 1997
Attribute_Definition_Source:
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: C1998
Attribute_Definition: Shellfish harvest classification 1998
Attribute_Definition_Source:
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value:
Enumerated_Domain_Value_Definition:
Enumerated_Domain_Value_Definition_Source:
Enumerated_Domain_Value: A
Enumerated_Domain_Value_Definition: approved
Enumerated_Domain_Value_Definition_Source: user defined
Enumerated_Domain_Value: CA
Enumerated_Domain_Value_Definition: conditionally approved
Enumerated_Domain_Value_Definition_Source: user defined
Enumerated_Domain_Value: P
Enumerated_Domain_Value_Definition: prohibited
Enumerated_Domain_Value_Definition_Source: user defined
Enumerated_Domain_Value: R
Enumerated_Domain_Value_Definition: restricted
Enumerated_Domain_Value_Definition_Source: user defined
Attribute:
Attribute_Label: Ud9798
Attribute_Definition: change from 1997 to 1998
Attribute_Definition_Source:

Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Mgmt
Attribute_Definition: Management District
Attribute_Definition_Source:
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: LC
Enumerated_Domain_Value_Definition: Low County
Enumerated_Domain_Value_Definition_Source: user defined
Enumerated_Domain_Value: TRI
Enumerated_Domain_Value_Definition: Trident
Enumerated_Domain_Value_Definition_Source: user defined
Attribute:
Attribute_Label: Number
Attribute_Definition: polygon number relating to nonpoint source application
Attribute_Definition_Source:
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 472
Range_Domain_Maximum: 885
Attribute:
Attribute_Label: Acres
Attribute_Definition: Area measurement
Attribute_Definition_Source:
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0.17
Range_Domain_Maximum: 54183.6
Attribute:
Attribute_Label: Descrip
Attribute_Definition: Polygon description relating to nonpoint source application
Attribute_Definition_Source:
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Closecau
Attribute_Definition: Reason for closure
Attribute_Definition_Source:
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value:
Enumerated_Domain_Value_Definition:
Enumerated_Domain_Value_Definition_Source:
Enumerated_Domain_Value: Admin
Enumerated_Domain_Value_Definition: Administrative issue
Enumerated_Domain_Value_Definition_Source: user defined
Enumerated_Domain_Value: Admin-PS
Enumerated_Domain_Value_Definition: Mixed
Enumerated_Domain_Value_Definition_Source: user defined
Enumerated_Domain_Value: NPS
Enumerated_Domain_Value_Definition: Nonpoint Source Pollution
Enumerated_Domain_Value_Definition_Source: user defined

Top

DISTRIBUTION_INFORMATION

Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)
Contact_Person:
Contact_Position:
Contact_Address:
Address_Type: mailing and physical address
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559

City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA
Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110 843-762-5110
843-762-5110
843-762-5110
843-762-5110

Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time
Resource_Description:
Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-ROM.

Top

METADATA_REFERENCE_INFORMATION

Metadata_Date: 20000317 20001207

Metadata_Review_Date: 20001207
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: South Carolina Department of Natural Resources' Marine Resource Research Institute
Contact_Person:
Contact_Position: GIS Manager
Contact_Address:
Address_Type: Mailing and physical address
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA
Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us wennere@mrd.dnr.state.sc.us
wennere@mrd.dnr.state.sc.us

Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time
Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998
Top

1999 ACE Basin Ecological Characterization: Shellfish Habitat coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19970901
Title:
1999 ACE Basin Ecological Characterization: Shellfish Habitat coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse

ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

Shellfish resource surveys have been conducted by the South Carolina Department of Natural Resources (SCDNR), Marine Resources Division (MRD) since 1980. The base maps were USGS 1:24,000-scale quad sheets photo- enlarged to approximately 1:12,000-scale and printed on Mylar. These maps are roughly equivalent to one quarter of a 1:24,000-scale USGS quadrant (i.e. quarter quad). During field surveys, the shellfish resource was mapped by hand onto paper copies of the base maps. After returning to the office, the data were then transferred by hand onto Mylar base maps. Multiple surveys were needed to cover many of the quarter quads, which resulted in multiple resource maps corresponding to the same geographic area. These maps were condensed into a single base map per quarter quad that contains all of the most recent surveys. Shellfish resources have been mapped in 115 quarter quads along the South Carolina coast. Because these resources have been mapped onto photo-enlarged 1:12,000-scale basemaps, two errors to the data must be compensated for. One error is with the photo-enlargement process which introduces a small amount of distortion to the maps. Although the Mylar base maps were intended to be 1:12,000-scale, this distortion introduces uncertainty to their scale. Secondly, three corners of the enlarged map have coordinates; the three corner positions relate only to how the original negative was divided into quarters. All corner coordinates were identified and labeled before subsequent digitization by the vendor. The Shellfish resource base maps contain data for both shellfish habitat and permit boundaries. Habitat codes identify the type of shellfish habitat(i.e. polygon). A unique collection number is also assigned to each shellfish polygon per quarter quad. This collection number is used to attach additional information that pertains to each individual shellfish habitat polygon. The permit type identifies the type of permit boundary and also includes a permit number as a numeric component. LAW Engineering and Environmental Services completed all digitizing of the base maps. LAW developed and implemented a procedure for data management which is proven successful in efficiently handling large volumes of data and streamlining the overall GIS development process. All of the quarter quads had been previously mapjoined in ArcInfo to create a coverage for the entire state of South Carolina. The data layer for the ACE Basin Project was clipped from the State-wide data layer. To remove any artificial polygon boundaries resulting from map joining and clipping, the coverage was dissolved on the "habcode" item. The "habcode" items represents the oyster habitat found at that location and is encoded as follows: intoybed = intertidal oyster bed smintbed = two or more intertidal oyster beds intoyflat = intertidal oyster flat unhoyrr = intertidal oysters on rip-rap acwshell = washed shell accumulation It should be noted that the shellfish permits issued by SCDNR are continuously changing. The permit boundaries as well as the permit types can change anually.

Purpose:

The shellfish permits and habitat digital datasets were created with the end goal of implementing an automated GIS System at the SCDNR-MRD. The shellfish database will be accessed by SCDNR Shellfish Management Program on a daily basis or as need arise. The digital database will replace the 1:12,000 Mylar base maps. The decision to develop a digital database of shellfish resources was entered in a MOA, effective October 23, 1995, between SCDNR and SCDHEC. The MOA stipulates that DNR will provide DHEC current maps depicting shellfish resource boundaries and management category designations. In turn, DHEC will provide contemporary shellfish water classification to the DNR.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19800000
Ending_Date: 19960000

Currentness_Reference: time period of content ending date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.7232
East_Bounding_Coordinate: -80.1966
North_Bounding_Coordinate: 32.6248
South_Bounding_Coordinate: 32.3347

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: shellfish
Theme_Keyword: oyster
Theme_Keyword: habitat

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo
Place_Keyword: Edisto
Place_Keyword: Combahee
Place_Keyword: Low Country
Place_Keyword: South Carolina Coast
Place_Keyword: Southeast Coast
Place_Keyword: Atlantic Coast

Access_Constraints: none
Use_Constraints:
Note that the time period of content is a reflection of the shellfish survey/resurvey date. However, the time period of the shellfish data is a reflection of the date of the base map used. For example, resurveys of shellfish maps have been conducted in 1994 this is a true survey of what exists in 1994 at a particular location. The process of hand positioning the 1994 shellfish resources on dated wetlands base maps reveals positional inaccuracies by referencing outdated boundaries for streams and rivers. For these reasons, the positional accuracy may not be well reflected when overlain with more recent data depicting streams, riverbanks, etc.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.1.1 indicate that arc and node topology exists.
Completeness_Report:
This data set was complete at the time the data layer was created.
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set was developed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: SCDNR-MRD
Publication_Date: 19970901
Title: South Carolina Intertidal Oyster Study
Edition: 1997
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher: SCDNR-MRD

Source_Scale_Denominator: 12,000
Type_of_Source_Media: Mylar
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19800000
Ending_Date: 19970901

Source_Currentness_Reference: time period of information ending date

Source_Citation_Abbreviation: none
Source_Contribution: Larger data set from which this data set was clipped.

Process_Step:

Process_Description:
This data set for the ACE Basin was clipped from the South Carolina Intertidal Oyster Survey using the ArcInfo "clip" command with the study boundary for the ACE Basin Ecological Characterization.
Process_Date: 19971202
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 1867

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: sf_hab.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.39189
Range_Domain_Maximum: 913805.95673

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 6.73360
Range_Domain_Maximum: 6240.88225

Attribute:

Attribute_Label: Sfhabitat_
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 1867

Attribute:

Attribute_Label: Habcode
Attribute_Definition: Code for the oyster habitat or bed type

Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Habitat
Attribute_Definition: Describes the oyster habitat or bed type
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:33 2000

1999 ACE Basin Ecological Characterization: Marine Resources Division water quality database coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Marine Resources Division water quality database coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-

Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:

STORET is EPA's primary water quality data system containing information on both surface and ground water. STORET was first developed by the U.S. Public Health Service in 1964 to collect and disseminate basic information on chemical, physical, and biological quality of the nation's waters. Today, EPA's STORET is applicable to programs initiated under the Federal Water Pollution Control Act. STORET is also applicable to programs initiated under the Toxic Substances Control Act (TSCA) and Resource Conservation and Recovery Act (RCRA), and to the functions of the Office of Ground Water and Drinking Water. STORET is a repository of waterway parametric data, including information on ambient, intensive survey, effluent, and biological water quality of the waterways within and contiguous to the United States. There are 11 files within STORET: REACH, Industrial Facilities Discharge file (IFD), Drinking Water, Gage, Biological Data System (BIOS), Daily Flow System (DFS), Water Quality System (WQS), Parameter, City, County, and Fish Kills (FK). Descriptions of the major files within STORET follow: * BIOS contains information on sites or samples collected at sites concerning the distribution, abundance, and physical condition of aquatic organisms in waters within and contiguous to the United States, as well as descriptions of their habitats. * DFS contains daily observations of stream flow and miscellaneous water quality parameters collected at gauging stations belonging to the U.S. Geological Survey's national network. * WQS contains information on monitoring site location and sample data from monitoring events (primarily physical and chemical). In 1990 the Environmental Protection Agency began a Water Systems Modernization process to better serve its user community. The scope of this process encompasses STORET, BIOS, ODES (the Ocean Data Evaluation System), and WQAS (the Water Quality Analysis System). The functionality of those systems will be combined into a new modernized system referred to as STORET X. Modernization is expected to be conducted in five steps and completed by 1997. In 1998, The South Carolina Department of Natural Resources compiled a database containing all of the readily available contaminant data for coastal South Carolina. This database includes 1994 and 1995 EMAP (Environmental Monitoring and Assessment Program) data, 1994 - 1996 NOAA/NERR (National Estuarine Research Reserve) ACE Basin data, and 1975 - 1996 STORET data compiled by EarthInfo. From this database, a subset of data was extracted that included solely information on sites within the ACE Basin. The data was compiled into an Excel table. This table was imported into ArcView and was linked to the acestoret attribute table using the Agency_code field. The attributes for these tables are listed in the attribute section of the metadata.

Purpose:
This database provides access to contaminant and water data for coastal South Carolina. This type of data is often useful when conducting surveys or determining the health of a particular watershed. The compilation of this type of data into one database facilitates research.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19750000
Ending_Date: 19960000

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0528
East_Bounding_Coordinate: -80.1850
North_Bounding_Coordinate: 32.9989
South_Bounding_Coordinate: 32.3368

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: STORET
Theme_Keyword: Water Quality
Theme_Keyword: Pollutants
Theme_Keyword: Contaminants

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report: This is an ARC/Info point coverage
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: John Jones
Publication_Date:
Title: none
Edition: none
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place:
Publisher:

Source_Scale_Denominator: 24000
Type_of_Source_Media: database
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19750000
Ending_Date: 19960000

Source_Currentness_Reference: most recent version

Source_Citation_Abbreviation: none
Source_Contribution: Data provided tables for the GIS data layer.

Process_Step:

Process_Description:
Data, including South Carolina STORET data, South Carolina EMAP (Environmental Monitoring and Assessment Program), and NOAA/NERR (National Estuarine Research Reserve), were compiled into one database. From this database, data on ACE Basin sites were extracted and entered into their own database.
Process_Date: 19980800
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:

The EPA STORET database was converted from the CD-ROM to a Microsoft Access database containing stations located in the South Carolina Coastal Counties.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
Longitude and latitude coordinates for each STORET station were taken from the MS Access database and put into a delimited text file. The text file was then brought into MS Excel and the stations given a new ID number. The ID number, longitude, and latitude were then saved as a new text file that was used with the ArcInfo "generate" command to create a point coverage.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422

Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The point coverage was then converted to the UTM projection using the ArcInfo "project" command. The ungenrate command was then used to add UTM coordinates to the MS Acces Storet database.
Process_Date: 19980400
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The Storet point coverage (in UTM) was then brought into ArcView and query was performed to select those points within the ACE Basin Characterization. The points were coded in ArcView and then reselected in ArcInfo to create a coverage of just those stations within the ACE. The tabular data was then joined to the ACE Basin Storet database.
Process_Date: 19981000
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource

Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
The storet point data was clipped to the ACE characterization boundary using the clip command in ArcInfo. Additional storet station data was then joined to the attribute table using the join tool in ArcView. Any overlapping or unnecessary fields were removed from the attribute table. The shapefile was then converted to a coverage using the shapearc command in ArcInfo.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 306

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: storet.dbf
Entity_Type_Definition: Point Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Acestoret_
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 306

Attribute:

Attribute_Label: Station_co
Attribute_Definition: station name
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Location
Attribute_Definition: general location
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Latitude
Attribute_Definition: latitude in decimal degrees
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Longitude
Attribute_Definition: longitude in decimal degrees
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Gis_id
Attribute_Definition: Number assigned to stations for creation of GIS database
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 311

Attribute:

Attribute_Label: Agency_cod
Attribute_Definition: code used to identify specific agencies
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Huc
Attribute_Definition: Hydrologic Unit Code
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Longitude2
Attribute_Definition: longitude (D M S)
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Latitude2
Attribute_Definition: latitude (D M S)
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Precision
Attribute_Definition: precision of measurement
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Full_agenc
Attribute_Definition: full name of agency
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Agency_sho_
Attribute_Definition: short name of the agency
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Telephone
Attribute_Definition: telephone number for the contact at the agency
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Contact
Attribute_Definition: name of the contact person
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Division_b
Attribute_Definition: the division responsible for the data
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Street_add
Attribute_Definition: street address for the agency
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: City_stat
Attribute_Definition: the city and state the agency is in
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Detailed_Description:

Entity_Type:

Entity_Type_Label: stortlnk.dbf
Entity_Type_Definition: Link table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Agency_cod
Attribute_Definition: agency code
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Station_co
Attribute_Definition: station code
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Date
Attribute_Definition: date of sample
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Time
Attribute_Definition: time sample was taken
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 51
Range_Domain_Maximum: 1635

Attribute:

Attribute_Label: Parameter_
Attribute_Definition: parameter being measured or sampled
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Group_name
Attribute_Definition: name assigned to classify parameter into groups
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Rep_depth
Attribute_Definition: replicate depth
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 99999

Attribute:

Attribute_Label: Rep
Attribute_Definition: replicate name
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Value
Attribute_Definition: measured amount
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.000000000
Range_Domain_Maximum: 941212.000000000

Attribute:

Attribute_Label: Units
Attribute_Definition: units of measurement
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Analysis_m
Attribute_Definition: analysis method
Attribute_Definition_Source: User Defined

Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Detection_
Attribute_Definition: detection limits
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Erl_tel
Attribute_Definition: effects range low
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Erm_pel
Attribute_Definition: effects range medium
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Remark
Attribute_Definition: comments
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston

State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:35 2000

1999 ACE Basin Ecological Characterization: Commercial shrimp trawling boundary

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: South Carolina Department of Natural Resources
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: Commercial shrimp trawling boundary
Edition: 1st
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Description:

Abstract:
This data set identifies the spatial location of the commercial shrimp trawling boundary. Identification of the boundary is spelled out in South Carolina department of Natural Resources - Marine Resources Division - Summary of Commercial Shrimp Trawling Laws, Seasons and Trawling Areas.
Purpose:
This data set was developed to identify a digital administrative boundary that locates the legal boundary for Commercial Shrimp Trawling in the ACE characterization area.
Supplemental_Information: none to report

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Currentness_Reference: Publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.4564
East_Bounding_Coordinate: -80.1642
North_Bounding_Coordinate: 32.5630
South_Bounding_Coordinate: 32.3317

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: administrative boundaries
Theme_Keyword: commercial shrimp trawling

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: South Carolina

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina department of natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no repsonsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: ArcView version 3.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Data set is complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: SCDNR
Publication_Date: 19990500
Title: Trawl boundary line within the ACE characterization area
Edition: 1st
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center

Other_Citation_Details: none
Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Source_Scale_Denominator: 24000
Type_of_Source_Media: cd-rom
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: provided data layer

Process_Step:

Process_Description:
Data layer was digitized based upon existing data layer which exists on Otter Island Ecological Characterization cd-rom. The boundary was extended to include areas beyond Otter Island based on information in South Carolina Department of Natural Resources - Marine Resources Division - Summary of Commercial Shrimp Trawling Laws, Seasons and Trawling Areas.
Process_Date: 19990115
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Complete Chain
Point_and_Vector_Object_Count: 1

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -81.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4000000
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: trawlbnd.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Id
Attribute_Definition: feature identification number
Attribute_Definition_Source: user identified
Attribute_Domain_Values:

Unrepresentable_Domain: Numeric Field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:35 2000

1999 ACE Basin Ecological Characterization: ACE Basin Ecological Characterization Boundary coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19970901
Title:
1999 ACE Basin Ecological Characterization: ACE Basin Ecological Characterization Boundary coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-

Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
This is a single polygon that represents the boundary of the ACE Basin Ecologiclal Characterization Project. The boundary was delineated based on two data sources. The first is a "preliminary" hydrologic units for the State of South Carolina by the USGS. The second data source was a boundary being used by the ACE Basin Task Force. The inland portions of the project boundary follow the 14 digit hydrologic units. Near the coast, a compromise was made to include the boundary of the ACE Basin Task force. This area is also where the water shed boundaries breakdown due to the network of tidal creeks and influence of the tides.

Purpose:
To delineate the ACE Basin Ecological Characterization Study Area or project boundary.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19971000
Ending_Date: present

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0724
East_Bounding_Coordinate: -80.1525
North_Bounding_Coordinate: 33.1211

South_Bounding_Coordinate: 32.3038

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: ACE Basin
Theme_Keyword: boundary
Theme_Keyword: study area

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: South Carolina Coast
Place_Keyword: Southeast Coast
Place_Keyword: Atlantic Coast

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.1.1 indicate that arc and node topology exist.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: None to report.

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: SCDNR-MRD
Publication_Date: 19971101
Title: ACE Basin Ecological Characterization Project Boundary
Edition: 1997
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher: SCDNR-MRD

Source_Scale_Denominator: 24,000
Type_of_Source_Media: digital
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19911101
Ending_Date: present

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: delineates study area boundary

Process_Step:

Process_Description:
The 14 digit HUC's for the two basins (SALED and SAVBAS)within the study area were map joined and the polygons composing the study area were selected and "put" (ArcEdit)into a coverage. That coverage was then joined using the ArcInfo "union" command with the ACE Basin Task Force Boudary. The necessary arcs were then selected from the joined coverage to delineate the ACE Basin Ecological Characterization Project Boundary.
Process_Date: 19971101
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC

Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 1

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: acebound.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Aceboundid
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC

Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:53 2000

1999 ACE Basin Ecological Characterization: 1:100,000-scale County coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD)
Publication_Date: 19990501
Title:
1999 ACE Basin Ecological Characterization: 1:100,000-scale County coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990501
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information,

data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
This 1:100,000-scale coverage contains county boundaries for the five counties that contain the ACE Basin Ecological characterization boundary.
Purpose:
This coverage is used to show the location of the ACE Basin Ecological Characterization boundary referenced to the local county boundaries.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970000
Ending_Date: 19980000

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.6610
East_Bounding_Coordinate: -80.2093
North_Bounding_Coordinate: 32.6689
South_Bounding_Coordinate: 32.3265

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: county
Theme_Keyword: boundary
Theme_Keyword: local
Theme_Keyword: political

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE
Place_Keyword: Charleston
Place_Keyword: Beaufort
Place_Keyword: Colleton
Place_Keyword: Dorchester
Place_Keyword: Hampton
Place_Keyword: South Carolina
Place_Keyword: Southeast
Place_Keyword: Atlantic

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibilty and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: None to report.

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: SCDNR
Publication_Date: Unknown
Title: South Carolina 1:100,000 Scale County Boundaries
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Columbia,SC
Publisher: SCDNR

Source_Scale_Denominator: 100,000
Type_of_Source_Media: 8mm tape
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: Unknown
Ending_Date: Unknown

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: as needed
Source_Contribution: Larger data set from which coverage was selected.

Process_Step:

Process_Description:
Data set was not changed by the South Carolina Department of Natural Resources GIS

department.

Process_Date:

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 647

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: cnty100k.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 313.734
Range_Domain_Maximum: 2653209088.000

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 81.543
Range_Domain_Maximum: 492946.844

Attribute:

Attribute_Label: cnty100k_
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computedAttribute_Domain_Values:
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: cnty100k_i
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Fipc
Attribute_Definition: FIP code
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Numeric field

Attribute:

Attribute_Label: Cntyname
Attribute_Definition: name of county
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:54 2000

1999 ACE Basin Ecological Characterization: ACE NERR Boundary coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division
Publication_Date: 19980400
Title:
1999 ACE Basin Ecological Characterization: ACE NERR Boundary coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990501
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention

for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
This coverage is used to delineate the ACE (Ashepoo River, Combahee River, and Edisto River) National Estuarine Research Reserve boundary. The coverage was created by the Westvaco Corporation with guidance from ACE NERR personnel.
Purpose: To delineate the ACE NERR boundary.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19960000
Ending_Date: 19970000

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.6610
East_Bounding_Coordinate: -80.2093
North_Bounding_Coordinate: 32.6689
South_Bounding_Coordinate: 32.3265

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: ACE
Theme_Keyword: NERR
Theme_Keyword: boundary
Theme_Keyword: research
Theme_Keyword: estuary
Theme_Keyword: reserve

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE
Place_Keyword: Edisto
Place_Keyword: Ashepoo
Place_Keyword: Combahee
Place_Keyword: South Carolina
Place_Keyword: Southeast
Place_Keyword: Atlantic
Place_Keyword: estuary

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set was developed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: None to report.

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: Protected Areas Geographic Information System (PAGIS) Team
Publication_Date: 19990200
Title: ACE Basin National Estuarine Research Reserve Base Data Layers
Edition: none
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Charleston
Publisher: NOAA-CSC

Source_Scale_Denominator: 24000
Type_of_Source_Media: CDROM
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19990200
Ending_Date: 19990200

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: provided CDROM containing NERR Boundary data layer

Process_Step:

Process_Description:
Revised NERR boundary data layer was obtained in CDROM format from the Protected Areas Geographic Information System (PAGIS) Team at the National Oceanic and Atmospheric

Administration Coastal Services Center. This data layer was then adapted. A new field was added to aid in dissolving extraneous polygons in the layer. The dissolve command in the geoprocessing extension was then used to create a single outline polygon depicting the extent of the NERRR boundary. This dissolved layer was converted to a shapefile named "nerrbndy." All unnecessary fields were then deleted.

Process_Date: 19990420
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 1

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17

Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: nerrbndy.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 569343651.5
Range_Domain_Maximum: 569343651.5

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at

<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:54 2000

1999 ACE Basin Ecological Characterization: ACE Basin Task Force Boundary

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: SCDNR-MRD
Publication_Date: 19970000
Title:
1999 ACE Basin Ecological Characterization: ACE Basin Task Force Boundary
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990501
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE

Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
This coverage delineates the ACE Basin Task Force Boundary. This is a political boundary used to delineate the ACE Basin and the primary focus of the ACE Basin Task Force. Westvaco Corp. delineated the boundary with guidance from ACE Basin personnel. The boundary is based on major roads within the area.
Purpose: To delineate the ACE Basin Task Force Boundary.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 1996
Ending_Date: 1997

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0085
East_Bounding_Coordinate: -80.1607
North_Bounding_Coordinate: 32.9149
South_Bounding_Coordinate: 32.3176

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: ACE
Theme_Keyword: Task Force
Theme_Keyword: boundary

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE
Place_Keyword: Ashepoo
Place_Keyword: Combahee
Place_Keyword: Edisto
Place_Keyword: South Carolina
Place_Keyword: Southeast
Place_Keyword: Atlantic
Place_Keyword: NERR

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibilty and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:

The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.

Completeness_Report: Complete

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set was developed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: None to report.

Lineage:

Process_Step:

Process_Description: Unknown
Process_Date: Unknown

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 1

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair

Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: taskbndy.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at [<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>](http://www.csc.noaa.gov/clearinghouse/prodreq_form.html)

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:05:55 2000

1999 ACE Basin Ecological Characterization: United States Geological Survey Airports coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Jeff Trudnak
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: United States Geological Survey Airports coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention

for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
This 1:24000 scale coverage contains airport coordinates identified in USGS DLGs. The data set covers the ACE ecological characterization area.

Purpose:
DLGs depict information about geographic features on or near the surface of the Earth, terrain, and political and administrative units. These data were collected as part of the National Mapping Program. The addition of the airports to this layer is designed to show the airports in relation to geographic features.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Currentness_Reference: Publication Date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0724
East_Bounding_Coordinate: -80.1525
North_Bounding_Coordinate: 33.1211
South_Bounding_Coordinate: 32.3038

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: airports

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: South Carolina Coast
Place_Keyword: Southeast Coast
Place_Keyword: Atlantic Coast

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info version 7.2.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:

The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.

Completeness_Report: Data set is complete

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: NONE

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator:
National Mapping Division U.S. Geological Survey

Publication_Date: Unknown

Title: Airport coordinates derived from 1:24000 USGS DLGs

Geospatial_Data_Presentation_Form: map

Publication_Information:

Publication_Place: Reston, VA

Publisher: U.S. Geological Survey

Source_Scale_Denominator: 24000

Type_of_Source_Media: magnetic tape

Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: Unknown

Ending_Date: Unknown

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none

Source_Contribution: Provided dlg data layers for ACE characterization

Process_Step:

Process_Description:
Mapjoined dlg coverages using ArcInfo. Mapjoined coverages were then clipped to the ACE Basin boundary. Larger dlg coverages were then split into three basins.

Process_Date: 19981100

Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Complete Chain
Point_and_Vector_Object_Count: 8

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: airports.dbf
Entity_Type_Definition: Arc Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Length
Attribute_Definition: Length of line
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 434.65522
Range_Domain_Maximum: 9717.17255

Attribute:

Attribute_Label: Acebn88apt
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Acebn88apt
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Aptname
Attribute_Definition: Name of airport
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address

Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:16 2000

1999 ACE Basin Ecological Characterization: United States Geological Survey Municipalities coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Jeff Trudnak
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: United States Geological Survey Municipalities coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention

for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
This 1:24000 scale coverage depicts the three municipalities that fall within the ACE Basin as identified in USGS DLGs.<cr>

Purpose:
DLGs depict information about geographic features on or near the surface of the Earth, terrain, and political and administrative units. These data were collected as part of the National Mapping Program. Municipalities that fall within the ACE were included as part of this data layer.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Currentness_Reference: Publication Date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.8653
East_Bounding_Coordinate: -80.4638
North_Bounding_Coordinate: 32.9527
South_Bounding_Coordinate: 32.6722

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: hydrography
Theme_Keyword: municipalities

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: South Carolina Coast
Place_Keyword: Southeast Coast
Place_Keyword: Atlantic Coast

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment:
Arc/Info version 7.2.1

-

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Data set is complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: NONE

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator:
National Mapping Division U.S. Geological Survey
Publication_Date: Unknown
Title: Hydrography derived from 1:24000 USGS DLGs
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Reston, VA
Publisher: U.S. Geological Survey

Source_Scale_Denominator: 24000
Type_of_Source_Media: magnetic tape
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: Unknown
Ending_Date: Unknown

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: Provided dlg data layers for ACE characterization

Process_Step:

Process_Description:
Mapjoined dlg coverages using ArcInfo. Mapjoined coverages were then clipped to the ACE Basin boundary. Larger dlg coverages were then split into three basins.
Process_Date: 19981100

Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service:
Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time M-F 8:30am - 5:00pm

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 3

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000

False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: cities.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 88120.16382
Range_Domain_Maximum: 11736816.15029

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1643.18510
Range_Domain_Maximum: 34463.74874

Attribute:

Attribute_Label: Acebn88mun
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Munname
Attribute_Definition: name of municipality
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Muncty
Attribute_Definition: county where municipality is found
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston

State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:16 2000

1999 ACE Basin Ecological Characterization Shellfish Waters within the ACE Basin Project Area

Table of Contents

IDENTIFICATION_INFORMATION

Citation:
Citation_Information:
Originator: South Carolina Department of Natural Resources - Marine
Publication_Date: 19980106
Title: 1999 ACE Basin Ecological Characterization Shellfish Waters within the ACE Basin Project Area
Edition:
Geospatial_Data_Presentation_Form: Map
Publication_Information:
Publication_Place: Charleston, SC
Publisher: National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)
Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.
Online_Linkage:
Larger_Work_Citation:
Citation_Information:
Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC
Online_Linkage:
Description:
Abstract:
This layer contains shows the major roads and highways of the ACE Basin.
Purpose:
The shapefile showing the major roads and highways of the ACE Basin and surrounding area was developd to facilitate use of other GIS data and the development of maps used for education and outreach.
Supplemental_Information:
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 19900000
Ending_Date: 19900000
Currentness_Reference: time period of content ending date
Status:
Progress: Complete
Maintenance_and_Update_Frequency: Unknown
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -80.7456
East_Bounding_Coordinate: -80.1790
North_Bounding_Coordinate: 32.7072
South_Bounding_Coordinate: 32.3233
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: streets
Theme_Keyword: highways
Theme_Keyword: interstates
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: Ashepoo River
Place_Keyword: Edisto River
Place_Keyword: Combahee River
Place_Keyword: ACE Basin
Place_Keyword: South Carolina Coast
Place_Keyword: Atlantic Coast
Access_Constraints:
none
Use_Constraints:
unknown
Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: South Carolina Department of Natural Resources' Marine Resource Research Institute
Contact_Person:
Contact_Position: GIS Manager
Contact_Address:
Address_Type: mailing and physical address
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA
Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time
Native_Data_Set_Environment:
ArcView version 3.2 shapefile format
i:\lcr\acebasin\cd_gis\infrastr\mjrroads.shp

Top

DATA_QUALITY_INFORMATION

Attribute_Accuracy:
  Attribute_Accuracy_Report:
    Coverage was reviewed by SCDNR and NOAA-CSC personnel
Logical_Consistency_Report:
  The data in this layer are believed to be topologically consistent.
Completeness_Report:
  The data in this layer are believed to be complete.
Positional_Accuracy:
  Horizontal_Positional_Accuracy:
    Horizontal_Positional_Accuracy_Report:
      This data set was developed to meet National Map Accuracy Standards.
  Vertical_Positional_Accuracy:
    Vertical_Positional_Accuracy_Report:
      none
Lineage:
  Source_Information:
    Source_Citation:
      Citation_Information:
        Originator: SCDNR-MRD
        Publication_Date: 199800000
        Title: Shellfisf Classifiction
        Edition: 1998
        Geospatial_Data_Presentation_Form: map
        Publication_Information:
          Publication_Place: Scharleston, SC
          Publisher: SCDNR-MRD
        Other_Citation_Details:
        Online_Linkage:
        Larger_Work_Citation:
          Citation_Information:
            Originator: NOAA-CSC
            Publication_Date: 19990500
            Title: ACE Basin Characterization
            Publication_Information:
              Publication_Place: Charleston, SC
              Publisher: NOAA-CSC
            Online_Linkage:
    Source_Scale_Denominator: 24000
    Type_of_Source_Media:
    Source_Time_Period_of_Content:
      Time_Period_Information:
        Range_of_Dates/Times:
          Beginning_Date: 19950000
          Ending_Date: 19980000
      Source_Currentness_Reference: time period of content ending date
    Source_Citation_Abbreviation:
    Source_Contribution:
  Source_Information:
    Source_Citation:
      Citation_Information:
        Originator: U.S. Census Bureau
        Publication_Date: 19950101
        Title: 1995 TOGER/line files
        Edition: 1995
        Geospatial_Data_Presentation_Form: map
        Publication_Information:
          Publication_Place: Washington, D.C.
          Publisher: U.S. Census Bureau
        Other_Citation_Details:
        Online_Linkage:
        Larger_Work_Citation:
          Citation_Information:
            Originator: NOAA-CSC
            Publication_Date: 19990500
            Title: ACE Basin Characterization
            Publication_Information:
              Publication_Place: Charleston, SC
              Publisher: NOAA-CSC
            Online_Linkage:
    Source_Scale_Denominator: 100000
    Type_of_Source_Media: unkown
    Source_Time_Period_of_Content:

Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 19900000
Ending_Date: 19900000
Source_Currentness_Reference: time period of content ending date
Source_Citation_Abbreviation:
Source_Contribution:
Process_Step:
Process_Description:
This shapefile was projected from Geographic into UTM Zone 17,
Source_Used_Citation_Abbreviation:
Process_Date:
Source_Produced_Citation_Abbreviation:
Process_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Organization: South Carolina Department of Natural Resources' Marine Resource Research Institute
Contact_Person:
Contact_Position: GIS Manager
Contact_Address:
Address_Type: mailing and physical address
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA
Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Top

SPATIAL_DATA_ORGANIZATION_INFORMATION

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: Complete Chain
Point_and_Vector_Object_Count: 12202

Top

SPATIAL_REFERENCE_INFORMATION

Horizontal_Coordinate_System_Definition:
Planar:
Grid_Coordinate_System:
Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:
UTM_Zone_Number: 17
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -81.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:
Abscissa_Resolution:

```
        Ordinate_Resolution:
      Planar_Distance_Units: Meters
  Geodetic_Model:
    Horizontal_Datum_Name: North American Datum of 1927
    Ellipsoid_Name: Clarke 1866
    Semi-major_Axis: 6378206.4000000
    Denominator_of_Flattening_Ratio: 294.98
```

Top

ENTITY_AND_ATTRIBUTE_INFORMATION

```
Detailed_Description:
  Entity_Type:
    Entity_Type_Label: mjrroads.dbf
    Entity_Type_Definition: Shapefile Attribute Table
    Entity_Type_Definition_Source: None
  Attribute:
    Attribute_Label: Length
    Attribute_Definition: Length of line
    Attribute_Definition_Source: Software generated
    Attribute_Domain_Values:
      Unrepresentable_Domain:
        Software computed
  Attribute:
    Attribute_Label: Id
    Attribute_Definition: ID
    Attribute_Definition_Source: User Defined
    Attribute_Domain_Values:
      Range_Domain:
        Range_Domain_Minimum: 1
        Range_Domain_Maximum: 32579
  Attribute:
    Attribute_Label: Cfcc
    Attribute_Definition: Census Feature Code
    Attribute_Definition_Source: User Defined
    Attribute_Domain_Values:
      Unrepresentable_Domain: Character Field
  Attribute:
    Attribute_Label: Color
    Attribute_Definition: Type of road
    Attribute_Definition_Source: User Defied
    Attribute_Domain_Values:
      Enumerated_Domain:
        Enumerated_Domain_Value: Highways
        Enumerated_Domain_Value_Definition: Highways
        Enumerated_Domain_Value_Definition_Source: User defined
        Enumerated_Domain_Value: Interstates
        Enumerated_Domain_Value_Definition: Interstates
        Enumerated_Domain_Value_Definition_Source: User defined
        Enumerated_Domain_Value: Roads
        Enumerated_Domain_Value_Definition: Roads
        Enumerated_Domain_Value_Definition_Source: User defined
  Attribute:
    Attribute_Label: Fdpre
    Attribute_Definition:
    Attribute_Definition_Source: User defined
    Attribute_Domain_Values:
      Unrepresentable_Domain: Character Field
  Attribute:
    Attribute_Label: Fname
    Attribute_Definition: Feature Name
    Attribute_Definition_Source: User Defined
    Attribute_Domain_Values:
      Unrepresentable_Domain: Character Field
  Attribute:
    Attribute_Label: Ftype
    Attribute_Definition: Feature Type
```

Attribute_Definition_Source: User Defined
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Fdsuf
Attribute_Definition:
Attribute_Definition_Source: User defined
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Leftadd1
Attribute_Definition: left address 1
Attribute_Definition_Source: user defined
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Leftadd2
Attribute_Definition: left address 2
Attribute_Definition_Source: user defined
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Rgtadd1
Attribute_Definition: Right address 1
Attribute_Definition_Source: user defined
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Rgtadd2
Attribute_Definition: Right address 2
Attribute_Definition_Source: User defined
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Zipl
Attribute_Definition: Zip left
Attribute_Definition_Source: user defined
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Zipr
Attribute_Definition: Zip right
Attribute_Definition_Source: User defined
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Leftzone
Attribute_Definition: Left Zone
Attribute_Definition_Source: User defined
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Rgtzone
Attribute_Definition: Right Zone
Attribute_Definition_Source: User defined
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Tract_avl
Attribute_Definition: Tract
Attribute_Definition_Source: User defined
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Tract_avr
Attribute_Definition: Tract
Attribute_Definition_Source: User defined
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Tlid
Attribute_Definition: ID
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Range_Domain:
Range_Domain_Minimum: 1.89542e+007
Range_Domain_Maximum: 1.78467e+008

Top

DISTRIBUTION_INFORMATION

Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)
Contact_Person:
Contact_Position:
Contact_Address:
Address_Type: mailing and physical address
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA
Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time
Resource_Description:
Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-ROM.

Top

METADATA_REFERENCE_INFORMATION

Metadata_Date: 20001207
Metadata_Review_Date: 20001207
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: South Carolina Department of Natural Resources' Marine Resource Research Institute
Contact_Person:
Contact_Position: GIS Manager
Contact_Address:
Address_Type: Mailing and physical address
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA
Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us wennere@mrd.dnr.state.sc.us wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time
Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Top

1999 ACE Basin Ecological Characterization: United States Geological Survey Pipe and transmission lines coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Jeff Trudnak
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: United States Geological Survey Pipe and transmission lines coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-

Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
This 1:24000 scale coverage contains the location of power and transmission lines within the ACE Basin as identified in USGS DLGs.

Purpose:
DLGs depict information about geographic features on or near the surface of the Earth, terrain, and political and administrative units. These data were collected as part of the National Mapping Program. Power and transmission line locations were added to alert people to their presence.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Currentness_Reference: Publication Date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0000
East_Bounding_Coordinate: -80.3386
North_Bounding_Coordinate: 33.1240
South_Bounding_Coordinate: 32.6233

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: hydrography
Theme_Keyword: power lines
Theme_Keyword: transmission lines

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: South Carolina Coast
Place_Keyword: Southeast Coast
Place_Keyword: Atlantic Coast

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info version 7.2.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: Data set is complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: NONE

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator:
National Mapping Division U.S. Geological Survey
Publication_Date: Unknown
Title: Hydrography derived from 1:24000 USGS DLGs
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Reston, VA
Publisher: U.S. Geological Survey

Source_Scale_Denominator: 24000
Type_of_Source_Media: magnetic tape
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: Unknown
Ending_Date: Unknown

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: Provided dlg data layers for ACE characterization

Process_Step:

Process_Description:
Mapjoined dlg coverages using ArcInfo. Mapjoined coverages were then clipped to the ACE Basin boundary. Larger dlg coverages were then split into three basins.
Process_Date: 19981100

Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Complete Chain
Point_and_Vector_Object_Count: 87

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: CLARKE1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: pipeline.dbf
Entity_Type_Definition: Arc Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Length
Attribute_Definition: Length of line
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 10.96950
Range_Domain_Maximum: 19262.64489

Attribute:

Attribute_Label: Acebn88ptl
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Acebn88ptl
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Ptlmajor1
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 190
Range_Domain_Maximum: 190

Attribute:

Attribute_Label: Ptlminor1
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 202
Range_Domain_Maximum: 401

Attribute:

Attribute_Label: Ptlmajor2
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 199

Attribute:

Attribute_Label: Ptlminor2
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 205

Attribute:

Attribute_Label: Ptlmajor3
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Ptlminor3
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Ptlmajor4
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Ptlminor4
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Ptltype
Attribute_Definition: pipe or transmission line type
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Mdist
Attribute_Definition: USGS attribute

Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0
Range_Domain_Maximum: 24

Attribute:

Attribute_Label: Quadname
Attribute_Definition: name of quad found in
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:17 2000

1999 ACE Basin Ecological Characterization: United States Geological Survey Railroads coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Jeff Trudnak
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: United States Geological Survey Railroads coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention

for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
This 1:24000 scale coverage contains the location of railroad tracks within the ACE Basin as identified in USGS DLGs.
Purpose:
DLGs depict information about geographic features on or near the surface of the Earth, terrain, and political and administrative units. These data were collected as part of the National Mapping Program. The railroad tracks were added as a tool.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Currentness_Reference: Publication Date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.1150
East_Bounding_Coordinate: -80.2943
North_Bounding_Coordinate: 33.0990
South_Bounding_Coordinate: 32.5378

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: railroads
Theme_Keyword: tracks

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: South Carolina Coast
Place_Keyword: Southeast Coast
Place_Keyword: Atlantic Coast

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info version 7.2.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this data set are topologically consistent. Post processing performed in ArcInfo Version 7.2.1

indicate that arc and node topology exist.
Completeness_Report: Data set is complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: NONE

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator:
National Mapping Division U.S. Geological Survey
Publication_Date: Unknown
Title: Hydrography derived from 1:24000 USGS DLGs
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Reston, VA
Publisher: U.S. Geological Survey

Source_Scale_Denominator: 24000
Type_of_Source_Media: magnetic tape
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: Unknown
Ending_Date: Unknown

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: Provided dlg data layers for ACE characterization

Process_Step:

Process_Description:
Mapjoined dlg coverages using ArcInfo. Mapjoined coverages were then clipped to the ACE Basin boundary. Larger dlg coverages were then split into three basins.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Complete Chain
Point_and_Vector_Object_Count: 277

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: railroad.dbf
Entity_Type_Definition: Arc Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Length
Attribute_Definition: Length of line
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 14.45297
Range_Domain_Maximum: 9602.31606

Attribute:

Attribute_Label: Row_id
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 277

Attribute:

Attribute_Label: Acebn88rrs
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1868
Range_Domain_Maximum: 13483

Attribute:

Attribute_Label: Rrsmajor1
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 180
Range_Domain_Maximum: 180

Attribute:

Attribute_Label: Rrsminor1
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 201
Range_Domain_Maximum: 208

Attribute:

Attribute_Label: Rrsmajor2
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 181

Attribute:

Attribute_Label: Rrsminor2
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 614

Attribute:

Attribute_Label: Rrsmajor3
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 181

Attribute:

Attribute_Label: Rrsminor3
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 614

Attribute:

Attribute_Label: Rrsmajor4
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 181

Attribute:

Attribute_Label: Rrsminor4
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 210

Attribute:

Attribute_Label: Rrsmajor5
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999

Range_Domain_Maximum: 180

Attribute:

Attribute_Label: Rrsminor5
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 210

Attribute:

Attribute_Label: Rrsmajor6
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Rrsminor6
Attribute_Definition: USGS attribute
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Rrsname
Attribute_Definition: Name of railroad
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Rrstype
Attribute_Definition: type of railroad
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Quadname
Attribute_Definition: name of quad
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.

City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at
<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:18 2000

1999 ACE Basin Ecological Characterization: United States Geological Survey Roads coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: United States Geological Survey Roads coverage
Edition: none
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center

in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Description:

Abstract:
This 1:24000 scale coverage contains primary roads, secondary roads, interchanges, cul-de-sacs, rest areas and trails as identified in USGS DLGs. The data set covers the ACE ecological characterization area. This metadata record is for ace88rds1, ace88rds2, and ace88rds3.

Purpose:
DLGs depict information about geographic features on or near the surface of the Earth, terrain, and political and administrative units. These data were collected as part of the National Mapping Program. The addition of the roads to this layer is designed to show the roads in relation to geographic features.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: Continually

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0606
East_Bounding_Coordinate: -80.4276
North_Bounding_Coordinate: 33.0211
South_Bounding_Coordinate: 32.3298

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: roads

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: southeast SC

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: ArcView version 3.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this set are topologically consistent. Post processing in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: data set is complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: National Mapping Division US Geological Survey
Publication_Date: Unknown
Title: Hydrography derived from 1:24000 USGS DLGs
Edition: none
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Reston, VA
Publisher: US Geological Survey

Source_Scale_Denominator: 24000
Type_of_Source_Media: magnetic tape
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: Unknown
Ending_Date: Unknown

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: provided DLG data layers for ACE characterization

Process_Step:

Process_Description:
Clipped original roads data layer to ACE boundary. Split clipped data layer into three basins.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource

Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Complete Chain
Point_and_Vector_Object_Count: 4098

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -81.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4000000
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: roads_a.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Fnode_
Attribute_Definition: From-node identifier of linear feature
Attribute_Definition_Source: Software generated
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Tnode_
Attribute_Definition: To-node identifier of linear feature
Attribute_Definition_Source: Software generated
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Length
Attribute_Definition: Length of line
Attribute_Definition_Source: Software generated
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Ace88rds2_
Attribute_Definition: internal feature number
Attribute_Definition_Source: software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Ace88rds2_
Attribute_Definition: internal feature number
Attribute_Definition_Source: software computed
Attribute_Domain_Values:

Unrepresentable_Domain: software generated

Attribute:

Attribute_Label: Rdsmajor1
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 170
Range_Domain_Maximum: 170

Attribute:

Attribute_Label: Rdsminor1
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 201
Range_Domain_Maximum: 613

Attribute:

Attribute_Label: Rdsmajor2
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 179

Attribute:

Attribute_Label: Rdsminor2
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999

Range_Domain_Maximum: 888

Attribute:

Attribute_Label: Rdsmajor3
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 178

Attribute:

Attribute_Label: Rdsminor3
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 616

Attribute:

Attribute_Label: Rdsmajor4
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 174

Attribute:

Attribute_Label: Rdsminor4
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: 616

Attribute:

Attribute_Label: Rdsmajor5
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Rdsminor5
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Rdsmajor6
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Rdsminor6
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Rdsmajor7
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Rdsminor7
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Rdsmajor8
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Rdsminor8
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: -99999
Range_Domain_Maximum: -99999

Attribute:

Attribute_Label: Rdsname
Attribute_Definition: name of road
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character Field

Attribute:

Attribute_Label: Rdstype
Attribute_Definition: type of road
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character Field

Attribute:

Attribute_Label: Rdscty
Attribute_Definition: county road is in

Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character Field

Attribute:

Attribute_Label: Usroad
Attribute_Definition: USGS attribute
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character Field

Attribute:

Attribute_Label: Sroad
Attribute_Definition: state road
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character Field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at
<http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:19 2000

1999 ACE Basin Ecological Characterization: ACE weather station coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:
South Carolina Department of Natural Resources - Marine Resources Division
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: ACE weather station coverage
Edition: none
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National

Geophysical Data Center, and the Corporation for Enterprise Development.

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Description:

Abstract:
In June 1995, USGS installed an automated weather station at a SCDNR field station. The station is approximately 4.0 nautical miles from the St. Pierre datalogger site and 7.5 nautical miles from the Big Bay datalogger site. The weather station is equipped with the following sensors. a. Barometric pressure sensor b. Relative humidity sensor c. Gill microvane and 3-cup anemometer d. Soil and air thermistors e. Heat flow transducer f. Net radiometer g. Tipping bucket rain gauge Real-time data are relayed by satellite to U.S. Geologic Survey office in Columbia, South Carolina, and data are uploaded weekly into the Southeast Environmental Automated Monitoring Network Database that is maintained by the SCDNR/Water Resources Division. The installation of automated weather stations at various locations in our state is an inter-agency project designed to build a meteorological database that is accessible to researchers, students and the general public. The weather stations were purchased with funds received from the USGS Excellence in Education program. Currently, there are five weather stations, and four are near the coast and the fifth is inland. The cost to maintain the database and weather stations is shared by USGS office in Columbia, S.C. and SCDNR/Water Resources Division's Southeast Regional Climate Center. Tabular data from the dataloggers within the ACE characterization area are not linked to the ACE weather station GIS data layer, but are found elsewhere on this CDROM.

Purpose:
To collect weather and climate data to serve as an educational tool for scientists, students and the general public.

Supplemental_Information: none

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19970600
Ending_Date: 19990500

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: Continually

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.4513
East_Bounding_Coordinate: -80.4513
North_Bounding_Coordinate: 32.5621
South_Bounding_Coordinate: 32.5621

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: weather station
Theme_Keyword: datalogger

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: southeast SC

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: ArcView version 3.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this set are topologically consistent. Post processing in ArcInfo Version 7.2.1 indicate that arc and node topology exist.
Completeness_Report: data set is complete
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none

Lineage:

Process_Step:

Process_Description:
Digitized ACE weather station location based on hard copy map locations provided by SCDNR Ace basin personnel.
Process_Date: 19981100
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 1

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -81.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Row and column
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4000000
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: weather.dbf

Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Id
Attribute_Definition: intenal feature number
Attribute_Definition_Source: software computed
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Feature
Attribute_Definition: feature identification
Attribute_Definition_Source: user defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character Field

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000

Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:21 2000

1999 ACE Basin Ecological Characterization: ACE Basin Islands coverage

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Jeff Trudnak
Publication_Date: 19990500
Title:
1999 ACE Basin Ecological Characterization: ACE Basin Islands coverage
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, SC
Publisher:
National Oceanic and Atmospheric Administration - Coastal Services Center (NOAA-CSC)

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE

Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Description:

Abstract:
The ACE Basin Island data layer provides geomorphic/physiographic data for 25 islands in the ACE Basin. These include 24 marsh, barrier, and sea islands and one offshore bank. Statistics on area, shoreline length, elevation above sea level, as well as other descriptive characteristics are attached as tables.

Purpose:
data layer was generated to provide statistics on 25 of the barrier, marsh, and sea islands of the ACE Basin. Delineation of individual islands was done by onscreen digitization using the 1989 NWI data layer and historic information on property boundaries and general knowledge. Data generated was land cover/land use, area of each island and land cover type, island perimeter length, and to provide upland to marsh ratios to help categorize islands into categories.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19981204
Ending_Date: 19981204

Currentness_Reference: publication date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: as needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -80.7121
East_Bounding_Coordinate: -80.1652
North_Bounding_Coordinate: 32.6586
South_Bounding_Coordinate: 32.3340

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: marsh island
Theme_Keyword: sea island
Theme_Keyword: barrier island
Theme_Keyword: geomorphology
Theme_Keyword: physiography
Theme_Keyword: island definition

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: ACE Basin
Place_Keyword: Ashepoo River
Place_Keyword: Combahee River
Place_Keyword: Edisto River
Place_Keyword: South Carolina Coast

Access_Constraints: none
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and can not be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment: Arc/Info

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Coverage was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
The data in this set are topologically consistent. Post processing p version 7.2.1 indicated that arc and node topology exists.
Completeness_Report: This data set is complete.
Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
This data set is assumed to meet National Map Accuracy Standards.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: none to report

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: George Riekerk
Publication_Date: 19990500
Title: ACE Ecological Characterization
Edition: 1999
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA-CSC

Type_of_Source_Media: digital
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19981100
Ending_Date: 19990500

Source_Currentness_Reference: publication date

Source_Citation_Abbreviation: none
Source_Contribution: digitized island boundaries for coverage

Process_Step:

Process_Description:
created outline of each island based on 1989 NWI data layer. Used NWI, historical maps, and

local knowledge to outline islands.
Process_Date: 19981204
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
used ArcView to generate statistics for area. Acquired sum of each land use type for each island. Compiled information in MS Excel and created summary table which was brought back into ArcView as dbf.
Process_Date: 19981202
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000

Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 25

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -81.0000
Latitude_of_Projection_Origin: 0.0000
False_Easting: 500000
False_Northing: 0.0000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: Islands.dbf
Entity_Type_Definition: Polygon Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1390376.000
Range_Domain_Maximum: 159763232.000

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 4658.924
Range_Domain_Maximum: 67712.320

Attribute:

Attribute_Label: Aceisland_
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1
Range_Domain_Maximum: 25

Attribute:

Attribute_Label: Island
Attribute_Definition: name of island
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Detailed_Description:

Entity_Type:

Entity_Type_Label: islndlnk.dbf
Entity_Type_Definition: Link table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Island
Attribute_Definition: name of island
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Landuse
Attribute_Definition: provides data on NWI land cover for island polygons
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Unrepresentable_Domain: Character field

Attribute:

Attribute_Label: Area_m2_
Attribute_Definition: area of land use polygon in meters squared
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 511
Range_Domain_Maximum: 159763511

Attribute:

Attribute_Label: Area_hec_
Attribute_Definition: area of land use polygon in hectares
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.1
Range_Domain_Maximum: 15976.4

Attribute:

Attribute_Label: Area_acre
Attribute_Definition: area of land use polygon in acres
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0.1
Range_Domain_Maximum: 39477.6

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210

Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:36 2000

1999 ACE Basin Ecological Characterization: Coast of South Carolina Derived from Shoreline derived from NOAA-NOS Topographic Sheets Developed from 1984 - 1987

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: NOAA Coastal Services Center
Publication_Date: 19991001
Title:
1999 ACE Basin Ecological Characterization: Coast of South Carolina Derived from Shoreline derived from NOAA-NOS Topographic Sheets Developed from 1984 - 1987
Edition: First
Geospatial_Data_Presentation_Form: Map
Publication_Information:

Publication_Place: Charleston, South Carolina
Publisher:
National Oceanic and Atmospheric Administration Coastal Services Center (NOAA-CSC)

Other_Citation_Details:
The ACE Basin Ecological Characterization is a digital source of information, data, and management tools related to management of the Ashepoo-Combahee-Edisto River Basin region of South Carolina. The ACE Basin is a region of diverse ecosystems in a largely undeveloped landscape and has received national attention for the quality of its natural resources. The challenge of management in the ACE Basin is to balance conservation efforts with economic growth. The ACE Basin Ecological Characterization provides, in an interactive, multi-media format, an interdisciplinary synthesis of information about the ACE Basin, including physical setting, biological and socioeconomic resources, and important ecosystem interactions. Spatial data are presented in a geographic information system and may be explored interactively. Users of this product may rapidly access information about the ACE Basin and explore and learn by comparing different management scenarios related to the

impacts of various land uses on the natural resources in the ACE Basin. This product is a tool that agencies, local governments, land managers, conservation groups, and private citizens can use to understand and conserve the unique character of the ACE Basin. This CD-ROM was produced by the National Oceanic and Atmospheric Administration's coastal Services Center in cooperation with the South Carolina Department of Natural Resources, NOAA's National Geophysical Data Center, and the Corporation for Enterprise Development.

Larger_Work_Citation:

Citation_Information:

Originator: NOAA-CSC
Publication_Date: 19990500
Title: ACE Basin Ecological Characterization
Publication_Information:

Publication_Place: Charleston, South Carolina
Publisher: NOAA-CSC

Description:

Abstract:
These data were automated to provide a suitable GIS data layer depicting the most current and accurate shoreline for South Carolina. These data are based on tide-controlled photography taken at mean high tide by the NOAA-National Ocean Service. To enable differentiation of water from land polygon topology was built and an earthscape attribute created.

Purpose:
This data layer was automated initially to support the efforts of an Ocean GIS as set forth by the Southeastern US Ocean Governance and Planning Community. An accurate shoreline data layer was identified as a crucial component in an ocean GIS database. To enable view of water and landscape sides of the shoreline, polygon topology was added to the arc shoreline coverage. This was to improve background visualization for the Ace Basin Ecological Characterization.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19840201
Ending_Date: 19991001

Currentness_Reference: Publication Date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: Unknown

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -81.0001
East_Bounding_Coordinate: -78.4997
North_Bounding_Coordinate: 33.8901

South_Bounding_Coordinate: 32.0000

Keywords:

Theme:

Theme_Keyword_Thesaurus: None
Theme_Keyword: AmeriCorps
Theme_Keyword: GIS
Theme_Keyword: Hydrography
Theme_Keyword: NOAA - NOS
Theme_Keyword: NOAA Coastal Services Center
Theme_Keyword: Shoreline
Theme_Keyword: Tide-controlled Photography
Theme_Keyword: Tsheets
Theme_Keyword: Vectorization

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: South Carolina
Place_Keyword: Atlantic Coast
Place_Keyword: Southeast Coast

Access_Constraints: None
Use_Constraints:
The developers/providers of this data; South Carolina Department of Natural Resources, National Oceanic and Atmospheric Administration, Technology Planning and Management Corporation, assume no responsibility and cannot be held liable for any end use of this data.
Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Native_Data_Set_Environment:
ArcView version 3.2 shapefile format r:\lcr\acebasin\cd_gis\shor_isl\scshore.shp

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report:
The attribute accuracy was reviewed by SCDNR and NOAA-CSC personnel.

Logical_Consistency_Report:
Linework was vectorized to the neatline of the T-Sheet. All data crossing the neatline was clipped to the neatline. All arcs were snapped by the nodes to create consistently tied strings without node dangles. In developing polygon topology, wherever nodes dangled, they where manually snapped.

Completeness_Report:
This T-sheet data depicts the most current large scale shoreline available that are based on tide-controlled photography.

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
The horizontal positional accuracy for the digital data was tested by producing checkplots of the vectorized data and overlaying it with a plot of the rasterized T-Sheet on a light table. Linework which appeared to be greater than a pen width off of the T-Sheet was considered in error, and revisions were made until new checkplots revealed an accurate depiction of the T-Sheet.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report:

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: NOAA National Geodetic Survey
Publication_Date: 19990301
Title:
Vectorized Shoreline of South Carolina Derived from NOAA - NOS Topographic Sheets Developed from 1984 - 1987
Edition: First
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA National Ocean Service

Source_Scale_Denominator: 10,000 and 20,000
Type_of_Source_Media: Stable-Based Material
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19840201
Ending_Date: 19870201

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: scshr
Source_Contribution: Used to delineate the shoreline

Source_Information:

Source_Citation:

Citation_Information:

Originator: NOAA National Geodetic Survey
Publication_Date: 19990301
Title:
Vectorized Shoreline of South Carolina Derived from NOAA - NOS Topographic Sheets Developed from 1984 - 1987
Edition: First
Geospatial_Data_Presentation_Form: map
Publication_Information:

Publication_Place: Charleston, SC
Publisher: NOAA National Ocean Service

Source_Scale_Denominator: 10,000 and 20,000
Type_of_Source_Media: Stable-Based Material
Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19840201
Ending_Date: 19870201

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: scshr
Source_Contribution:

Process_Step:

Process_Description:
All of the individual T-Sheets that are contained within the borders of this state were projected into the North American Datum (NAD) 1983 coordinate system and then edgematched together. Remaining attributes were added to the attribute table and then all T-Sheets were appended together to create this final coverage.
Process_Date: 19990301
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Process_Step:

Process_Description:
A box was created to enclose the shoreline arcs and enable building of polygon topology. Numerous node gaps were discovered and closed. Polygon topology was built and an attribute added to the coverage called earthscape. Earthscape has two value represent either a water connection to the Atlantic Ocean or Upland. Only shoreline delineates the earthscape. Any water features in upland polygons are not captured. The cover was then projected into Universal Transverse Mercator, Zone 17, NAD27.
Process_Date: 19991001
Source_Produced_Citation_Abbreviation:
Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110

Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

---

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 4471

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:

UTM_Zone_Number: 17
Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -81.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair
Coordinate_Representation:

Abscissa_Resolution:
Ordinate_Resolution:

Planar_Distance_Units: METERS

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4000000
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: scshore.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:

Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software generated
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software generated
Attribute_Domain_Values:

Unrepresentable_Domain: Software computed

Attribute:

Attribute_Label: Earthscape
Attribute_Definition: Polygon identified as water or coastal upland
Attribute_Definition_Source: User defined
Attribute_Domain_Values:

Enumerated_Domain:

Enumerated_Domain_Value: 1
Enumerated_Domain_Value_Definition: Water
Enumerated_Domain_Value_Definition_Source: User Defined

Enumerated_Domain:

Enumerated_Domain_Value: 2
Enumerated_Domain_Value_Definition: Coastal Upland
Enumerated_Domain_Value_Definition_Source: User Defined

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: ACE Basin National Estuarine Research Reserve (NERR)

Contact_Address:

Address_Type: mailing
Address: ACE Basin NERR, SC Department of Natural Resources Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5050
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact the ACE Basin NERR and request a copy of the ACE Basin Ecological Characterization CD-Rom.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: NOAA Coastal Services Center

Contact_Position: Clearinghouse Manager
Contact_Address:

Address_Type: mailing and physical address
Address: 2234 South Hobson Ave.
City: Charleston
State_or_Province: SC
Postal_Code: 29405
Country: USA

Contact_Voice_Telephone: 843-740-1210
Contact_Facsimile_Telephone: 843-740-1224
Contact_Electronic_Mail_Address: clearinghouse@csc.noaa.gov
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Distribution_Liability:
Users of this data must assume responsibility for determining proper use. The distributors assume no liability for the data.
Custom_Order_Process:
Contact NOAA Coastal Services Center's Clearinghouse Manager and request a copy of the ACE Basin Ecological Characterization CD-Rom. Alternatively, fill out a CSC Product Request Form at <http://www.csc.noaa.gov/clearinghouse/prodreq_form.html>

Metadata_Reference_Information:

Metadata_Date: 20000317
Metadata_Review_Date: 20000317
Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization:
South Carolina Department of Natural Resources' Marine Resource Research Institute

Contact_Position: GIS Manager
Contact_Address:

Address_Type: mailing
Address: Box 12559
City: Charleston
State_or_Province: SC
Postal_Code: 29422
Country: USA

Contact_Voice_Telephone: 843-762-5000
Contact_Facsimile_Telephone: 843-762-5110
Contact_Electronic_Mail_Address: wennere@mrd.dnr.state.sc.us
Hours_of_Service: Monday through Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.2.4 on Fri Mar 17 16:06:36 2000

M
E
N
U

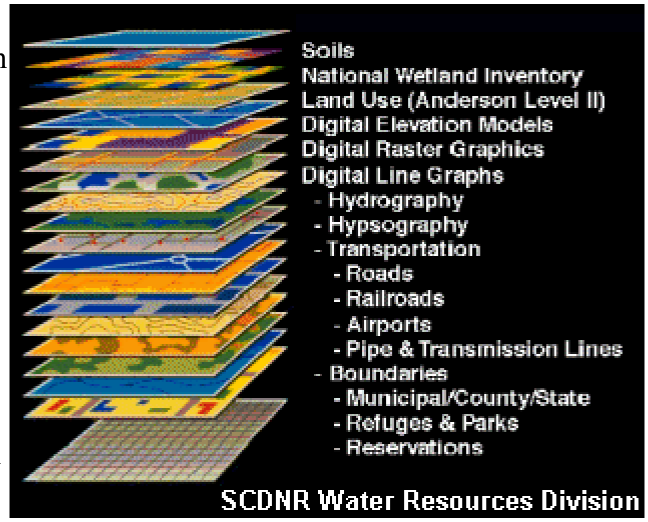
Introduction

How is GIS used?

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

What is GIS?

Introduction



A geographic information system, or GIS, is a computerized data management system used to capture, store, manage, retrieve, analyze, and display spatial information. Data captured and used in a GIS commonly are represented on paper or other hard-copy maps. A GIS differs from other graphics systems in several respects. First, data are georeferenced to the coordinates of a particular projection system. This allows precise placement of features on the earth's surface and maintains the spatial relationships between mapped features. As a result, commonly referenced data can be overlaid to determine relationships between data elements. For example, soils and wetlands for an area can be overlaid and compared to determine the correspondence between hydric soils and wetlands. Similarly, land use data for multiple time periods can be overlaid to determine the nature of changes that may have occurred since the original mapping. This overlay function is the basis of change detection studies across landscapes.

Second, GIS software use relational database management technologies to assign a series of attributes to each spatial feature. Common feature identification keys are used to link the spatial and attribute data between tables. A soil polygon, for example, can be linked to a series of database tables that define its mineral and chemical composition, crop yield, land use suitability, slope, and other characteristics.

Third, GIS provide the capability to combine various data into a composite data layer that may become a base layer in a database. For example, slope, soils, hydrography, demography, wetlands, and land use can be combined to develop a single layer of suitable hazardous waste storage sites. These data, in turn, may be incorporated into the permanent database of a local government and used for regulatory and planning decisions.

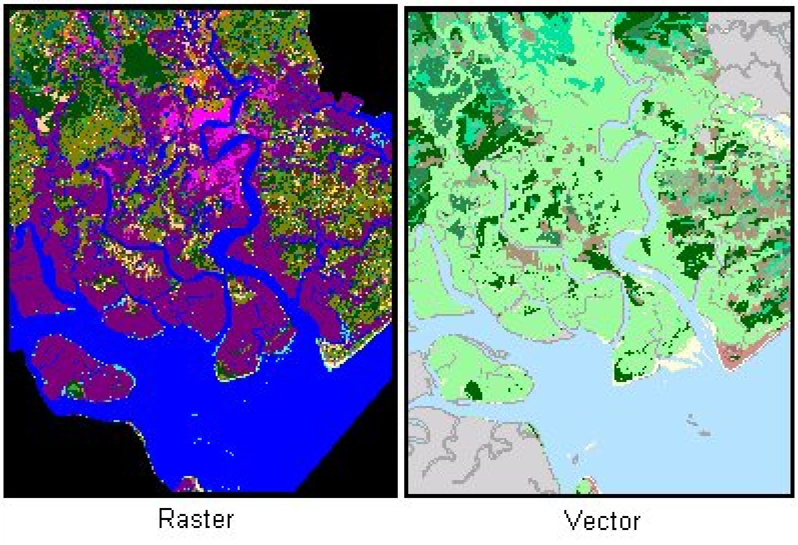
GIS software generally allow for two types of data. Some use raster data (i.e., discrete cells in a rigid row by column format), such as satellite imagery or aerial photography, while others use vectors (points, lines and polygons) to represent features on the earth's surface. Most systems allow for full integration of both types of data. In either case, a fully functioning GIS allows the user to enter or digitize data that are georeferenced; link specific attributes to each feature using relational database management system technology; analyze relationship between various geographic features using a wide range of spatial operations and functions; and produce high-resolution images or graphics on color monitors or plotters.

Back to Top

How is a GIS used?

A GIS can be used to answer basic locational questions such as: What is located at a given point on the earth; or where is a specific feature located? For example, using a mouse-driven cursor, a specific point on a map can be queried to determine its land use, vegetation, soil type, elevation, and land ownership characteristics. Similarly, soils data across an entire watershed can be queried to determine the distribution of areas with hydric soils of greater than 100 acres and are adjacent to a major river system. In the first case, a specific, known point was identified and queried to determine preselected attributes. In the second case, however, specific locations were not known. Rather, the database was searched by the GIS to determine where specific conditions were satisfied (hydric class, size restrictions, and neighboring or adjacent feature characteristics).

One of the more powerful functions of a GIS is that it allows users to synthesize or combine different layers of information to identify resource distribution patterns that may otherwise not be obvious. For example, using various map overlay techniques, threatened and endangered species data may be combined with wetland information to determine if any of the freshwater tidal wetlands in an area provide habitat for sensitive or critical species. This information could be used to develop specialized resource management plans that protect critical wetlands or it could be used to identify areas where the reintroduction of a threatened or endangered species might be successful. This information also can be used in the design of survey strategies and methods to focus on areas of potential threatened and endangered species locations.



Types of Data Representation of the ACE Basin

A GIS also can be used for complex modeling to answer a wide range of "what if" and ecosystem simulation questions. These may be cartographic models designed to document the co-occurrence or interrelationship of multiple data layers or they may be hypothetical research models designed to mimic natural ecological systems. Similarly, modeling with GIS can be used to predict the impacts that one set of parameters will have on another. For example, wetlands, soils, hydrography, climatology and elevation data can be combined to model flooding within a river system. Upstream changes in land use within the same system can be modeled to determine the potential impact of conversion of a forested floodplain to residential development or to agriculture. As a result, both natural system responses to storm events and the impact of human land use decisions can be assessed prior to the proposed action.

Regardless of the application in which GIS technology is used, these systems provide rapid data access and multidimensional analysis and graphical output capabilities that can result in more effective resource management decisions.

Next section: GIS in the ACE Basin

Author

J. Scurry, SCDNR Land, Water and Conservation Division

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

M E N U

Introduction

Improved Decision-Making

Resource Monitoring

Summary

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

GIS in the ACE Basin

Introduction

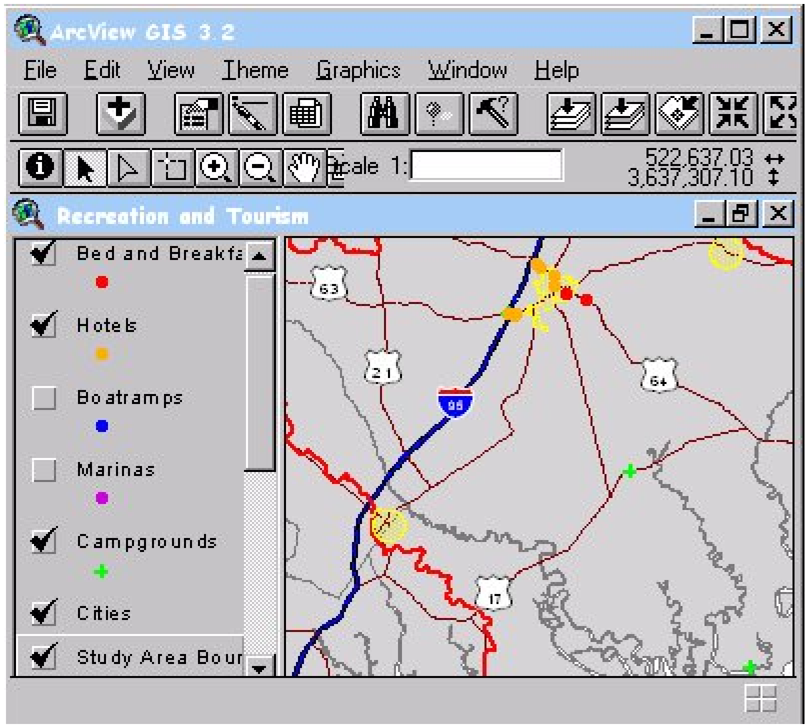
The narrative portion of the ACE Basin Characterization provides detailed overviews of the area's geology, ecology, history, and socioeconomic conditions. While this is useful information, without specific locational or spatial information about the resources of the basin, the product is of limited use to resource managers. Most resource management decisions involve the determination of impacts to resources at the scale of individual land parcels. This may include such questions as whether to fill a wetland in order to build an access road to an isolated property or whether to permit a storm water outfall pipe near a sensitive habitat. In the absence of regional zoning ordinances and land use plans, such decisions are often made without knowledge of the regional status of the resource or the potential impacts to neighboring resources. Resource managers need access to a wide range of data that can be identified and characterized at specific points on the ground.

A GIS provides the capabilities to support informed decision-making and can be used to address a wide variety of scientific research and resource management issues in the ACE Basin. Critical to the successful implementation of a GIS, however, is access to accurate, reliable and timely data. In the early stages of the ACE Basin project, an informal user needs assessment was conducted to determine which data are required for the characterization. However, budget and time constraints limited the amount of new data that could be collected. As a result, an inventory of existing data was collected from numerous state, federal and local agencies and those data critical to the characterization are included on this CD-ROM. The database includes over 70 layers that address historical resources, environmental conditions, biological resources, societal demographics, recreation and tourism, resource management, and county infrastructure. Specific software functions allow the user to browse the database, retrieve and display selected layers, customized query of the database, and display desired data distributions.

Back to Top

How can the data included on this CD-ROM improve decision-making in the ACE Basin?

Generally, resource management issues can be classified into three primary areas: resource inventory, resource monitoring, and modeling applications.



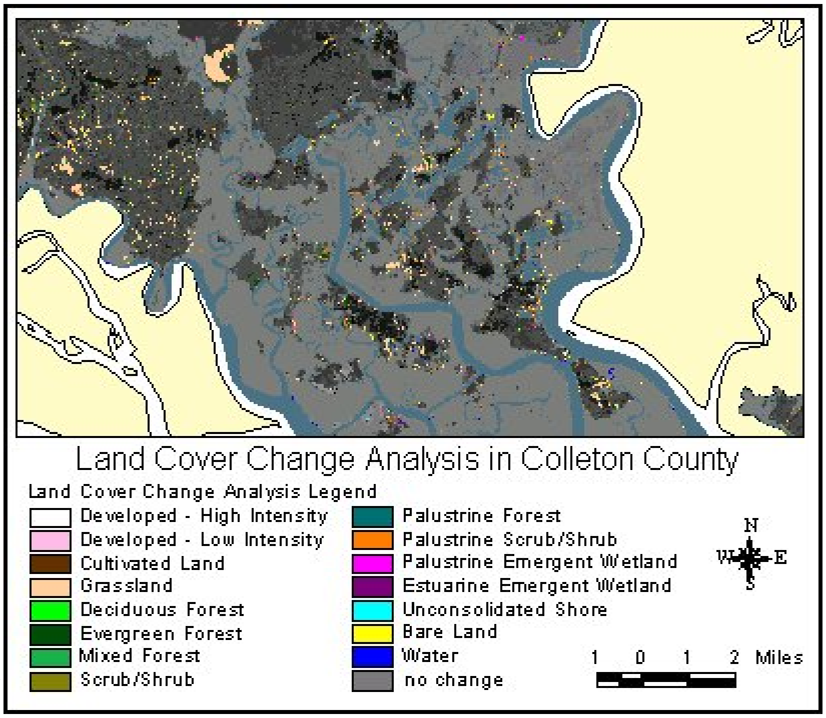
Inventories are critical to resource management. They provide information on the nature and extent of resources in the basin and answer the basic question of what is located where. A wide variety of resource inventory data is included in this characterization. The Data layers such as wetlands, land use, soils, recreational facilities (boat ramps, golf courses, hotels), biological resources (plant communities, threatened and endangered species, fisheries, breeding bird and Christmas bird surveys) and transportation infrastructure (roads, railroads, airports) allow the resource manager to derive summary statistics and graphically display the distribution of these resources across the basin.

With the tabular attributes that accompany these data, the query and display function can be extended beyond simple display of resource distributions. For example, the spatial data about soils are linked to a series of tables that provide more detailed information about each soil type. The forestry table includes soil unit productivity for silviculture and the yield table includes agricultural productivity indices. As a result, a manager can use the soils data to determine areas of the basin most or least productive for these competing activities and land use management decisions can be tailored to the best use alternative.

Back to Top

Resource Monitoring

Resource monitoring in the ACE Basin is the second potential application of the GIS data. Two types of monitoring are change detection and permit evaluation. Change detection compares data from multiple time periods to determine areas of natural or man-made change. National Wetlands Inventory (NWI) wetlands and land use data for the ACE Basin project area were developed from 1989 and 1994 color infrared aerial photography. This data conforms to a hierarchical classification system in which freshwater, estuarine, marine, lacustrine and riverine wetlands are identified as forested, emergent, scrub-shrub, and other vegetation types. In addition, the uplands are classified into general land use/land cover categories that include urban (residential, commercial, industrial), agriculture, forested (evergreen, deciduous, and mixed), rangeland, and other land cover types. Using the intersection GIS function, the 1989 and 1994 NWI data can be overlaid to determine areas where change has occurred. Associated attribute tables indicate the 1989 and 1994 classifications for each polygon or map feature. Stable areas should remain unchanged between the two dates. Areas where change has occurred will exhibit different attributes for the two time periods. Some changes may be natural such as a change from fresh to brackish wetlands or from marsh to open water. This may result from subsidence or sea level rise. Other changes such as a change from forested to urban or from wetland to upland occur from man-induced land use alteration decisions.



Data from change detection studies have indicated a 200 to 300 percent increase in impervious surface (i.e., the area of human-made surfaces, such as rooftops, side walks, parking lots, and buildings, that prevent water from filtering into the soil) for several coastal counties within the past thirty years. As a result, the South Carolina Department of Natural Resources (SCDNR) and other state and local agencies have identified urban encroachment as a major threat to natural habitat within the state. With the rate of development increasing, change detection studies are essential to long-term monitoring and conservation of resources in the ACE Basin. Digitization of wetlands/land use data from recently acquired 1999 color infrared photography or use of imagery from high resolution satellite sensor systems can be incorporated into the analysis to further document these changes.

The GIS data included on this CD-ROM also can be used for permit evaluation and assessment. Various state and local agencies, including the SCDNR, have comment and review authority in the regulatory process. Notice of permit application is sent to review agencies for comment on potential impacts to resources under their jurisdiction or concern. Generally, manual photo inspection techniques and staff institutional knowledge are used to evaluate the potential impacts of the proposed activity. The various data from the ACE Basin can be used to identify significant resources in the proposed permit area and quantitatively assess any negative impact from the proposed project. For example, a permit application for industrial waste discharge into the Ashepoo River can be evaluated with respect to adjacent wetlands, fisheries resources, recreational boating facilities, existing discharge sites, and water quality classification. Additionally, future discharge permit applications can be similarly evaluated. This methodology provides both a comprehensive landscape perspective on potential project impacts and a context for consistent implementation of an agency’s permit review authority.

The use of a GIS for modeling represents the third and final potential application of the ACE Basin CD-ROM. Models are not used extensively by resource managers but more commonly are used by researchers to address cause-and-effect relationships and hypothesis testing. However, application of general cartographic models to resource management issues can provide significant information. For example, species-specific habitat requirements such as vegetation type, patch size, corridor connectivity, and edge can be derived from the NWI data and used to identify potential vertebrate species distributions. These distributions can be used to direct species inventories and survey strategies, develop habitat protection plans or assist in permit evaluations.

More complex models such as the USDA Soil Conservation Service (now called the National Resource Conservation Service) Curve Number, Universal Soil Loss Equation (USLE), and non-point source (NPS) pollution models can be used with data from the ACE Basin to determine impacts of land use modifications on the landscape. For example, the USLE model combines land use and soil drainage characteristics to calculate the amount of runoff generated by a storm event. By reclassifying the land use data to simulate changes to the landscape, the impact of converting forestlands to agriculture or urbanization can be estimated.

GIS also can be used to develop and manage data used as inputs to stand-alone models or to examine the output from these models. Since 1972 the Clean Water Act has required states to establish Total Maximum Daily Loads (TMDLs) for watersheds as a means of managing point and non-point source pollution. To support this mandate, the U.S. Environmental Protection Agency (USEPA) has developed a comprehensive watershed assessment tool called BASINS (Better Assessment Science Integrating Point and Non-point Sources), which is a GIS-based environment for evaluating watersheds both qualitatively and quantitatively. BASINS consists of both regional datasets and a graphic interface incorporating tools for 1) generating maps and summary reports, 2) searching the included databases, and 3) implementing several external programs, such as a variety of numerical water quality models. The ACE Basin Characterization included pilot simulation of runoff in the Ashepoo River Basin using BASINS and the water quality model HSPF (Hydrologic Simulation Program – FORTRAN). (See related section: Sediment Loading Model .)

Back to Top

Summary

The intent of the ACE Basin CD-ROM is to characterize the natural, cultural and socioeconomic resources of the Basin. Most characterizations are designed to provide overviews of important ecological processes but do not allow for user query and interaction with a database. Inclusion of the ACE Basin data suitable for use in a GIS format, however, provides a capability that substantially exceeds its original intent. With this product, resource managers can seek immediate answers to operational questions not anticipated or addressed in the characterization. As a result, this product is more than a document; it is a tool for better resource management in the Basin.

Next section: GIS Viewing Tools

Author

J. Scurry, SCDNR Land, Water and Conservation Division

MENU

Introduction

ArcView Project Files

ArcExplorer Project Files

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

GIS Viewing Tools

Introduction

The "GIS data" folder in the root directory of this CD-ROM contains nearly 100 GIS data layers that are part of the ACE Basin Characterization. To view these data fully, you must use GIS software, such as ArcInfo, ArcView or ArcExplorer from Environmental Systems Research International (ESRI) or MapInfo from MapInfo Corporation. To provide a quick overview of these data, the "GIS data" folder contains ArcView and ArcExplorer project files. You must have ArcView to use the ArcView project files, and the contents of these files are described below. **If you do not have GIS software installed on your computer**, you can still use the ArcExplorer project files. This CD-ROM has a copy of ArcExplorer, and a section below describes how to install and use this program. In addition, the Image Atlas provides a cursory overview of the data that does not require GIS software.

ArcView® Project Files (for V. 3.1 Users Only)

For those users with ArcView GIS software installed on their computers, several ArcView V. 3.1 project files have been included on this CD-ROM. These project files incorporate all of the vector, image, and tabular data that are available on this CD-ROM. The file named **gis_tour.apr** contains an overview of the data with related themes grouped into respective views. On slower computers, this file make take a few minutes to load. The following is a list of views available in this project file.

Views in Gis_tour.apr	
View Name	Principal Data Layers
1989 National Wetland Inventory	Wetlands by river basin according to the revised 1989 data from the National Wetland Inventory program.
1994 National Wetland Inventory	Wetlands by river basin according to the revised 1994 data from the National Wetland Inventory program.
Aquatic Fauna	Locations of stations for surveying populations of fish and benthos; shellfish habitat; and sea turtle and horseshoe crab nesting beaches.
Environmental Monitoring	Locations of USACE and NPDES permits, STORET water quality monitoring stations, EMAP sediment monitoring, stations, and erosion/accretion monitoring stations.
Hydrology	Rivers, streams and creeks by river basin (represented as arcs and polygons); 8, 11, and 14-digit HUCs; and the boundaries between fresh

	and salt water
Infrastructure	Major highways, streets by river basin, power transmission lines, railroads, and airports.
Population Census Data	Census data by blocks, block groups, tracts, and county.
Recreation and Tourism	Locations of public beaches, birding areas, hiking and biking trails, boat ramps, marinas, outfitters, museums, campgrounds, hotels, bed and breakfast inns, and golf courses.
Terrestrial Fauna	Locations of stations and transects used for surveying populations of birds and furbearing animals; endangered species by 14-digit HUC.
Tutorial	Study area boundary and counties of the ACE Basin serve as the base map for conducting the GIS Tutorial on this CD-ROM.
Tutorial for Data Summary	Roads, permits, protected lands, and some aquatic fauna and recreation/tourism data to be used in conjunction with the Data Summary Tool portion of the GIS Tutorial on this CD-ROM.

ArcView Project Files with Link Tables

The CD-ROM also provides several ArcView project files that focus on a particular resource or aspect of the Basin. These files include tabular data linked to the spatial data. Tables are located in the tables folder within the gis_data directory.

Fish_tables.apr		
Shapefile	Link Tables	Description
trawls	trwlcoll.dbf trwlsum.dbf	The shapefile shows the locations of trawl samples within the ACE Basin. The table trwlcoll.dbf describes general environmental conditions at the time of sampling; trwlsum.dbf describes the catch from each sample. The attributes "station" and "collection" link these tables to the shapefile.
trammel	tramcoll.dbf transum.dbf	The shapefile shows the locations of trammel net samples within the ACE Basin. The table tramcoll.dbf describes general environmental conditions at the time of sampling; tramsum.dbf describes the catch from each sample. The attribute "station" links these tables to the shapefile.

Bird_tables.apr		
Shapefile	Link Tables	Description
bredbird	bird1lnk.dbf bird2lnk.dbf	The shapefile shows the route traveled for the annual survey of breeding birds in the ACE Basin (there is only one route). The tables describe the findings of each annual survey; birdlnk1.dbf describes general environmental conditions at the time of sampling, birdlnk2.dbf describes the birds found during each survey. The attribute "year" links the two tables; no link is provided to the shapefile because the same route is surveyed each year.
cwbnests	cwb1lnk.dbf	The shapefile shows areas where colonial waterbird nests have been found within the ACE Basin. The table provides the species and number of nests by year found within each area. The attribute "site_num" links the table to the shapefile.

eagles	eaglelnk.dbf	The shapefile shows the 14-digit HUC's within the ACE Basin. The table provides the number of eagle nests by year found within each 14-digit HUC. The attribute "huccode" links the table to the shapefile.
quail	quaillnk.dbf	The shapefile shows the route traveled for the annual survey of quail in the ACE Basin. The table describe the findings of each survey. The attributes "id" and "quail_id" link the table to the shapefile.
xmasbird	xmaslnk.dbf	The shapefile shows the area surveyed each Christmas for birds (there is only one area surveyed in the ACE Basin). The table describes the findings of each annual survey. No link is provided to the shapefile because the same area is surveyed each year.

Other_tables.apr		
Shapefile	Link Tables	Description
deepcore	dcorelnk.dbf	The shapefile shows locations of two deep (approximately 50 cm) sediment cores in the ACE Basin. The table provides the concentrations of metals in those cores by sediment layer. The attribute "station" links the table to the shapefile.
emapseds	emaplnk.dbf	The shapefile shows locations of sediment cores in the ACE Basin that were collected by the EMAP Program, US Environmental Protection Agency. The table provides the concentrations of pesticides, organochlorines, heavy metals, and other pollutants in those samples. The attribute "station" links the table to the shapefile.
fursrvy	furlink.dbf	The shapefile shows the routes traveled for the annual surveys of furbearers in the ACE Basin. The table describe the findings of each survey. The attribute "lin_numb" links the table to the shapefile.
plantcom	plantlnk.dbf	The shapefile shows the areas identified by The Nature Conservancy to contain high-quality plant communities. The table describes the plants and community associations found within each area. The attribute "polygonid" links the table to the shapefile.
islands	islndlnk.dbf	The shapefile shows the principal islands within the ACE Basin. The table describes the landuse on each island. The attribute "island" links the table to the shapefile.

ArcView Project File for the BASINS Model

The ArcView project file named **model.apr**, which also is in the data folder, illustrates output from the BASINS model.

Back to Top

ArcExplorer® Project Files (Windows 95 OR NT 4.0 Users Only)

- Installing ArcExplorer
- System Requirements for ArcExplorer

ArcExplorer is a lightweight GIS data explorer developed by ESRI. As a stand-alone application, ArcExplorer allows users to display and query a wide variety of standard data sources. ArcExplorer also features legends, overview maps, multiple views, saving and retrieving views, and map printing. This free GIS software is on this CD-ROM and ready to be installed. If you've never worked with GIS software, give it a try — it's easier than you think!

To learn more about ArcExplorer, visit the ESRI home page.

The ArcExplorer project files are located in the arcexplr folder of this CD-ROM set. These projects files have been designed for users that do not have ArcView® to view the spatial data provided on this CD-ROM. The below table lists the ArcExplorer project files included in this CD-ROM. These pre-made views combine the various ACE Basin data layers into an easy-to-use format for viewing. These files can be accessed by starting the ArcExplorer software, choosing the **File Open** option, and navigating to the *.aep file in the arcexplr folder. For more instructions, please see on the on-line help files.

ArcExplorer Project Files		
File Name	Description	Location
bio_res.aep	Locations of stations or transects for surveying populations of fish, benthos, birds, and furbearing animals.	arcexplr/bio_res.aep
demog.aep	Census data by blocks, block groups, tracts, and county.	arcexplr/demog.aep
hydro.aep	Rivers, streams and creeks by river basin; 14-digit HUCs; and the boundaries between fresh and salt water.	arcexplr/hydro.aep
rec_tour.aep	Locations of public beaches, birding areas, hiking and biking trails, boat ramps, marinas, outfitters, museums, campgrounds, hotels, bed and breakfast inns, and golf courses.	arcexplr/rec_tour.aep
res_mgmt.aep	Locations of USACE and NPDES permits, STORET water quality monitoring stations, EMAP sediment monitoring, stations, shellfish permit areas, sea turtle and horseshoe crab nesting areas, and protected lands.	arcexplr/res_mgmt.aep

Installing ArcExplorer

- Use either the File Manager® or Windows Explorer® to navigate to the arcexplr directory on the CD-ROM.
- Double-click on the file aeclient.exe.
- Follow the ArcExplorer installation instructions displayed on your monitor.

Note: After ArcExplorer is installed on your computer, a full set of instructions for operating the software is located in the on-line help section of the program. Also, please see the licensing agreement that will be installed on your computer with the software.

System Requirements for ArcExplorer

ArcExplorer is built with 32-bit MapObjects® technology. Therefore, to use ArcExplorer®, you must have Microsoft Windows 95/98 or Microsoft Windows NT 4.0 or later installed on your system. The tables below provide minimum and recommended system requirements for running ArcExplorer.

Minimum Requirements		
System Feature	Windows 95/98	Windows NT 4.0 or later
System RAM	8 MB	12 MB
CPU	486DX 33	486DX 33
Video Adapter	VGA	VGA
Free Disk Space	5 MB	5 MB

Recommended		
System Feature	Windows 95/98	Windows NT 4.0 or later
System RAM	16 MB or better	16 MB or better
CPU	Pentium 60 or better	Pentium 60 or better
Video Adapter	PCI Video Card	PCI Video Card
Free Disk Space	10 MB	10 MB

As with most Windows software, performance will improve with more memory and faster systems.

** Note for NT Users: ArcExplorer Version 1.1 requires both Service Pack 3 and administrator privileges.

Next Section: GIS Tutorial

Author

NOAA Coastal Services Center

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

GIS Tutorial

Introduction

The following tutorials were developed for people who have access to and basic knowledge of, ArcView® GIS software (Version 3.1 or higher) but may not be familiar with some aspects of GIS and remote sensing data. The tutorials illustrate GIS features that allow the GIS data contained on this CD-ROM to be tailored to meet user needs. The features are common to many GIS packages; however, the Data Summary Tool was specially developed for use with the ACE Basin Characterization. With the exception of the Data Summary Tool, the ArcView Help menu provides detailed discussions of these features. This tutorial reviews some of these discussions with examples that use the ACE Basin data.

Manipulating Legends in ArcView®
This tutorial describes how to work with the Legend Editor to customize data presentation.

Linking Tables in ArcView®
This tutorial describes how to link data tables to geographic features in order to access more information about the features.

Loading Useful ArcView® Extensions
This tutorial describes how to add extensions to your project files in order to increase the functionality of ArcView.

Projecting Data and Shifting Datums in ArcView®
This tutorial describes how to project data into different coordinate systems.

Using the Data Summary Tool
This tutorial describes how to use the Data Summary Tool, an extension developed by NOAA, to produce customized summaries of shapefiles within user-defined geographic locations.

Retrieving Other GIS Data from the South Carolina Department of Natural Resources
This tutorial describes how to download additional spatial data from a website at the South Carolina Department of Natural Resources.

Descriptions of the ArcView project files contained on this CD-ROM, and their associated views, are presented in the section entitled GIS Viewing Tools . Note that the project file **gis_tour.apr** includes a **Tutorial** view. This will be the primary view utilized in these tutorials; however, the GIS techniques learned here can be applied to other projects on this CD-ROM as well as other data sources.

Next subsection: Manipulating Legends in ArcView®

Author

NOAA Coastal Services Center

M
E
N
U

Atlantic States Marine Fisheries Commission

South Atlantic Fishery Management Council

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Regional Contacts

Atlantic States Marine Fisheries Commission

The Atlantic States Marine Fisheries Commission (ASMFC or the Commission) is an extension of the Eastern Conservation Conference established in 1937. Although the states determine all policy within their respective jurisdiction, the Commission provides a forum for discussion and resolution of common problems and assists the state in developing joint programs. It also carries out a number of programs coordinating state activities in fisheries management, research and statistics, habitat, sport fish restoration, and law enforcement. These fisheries management programs may lead to uniform laws or varying but coordinated measures. The Commission also adopts cooperative interstate management plans for particular species of fish or bodies of water common to two or more states. Each state must implement the management plan or the Commission may recommend to the Secretary of Commerce that a federal moratorium on fishing be imposed on the non-complying state.

The Commission has a membership of fifteen Atlantic seaboard states; each represented by three commissioners: a representative from the state agency in charge of fisheries resources, a legislator appointed by its Natural Resources Committee or the Commission Interstate Cooperation, and a person appointed by the governor for a three-year term. Each participating state pays dues for the support of the Commission in proportion to the value of its marine fisheries catch (Code Natural Resources Article, sections. 4-301 through 4-305).

Contact:
David Cupka, South Carolina Governor's Appointee Commissioner
PO Box 12559
Charleston, SC 29422
843-762-5010

South Atlantic Fishery Management Council

The South Atlantic Fishery Management Council has its headquarters in Charleston, South Carolina. The council is responsible for the conservation and management of fish stocks within the 200 - mile limit of the Atlantic, off the coasts of North Carolina, South Carolina, Georgia and east Florida to Key West.

When Congress passed Public Law 94-265, the Magnuson-Stevens Fishery Conservation and Management Act of 1976, it extended the U.S. jurisdiction of fisheries out to 200 miles and created a new form of regional government through the eight regional fisheries management councils. The role of the councils is to develop fisheries management plans needed to manage domestic and foreign fishing within 200 miles of the US coast, referred to as the Exclusive Economic Zone or EEZ.

Council members are citizens of these states who are knowledgeable of some aspects of the fisheries. They serve three-year terms and are appointed by the Secretary of Commerce from lists of nominees submitted by the governors of the states. The official responsible for marine fisheries management in each state as well as the regional administrator of the National Marine Fisheries Service are voting members. Non-voting members include representatives of the U.S. Fish and Wildlife Service, U.S. Coast Guard, State Department, and Atlantic States Marine Fisheries Commission.

Contact:
Robert Mahood, Executive Director
Suite 306, 1 Southpark Circle
Charleston, South Carolina 29407
843-571-4366

http://www.safmc.nmfs.gov/ EXIT

ACE Contacts

Local | State | Regional | National

Introduction

The ACE Contacts section of the ACE Basin Characterization is provided as a source of information for contacting agencies and organizations that have some management, stewardship, or service responsibility in the ACE Basin. Each entry includes a brief description of the agency or organization and contact information. While fairly complete, the contacts list likely is not exhaustive. Also note that individuals listed as the contact point were in those positions at the time this list was created (1999), but may no longer be the appropriate contact person.

For ease of using the contact information, the entries are listed alphabetically within each of four categories: Local, State, Regional, and National. For example the Low Country Council of Governments is listed in "Local" and The Nature Conservancy, while it has a local office, is a national organization and is found listed in "National."

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Resource Management

Assessment of Issues and Goals

The ACE Basin remains less affected by natural and cultural impacts that have altered other portions of the coastal region over the centuries. Hurricanes, floods, rice cultivation, timber extraction, phosphate and peat mining, and development have each left their mark on the rivers and land over time. Nevertheless, the ACE Basin's 182,115 hectares (450,000 acres) support more than 1,500 species of plants and animals within its six distinct ecological systems. These include upland, maritime, coastal marine, estuarine, riverine, and palustrine systems (Representative Ecosystems). These interrelated macroecosystems provide spectacular biological diversity including an estimated 274 species of birds, 110 species of amphibians and reptiles, 47 species of mammals, and 22 ecological plant communities.

However, for all its biological diversity, the ACE Basin is not considered pristine and untouched, but rather a "working landscape system." For more than a century, large tracts of privately held land containing stands of timber and abandoned rice fields have been managed and utilized for resource extraction, hunting and other recreational uses. More recently, public-management entities have secured just over 19,959 hectares (49,319 acres) of public lands for hunting and recreational uses as well as resource protection. In addition, public and private management during the last two decades have provided critical habitats for protected and endangered species.

American alligator
(Alligator mississippiensis)

Among the most notable examples of these endangered and protected species is the wood stork, which began nesting in the ACE Basin in the early 1980s as development encroached upon its traditional nesting habitats in Florida. Although it was once classified only as a post-breeding resident of South Carolina, the wood stork now breeds in the Basin in increasing numbers. Likewise, the formerly endangered Southern bald eagle has nested in the region continuously since the 1970s, and the Basin is now home to the largest population of these threatened birds in South Carolina. The American alligator is another signature species of the region and one that is experiencing a successful recovery in the ACE Basin. Once a federally protected species, alligators have rebounded to the point that large land owners are permitted to conduct controlled harvests on their property in exchange for wetland habitat conservation. The ACE Basin provides critical habitat for a wide array of biological diversity from endangered species to abundant species. (See related sections: Mammals, Birds, Fish, and Herpetofauna.)

Historically, resource use in the ACE Basin has varied in intensity from seasonal hunting and gathering to extensive agriculture. However, because land-uses traditionally "mirrored" rather than fully converted the original ecosystems, the Basin continues to exist relatively unchanged. In fact, cultural impacts have not only contributed to maintenance of the Basin's ecological integrity, they have been instrumental in shaping the Basin's character as well. Thus, unlike many ecosystems that have been protected because of a lack of human contact, the ecological integrity of the ACE Basin has been maintained through continuous use and management of the resources.

The earliest evidence of resource use in the Basin is attributed to Native Americans, who inhabited the ACE Basin from approximately 8,000 BCE to the time of European contact in the 16th century. Loosely affiliated tribes lived in the Basin during the summer months, hunting and harvesting from the forests and marshes. Although Native Americans were seasonal residents of the Basin for thousands of years, their presence and impact is evident only in pottery shards, arrow points and the remnants of giant shell rings and middens found along the coast (Milling 1940). (See related section: History of the ACE Basin).

Pottery shard

The introduction of rice in the late 17th century has perhaps had the most influence on altering the ACE Basin's landscape. Wealthy planters from Charleston purchased large tracts of land along the three major rivers of the ACE Basin as fertile, low-lying land that was ideal for tidewater rice cultivation. The planters and African slaves became pioneers of land and water management through the creation and maintenance of an extensive system of canals, dikes and rice trunks, which is still in use today. This intricate system of dikes and waterways transformed the Lowcountry marshes into thousands upon thousands of acres of rice fields and made rice production a profitable industry for South Carolina. About 6,070 hectares (15,000 acres) of the Lowcountry was rice culture by the mid-1800s and in 1859, rice production reached an all-time high of 81 million kilograms (179 million pounds) of clean rice or approximately 96 percent of the nation's total production (Doar 1936).

Hurricane damage and the loss of slave labor made rice production unprofitable after the Civil War. Plantations and impoundments might have fallen into decline and become subdivided through other forms of development, but the Basin's natural beauty attracted wealthy industrialists from the north who realized that the abandoned impoundments made ideal waterfowl habitats. At the turn of the twentieth century, many former plantations, encompassing thousands of acres of wetlands and forests, were purchased and turned into private hunting retreats by their new owners. Secured by private landowners who were not intent on deriving immediate economic return from these properties, their natural resources were protected, and even enhanced, through new patterns of land management that have continued through today (Hilliard 1975).

As one of the largest undeveloped estuaries on the East Coast, the ACE Basin provides significant watershed protection, quality habitat, and untapped potential for economic benefit and recreational opportunity. Considerable effort has been made in the last decade to maintain the Basin's ecological integrity despite encroachment by nearby urban development. Many individuals and organizations have been involved in protecting the

Basin through progressive management and conservation techniques. Recently, The Nature Conservancy named the ACE Basin one of its "Last Great Places," one of a series of important ecosystems that the organization seeks to protect by working in partnerships with local communities.

One fourth of the Basin is now protected by conservation easements, nonprofit organizations, special management agreements and publicly-managed entities. The result of these collective efforts is an intensively managed area that supports traditional uses, such as hunting, fishing, agriculture and forestry, as well as more recent recreational pursuits such as bird watching, photography, and paddling. While many are committed to protecting and conserving the resources of the ACE Basin, there are important issues that must be considered in planning for the long-term sustainability in the watershed.

The following sections provide information about the ACE Basin Task Force Project , Management Strategies for Resource Protection, Specific Resource Management Issues and Goals, and Nature-based Tourism and Public Access. Information used here derives from extended discussion and interaction (through many forums) among professional managers, scientists, technicians, educators, private landowners, farmers, foresters, fishermen, local government officials, business representatives and others interested in the ACE Basin Initiative.

NEXT SECTION: ACE Basin Task Force Project

Author

M. McKenzie, SCDNR Marine Resources Division

References

Doar, D. 1936. Rice and rice planting in the South Carolina low country. Charleston Museum. Charleston, SC.

Hilliard, S.B. 1975. The tidewater rice plantation: An ingenious adaptation to nature. Geoscience and Man 12:57-66.

Milling, C.J. 1940. Red Carolinians. University of North Carolina Press, Chapel Hill, NC.

MENU

Introduction

Resource Protection and Management

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Resource Management
ACE Basin Task Force Project

Introduction

Recognizing the need to protect the exceptional natural resources of the ACE Basin, federal, state and private conservation interests met in 1988 to develop a plan for habitat protection and enhancement. This unprecedented conservation initiative was coordinated by the ACE Basin Task Force, consisting of representatives of the U.S. Fish and Wildlife Service (USFWS), South Carolina Department of Natural Resources (SCDNR), Ducks Unlimited (DU), The Nature Conservancy (TNC), and private landowners. The major impetus for this meeting was to respond to the North American Waterfowl Management Plan (NAWMP) which created regional Joint Ventures made up of government agencies, private conservation groups and individuals whose mutual purpose was to restore migratory bird populations to levels of the 1970's and to protect 2.4 million hectares (6 million acres) of priority wetlands throughout North America.

Protection of the ACE Basin became a flagship project of the Atlantic Coast Joint Venture and a significant component of the NAWMP. The goals set forth by this group to conserve the ACE Basin were as follows:

- Maintain the natural character of the Basin by promoting wise resource management on private lands and protection of strategic tracts by public conservation agencies.
- Continue traditional uses such as hunting, commercial and recreational fishing, forest management, and farming.
- Acquire land or easements only from willing sellers and participants. No condemnation procedures will be undertaken.
- Provide assistance in wildlife management to improve habitat.
- Maintain or improve public access.

These goals have provided a successful framework for land protection in the ACE Basin over the past decade. Broad-based public support, including the endorsement of over 70 citizen groups within the first year, ensured the project's initial success. While encouraging traditional land uses such as agriculture, timber production, hunting and fishing, the overall management goal is to maintain the area's character while restricting industrial and resort development typical of much of the state's coastal zone in the past 30 years. Through land purchases by state and federal agencies from willing sellers, and through conservation easements granted to conservation organizations by private landowners, the project has protected 51,802 hectares (128,000 acres) to date. Success of the ACE Basin initiative rests primarily on the willingness of current landowners to protect the area. Private ownership that protects and enhances habitat is fundamental to the ACE Basin Project. (See related section: Protected Lands.)

Resource Protection and Management

- Conservation
- Research and Monitoring
- Education
- Cooperation

Resource protection and management, within the context of the ACE Basin Task Force Project, is a systematic process that includes planning for the long-term sustainability of natural resources. Gregg (1984) listed four functions that must be effectively integrated to maintain or improve the health of a region's ecosystem and the well-being of its people: conservation, research /monitoring, education and cooperation. These four elements have also provided the basic architecture for the ACE Basin Task Force Project.

Conservation

Conservation in the ACE Basin embraces preservation, maintenance, and sustainable use of the landscape and its natural resources. "Sustainable growth" is a key consideration in the project area, consistent with the desire of rural communities to maintain their quality of life without pressure to develop for immediate economic gain. This opportunity to pursue sustainable growth has been unusual and was shaped by historical good fortune in the ACE Basin. The concept of incorporating the needs of a community with preservation of natural values, goods and services that the environment provides is still a new idea. It is this balancing of a community's socio-economic needs with the need to protect the benefits of natural systems that defines conservation in its modern sense. Conservation must also have a strong basis in scientific knowledge and must rely on commitment and leadership in local communities. The ACE Basin Economic Forum (1996) created an action agenda underpinned by three guiding conservation principles:

- Economic development and environmental conservation are not mutually exclusive – instead, they can be mutually reinforcing.
- Conservation of natural resources and protection of the environment can lead to economic opportunity for local residents.
- Economic development need not lead to environmental damage and loss of natural and cultural heritage.

After working on the economic development plan for over a year, the ACE Basin Economic Forum group concluded that working within this framework is not merely wishful thinking but instead is a practical and effective approach. Increasingly, economic development professionals and conservationists are using this approach to find common ground between their respective agendas. Three strategies have been implemented in ACE Basin planning efforts:

1. create a framework for responsible growth;
2. enhance the awareness, understanding and appreciation of the ACE Basin; and
3. promote environmentally compatible business development.

A unique practice in the ACE Basin is the conservation of traditional land use systems, which illustrates the harmonious relationships possible between indigenous populations and their environment. These relationships reflect centuries of human experience and can provide information of immense value in improving the productivity and sustainability of modern land use and management practices.

Research and Monitoring

Because of its remote location, comparatively large size, and relatively unspoiled landscape, the ACE Basin provides ideal sites for monitoring changes in the physical and biological components of the region. The fact that a National Estuarine Research Reserve, National Wildlife Refuge, and Nature Conservancy Bioreserve are located here make the Basin even more attractive for gathering scientific information. Scientists can have more confidence that the integrity of study sites will be respected and that their data will contribute to a growing data bank of increasing scientific significance. As land use changes and human impacts progressively diminish the availability of suitable monitoring sites, scientific interests in sites like the ACE Basin increase. Interdisciplinary research is encouraged to develop models for sustainable conservation of ecosystems. The ACE Basin provides sites for coordinated research to determine requirements for conserving biological diversity, to assess the impacts of pollution on the structure and function of ecosystems, to evaluate the effects of traditional and modern land use practices on ecosystem processes, and to develop sustainable production systems for altered habitats. In addition, the national network of reserves provides a framework for comparative studies of similar problems in different parts of the coastal U.S. This capacity is useful for testing, standardizing and transferring new methods and for coordinating the development of information management systems.

Education

The ACE Basin also plays an important role in environmental education and interpretation based on sound scientific principles to strengthen the understanding, appreciation, and stewardship of estuaries, coastal habitats, and associated watersheds. Local communities have been introduced to the ideas that protecting natural areas and sustainable development are to their benefit. The Basin provides an ideal setting for interpreting food webs, general biological principles and coastal processes. Opportunities exist for focusing on the national significance of the ACE Basin as a refuge for endangered and threatened species and demonstrating sustainable development. (See related sections: Research and Monitoring and Education Programs.)

Cooperation

There are many excellent examples of ecosystem management, but few require the degree of cooperation between private landowners, government agencies, and conservation groups needed for the ACE Basin Project. The strategy for protecting natural resources of the ACE Basin is expressed in five key project elements:

- National Estuarine Research Reserve
- National Wildlife Refuge
- State Wildlife Management Areas
- Conservation Easements
- Private Land Initiatives.

The following figure presents a conceptual model of the ACE Basin alliance illustrating the relationships between project cooperators, habitat protection and enhancement strategies and benefits.

NEXT SECTION: Management Strategies for Resource Protection

Author

M. McKenzie, SCDNR Marine Resources Division

References

ACE Basin Economic Forum. 1996. An action agenda for compatible economic development. ACE Basin Economic Forum. Walterboro, SC.

Gregg, W. P., Jr. 1984. The international network of biosphere reserves: a new dimension in global conservation. p 65-85 *In* T. N. Veziroglu (ed.). The biosphere: problems and solutions. Elsevier Science Publishers, Amsterdam.

Resource Management

Strategies for Resource Protection

Introduction

Because history has been kind to the ACE Basin, it does not face the same pressures as many coastal areas of the U.S. and elsewhere do. There are certain human activities and environmental alterations, however, that can and do affect the natural resources in the ACE Basin. The concepts of ecosystem management and sustainable development have been discussed throughout development of the ACE Basin Task Force Project. But, as of this writing, how to implement these concepts in the overall context of the Task Force Project area is not readily understood. The traditional approach to managing natural resources in the ACE Basin has been to focus on specific resources like waterfowl, fisheries, upland game, and forestry through public and private ownership.

We are just now learning of the complexities in coastal management and how to integrate science into the decision making process. We need to consider how the activities of one sector (such as forestry) might affect other sectors (such as fisheries) and the environment (fisheries habitat). Also, we need to find ways to resolve conflicts between sectors and adopt flexible management plans that can be modified when necessary. Two important concepts to address complex coastal issues have recently emerged: integrated management and adaptive management. According to the Committee on Science and Policy for the Coastal Ocean (1995), "integrated management attempts to encompass the complex scope of multiple sectors, jurisdictions, and actors to achieve management that cuts across users, agencies, geography, resources, and disciplines." Adaptive management, aimed at the temporally dynamic aspect of management, is an approach that incorporates, on a continuous basis, learning about natural and social environments and about the performance of government programs in the management process." Crosby (1997) summarizes the process of adaptive management into a structure consisting of models, special studies, and monitoring. This structure in turn is used as a coordinated, supportive tool and provides feedback between managers and scientists. He also emphasizes the need for periodic assessment to focus monitoring and apply models in the management process. In the end, adaptive management requires that scientists work closer with managers and in roles that are nontraditional.

Enforcement

- Enforcement Philosophy and Goals
- Enforcement of Critical Areas
- Enforcement of Non-Critical Areas
- Enforcement Authority

Enforcement is a critical element in conservation and natural resources management. The perceptions by user groups of the regulatory and enforcement process have significant bearing on compliance behavior. Strategies involving public input, communications, and information may reduce conflicts between user groups and thus, lessen the need for increased enforcement activities in the ACE Basin. Although studies are limited to enforcement in reserve areas, previous studies in commercial fishing sectors (Sutinen 1988, Sutinen and Gauvin 1989, Sutinen et al., 1990, Sutinen 1992) suggest that many variables influence the success of the enforcement process including:

- the process (creating regulations) itself,
- types and level of enforcement activities,
- effectiveness of enforcement as perceived by users,
- penalties for noncompliance and users’ perception of effective penalties for noncompliance,
- social pressure placed on users, and
- fairness of the regulations and enforcement process in the eyes of users.

Enforcement Philosophy and Goals

Law enforcement in the ACE Basin is an essential component of resource protection. A major goal is "preventive enforcement" which seeks to prevent resource stresses. This is best accomplished through frequent patrols within the watershed to deter violations. The ACE Basin is much too large an area to cover fully with limited manpower, however, and many times violations go undetected.

Aerial view of Otter Island - southwest

Violations are of two types - willful and inadvertent. Willful violations occur frequently under the pretext of traditional use. Historically, hunting and fishing on the maritime islands, waters and associated uplands in the ACE Basin has been considered a God-given right and trespassing/poaching has mostly been ignored, except on the larger plantations where managers and caretakers actively have patrolled their uplands by vehicle. This is especially true, however, in hunting for deer and waterfowl on such areas as Otter Island where "poaching" has been interpreted by some as a traditional and legitimate use. (See related section: Hunting).

Inadvertent violations take place when users do not understand the impacts of humans and their actions on natural resources. Recognizing this factor and the acute shortage of law enforcement officers, the ACE Basin enforcement philosophy is shifting to a form of law enforcement known as "interpretive enforcement", very similar to that used in the National Marine Sanctuary Program. Interpretive enforcement seeks voluntary compliance by informing users through educational messages and literature on responsible behavior before they adversely impact natural resources. Presently, this is accomplished through brochures and direct contact with users while officers and staff are on patrol. An ACE Basin Speakers' Bureau has been delivering the habitat protection message to thousands of people over the last decade. The proposed ACE Basin Interpretive Center and its network of satellite stations will also play a major role in this concept of law enforcement.

The principal goals of law enforcement activities include:

- increasing the public's understanding of why it is important to comply with rules and regulations,
- achieving voluntary compliance with applicable laws, and
- promoting public stewardship of natural resources through interpretive enforcement activities.

The following strategies have been recommended for accomplishing the above goals:

Agreements and Cooperative Efforts

- Strengthen the existing District Nine (coastal) law enforcement unit within South Carolina Department of Natural Resources (SCDNR).
- Develop partnerships with other state and federal local enforcement agencies in an effort to provide a stronger presence throughout the ACE Basin watershed area.
- Identify areas of mutual concern and develop cooperative responses to enforcement issues.
- Develop and enter into memoranda of understanding, cooperative agreements, and joint operation plans with other agencies with enforcement arms in the ACE Basin.
- Facilitate communication among enforcement assets to avoid duplication.
- Promote cooperation and coordination of limited resources (i.e., gear, vessels, radios, and training).
- Promote training and cross-deputization among enforcement agencies.

Community Involvement

- Encourage site-specific interpretive patrols by organized volunteer groups.
- Involve organized groups (i.e., power squadrons, charter boats, marinas, and concessionaires) in promoting rules and regulations.
- Maintain and enhance relationships with citizen groups interested in natural resource conservation,
- Conduct a community outreach program to encourage compliance with laws.
- Establish an enforcement auxiliary.

Education

- Use education as a tool to achieve compliance with regulations.
- Promote voluntary compliance and stewardship by the general public through specific outreach programs.
- Train user groups to identify and report violations.

Operations

- Develop and maintain capabilities for quick response to willful violations.
- Develop and maintain capabilities for effectively responding to emergencies.
- Establish an enforcement advisory committee consisting of cooperating agencies with enforcement groups.
- Identify enforcement strategies and priorities; this includes high-use and sensitive areas.

Enforcement of Critical Areas

The S.C. Coastal Management Act defines the critical area as all coastal waters, tidelands, beaches, and primary ocean front sand dunes within the coastal zone of the state. A permit is required for any activity that impacts a critical area; in order to receive a permit, the activity must be evaluated in accordance with a strict set of policies and regulations. The policies for wetland areas prohibit permanent alteration of productive salt, brackish, or freshwater wetlands unless there is an overriding public interest, no feasible alternatives, and all environmental impacts are minimized. Regulated activities include not only major activities such as dredging or filling, but also activities such as installation or work on pipelines, power lines, docks, piers, intact structures and many others.

Any activity occurring within the critical area of the ACE Basin is regulated by permit through the S.C. Coastal Management Program. Much of the ACE Basin, especially that area defined within established boundaries of the National Estuarine Research Reserve (NERR), is considered a "Geographic Area of Particular Concern" and receives special attention through an agreement between the Office of Ocean and Coastal Resource Management of the S.C. Department of Health and Environmental Control (OCRM/SCDHEC) and cooperating agencies.

The State Coastal Management Program was created by Act 123 of the 1977 South Carolina General Assembly with three primary missions: 1) to establish the S.C. Coastal Council (reorganized into the SCDHEC in 1994 as OCRM) and provide for its powers and duties for the protection and improvement of coastal tidelands and wetlands under a coastal zone management plan, 2) to provide for enforcement of policies of the Council and penalties for violations, and 3) to authorize legal proceedings for the determination of tideland properties. Act 123, better known as the S.C. Coastal Management Act, was implemented in accordance with the Federal Coastal Zone Management Act as amended (Public Law 92-583, 94-370) and a subsequent coastal zone management program was developed and approved by the U.S. Secretary of Commerce in 1979 which met the requirements of 15 CFR part 923 (Federal Register, March 1, 1978).

Enforcement of Non-Critical Areas

Both the Federal Coastal Zone Management Act and the S.C. Coastal Management Act require consistency of all direct and regulated state and federal activities that occur in the designated coastal zone of S.C., which includes the entirety of all eight coastal counties bordering the Atlantic Ocean. Therefore, any activity which requires a state or federal permit must undergo a coastal zone management consistency determination by the OCRM before the permit can be issued by the issuing state or federal agency. The policies used to make a consistency determination are similar to those required for critical areas. The OCRM has a Memorandum of Agreement with all regulatory state agencies that establishes a consistency determination review procedure. Federal regulations (15 CFR 930) establish a review procedure with federal agencies.

Permits reviewed for coastal zone management consistency include:

Section 404 Permits	Section 10 Permits
Section 401 Permits	Coast Guard Bridge Permits
Wastewater Permits	Water Supply Permits

Air Quality Permits

Underground Tank Permits

Landfill Permits

Mining Permits

State Navigable Water Permits

Capacity Use (Wells) Permits

Septic Tank Permits

NPDES Permits

State Stormwater Management and Sediment Control Permits

Activities associated with the above permits which result in land disturbance (i.e., subdivisions, malls, gas stations, etc.) must submit specific plans to address policies and approved guidelines of the Coastal Zone Management Program. Plans that must conform to coastal zone policies before permits can be issued include: stormwater management plans, wetland management plans, and dock master plans (if applicable).

Enforcement Authority

OCRM has an enforcement section of specially trained field biologists to ensure enforcement of the coastal management program. Their weekly aerial flights and daily routine patrolling by motor vehicle represent the first level of enforcement. OCRM is also in alliance with SCDNR whose Conservation Officers patrol the waters and land of the coast daily. Violations are reported to OCRM staff who conduct field inspections with state conservation officers providing needed backup. Fines for violations range up to $1,000 per day.

Enforcement of activities requiring coastal zone consistency certification generally takes place through the agency issuing the permit. The majority of activities, however, require a final OCRM sign-off prior to permit issuance. For example, an OCRM staff engineer conducts a site inspection to ensure a stormwater system is constructed according to an approved design before the applicant can operate the system. This provides a strong incentive to comply with the coastal zone management program. Additionally, OCRM has an active Beach and Creek Watch Program to provide a forum for citizen awareness and violation reporting. OCRM has implemented its full authority in the coastal zone through a cooperative network developed between OCRM and other state agencies. This authority is granted through the statutes of SC, most of them enacted prior to the Coastal Management Act. In addition, various managers on public and private properties within the ACE Basin also have law enforcement authority through SCDNR for on-site enforcement activities.

Back to Top

Human Use and Conflicts

Management concerns for the ACE Basin center on potentially negative effects of natural processes and human activity on wildlife and their habitats. Natural processes that may negatively impact the Basin's habitats include erosion, storms, hurricanes, flooding, drought, and fires. Human use impacts are of greater variety and concern and have in large part been addressed in current management plans. Still, some concerns have not been fully dealt with and these remain to be addressed over time through research, monitoring, and adaptive management.

Traditional Uses

The ACE Basin has traditionally been used for hunting migratory game birds (including waterfowl), white-tailed deer, wild turkey, mourning dove, bobwhite quail, and other game species. Recreational fishing in the rivers, creeks, and impoundments and commercial fishing and shellfishing in coastal waters are also recognized traditional uses. Each of these activities is currently subject to state regulation through required licenses, permits, boundaries, seasons, bag limits, catch limits, and other laws. Agriculture and forestry activities are conducted in accordance with recommended environmentally sound best management practices (BMPs) established by the S.C. Forestry Commission and Department of Agriculture. Establishment of the ACE Basin Task Force Project has not changed any of the existing laws and regulations concerning these or any other traditional uses of the area. Project goals and recommendations seek to maintain the present emphasis on traditional uses and factor these important socio-economic activities into the coastal decision-making process. (see related section Resource Use: Current and Traditional Use.)

There are a number of long-standing uses of the marshes, bottoms, and waters in the ACE Basin, including hunting, fishing, shellfishing, bird watching, and others which are considered "traditional." These are accepted uses, even though participants – in some cases – may have had to trespass on private property to engage in activities such as surf fishing, deer hunting, waterfowl hunting, trapping, hiking, bird watching, beachcombing, boating, water skiing, having beach parties, camping, and swimming. For the most part these activities are compatible with the integrity of the Basin's resources. Others, however, such as clear cutting of forests and excessive use of pesticides have been in direct conflict with proper stewardship of its natural resources.

Commercial Fishing

The marsh/estuarine system in the ACE Basin is extremely valuable as habitat and as spawning and nursery grounds for species of commercial importance. Commercial fisheries take penaeid shrimp, blue crabs, oysters, clams, and various species of finfish. Shrimp fishing is conducted primarily in the lower estuary and adjacent ocean waters. Blue crab pot fishing is confined to the inner estuarine area of the sound and creeks. Most shellfish growing areas are intertidal; they require a permit for commercial harvesting or are designated as state or public grounds.

At present, there is no evidence of over-exploitation of any marine or estuarine resources in the ACE Basin. Management involves

Horseshoe crab
(Limulus polyphemus)

primarily the opening and closing of seasons, setting of catch and size limits, and addressing commercial fisheries enforcement problems. A recent exception, which suggests caution is needed, involved conflicts with commercial fishermen harvesting horseshoe crabs from the front beach of Otter Island. This island is evidently an important spawning ground for horseshoe crabs. In the last several years, fishermen have been hand harvesting these animals at night for a local buyer who processes and sells their blood (Thompson, pers. comm.). Their blue, copper-based blood contains a clotting agent that attaches to bacterial toxins and provides an excellent method of checking pharmaceuticals for contamination by bacteria. This has become a standard test in the industry; no drugs leave a pharmaceutical manufacturer without it. As a consequence, the horseshoe crab's blood has become quite valuable. Live crabs are harvested during the spring spawning season and taken to the laboratory where approximately 20% of their blood is extracted. The live animals are required to be returned to the water as soon as possible after processing.

The problem with the horseshoe crab harvest, as it relates to Otter Island and the ACE Basin, involves the mission of the National Estuarine Research Reserve – "to provide a protected area for compatible research and education." It is precisely this protection that makes the ACE Basin particularly valuable as a source of scientific information; scientists can have more confidence that the integrity of study sites will be respected. In this particular case, the fishermen using Otter Island to collect horseshoe crabs at night have violated the Heritage Trust Act and Otter Island Management Plan. Such activities also impact sea turtle nesting areas and current research projects. One such project collects life history information about the horseshoe crab. In the incident used as an example, a researcher found himself competing with commercial fishermen for live specimens for study (Thompson, pers. comm.). To eliminate conflicting commercial activity, managers have placed Otter Island off-limits for the commercial harvest of these animals. This action conforms to resource management objectives and provides sanctuary for the horseshoe crab.

Recreational Fishing
Saltwater sport fishing is a popular recreational activity in the ACE Basin. These recreational fishing activities take place in the sound, tidal

Surf fishing

rivers, and ocean waters adjacent to maritime and barrier islands. The front beaches of barrier islands (Edisto Beach, Otter Island, Hunting Island) within the ACE Basin are popular surf fishing areas. Public shellfishing also occurs in the creeks and intertidal flats behind these islands. Surf fishing occurs on the northeast end of Otter Island. In past years, this has been the location of nesting shorebird colonies (least terns) and the presence of fishermen has placed unnecessary stress on these birds. Recommendations are to confine fishing activities below the mean high water mark and to keep public access at least 200 yards away from nesting birds. It should be noted that nesting locations vary from year to year so monitoring is required to reposition such access points.

Nature Tours

Nature-based tourism has become an established business in the ACE Basin, most of which is centered in the Edisto Beach area and on Otter Island in particular. There are three to five tour boat operations in the area. Major boat access points are located on the northeast end of Otter Island in the vicinity of nesting birds, and these must be closed when shorebirds are nesting.

According to boat operators, people most frequently ask to visit the front beach of these islands for beachcombing. This poses several management problems of wildlife disturbance and shorebird nesting requirements. The largest local operator can accommodate up to 38 passengers and could, if business is good, shuttle many people to and from these islands (Otter, Ashe, Beet, Big, Warren and South Williman). Such intensive visitorship would certainly not be in the best interest of wildlife or other natural resources. If large numbers of people are allowed to roam these remote areas freely, other conflicts will arise during hunting season (archery hunts), creating unnecessary wildlife disturbance and public safety concerns. Limits may eventually have to be imposed on the total number of people allowed into these areas at the same time. Important management questions are:

- What is the human carrying capacity of these remote islands?
- Could this carrying capacity be properly allocated among different users?
- At what point does such intensive use destroy the natural experience?

Answers to these and many other questions can be obtained through continuous monitoring, research, and management. Martin and Uysal (1990) demonstrated a link between the carrying capacity and tourism lifecycle and the management implications of that relationship. They concluded that carrying capacity must be determined concurrently with tourism lifecycle stage and that such information is critical if managers are to understand probable changes to wildlife habitats. Another framework for establishing acceptable and appropriate resource and social conditions in these recreational settings is known as the Limits of Acceptable Change (LAC). This technique has been developed to assist managers to cope with increasing demands on wilderness recreational areas. It emphasizes carrying capacity in relation to conditions desired in the area rather than how much use an area can withstand before its resources degrade. Stankey et al. (1985) outlined the LAC system for wilderness management, requiring managers to define desired wilderness conditions and to implement management strategies to maintain or achieve these conditions. The need to preserve environmental quality and to provide opportunities for solitude and primitive recreation is served by this method. In the ACE Basin, rather than focusing on the number of users, it may be more appropriate to concentrate on desired environmental quality and take corrective action when necessary to protect it; this may or may not involve limits on recreational use.

Camping

Camping in the ACE Basin is allowed in designated areas with a permit . Designated areas have been selected to minimize impacts on cultural and natural resources and to avoid conflicts among user groups (e.g., consumptive versus non-consumptive users). Campers generally include hunters and those interested in more passive (or less consumptive) forms of recreation. Current management plans direct hunting activities to one area while camping is permitted in other areas. For example, on Otter Island, hunting is directed to the western side of the island near major access points. Non-hunting activities are permitted on the front beach area. This separation of uses reduces the likelihood of conflict and takes advantage of the forest as a natural buffer between hunters and campers. Seasonally permitted camping also reduces conflict with wildlife conservation and its management objectives. The primary management issue may be a societal one: how many users are too many? The physical effects of camping on these remote islands needs to be monitored closely. Currently, it appears that effects on the front beach areas are sufficiently mitigated by the scouring action of ocean waves. Buerger et al. (1995) had similar conclusions in a study conducted on Masonboro Island, a barrier island component of the North Carolina NERR. There it was found that no long-term recreational impacts occurred on a section of Masonboro Island where overwash by storm surge was prominent during the winter. These natural processes were effective in eliminating traces of human impacts. Managers have applied this knowledge and now encourage more recreational use in these highly wave-stressed areas rather than on those areas where long-term impacts are more likely to be long-term. Effects of camping in the forested areas are much more noticeable and probably more damaging in the long-term. McKenzie (1990) found this to be true on Capers Island, a barrier island 58 miles north of the ACE Basin. In wooded campsites there, visible impacts occurred year-round as opposed to its front beach sites where wind and wave action essentially eliminated all signs of human activity. The broader benefits of these findings may be in assisting managers of coastal recreational resources to better understand the relationship between recreational use, its associated impacts, and the ability of physical systems to tolerate or mitigate these impacts.

Hunting

Hunting occurs in the open waters and marshes, impoundments and uplands in the ACE Basin. Normally, conflicts are minimal on private lands (e.g., occasional trespassing). User conflicts on public lands, however, especially in open estuarine waters and marshes, have increased in recent years. Traditionally, rails and waterfowl are hunted in navigable waters during the fall and winter when

Waterfowl hunters

potential for conflict is greatest between hunters and those paddling the same waters in kayaks and canoes. Again, management questions arise: should navigable waters be zoned to separate different user groups? Can management plans adequately reduce such conflicts (temporal or spatial separation of conflicting activities)? These questions must be answered if the issue is to be resolved.

Other

A number of other human uses of natural resources within the ACE Basin have potential management implications. For example, pets are commonly taken to these remote and sensitive areas with the result that despite leash laws wildlife (e.g., sea turtles and shorebirds) is disturbed. These areas are also used as launching points for water skiing, parasailing, jet skiing, social activities, and motorized vehicles (including ATVs, dune buggies, and motorcycles). This, in addition to the cutting of trees and shrubs and occurrence of low-level military training flights, is treated in management plans in force for the ACE Basin. Although the plans outline basic measures needed to preserve significant wildlife habitats, there are many unanswered questions about how to do a better job. Ecological and sociological impacts of alternate strategies for public use of the ACE Basin must be investigated so that managers can adapt their strategies to these uses. This will protect the Basin's natural resources and the public's ability to continue enjoying them.

Land Use and Stewardship Considerations

Another important consideration is the kind of development that takes place outside the conserved lands in the ACE Basin and its impact on natural, historic, and cultural resources of the region. In recent years, suburbs have begun to alter the more traditional landscape composed of working farms, rural vistas, forests, and wildlife habitat. Recent findings on urban and suburban development are provocative. Using Census information and satellite photos, the SCDNR found that the Charleston metropolitan urban area grew more than 250 percent between 1973 and 1994, while its population increased only 41 percent. This contrast indicates an inefficient use of natural resources through urban sprawl. The dynamics of all the economic and social factors associated with the broad concept of sustainable land use make progress toward sustainability an elusive goal. The land use debate is driven by the South Carolina Local Government Comprehensive Planning Enabling Act of 1994 which provides clear guidance to local governments on the purpose, approach, and procedures for plan preparation, approval, and enforcement. This Act will repeal all previous statutes relating to land use planning and zoning as of May 3, 1999. It does not, however, mandate a state review process for local plans, so there is no guarantee that local plans will be compatible, and the law does not require that local governments plan together on a regional scale. There is no incentive for coordination. Local governments are doing their individual, separate plans and are not necessarily trying to achieve similar objectives. (see Synthesis Modules: Land Use Module).

In Colleton County, which constitutes most of the ACE Basin study area, the impetus for preparing a plan was the "community strategic planning process" conducted by the ACE Basin Economic Forum. Recommendations were made "to create a plan for responsible growth which seeks to balance economic and environmental needs for the greater benefit of the county and its residents." A planning committee task force was formed which found through public meetings that while people in the county were not familiar with land use planning, they were concerned about additional government in their lives, and particularly about being told what they can and cannot do with private lands. Also, there was some concern about changes occurring in the county over which they had no control. They felt powerless and that their quality of life was in jeopardy from new development, new taxes to pay for new development, increased traffic, and a lack of concern for their environment. Major challenges expected in the future include significant growth in population accompanied by changes in the rural character of the county. Farmland and forests may be converted to scattered developments of mobile homes and commercial and retail outlets. The ACE Basin Task Force identified the following critical issues facing Colleton County:

- Coping with population growth.
- Protecting what makes Colleton and the ACE Basin a special place.
- Upholding property rights while maximizing public benefit.
- Tackling poverty and creating more jobs.
- Balancing development pressures.
- Building adequate infrastructure.
- Demanding better quality development.
- Providing affordable homes.
- Capitalizing on the strengths of the forestry industry.
- Supporting farming as a way of life.
- Conserving the county's unique environment.
- Recognizing sustainable development as a necessary goal.
- Safeguarding the county's history and culture.
- Improving the planning system.

It is important to realize that when local government adopts a land use plan, it does not necessarily dictate changes in the community's development patterns. Instead, the plan is a broad policy document, establishing a framework that can guide future development. To fully implement the plan, elected officials must follow up with new ordinances that correspond to the plan's guidelines. Effective ordinances almost always include zoning regulations or development standards that execute such guidelines. Unfortunately, local officials often do not pass new ordinances consistent with new plans or when they do, they are poorly enforced or ignored.

Conservation easements have played an important part in preserving historic properties, natural lands and scenic vistas in the South Carolina Lowcountry. They are expected to continue to forestall the sprawl that comes with increasing development. While the state has strongly encouraged economic development, particularly in rural areas, it also has encouraged citizens to put important natural lands into perpetual trust.

The S.C. Department of Revenue recently completed a comprehensive guide to tax benefits of conservation easements. Increased values of such private easements has been most noticeable in the ACE Basin where they have more than matched expenditures for acquisition of public lands for conservation purposes. Over 18,212 hectares (45,000 acres) have been preserved by major landowners. Elsewhere in Charleston, Berkeley and Dorchester counties, about 5,261 hectares (13,000 acres) have been placed into conservation easements.

In Florida, easements have been cited as an important element in the creation of a comprehensive greenbelt system that would help limit urban growth (Florida Greenway Commission 1994). Involvement by the state of South Carolina in the preparation of a guide to create conservation easements should reduce public skepticism about the potential benefits of easements that accrue to the property owner. Easements, in conjunction with comprehensive plans for a greenbelt, will not halt development; but they could manage growth in a way that will help preserve forests and farmland.

Sustainable Development

Sustainable development is a strategy used by communities that seek economic development approaches which may benefit the local environment and quality of life. It has provided important guidelines to many communities that have found that traditional approaches to planning and development are leading to problems such as congestion, sprawl, pollution, and resource overconsumption. By providing a framework under which communities focus on environmental, cultural and economic resources, sustainable development can protect and enhance quality of life, and create new businesses to strengthen community economies. (see Synthesis Module: Alternative Approaches to Development).

NEXT SECTION: Specific Management Issues and Goals

Author

M. McKenzie, SCDNR Marine Resources Division

References

Buerger, R., J. Hill, J. Taggart, and J. Hernstine. 1995. The impact from recreational use on the physical features of Masonboro Island, North Carolina. *In*: B.L. Edge (ed.). Coastal zone '95: Extended abstracts for the ninth conference, Tampa, Florida, July 16-21, 1995. American Society of Civil Engineers, New York, NY.

Committee on Science and Policy for the Coastal Ocean Studies Board. 1995. Science and policy and the coast. National Academy Press, Washington, DC.

Crosby, M.P. 1997. Alternative access management strategies for marine and coastal protected areas: a reference manual for their development and assessment. National Oceanic and Atmospheric Administration and Office of Ocean and Coastal Resource Management.

Florida Greenway Commission. 1994. Creating a statewide greenway system. Florida Greenways Commission Report to the Governor, Tallahassee, FL.

Martin, B.S. and M. Uysal. 1990. An examination of the relationship between carrying capacity and the tourism lifecycles: Management and policy implications. Journal of Environmental Management 31(4):327-333.

McKenzie, M.D. 1990. Unpublished data. SC Wildlife and Marine Resources Department.

Stankey, G.H., D. Cole, R. Lucas, M. Peterson, and S. Frissell. 1985. The limits of acceptable change (LAC) system for wilderness planning. General Technology Report INT-176.

Sutinen, J.G., A. Reiser, and J. Gauvin. 1990. Measuring and explaining noncompliance in federally managed fisheries. Ocean Development and International Law 21:335-372.

Sutinen, J.G. 1988. Enforcement economics in exclusive economic zones. GeoJournal 16:273-281.

Sutinen, J.G. 1992. Morality and fairness, and their role in fishery regulation. Proceedings of the IV Annual Conference of the European Association of Fisheries Economists. Salerno, Italy, April 1992.

Sutinen, J.G. and J. Gauvin. 1989. An econometric study of regulatory enforcement and compliance in the commercial inshore lobster fishery of Massachusetts. *In*: P. A. Neher, R. Arnason and N. Mollett (eds.). Rights based fishing. NATO Applied Science Series 169. Kluwer Academic Publishers, Boston, Massachusetts, USA.

Thompson, M. Personal Communication. South Carolina Department of Natural Resources, Marine Resources Division. 1997.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

MENU

Introduction

Wildlife Habitat Management Issues and Goals

Wetlands Management Issues and Goals

Forest Management Issues and Goals

Water Quality Management Issues and Goals

Fisheries Habitat Issues and Goals

Cultural Resource Management Issues and Goals

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Resource Management Issues and Goals

Introduction

This section addresses a number of management issues in the ACE Basin and provides goals and recommendations. Although landscape-level issues and management are discussed, the goals and recommendations are primarily resource-specific recommendations designed to guide management activities for one type of resource (e.g., wildlife habitat, forestry, etc.). Others are broader in scope and concern policy and management, which cut across the resources of the entire watershed.

Wildlife Habitat Management Issues and Goals

Game and Non-Game Species

Game and non-game species are managed to preserve overall health of their populations within the ACE Basin. Relevant issues are directly linked to the subjects of habitat protection and enhancement. The South Carolina Department of Natural Resources (SCDNR) and the U.S. Fish and Wildlife Service (USFWS) work cooperatively with private landowners and the forestry community to establish wildlife management plans within the project area. Specific management issues for conservation of wildlife habitat in this region include: fragmentation of upland habitats, increasing total acreage and size of monoculture forest stands and agricultural fields, urban sprawl, human use conflicts, human contact/interactions with wildlife, and decreasing incentive for landowners to manage their land for wildlife.

Timber management practices (i.e., harvesting, site preparation, and prescribed burning) can be used to enhance wildlife habitat. Most significant wildlife habitats in the ACE Basin include naturally occurring vegetative communities, which are large enough to create habitat connectivity across landscapes, if managed properly. In many other coastal areas, land use practices have resulted in continued declines of such natural vegetative communities. Size of natural vegetative communities is an important determinant of habitat quality. Larger habitat units tend to have higher species diversity (Diamond 1975, Harris 1984) and are considered critical elements in conserving sensitive species such as neotropical birds, large far-ranging mammals and raptors (Gosselink and Lee 1989). Connectivity is essential in sustaining wildlife diversity.

Riparian habitats in the ACE Basin satisfy the above

Tidal freshwater wetland

requirements of good wildlife habitat. They include a mix of wetland and upland communities adjacent to rivers and streams in the tri-river system. Riparian habitats in the Basin are largely intact and serve as critical corridor-like linkages between otherwise larger, detached landscape units. Important nonriparian habitats include large clusters of mixed upland and wetland forests and unique areas supporting sensitive species and imperiled communities.

Management Goals
The goals are as follows:

- Identify and conserve significant riparian habitats in the ACE Basin watershed,
- Maintain or increase the acreage of natural habitats.
- Maintain large contiguous blocks of natural habitats and enhance connections between these areas.
- Expand the private land initiative and develop best management practices for wildlife habitat in the ACE Basin.
- Expand and formalize the cooperative landscape-level management program.
- Promote the use of incentives for drawing landowners into the private land initiative and managing for wildlife habitat diversity.
- Leave primary streamside management zones wider than the minimum widths specified in the S.C. Forestry Commission's BMP Manual.
- Maintain stands of trees in different age and size classes throughout the forest.
- Leave some mature mast-producing trees, such as oak, which are important for wildlife food. Mast producers are most effective if retained in groups or stands.
- Manage for tree species diversity as well as age class diversity across the forest.
- If clearcutting, harvest smaller areas in somewhat linear, irregular shapes, preferably along natural topographic breaks.
- Leave strips of trees connecting mature stands to serve as cover and wildlife travel corridors where areas have been or will be clear cut within a few years of one another.
- Leave snags and hollow den trees for cavity-dwelling wildlife species, preferably in association with groups of mature trees.
- Provide supplemental wildlife plantings. These plantings can be made on old logging decks, under electric transmission lines, at edges of clear cuts, in firebreaks, or in other openings.

Sensitive Species

Some areas within the ACE Basin which possess endangered or threatened species are managed in accordance with the amended Federal Endangered Species Act of 1978 , and in conformity with recovery plans developed by the USFWS (bird and terrestrial species) and the National Marine Fisheries Service (NMFS) (sea turtles and marine mammals are jointly managed by these agencies). The SCDNR, Wildlife Diversity Section coordinates and manages endangered species in the ACE Basin. The presence of endangered or threatened species does not necessarily preclude continued or compatible uses of an area. Flora and fauna within the Basin are surveyed and mapped on public and participating private lands by SCDNR with assistance of The Nature Conservancy (TNC), Ducks Unlimited (DU) and USFWS.

An important problem for managers is that many landowners are reluctant to cooperate in managing endangered and threatened species because of regulatory restrictions and economic losses. Hence, financial incentives must be created to motivate landowners to restore, rather than destroy habitat that may contribute to the recovery of endangered species.

According to an expert committee of the Edisto River Basin Project (Beasley et al. 1996), the most frequently used forestry practices involve harvesting and regenerating everything within the same ownership boundary in a single operation. Other more selective, technologically advanced approaches, which could encourage increased diversity, are not common.

Westvaco Corporation, the largest private landowner with 6,880 hectares (17,000 acres) in the ACE Basin, is an exception and has adopted "ecosystem-based" management techniques (Muckenfuss 1994). Liability and smoke management guidelines have made landowners reluctant to use prescribed burning. Yet, the necessity of burning to maintain certain habitats is a critical fact that needs to be better communicated to the general public as well as to private landowners.


Southern bald eagle

Another major issue facing managers in the ACE Basin is that very few bottomland areas are protected. Isolated bottomland areas are especially threatened by increased timber harvest and conversion to other land uses. In the long-run, rural development, urbanization and loss of productive forest lands are potential threats to endangered, threatened and sensitive species and their habitats. Although there is a great deal known about nesting activities for high profile species (i.e., bald eagles , wood storks, etc.) in the ACE Basin, there is insufficient knowledge of habitat locations and status of other sensitive species.

Management Goals

- Increase the public’s understanding and appreciation of habitat needs for sensitive species and how individual stewardship actions might affect those needs.
- Manage for biodiversity at the species, community and landscape levels.
- Encourage local decision makers to take into consideration the needs of sensitive species.
- Increase research efforts and determine distribution, status and inter-

relationships of endangered / threatened species. Create a biological survey team to focus on standardized surveys of major taxa groups in the ACE Basin.

Back to Top

Wetlands Management Issues and Goals

- Private Ownership
- Cumulative Impacts
- Impoundments
- Management Goals

All tidal and non-tidal wetlands in the ACE Basin study area, defined as critical by the S.C. Coastal Zone Management Program and the US Army Corps of Engineers (ACOE), should be protected in their natural condition. Wetlands include bogs, swamps, isolated freshwater wetlands and tidal vegetated marshes, tidal and non-tidal impoundments and unvegetated flats. (See related section: Plants.)

Private Ownership

Private ownership and the unique values associated with wetlands have contributed to management controversies in the area. Although they may be located on private lands, wetlands support many ecological processes that benefit society in general. Wetlands enhance water quality, moderate flooding, produce high volumes of diverse timber products, and provide a wealth of diverse and productive habitats for fish and wildlife throughout the ACE Basin landscape. More recently, the protection of private property rights has come to the public's attention, placing emphasis on developing alternative approaches to regulation. A major focus has been on education and financial incentives for landowners which supports wetland conservation programs.

Cumulative Impacts

Cumulative impacts is perhaps the most significant wetlands issue not only in the ACE Basin but also at regional and national levels. According to the Committee on Science and Policy for the Coastal Ocean (1995), "Cumulative impacts are those that result from the interactions of many incremental activities, each of which become cumulatively significant when seen in aggregate. Cumulative effects may interact in an additive or synergistic way, may occur onsite or offsite, may have short-term or long-term effects, and may appear soon after disturbance or be delayed" (Dickert and Tuttle 1985). For instance, Holland et al. (1996) found the kinds and abundance of living resources as well as the health of individual organisms in tidal creeks are adversely affected by the cumulative impacts of watershed development. Vestal et al. (1995) reviewed methods and mechanisms for management of cumulative coastal impacts. They concluded that cumulative impact assessment, management and monitoring require multidisciplinary contributions from the fields of science, law and environmental management. In the coastal context, there are significant gaps in understanding of cause and effect relationships as well as deficiencies in making cumulative impact projections; lack of historical data; and basic concerns over applying terrestrial methods in a marine ecosystems context. A major legal barrier to consideration of cumulative impacts as part of environmental decisions relates to a general lack of statutory guidance and useful definitions of key terms. The courts have a tendency to interpret statutory and regulatory requirements in a narrow context, often resulting in minimum consideration of cumulative impacts by agencies in authority. Current trends toward protection of private property rights also present a legal barrier as does public pressure to expedite permit reviews and the inherent focus on site-by-site decision-making. There is, however, a growing consensus to make cumulative impact standards more enforceable at the local level. Innovative planning and regulatory techniques rather than end-of-the-line permitting are beginning to deal with these issues.

In addition to these science and legal impediments, Vestal et al. (1995) also suggest management-specific ones. They find that managers tend to minimize their authority when considering cumulative impacts and that adjustments are needed at leadership levels. Political problems also arise when relying on regulatory strategies. New, active, non-regulatory measures (e.g., education, economic incentives, etc.) need to be developed to supplement (or replace) primary strategies to control cumulative impacts. Managers must also develop long-term perspectives for monitoring coastal ecosystems to assess cumulative impacts, and the ACE Basin NERR monitoring program can provide useful data for this purpose. Also, the history of land use and development will help determine long-term goals. What is needed to assess cumulative impacts is a substantial shift in focus toward monitoring, establishing data bases, and planning goals refined to fit in a wetlands context.

Impoundments

In the context of manipulated wetland ecosystems, the value of well-managed impoundments as functional resources is recognized. In addition to Bear Island Wildlife Management Area and Donnelley WMA , other important impoundment habitat is owned by approximately 45 private landowners who individually control areas ranging from less than 16 hectares (40 acres) to complexes exceeding 1,416 hectares (3,500 acres). Benefits to migratory waterfowl, under individual habitat management and hunting practices, vary significantly among these privately-managed properties. Although an abundance of wetland habitat in the Basin (10,522 hectares or 26,000 acres) is managed primarily for waterfowl, the National Wildlife Refuge (NWR) is the only area where migratory ducks are afforded refuge. The NWR has been established in selected habitats and complements significantly the waterfowl benefits currently provided by Bear Island and Donnelley WMAs, and well-managed privately-owned wetlands.

SCDNR, TNC and DU provide technical guidance to owners of private impoundments in order to enhance related habitat values to waterfowl and other wetland-dependent species. Construction of new impoundments and physical alteration of existing impoundments are regulated through S.C. Department of Health and Environmental Control’s Office of Ocean and Coastal Resource Management (OCRM). Any such alterations in the ACE Basin are evaluated under existing authority with careful consideration of effects on the basin’s ecological integrity. The re-impoundment of selected wetlands that once were impounded and managed during the era of tidal rice culture (Gordon et al. 1989) has been a long-standing management issue.

Special Area Management Plan

The biological committee to the ACE Basin Task Force has explored the possibilities of a Special Area Management Plan (SAMP) as a regulatory mechanism that could help resolve this issue. The following comments on this issue are taken from meetings of this committee and compiled by Gordon (1993). Goode (1989) generally defined a SAMP as a "joint local/state/federal planning effort designed to improve regulatory predictability in sensitive aquatic areas," or, "any of the many variations of proactive regulatory mechanisms developed for a specific geographic area." SAMPs have been successfully used in estuary planning efforts (Walters 1987) and are recognized as an effective mechanism to control development and provide long-term protection to important, sensitive wetland areas (Goode 1989). SAMPs also provide opportunity for groups to recognize and respect the interests and rights of other groups.

The benefits of a SAMP include:

- Long-term conservation and protection of natural resources.
- Problems associated with the traditional case-by-case review are avoided.
- Preservation interests do not have to challenge each proposal.
- Development interests can plan with predictability.
- Cumulative impacts can be more easily predicted, assessed, and planned for in advance.
- Developmental restrictions involving local, state, and federal agencies are stronger and more durable.

Problems Specific to Wetland Impoundments

The effects of impoundments on coastal wetlands and their functional relationship to estuaries is a primary environmental concern. This concern is further grounded in federal and state policies and regulations that call for the "no net loss" of wetlands. In a review of the ecological effects of coastal marsh impoundments, Montague et al. (1987) identified the following problems:

- Changes in the exchange of organic materials (e.g., detritus) and nutrients (e.g., nitrogen and phosphorous) with surrounding estuarine waters in quantities of great significance to the production of estuarine fish and shellfish.
- Direct and indirect effects on habitat for fragile estuarine fish and shellfish.
- Hydrologic alterations, specifically changes in the frequency and amplitude of water exchange and depth of flooding.
- Changes in salinity, which is generally lower in impoundments.
- Dikes and ditches are physical structures that alter water flow patterns and reduce wind and wave action on marshes.
- Alterations to the composition of wetland plant communities, shifts in species composition and primary productivity,
- Dikes and ditches are physical impediments to the ingress and egress of estuarine fish and shellfish.
- Effects of various impoundment management protocols on the structure and functions of the wetlands within and adjacent to impoundments.

Before any progress can be made on the issue of re-impoundment of previously impounded wetlands, the above problems must be addressed. Unfortunately, adequate scientific understanding to properly evaluate these problems is lacking. For example, transport of organic carbon and nutrients are best understood in salt marshes but poorly understood in brackish and freshwater marshes where the more typical kind of impounded or formerly impounded marshes occur, i. e. in the southeastern U.S. Such lack of information makes it difficult to assess the potential cumulative impacts of impoundment and re-impoundment on the natural resources of concern. Developing and adopting impoundment Best Management Practices that minimize impacts on wetland systems could be made integral to a SAMP that allows certain impoundment activities. But this may be perceived as government control over private lands.

Management Goals

- Proactively conserve, enhance, and protect the wetland resources of the ACE Basin through landowner education programs, voluntary cooperative land management programs (BMPs), incentive programs, voluntary land acquisition, conservation easements; and improve comprehensive planning and enforcement

of existing regulations.
- Develop systematic approaches for detecting and quantifying cumulative impacts.
- Maintain the extent of upland perennial vegetative cover to support wetland ecological functions of the Basin.
- In high quality areas where vegetative cover has been removed or suppressed and the hydrology has been altered, target wetlands restoration activities.
- Floodplain management ordinances to protect wetland functions should be adopted by local governments that participate in the National Flood Insurance Program.
- The conversion of wetlands to annually tilled croplands should be discouraged and wetlands restoration encouraged through the Agriculture Subsidy and Insurance Programs.
- All development and traditional farming and forestry activities should be encouraged to use best management practices. Target information and education efforts toward such an end.
- Encourage public and private landowners to develop management plans aimed specifically at protecting wetlands on their properties.
- Establish a wetlands mitigation banking program in the ACE Basin and identify priority locations for ecological values, using the three value classes for wetlands.
- Take advantage of government cost share programs in the conservation of riparian and other important ecosystems in the ACE Basin.
- Work with the Water and Land Resources Division, SCDNR in assessing data and information needs for improved management of wetlands in the basin.
- Conduct a state-of-the-wetlands conference in the ACE Basin to focus on timely management issues.

Back to Top

Forest Management Issues and Goals

The ACE Basin Task Force and local forestry community have worked together over the last decade in developing good forestry management practices. One of the first landowners to publicly endorse the ACE Basin Task Force Project was Westvaco Corporation, a major manufacturer of paper products and chemicals. Through a memorandum of understanding with the ACE

Logging of cypress trees

Basin Task Force, Westvaco agreed to support project objectives of the task force within the company's property management activities and in accordance with multiple-use forestry principles. As the largest single private landowner in the Basin, Westvaco's action was a major advance in reaching the larger forestry community and gathering additional private support for the ACE Basin Task Force Project. Muckenfuss (1994) has described Westvaco's ecosystem management philosophy and the cooperative approach used in the ACE Basin initiative.

Sustainable Forestry Initiative

In 1994, a program known as the Sustainable Forestry Initiative (SFI) was launched by the American Forest and Paper Association (AF&PA). SFI is a system of principles, guidelines and performance measures that integrate the perpetual growing and harvesting of trees with the protection of wildlife, plants, soil, air and water (American Forest and Paper Association 1998). AF&PA companies in the ACE Basin are instituting sustainable forestry practices which range from promptly reforesting lands to promoting the biodiversity of plant and wildlife species. These companies understand that to be truly successful in conserving natural resources for future generations, the forest industry must demonstrate progress each year. As part of their commitment to the program, members pledge to issue annually a progress report summarizing industry activity. Understanding that no issue, from protecting endangered species to watershed analysis, can be dealt with in isolation, members are cooperating with conservation and other groups to develop and employ management strategies that foster forest growth. This is being done in a manner that is consistent with the promotion of biological diversity and with the protection and conservation of wildlife habitat. Sustainable forestry contributes to water quality enhancement. Members are committed to protecting streams, lakes and other water bodies on their lands. Using sustainable forestry practices also includes recognizing company lands that have special ecological, geographic or historic value and pledging that these places will be managed to protect their unique qualities for the benefit of citizens.

Westvaco has led the SFI program's development in the ACE Basin with their "Ecosystem-Based Multiple Use Forest Management System". The program designates six different management zones, taking into account water quality, site productivity, wildlife habitat, visual quality, biodiversity, and protection of special areas (Westvaco 1998).

- Water quality zones include areas around perennial streams, ponds, lakes and many places that may be wet only periodically.

- Non-forest management zones include areas where continuous forest management is not possible or practical, such as right-of-ways, lakes, marshes and other non-forested wetlands. These sites can provide important food and cover for wildlife.
- Special area zones are sites of unique biological, geological, archaeological or historical significance. Nature trails, endangered plant or animal habitats, and historic sites are a few examples.
- Timber management zones are intensely managed to produce pine and/or hardwood fiber to meet the needs of Westvaco's mills. Harvesting activities are scheduled in a way that maintains a variety of stand ages, providing a range of wildlife habitats and helping maintain diversity.
- Habitat diversity zones exist primarily to provide mature forest habitats critical to certain wildlife species, including many neotropical migratory birds. These zones often connect with other non-timber management zones, forming a web of continuous, mature forest habitats.
- Visual quality zones are places where special efforts are made to maintain aesthetic quality or soften the visual impact of forestry operations.

Best Management Practices and Guidelines

The South Carolina Forestry Commission in cooperation with the South Carolina Forestry Association and an expert Task Force has developed Best Management Practices (BMPs) for forestry. These guidelines assist the professional forestry community in practicing good stewardship on forest lands and protecting the water quality of nearby streams, lakes, rivers, and ponds. Most of the BMPs address the protection of water quality or the requirements of Section 404 (dredge and fill) of the Clean Water Act. The guidelines are consistent with the management measures described by Environmental Protection Agency. All forestry practices must comply with the Endangered Species Act, enacted in 1973 to conserve threatened and endangered species of wildlife and plants. (see Forestry .)

BMPs were first introduced in response to the Federal Clean Water Act, as practical and effective means to reduce nonpoint source pollution. Compliance with BMPs is required for forestry activities which involve discharge of dredge and fill materials into jurisdictional wetlands to qualify for the silvicultural exemption under Section 404 (f) of the Clean Water Act.

Hardwood forest

Compliance with BMPs is recommended on all sites on which there is a potential for violating water quality criteria as defined by the South Carolina Pollution Control Act.

The local forest management community in cooperation with the ACE Basin Task Force has also developed rather specific guidelines and recommendations for hardwood forest management in the ACE Basin:

- All forestry practices must conform to BMP guidelines.
- Bottomland hardwood sites should not be converted into pine plantations or

other uses not in keeping with the spirit of the ACE Basin goals and objectives.
  - Draining bottomland hardwood areas is discouraged.
  - Rotation ages should be established that promote mast production and diversified stand ages across a landscape.
  - The best method for regenerating most hardwoods is clear cutting to promote shade intolerant species and to restore the poor quality stands left by past high grading. However, other harvesting and regeneration methods are acceptable. Other even-aged alternatives include shelterwood and seed tree methods.
  - If retention of a proportion of the original canopy is desired, then uneven-aged harvest such as group selection, should be considered.
  - The protection of live oaks is advocated in the ACE Basin as well as appropriate maintenance of wildlife corridors and streamside management zones, maintenance of buffer zones along public roads for aesthetic and wildlife purposes, maintenance of den and snag trees and protection of endangered plants and animals.

These guidelines were designed to enhance flexibility for the variety of owners and willing participants in the ACE Basin while recognizing hardwood forest management as an important traditional use.

Timber management in the ACE Basin National Estuarine Research Reserve (NERR) is directed toward development and preservation of significant old growth stands. Disease, insect or exotic plant control, and stand improvement considerations are controlling factors in timber harvesting. Any harvest of timber is conducted in accordance with guidelines established by SCDNR and other project cooperators. SCDNR works with appropriate state and private interests to develop an inventory and evaluation of standing timber in the NERR core area and to recommend management procedures.

Challenges in Forest Management

Challenges facing managers in the ACE Basin are as follows:

  - Some landowners engage in careless or inappropriate application of forest management practices.
  - Forest management practices such as prescribed burning, clear-cutting, intensive pine production, and drainage are often misunderstood by the public. Thus, negative perceptions of forest management techniques have resulted.
  - Shorter rotation lengths and the effects on wildlife diversity are seen as problematical; more intensive management practices, however, are resulting in greater production from fewer acres and less pressure overall on forestlands.
  - Property taxes, capital gains taxes and estate taxes have negative effects on private, non-industrial landowners with little or no incentives for better forest management. This results in the harvesting of pine timber following natural regeneration. The reduction of government reforestation cost share programs has also had an impact on forest management.
  - Due to regulatory restrictions for endangered/threatened species (avifauna primarily), landowners tend to avoid longer rotations and burning which attract these birds.
  - There is an overriding challenge to balance demand for wood products with the ecological benefits derived from forest ecosystems. Private landowners must have incentives to encourage their cooperation.

Management Goals

Management goals for forestry in the ACE Basin include:

- Respect for private property rights and encourage use of ACE Basin information by governments affecting development.
- Provide incentives rather than disincentives for managing forest resources. Tax structures should be revised to encourage private non-industrial landowners to maintain large landholdings and continue forest management. Landowners who maintain critical habitats for endangered/threatened species should be afforded tax incentives.
- Educate the public, including lawmakers and regulators, about the ecological and economic values of forestry to the basin.
- Promote good forest stewardship and the use of best management practices. Issues including controlled burning, clear cutting, intensive pine production, and drainage/water management should be addressed.
- Promote and develop new economic opportunities and cross-marketing for forest products. Also, marketing alternative forest products and recreational uses should be explored.
- Encourage forestry research.
- Promote optimal land use through good forestry techniques on productive forestlands and wetlands.

Fire Management Issues and BMPs

Prescribed burning is an invaluable tool in forest and wildlife management. It is commonly used in the ACE Basin not only in silviculture but also in impoundment management. State law requires that the S.C. Forestry Commission be notified prior to burning and precautions must be taken to prevent the fire's escape. Landowners must ensure that a burn site is enclosed by adequate fuel breaks; sufficient manpower, tools, and equipment are available to control the fire; and that the fire is attended until it is safely extinguished. Fire is also used to prepare sites for planting by reducing logging debris or to prepare a seedbed for germination. Prescribed fire can also improve wildlife habitat and reduce the hazard of wildfire. Studies have shown that properly planned and conducted prescribed burning has no significant impact on water quality. Most problems associated with prescribed burning are a result of poor planning and changing weather conditions. If a prescribed fire becomes too hot, for example, the entire humus layer can be consumed, exposing the underlying mineral soil to erosion. Prescribed burning requires an understanding of weather conditions, fuel conditions, wildfire danger, smoke management, and a host of other considerations and should only be attempted by experienced personnel. The South Carolina Forestry Commission (1994) lists the following BMPs:

- Comply with smoke management guidelines. Smoke should be monitored after the burn until it is no longer a hazard.
- Have fire-fighting equipment readily available.
- Time prescribed fires so that the moisture level of the forest floor prevents the entire humus layer from being burned.
- Locate firebreaks on the contour as much as possible.
- On grades over five percent and over 200 feet long, construct water bars in firebreak lines at frequent intervals to slow surface runoff.
- Use hand tools when necessary to tie firebreak lines into stream channels.

The Commission also recommends avoiding the following practices:

- Burning when conditions will cause a fire to burn too hot and expose mineral soil.
- Impacting smoke sensitive areas.
- Allowing high intensity fire to enter filter strips or primary Streamside

Management Zones (SMZs).
- Burning on severely eroded forest soils where the average litter duff depth is less than one-half inch.
- Constructing water bars in firebreak lines that divert surface runoff directly into streams.

Back to Top

Water Quality Management Issues and Goals

The Areawide Water Quality Management Plan, now under revision, will provide the regional framework and policies, including broad goals and objectives, for the Lowcountry and ACE Basin region. Basin and sub-basin management plans will address specific issues related to point and non-point source pollutants, local development trends, and local planning and policies. (see Water Quality and Water Quality Synthesis Module.

All activities within the ACE Basin must be conducted in compliance with existing state water control quality standards in accordance with SCDHEC. Water quality is monitored by SCDHEC at established stations within the Basin. According to the Edisto River Basin Project findings, nonpoint source pollution poses the greatest threat to the basin's water quality (Beasley et al. 1996). And, landowners and the general public do not have sufficient knowledge of the impacts of their land use practices on water quality. For example, there is insufficient public awareness about the importance of a forested or vegetated riparian zone (or floodplain) in filtering pollutants and protecting water quality. Although much water quality data are collected, they are not analyzed sufficiently, resulting information on water quality is not readily accessible, and reporting on water use is incomplete, failing to provide a full picture of water use in the basin. The Water Resources Committee lists the following management goals:

- BMPs should be developed and implemented for all land use activities that potentially impact water quality.
- Those areas with the highest nonpoint source pollution potential should be targeted for BMP education with a focus on voluntary implementation.
- Encourage conservation of the riparian zone to ensure that floodplains are forested and vegetated to filter out pollutants.
- Encourage erosion and sediment control ordinances (Beasley et al. 1996).

Back to Top

Fisheries Habitat Issues and Goals

Issues, opportunities and challenges related to fisheries management in the ACE Basin center around habitat protection and maintenance of good water quality. Fishery resources in the Basin include marine, estuarine, freshwater, anadromous and catadromous species. Although a number of fisheries research activities are on-going in the Basin, little information exists about the linkages between saltwater, riverine, stream, floodplain and upland habitats. An integrated, basin-wide management plan is needed to assess future impacts on these resources. Again, the riparian zone is critical to healthy fish populations in the ACE Basin and private landowners, including those in the agricultural and forestry sectors, need to work cooperatively in reducing negative impacts on such areas. It is essential that the riparian zone remain intact and that water flows unaltered. Also, the importance of non-point source pollution and introduction of exotic species should be emphasized. Public education appears to be the greatest challenge in protecting fishery resources in the Basin. (see Commercial Fisheries and Recreational Fisheries.)

It has been found that the ACE Basin supports unique fishery resources. Allen (1998) has described a distinctive population of striped bass reproducing in the Combahee River. Tagging studies have confirmed that a relatively small population of striped bass in the Combahee River are isolated from those of other coastal rivers in S.C. and may acquire local genetic adaptations. These local adaptations equip a population with genetic traits tailored for a specific habitat, increasing the long-term fitness of that population.

Striped bass ***(Morone saxatilis)***

In addition to striped bass, the ACE Basin also provides critical habitat for five other species of anadromous fish (i.e., American shad, hickory shad, blueback herring, Atlantic sturgeon, and the endangered shortnose sturgeon). Important spawning grounds for these fishes have been documented upstream in the ACE Basin watershed area (Hildebrand and Cable 1938, Walburg 1956, Walburg and Nichols 1967, Curtis 1970, Wade 1971). From these upstream sites, adults and juveniles move downcurrent to overwintering habitat in the ACE river system. Tidal wetlands, rivers, streams and the island-marsh/creek interface are critical elements in providing structural protection from larger predatory fish and abundant food sources. Long-term protection of these resources will continue to assure quality feeding grounds, shelter and migratory pathways for these fishes. Viability of the endangered shortnose sturgeon is of particular concern and important on a regional/national scale. Research shows that this species is primarily riverine and estuarine in its distribution, and is not known to make regular migrations to the ocean (Sandifer 1980). Recent research (Ulrich and McCord 1998) shows that a significant number of juvenile shortnose sturgeon frequent the ACE Basin to overwinter. Studies since 1979 indicate that this system is an important staging area for overwintering Atlantic and shortnose sturgeon. The occurrence of deep holes in the lower estuaries also provide thermal refuge for these fish. Long-term protection of this area will enhance future research opportunities for these and over 60 other inter-jurisdictional species.

Fishes typically partition their use of important habitats according to their salinity and temporal behavior such that different species of inter-jurisdictional fishes would cycle in and out of these habitats throughout the year. Habitat protection for these fishes also has geopolitical significance since many species often come under jurisdictional control of two or more states. Some of the major species include red drum, spotted sea trout, weakfish, Spanish mackerel, king mackerel, flounder, bluefish, menhaden, spot and croaker. Penaeid shrimp, which constitutes a major commercial fishery in the southeast, use the ACE Basin extensively as nursery and overwintering grounds. Blue crab and oyster fisheries, both estuarine dependent and commercially important locally, also benefit from protection of nursery habitat in the ACE Basin.

Another significant fisheries management issue is the input of contaminants from resort residential development which is occurring at an alarming rate to the north and south of the basin and is present in the surrounding areas of nearby Edisto Island, Fripp Island and Hilton Head Island. Increased nutrient loading to adjacent estuaries is occurring from lawn and golf course fertilization, pesticide use, and runoff from septic fields. (see Hydrochemistry and Pollution.)

The series of marsh/barrier islands in this area of the ACE Basin have soils developed from a near homogeneous quartz sand deposited during geologic formation (Richardson and Worthington 1975). An important characteristic of these soils is their capacity for rapid leaching and nutrient recycling which is a major management issue in developing such islands in pristine estuaries. Particularly susceptible to contaminants are salinity-pulsed sloughs, which are important nursery areas. Artificial application of fertilizers to these areas also alters the structure of natural vegetation which has become adapted to specific natural conditions such as prevailing winds, salt spray, and nutrient-poor, acidic soils.

The introduction of exotic species is also a management issue of special concern. Flathead catfish, non-indigenous shrimp, and hydrilla are examples of exotic species whose introductions have negative effects on fishery resources.

Management Goals

Management goals for fisheries include:

- Encourage an ecosystem approach to fishery management, which includes habitat protection and linkages between stream, river, floodplain, estuaries, and adjacent uplands.
- Expand public outreach programs to improve cooperation between regulatory agencies, agriculture and timber industries and private landowners regarding impacts on fishery resources.
- Develop best management practices to reduce nonpoint source pollution and protect critical fishery habitat. This includes floodwater from new development in the area and the design of stormwater retention ponds and other techniques.
- Evaluate possibility of placing limits on the number, location and size of docks and marinas to reduce their impacts and protect fishery resources.
- Evaluate and review exotic species laws and enforcement of such laws. Develop and modify plans as required for controlling existing exotic species and preserving populations of indigenous species to ensure biodiversity,
- Protect and enhance existing shellfish beds. Consider developing shellfish beds and artificial reefs in inshore estuarine areas to increase shellfish and finfish production.
- Conduct relevant research in cooperation with state, federal and other research institutions throughout the state and region.

Back to Top

Cultural Resource Management Issues and Goals

The ACE Basin has a rich history and many significant archaeological and historic assets (see Cultural Resources). Linder (1995) has compiled information on 92 plantations in the Basin that produced rice in the 1860s, just a fraction of the many working plantations during the rice culture era. Intensive archaeological reconnaissance has not been undertaken in the basin and many unknown sites may exist. Most of the records of discovered sites contained in the files of the state archaeologist have been placed there by interested laymen and are not the result of any scholarly research. Generally, such records contain only brief descriptions or, frequently, no description at all. Many sites are not officially recorded because of lack of information and increased development pressures. This presents a real threat to valuable cultural resources of the basin. As outlined in the Edisto River Basin Project Report (Beasley et al. 1996), there are opportunities to effectively use these resources and generate revenue in the process, but it will be necessary to proceed with caution. The negative consequences of exploitation and destruction need to be avoided at all costs. Some significant management issues are:

- Archaeological and historic assets are fragile, non-renewable and vulnerable to vandalism.
- Limited information is available on location, significance, and economic values.
- General lack of knowledge about the resource base.
- Development, land-clearing activities, forestry, and other land disturbing activities threaten archaeological resources.

Management Goals

Management goals for cultural resources include:

- Inventory and locate all archaeological sites and objects of prehistoric and/or historic significance, recording data in a GIS compatible format.
- Encourage public and private land managers and owners to preserve and protect cultural properties through available mechanisms (i.e., state and local land trusts, conservation easements, and partnerships in national land conservation programs).
- Link information and data gathered for the Edisto River Basin Project, SCDNRs Heritage Trust Program , and S.C. Parks Recreation and Tourism’s Heritage Corridor Project.
- Identify sources of funding to preserve cultural resources.
- Improve awareness and educate the public about cultural resources in the ACE Basin, their value, and the importance of protecting them.

NEXT SECTION: Tourism and Public Access Management Issues and Goals

---

Author

M. McKenzie, SCDNR Marine Resources Division

References

Allen, D. 1998. ACE Basin: A distinctive population of striped bass. ACE Basin Current Events: Newsletter of the Ashepoo, Combahee, Edisto Basin 8(2):6-7.

American Forest and Paper Association. 1998. Sustainable forestry for tomorrow's world. Third Annual Progress Report on the Sustainable Forestry Initiative. Washington, DC.

Beasley, B.R., W.D. Marshall, A.H. Miglarese, J.D. Scurry, and C.E. Vanden Houten. 1996. Managing resources for a sustainable future: The Edisto River Basin project report. South Carolina Department of Natural Resources, Water Resources Division, Columbia, SC.

Committee on Science and Policy for the Coastal Ocean Studies Board. 1995. Science and policy and the coast. National Academy Press, Washington, DC.

Curtis, T.A. 1970. Anadromous fish survey of the Combahee River watershed. Job Completion Report, Project AFS 2-4. July 1, 1969 to June 30, 1970. (unpubl.). SC Wildlife Marine Resources Department, Columbia, SC.

Diamond, J.M. 1975. The island dilemma: Lessons of modern biogeographic studies for the design of natural preserves. Biological Conservation 7:129-146.

Dickert, T.G. and A.E. Tuttle. 1985. Cumulative impact assessment in environmental planning: A coastal wetland watershed example. Environmental Impact Assessment Review 5:37-64.

Goode, B.N. 1989. Regulating wetlands by special area management planning. *In*: R. Sharitz and J.W. Gibbons (eds.). Freshwater wetlands and wildlife. Department of Energy Symposium Series No. 61, USDOE Office of Scientific and Technical Information, Oak Ridge, TN.

Gordon, D. 1993. Issues pertinent to a proposal for a special area management plan for the ACE Basin focus area. (unpubl.)

Gordon, D., B.T. Gray, R.D. Perry, M.B. Prevost, T.H. Strange, and R.K. Williams. 1989. South Atlantic coastal wetlands. *In*: L.M. Smith, R.L. Pederson, and R.M. Kaminski (eds.). Habitat management for migrating and wintering waterfowl in North America. Texas Technical University Press, Lubbock, TX.

Gosselink, J.G. and L.C. Lee. 1989. Cumulative impact assessment in bottomland hardwood forests. Wetlands 9:(Special Issue).

Harris, L.D. 1984. The fragmented forest: Island biogeographic theory and the preservation of biotic diversity. University of Chicago Press, Chicago, IL.

Hildebrand, S.F. and L.E. Cable. 1938. Further notes on the development and life history of some teleosts at Beaufort, NC. Fisheries Bulletin 24:505-642.

Holland, A.F., G.H.M. Riekerk, S.B. Lerberg, L.E. Zimmerman, D.M. Sanger, T.D. Mathews, G.I. Scott, M.H. Fulton, B.C. Thompson, J.W. Daugomah, J.C. DeVane, K.M. Beck, and A.R. Diaz. 1996. The tidal creek project: Interim report. South Carolina Department of Natural Resources, Marine Resources Division, Charleston, SC.

Linder, S.C. 1995. Historical atlas of the rice plantations of the ACE river basin - 1860. South Carolina Department of Archives and History, Columbia, SC.

Montague, C.L., A. Zale, and G. Precival. 1987. Ecological effects of coastal marsh impoundments: a review. Environmental Management 11:743-756.

Muckenfuss, E. 1994. Cooperative ecosystem management in the ACE Basin. Journal of Forestry 92(8):35-36.

Richardson, J.I. and J.S. Worthington. 1975. Terrestrial ecology of the Georgia barrier islands. *In*: The value and vulnerability of coastal resources - Background papers for review and discussion. Georgia Department of Natural Resources, Office of Planning and Research, Atlanta, GA.

Sandifer, P.A., J.V. Miglarese, D.R. Calder, J.J. Manzi, and L.A. Barclay. 1980. Ecological characterization of the sea island coastal region of South Carolina and Georgia. Volume III: Biological features of the characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-79/42.

South Carolina Forestry Commission. 1994. South Carolina's best management practices for forestry. Columbia, SC.

Ulrich, G. and W. McCord. 1998. Personal communication. South Carolina Department of Natural Resources, Marine Resources Division.

Vestal, B., A. Rieser, M. Ludwig, J. Kurkland, C. Collins, and J. Ortiz. 1995. Methodologies and mechanisms for management of cumulative coastal environmental impacts. Part I: Synthesis. Part II: Development and application of a cumulative impact assessment protocol. NOAA Coastal Ocean Program Decision Analysis Series No. 6. National Oceanic and Atmospheric Administration, Coastal Ocean Office, Silver Spring, MD.

Wade, C.W. 1971. Commercial anadromous fishery, Edisto River, SC. Annual Progress Report, Project number AFC-4-1. SC Wildlife Marine Resources Department, Columbia, SC. (unpubl.).

Walburg, C.H. 1956. Commercial and sport shad fisheries of the Edisto River, South Carolina, 1955. Special Scientific Report - Fisheries No. 187. U.S. Department of Interior, Fish and Wildlife Service, Washington, DC.

Walburg, C.H. and P.R. Nichols. 1967. Biology and management of the American shad and status of the fisheries, Atlantic coast of the United States, 1960. Special Scientific Report - Fisheries No. 550. U.S. Department of Interior, Fish and Wildlife Service, Washington, DC.

Walters, C.K. 1987. Special area management planning in coastal areas: The process. *In*: D.J. Brower and D.S. Carol (eds.). Managing land-use conflicts. Duke University Press, Durham, NC.

Westvaco Corporation. 1998. Annual report: Environmental safety and health. New York, NY.

M E N U

Nature-Based Tourism Issues and Management Goals

Public Access/Recreational Use

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Resource Management

Nature-based Tourism & Public Access Management and Goals

Nature-Based Tourism Issues and Management Goals

- Issues
- Visitor Management Strategies
- Vision of Visitor/Educational Network

Issues

Three critical use issues must be considered in planning for long-term sustainability in the ACE Basin: 1) increased public demand for access to and use of the Basin's resources, 2) visitor management and resource protection strategies to secure the Basin against overuse and inconsistent use of its resources, and 3) economic development initiatives that can leverage the intrinsic value of the area's natural resources without compromising the integrity of the environment. Nature-based tourism (NBT) is a development tool that may be used in a manner consistent with these concerns. (see Resource Use: Tourism).

NBT is one of the fastest growing portions of the travel industry, having captured 7.5 percent of the travel market in 1994 and 13.5 percent in 1995 (Travel Industry Association of America 1998). People's desire to see unusual, untouched places, and their willingness to pay for such an experience, has fueled rapid growth of this market. The 1995-96 American Traveler Survey reveals that over 34 million Americans took a nature-based trip on their last vacation or plan to do so (Travel Industry Association of America 1998).

However, for the ACE Basin to take advantage of its unique resource base and capitalize upon its proximity to recognized destinations, it needs a destination identity. In fact, the ACE Basin is a vaguely defined area without a clear point of entry. To provide a focal point, the South Carolina Department of Parks, Recreation and Tourism (SCPRT) and South Carolina Department of Natural Resources (SCDNR) has been planning a central visitor center to serve as the entry point for visitors and an "anchor" for the NBT market in the Lowcountry. As the primary visitor destination in the ACE Basin, a sustained-design visitor center will serve as: 1) a reception focal point, providing educational experiences, recreational opportunities and visitor services; 2) a visitor-management tool, functioning as a central collection and distribution point to manage visitors and minimize their impact upon the resource base; 3) a revenue-capture point, securing a source of income from visitor expenditures; and 4) a model for development, establishing both standards for future development initiatives in the Basin and the platform to support such development. The ACE Basin's inherent resource value and strategic position can make it into a signature destination for South Carolina.

Visitor Management Strategies

The main purpose of a visitor center is to serve as the primary visitor destination in the ACE

Basin. In serving this purpose, the center creates a marketing focal point for the Basin, as well as a capture-point for the greatest concentration of visitors, thereby lessening their impact across the Basin. To maintain the quality of the natural resources at the visitor center and to provide a model visitor-management system for properties beyond the visitor center, there is a need to develop a visitor-management plan. Limits of acceptable change (LAC) should be established through research on carrying capacity and visitor preference surveys (Stankey et al. 1985).

Carrying capacity is the amount of recreational use of a resource most appropriate for both the protection of the resource and the satisfaction of participants (Hovinen 1982). Three elements are considered in establishing a region's carrying capacity:

(1) Identify Acceptable Limits of Impact

- Identify the site's values and possible concerns; examine these issues vis-a-vis its diversity of recreational uses.
- Define and describe the range of preferred conditions (both biological and social). This should reflect resource, social, and management conditions and address impact severity and prevalence.

Maritime Forest

Example: Undisturbed Maritime Forest (Hunting Island State Park)

Indicators: number of groups met per day, group size, parking lot size and capacity.

Resource Conditions: Minimal impact on resource; impact on understory and wildlife is minor and not apparent to visitors.

Social: Very little contact with others; solitude.

Management: On-site management of visitors not practiced; park personnel not readily visible.

- Select indicators. It is important for indicators to be responsive to management techniques and directly related to the impact being measured.

Salt marsh habitat

Example: Intertidal Wetlands: salt marshes and impoundments.

Indicators: water quality, waterfowl diversity and disturbance, shorebird and wading bird numbers, and quality of shellfish grounds.

Social: solitude, walking, biking.

- Inventory existing resource and social conditions. This process includes the gathering of initial baseline inventories at both peak and low periods to include the extremes.
- Establish standards that are set through research, managerial experiences and public input.

Maritime dry grassland in a beach community

Example: Semi-disturbed dunes (Hunting Island State Park)

Factor: wildlife observation

Indicators: wildlife disturbance, sea oats destruction, sea turtle disturbance, and group size

Standards: access limited outside bird nesting season, no more than two groups per day, group size restricted to 10 or fewer

- Select and identify management alternatives.
- Select and identify management actions, evaluate and select appropriate management options for implementation. Once management strategies are established, a follow-up educational program should be implemented.
- Implement actions and establish a monitoring plan.

(2) Monitor Use Patterns Over Time. Establish a monitoring program to assess the biological components or physical conditions susceptible to impact. The monitoring program should measure impacts on "indicator" species to help insure that set standards are being met.

(3) Take Corrective Action When Necessary. Any corrective actions should be based on research results obtained from the monitoring program.

Once site limitations and visitor preferences are determined, management tools such as visitor limits, user fees, centralized transportation services, and diel and seasonal restrictions, can be implemented. Over the long-term, visitor impact will be assessed through periodic monitoring and the results will determine if alternative management tools are required.

The ACE Basin Visitor Center can benefit from and serve as a value-added resource for the South Carolina Heritage Corridor. Recognized by Congress as a National Heritage Area, the Corridor is the product of a comprehensive community development strategy aimed at revitalizing rural economies and building urban-rural partnerships through heritage and NBT initiatives.

As a defining feature of Colleton County, one of the 14 counties within the corridor, the ACE Basin and its proposed visitor center can expect to raise its profile and leverage its presence as a visitor destination. As part of a nationally significant historic area that is also characterized by a singular natural environment, the ACE Basin has an unequaled marketing opportunity through an association with the Heritage Corridor.

At the same time, the Basin and its proposed visitor center add a unique, high quality visitor experience to South Carolina’s Heritage Corridor. Except for Charleston, there is no single destination within the Corridor of equal quality or variety as the ACE Basin and its proposed visitor center. The ACE Basin, developed as a visitor destination, can be an impetus for additional business development along the Corridor. There is a natural synergy possible between the Heritage Corridor and the ACE Basin and its proposed visitor center.

Vision of Visitor/Educational Network

The vision for the ACE Basin involves a network of interpretive, educational, recreational and research facilities which take advantage of the resources of two state parks (Edisto Beach State Park and Hunting Island State Park), one Federal/State National Estuarine Research Reserve (ACE Basin NERR), two state Wildlife Management Areas (Donnelley

WMA and Bear Island WMA), and one U.S. Fish and Wildlife Refuge (ACE Basin National Wildlife Refuge). These facilities become additional points of entry and interpretation centers for visitors to the ACE Basin. The critical components are:

- A centrally located education/interpretive center to serve as the primary visitor reception center and provide a broad overview of the ACE Basin, along with a limited number of low-impact, environmentally sensitive accommodations on-site to establish a nature-based visitor destination.
- A research center dedicated to estuarine and marine research.
- Five satellite interpretive centers and recreation areas strategically located throughout the Basin.

The need for multiple facilities is a function of several aspects of the Basin. First, the area's geography is defined by three rivers and a number of sea islands that make key locations remote from one another and transportation from place to place difficult. Second, there are a number of existing properties and facilities that could be used for education, recreation, research, and nature-based tourism. Finally, the varied habitats of the Basin are an asset that should be highlighted and the multiple public properties provide access to the Basin's seven distinct habitats.

The following list describes the proposed network of facilities that will provide educational, recreational, and scientific research opportunities to both residents and visitors to the ACE Basin.

- **Central Visitor and Interpretive Center/Eco-Lodging:** The center, designed in an environmentally-sensitive manner, will serve as a collection point from which visitors can be directed to satellite locations. The experience at this center is expected to provide an overview of the ACE Basin and satisfy the greatest number of visitors, providing them with a fundamental appreciation for the natural environment and the area's history and culture. On-site, but separate from the center, will be a small, low-impact enclave of environmentally-sensitive single, detached lodging facilities. This "eco-lodge" will provide visitors with a high quality overnight experience and serve as a showcase for sustainable, "green" development practices.
- **Estuarine and Marine Research Center:** The ACE Basin National Estuarine Research Reserve (NERR) Center at Bennett's Point is envisioned as a facility dedicated to estuarine and marine research and education. The NERR, a partnership between National Oceanic and Atmospheric Administration (NOAA), Ocean and Coastal Resource Management (OCRM) and SCDNR, is expected to host marine scientists from the South Carolina Marine Resources Research Institute and other institutions. It also will provide educational opportunities for high school, college, and graduate students.
- **Edisto Beach Discovery Complex:** This education and interpretive center is proposed for Edisto Beach State Park as a joint effort between NOAA (who is assisting with funding), SCPRT and SCDNR (specifically the ACE Basin NERR). The park, located on the north side of the ACE Basin watershed, offers an excellent location and is expected to provide the general public with educational and recreational opportunities to experience and better understand the importance of estuaries and their significance to South Carolina. It also is expected to be a catalyst for expanded NBT opportunities in the region.
- **Hunting Island Interpretive/Education Center:** Located nearly three hours away by car, the Hunting Island Interpretive Center is designed to complement the Edisto Beach Center program. The Hunting Island Center is expected to meet the overwhelming public demand for informative programs on coastal dynamics and barrier islands. This Center will closely look at the constantly changing marine

environment and how biological communities and environments respond.

- **Donnelley and Bear Island Wildlife Management Areas:** A visitor reception center is planned for one of these two properties. Both properties offer varied inland maritime environments that are home to a wide range of wildlife such as deer, waterfowl, alligators, turkey, endangered southern bald eagles, and wood storks. Impoundments, remnants of the Basin's rice cultivation period, are present on both these properties.
- ACE Basin National Wildlife Refuge-Grove Plantation: The refuge encompasses more than 4,452 hectares (11,000 acres) and provides an excellent environment in which to observe wildlife, including deer, turkeys, waterfowl, and wood storks. The property is also the site of a restored plantation home that is representative of historic Lowcountry and ACE Basin architecture and design.
- **Westvaco Nature Trail:** This satellite facility will provide visitors with an understanding of, and appreciation for, a blackwater swamp, which is characteristic of the upper ACE Basin. It will give visitors an idea of the importance of rivers in shaping the submerged lowlands and defining the Basin's wetlands habitat, and will emphasize the practice of sustainable forest management. Its convenient location at Jacksonboro will allow visitors to identify opportunities for more in-depth experiences at other satellite locations throughout the Basin.

Back to Top

Public Access/Recreational Use

- Critical Issues
- Management Goals

Background

Insufficient public access to the nation's coastal areas has been recognized nationally for over 60 years. In 1935, the U.S. Department of the Interior recommended that the federal government buy undeveloped land along the Atlantic seaboard for public recreation. Subsequent reports acknowledged by the federal government recognized the shoreline as a unique national resource with unusually high recreational qualities (Campbell et al. 1961). Such federal interest has provided the impetus for increased recognition that access to public beaches and waters is a critical problem facing state and local governments. The Coastal Zone Management Act (CZMA) of 1972 addressed this issue and, as amended in 1976, provides that "the management program for each coastal state shall include…a planning process for the protection of, and access to, public beaches and other coastal areas…" The Act also authorizes grants to states for acquisition of lands for public access.

South Carolina law does not require that an oceanfront or other coastal developer must provide any type of public access to the resource. However, once any access is provided or established, South Carolina law will protect the continuation of such access for the benefit of the public. Since 1993, the Coastal Access Improvement Program (CAIP),


Public boat ramp on Edisto River at Willtown Bluff

managed by the OCRM, has assisted local communities and state agencies in funding coastal access through a matching fund established from permit fees collected for critical area permits. The ACE Basin provides invaluable assets to the state, those being sites for public recreation and compatible traditional uses. Currently, there are 30 boat ramps in the study area and public use activities are conducted on two state parks, ACE Basin National Wildlife Refuge, Donnelley and Bears Island Wildlife Management Areas, and the state, federal ACE Basin National Estuarine Research Reserve.

Rough indications of supply and demand factors associated with coastal resource use demonstrate that the demand for public access in the ACE Basin remains high relative to the availability of land. Specific public access issues are related to beaches and navigable waters. South Carolina law contains the precept that the state owns all lands below the mean high water mark. This presumption of state ownership may be overturned if a property owner can show a clear chain of title leading all the way back to either a king's grant (from the King of England) or a grant from the state legislature (South Carolina Water Resources Commission 1970). Otherwise, there is a presumption that all those areas below the mean high water mark are open for public use, including recreational use, even if the contiguous land is privately owned. This line of reasoning is based on the Public Trust doctrine which has roots in ancient Roman and English law and originated with the concept that the king or ruler of the country held such common area as the river beds and shore lands under water for the benefit of the public (Brower 1978). In South Carolina, this means that the public has the right to use and enjoy the beaches and other tidally influenced water bodies along its coast regardless of their ownership. However, caution must be used when in such tidally influenced areas so that one does not trespass across boundaries onto strictly private property. The uses protected under such ownership, referred to as the *jus publicum*, were originally deemed to include navigation and fishing by the public. In more modern times, however, across the nation the concept of public use has been broadened to include recreational pursuits as well (Fawcett et al. 1979). Additionally, some courts have held that the Public Trust doctrine would apply to any lands subject to the ebb and flood of the tide, without regard to navigability.

South Carolina's Constitution declares that all of the state's waterways, rivers and streams shall be open and forever free as public highways. Developers and land owners, however, were not required to provide public access to such waters. There are state programs that seek to provide adequate public access to South Carolina's waters by purchasing property for boat ramps or other public facilities. Access to coastal waters is also available by paying a fee to those who have received federal and state permits to develop access facilities such as marinas and private boat ramps. There are also two means by which private land may be considered for public access against the owner's wishes-- prescriptive easement and implied dedication (Brower 1978). There are very few cases in which these means have been used because there already exist in the coastal area a significant number of public access points. However, if anyone challenged the public's right to continue using an access to South Carolina's coastal resources, the courts would need to determine whether or not a legal right was vested in the public.

Critical Issues

Since passage of the CZMA in 1972, public access to coastal resources has been a major focus area in South Carolina. During this time, many questions have been asked, some of which are still unanswered. The following questions form the basis of critical management issues in the ACE Basin today. Many of these same questions were also asked thirty years ago.

1) Why do we manage coastal access?

The issues of providing public recreational access have been documented in several landmark studies (Campbell et al. 1961, California Coastal Zone Conservation Commission 1975, Ditton and Stephens 1976). These studies establish the social values of coastal recreation access and show how planning approaches can help solve management problems. Other studies focus on the environmental impact of public access (McHarg 1969, Sorenson 1971). Ditton and Stephens (1976) present a sophisticated perspective on managing in the context of land-use planning for coastal areas. They conclude that "…..the process requires an information-rich environment where local governments and the state have a scientific or technical policy ambiguity… The percentage of accessible shoreline is only a partial indicator of public access. Coastal access is far more a function of how many people have convenient access to a given stretch of the coastline than miles of publicly accessible coastline."

2) Maximum Access – How do we manage it?

Whether we really want to provide maximum access is not clear. Coastal managers, in many cases, do not have definitive goals and objectives, and they find it difficult to define the opportunities they should be providing via programs and facilities. In the ACE Basin, an active approach is being taken through a network of satellite stations to control visitors, tourism and associated recreational activities.

3) How much public access is enough?

There is no rule of thumb but through the process of adaptive management, answers can be provided. It could be argued that there is sufficient access when there is not any perceived crowding and when user satisfaction is maintained at high levels. Dissatisfaction can be alleviated through management information systems that allow people to select the type, timing and quality of access they desire.

4) What role can the private sector play in providing public access?

The private sector is already playing an important role in the ACE Basin by providing access to many of these isolated coastal areas, primarily through services provided for fees. However, there is unlimited potential for plantation and other large landowners to provide greater access to natural resources in the ACE Basin. Holiday outings, birding and wildlife observation opportunities could be coordinated through the proposed Network hub.

5) Does multiple use conflict with managing coastal access?

Multiple use can mean maximizing uses of one particular site (i.e., Bear Island WMA) or it can mean maximizing single use sites within some defined larger area (camping in Reserve boundaries). Different recreational behaviors do frequently result in conflicts within the ACE Basin. For example, there are occasions when non-consumptive wildlife users (such as kayakers and canoeists) are precluded from public areas because of hunting activities. Managers, however, are working to separate certain recreation behaviors in time and space. Multiple use is a management goal in the ACE Basin where managers are striving to create and maintain a system of sites for different recreation behaviors. Also, the multiple use concept goes beyond the physical features of the landscape and includes infrastructure in the region. Bridges, waste treatment plants and roads/highways must be considered as potential contributors to recreation access.

6) Should we encourage more public use in isolated areas?

The approach taken in the ACE Basin NERR is that of maximizing an individual's enjoyment or experience in the area. This strategy is the opposite of maximizing visitor "head-counts" to justify budget and appropriation increases. Certainly, there are areas where more use can be established. The continuous management process will identify these areas over time.

7) How do we avoid crowding problems?

Since distribution of uses varies greatly, we probably cannot avoid crowding problems. Redistribution of uses does appear to be a goal worth consideration; there is a lack of understanding of techniques involved and the end results may not be desirable. In attempting to redistribute use, managers must have regard for user differences, target resources and experience requirements or people may be forced to accept less satisfying experiences (Schreyer 1976). The ACE Basin is so large and remote that user distribution has thus far taken care of itself. But there are signs of crowding on popular beaches like Edisto Beach and Hunting Island, as well as on boat ramps and waterways in the Bennett's Point area during shrimp baiting season.

8) Should environmental impacts take precedence over socio-psychological benefits that public use and recreation activities may provide?

Delicate and sensitive habitats in the ACE Basin should be protected. Public access and recreational activities may not be compatible in some areas under any circumstances. Environmental changes or impacts need to be evaluated as to their magnitude and importance. Significant impacts need to be defined in the context of long-term environmental costs and not just in terms of public recreational benefits.

9) How does access parking facilities impact crowding and experience quality?

Sensitive habitats and significant environmental impacts or aesthetic concerns should limit parking location, size and in some cases the extent of development. There should be diversity in site densities throughout the ACE Basin. In the long-term, such consideration in an access system is more important than maximizing access at all points. The Fields Point boat ramp proposal is an excellent example. The project was to build a modern boat ramp facility with paved parking, courtesy docks, and other amenities. During the review process, the area's sensitivity and aesthetic values were emphasized. Several major objections were filed with the Army Core of Engineers (ACOE). The permit application was modified to reflect the public's concerns. The resulting scaled-down project is much more environmentally friendly and yet functional for public access.

10) How do we restrict users?

There is no "magic number" at which to place a cap on the number of users of the ACE Basin. A detailed user-resource study would be helpful in making decisions on limiting number of users before overuse, crowding-conflicts, and habitat damage occurs. There are also many legal aspects of such decision-making. Generally, coastal use problems are controlled by regulations (e.g. law enforcement, length of stay, use rationing, parking location, and permits). In many cases, the public feels overly restricted and unnecessarily controlled. There are other techniques, however, that are less obtrusive to users and perceived freedom of choice. Managers can influence or direct users away from sensitive or problem areas toward areas better suited to their particular needs by using non-regulatory methods. For example, the specific attributes of an area can be advertised while simultaneously improving the physical access to that area. Conversely, access to problem areas may not be improved and less attention focused on them. The concept of carrying capacity (O'Reilly 1986, Martin and Uysal 1990, Hovinen 1992) must be a part of the planning process.

11) How do we understand our constituencies?

Once we have an accurate database about users, their experiences, and their impacts on the resources, we need to know the public's concerns. A user's permit scheme has provided a feedback system in the ACE Basin. In addition, on-site observations and survey research instruments have been useful. The goal of continuously managing and monitoring users should assist with routine data collection systems. However, the manager's mission is broader than resource management; it includes human development as well. User satisfaction is the essence of public access.

Management Goals

The overall goal is to provide public access to all elements of the ACE Basin, exposing visitors to representative aspects of the watershed, with opportunities for environmental awareness and compatible recreational activities, while protecting the natural integrity of the area. The specific management goals are to:

- provide objective, current and relevant information to community decision-makers about the quantity and quality of existing, or potential, user opportunities;
- strive to maintain and/or improve the recreational/leisure experience for visitors to the ACE Basin;
- define the optimal range, mix and location of recreational/leisure opportunities for all users;
- preserve appropriate recreational resources to serve their best use;
- incorporate recreational plans into other types of planning for the ACE Basin;
- promote public understanding and support for more effective recreational planning;
- evaluate the effectiveness of existing and proposed public and private recreation development;
- encourage public and private cooperation to provide leisure opportunities in the ACE Basin; and
- encourage innovation, demonstration, and research to improve the state-of-the-art facilities and services.

NEXT SECTION: Research and Monitoring

Author

M. McKenzie, SCDNR Marine Resources Division

References

Brower, D.J. 1978. Access to the nation's beaches: Legal and planning perspectives. Sea Grant Consortium, Publication UNC-SG-77-18.

California Coastal Zone Conservation Commission. 1975. California Coastal Plan. California Coastal Zone Conservation Commission, Sacramento, CA.

Campbell, R. D., H. L. LeBlanc, and M. A. Mason. 1961. An evaluation of the shoreline recreational resources of the United States. Final Report. U.S. Outdoor Recreation Resources Review Commission. Georgetown University, Washington, DC.

Ditton, R. and M. Stephens. 1976. Coastal recreation: A handbook for planners and managers. National Oceanic and Atmospheric Administration, Office of Coastal Zone Management, Silver Spring, MD.

Fawcett, J.A., A.T. Manus, and J.C. Sorensen. 1979. Proceedings of a forum on recreational access to the coastal zone. University of Southern California Sea Grant Consortium, Los Angeles, CA.

Hovinen, G.R. 1982. Visitor cycles-outlook for tourism in Lancaster County. Annals of Tourism Research 9:565-583.

Martin, B.S. and M. Uysal. 1990. An examination of the relationship between carrying capacity and the tourism life cycles: Management and policy implications. Journal of Environmental Management 31(4):327-333.

McHarg, I.L. 1969. Design with nature. National History Press, Garden City, NJ.

O'Reilly, A.M. 1986. Tourism carrying capacity-concept and issues. Tourism Management 7:254-258.

Schreyer, R. 1976. Sociological and political factors in carrying capacity decision making. *In*: Proceedings of the National Park Service Visitor Capacity Symposium, Ft. Worth, TX. [unpublished]

Sorenson, J.L. 1971. Framework for identification and control of resource degradation and conflict in the multiple use of the coastal zone. Department of Landscape Architecture, University of California at Berkley, Berkley, CA.

South Carolina Water Resources Commission. 1970. South Carolina tidelands report. SC Water Resources Commission, Columbia, SC.

Stankey, G.H., D. Cole, R. Lucas, M. Peterson, and S. Frissell. 1988. The limits of acceptable change (LAC) system for wilderness planning. General Technical Report INT-176. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Research Station, Ogden, UT.

Travel Industry Association of America. 1998. The adventure travel report, 1997. Travel Industry Association of America, Washington, DC.

MENU
Introduction
Research
Monitoring
Coordination of Research and Monitoring Efforts
References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Resource Management

Research and Monitoring

Introduction

Although the various partners involved in the ACE Basin Initiative are engaged in education, research and monitoring to some extent, the National Estuarine Research Reserve (NERR) is the only entity designed to promote informed management of the estuarine area and provide a stable environment for research and monitoring. In fact, it is the dual objectives of research and education that distinguishes the NERR from other programs in the ACE Basin. The NERR System (NERRS) connection to the Coastal Zone Management Program is a critical element in the overall project initiative because coastal management issues are addressed through integrated research and monitoring within the national network of reserves. The following section, although geared toward the NERR, can be extrapolated to the ACE Basin watershed region.

The overall mission of the NERRS (NOAA 1995) is as follows: "The National Estuarine Research Reserve System is a protected areas network of federal, state, and community partnerships which serve to promote informed management of the Nation's estuarine and coastal habitats through linked programs of stewardship, public education, and scientific understanding."

Research

- Research Goals of the NERRS
- ACE Basin Goals and Priorities
- ACE Basin Guidelines and Policies for Research

Research and monitoring in the ACE Basin is a major priority. The Basin, because of its relatively low level of development, has retained many of the attributes associated with estuaries at the turn of the century. This provides a benchmark against which to compare other coastal areas where significant human disturbances are

Trawling activities in the ACE Basin

occurring. Such comparisons are necessary in developing an understanding of the impacts, both obvious and subtle, on coastal resources. It is particularly important to make research results available in a useful form to those responsible for resource management and coastal zone planning at individual, local, state and federal levels. The large expanse of the ACE Basin, its biological diversity and high water quality standards provide an outstanding environment for research (See Biological Resources and Water Quality sections for additional information). The ACE Basin NERR, especially in the lower maritime area ("core"), is well protected and serves as an undisturbed baseline monitoring area while the multiple-use area or "buffer zone" is large and diverse enough to serve as an experimental research and demonstration area. For example, the Bear Island and Donnelley WMAs and the Westvaco properties in Colleton County could serve as "staging" areas for demonstrating the sustainability of managed ecosystems and the study of harmonious land uses, short-term studies for specific management needs, and wildlife management in general.

Research and monitoring activities in the ACE Basin are guided by national, state and local plans that identify goals, priorities, and implementation strategies for these programs. This approach, when coordinated with a comprehensive program of education and interpretation, provides for management-oriented research that has long-term, system-wide consistency and utility for solving management issues.

Research Goals of the NERRS

The Code of Federal Regulations defines research policy that must be fulfilled at each designated reserve within the national system. This forms the basis for research programs in the ACE Basin and includes the following goal taken from the NERRS Strategic Plan (NOAA 1995): Scientific Understanding Through Research – Design and implement a comprehensive program of scientific research to address coastal management issues and their fundamental underlying processes.

The NERRS research plan represents a comprehensive, interdisciplinary approach to scientific and technical aspects of coastal management problems and reflects major programmatic initiatives as described in the National Oceanic and Atmospheric Administration (NOAA) Strategic Plan's Coastal Ecosystems Health component (1995-2005), including activities to: 1) integrate operations for coastal ecosystem management, 2) enhance ecosystem assessment activities, 3) develop a national comprehensive monitoring program, 4) increase scientific understanding, and 5) provide a strong information base for informed public policy decision making. The South Carolina Department of Natural Resources, Marine Resources Division (SCDNR/MRD) has developed its research program in the ACE Basin NERR around these federal goals and objectives.

ACE Basin Goals and Priorities

Research that relates directly to the management of reserve and coastal resources is actively encouraged and receives the highest priority in the ACE Basin. An overall goal is to:

Goal 1: Encourage, promote, support and conduct research of the highest quality within the ACE Basin.

It is toward this end that key areas within the ACE Basin are acquired and managed for long-term use as natural field laboratories. Diverse, multi-disciplinary research which improves basic knowledge of the processes controlling estuaries and coastal ecosystems is a top priority. The ACE Basin NERR encourages research within established boundaries of the reserve. However, it is recognized that many important issues transcend boundaries and should be incorporated into the research agenda. It is also recognized that research results must be translated and made available to potential user groups. Therefore, other goals include:

Goal 2: Coordinate research projects with other efforts in the ACE Basin watershed in order to streamline scientific energies, maximize efficient use of funds, and avoid unnecessary duplication of efforts.

Goal 3: Ensure that research results and information needed by coastal managers and decision makers are made available on a timely basis for improved understanding and management of coastal resources and estuarine ecosystems.

The ACE Basin NERR encourages research projects falling within the current national research priorities: 1) non-point source pollution, 2) habitat restoration, 3) biodiversity and invasive species, and 4) mechanisms for sustaining resources within estuarine ecosystems. Funding decisions for NERRS research projects are based on the relationship between proposed research and these national priorities. As a general rule, projects that will benefit more than one reserve in the national system are given a higher emphasis than reserve-specific projects. All research funded through NOAA should be designed to provide information of significant value to the development and implementation of management policy governing the U.S. coastal zone for which NOAA's Office of Ocean and Coastal Resource Management has management and regulatory responsibilities.

ACE Basin Guidelines and Policies for Research

Policies

Research opportunities within the ACE Basin NERR are available to any qualified scientist, academician, or student affiliated with any university, college, school, non-profit research institution, private profit organization, or state, local, or federal government agency. Unaffiliated individuals who have the capability and facilities needed to perform research may also qualify for research funds.

Funding for national research priorities in the ACE Basin is available through NOAA on a competitive basis to qualified researchers and must be matched by the recipient according to current NERRS regulations. An annual announcement of research opportunities, reflecting priority needs and levels of funding, are distributed. Also, a research prospectus is provided to potential researchers, including the basic information on reserve resources, unusual features, support facilities and a listing of research reports from the ACE Basin NERR.

Activities permitted in the core area are limited to research activities which do not manipulate habitats. Manipulative research may be permitted in the buffer zone of the reserve as long as it is consistent with permitting requirements. By federal regulation, projects known to be destructive to habitat or otherwise in conflict with established policy are not permitted. Approved projects must be discontinued if they produce adverse impacts on reserve property. All researchers must obtain a scientific collection permit from the SCDNR as authorized by the S.C. Code of Laws and must discuss proposed projects with the research coordinator. This process allows reserve staff to track and document research activities and also places some obligation on researchers to conduct their work in a professional and responsible manner.

The ACE Basin NERR research coordinator is responsible for coordinating all research and monitoring activities for the reserve. As such, the research coordinator maintains regular contact with the researchers. Researchers are required to present project findings at the appropriate time and site negotiated by the research coordinator and the researcher. These presentations help to provide information for improved understanding and management of estuarine resources and coastal decision making. Peer-reviewed publications are encouraged as are presentations at appropriate symposia, conferences, and meetings.

Research Topics

Research may be conducted by qualified scientists on any topic consistent with the NERRS goals and may be funded from any source. NOAA funds are available for priority topics and can be used to: 1) support management-related research that will enhance scientific understanding of the reserve ecosystem, 2) provide information needed by reserve managers and coastal ecosystem policy makers, and 3) improve public awareness and understanding of estuarine ecosystems and estuarine management issues.

NOAA encourages coordinated research among reserves and other scientists by preferentially funding research proposals on specific estuarine topics which it has identified as national priorities. This unified approach promotes the exchange of research findings among reserves, state and federal agencies, and the academic community. Consideration is given to proposals of special merit that address other significant coastal management issues on a regional or national scale.

During 1996, the competitive research funding was restructured to support a wider array of research in terms of content and geographic coverage. Each reserve within the national system receives up to two graduate student fellowships per year. These assistantships are highly competitive and are awarded on criteria established by NOAA and the local reserve. The general topic areas are the same as identified as national priorities. All research priorities and the overall program for funding research at the federal level are reviewed periodically.

Other Research in the ACE Basin

Special studies to answer specific management questions and improve coastal resource management are recommended for the ACE Basin. The following topics not only apply to the NERR, but also to the various management issues and goals previously summarized in the Assessment of Management Issues and Goals section. In the broadest sense, research should encompass the following:

- Initial Short-Term Priorities – Research to provide management information on sediment /water column nutrient flux; evaluation of BMP effectiveness; analysis of living resource data sets; stock assessments; evaluation and analysis of monitoring capabilities; and sub-lethal responses to toxins and development of indicator species (i.e. oysters).
- Longer-Term Priorities – Fundamental research on circulation and mixing processes; water quality, habitat and ecosystem-level models; interaction between various trophic levels; genetic makeup of living resources (particularly exploitable stocks);

significance of groundwater flow; and impacts of specific land uses on aquatic, wetland, and riparian habitats.
- Special Studies – Other research topics that address coastal management issues identified as having a local, regional, or national significance. Examples may include: methodologies and mechanisms for management of cumulative coastal environmental impacts; quantifying the effects of sea level rise on wetlands formation and productivity; temporal and spatial variability in the use of marsh/tidal creek ecosystems as nursery areas for species of commercial and recreational importance; studies comparing tributary systems protected within the ACE Basin to those in other more developed areas; identifying criteria and standards for mitigation by using the ACE Basin as a control for offsite mitigation projects; quantifying the effectiveness of forested and agricultural buffer strips and other BMPs including the value to water quality, flood control, sediment stabilization and wildlife; succession of plant communities within the ACE Basin; shellfish production and diseases and enhancement of growing area; effects of fire on barrier/maritime island ecology; coastal geology – erosion, geological mapping, benchmarks for monitoring marsh subsidence and sea level rise events; surveys of flora and fauna to determine population densities, distribution, dynamics, conditions and habitat requirements; visitor use surveys and relationships between social carrying capacity and ecosystem health; and ecosystem modeling – predictive, interactive models to assist managers in assessing the implications of proposed and potential activities in the ACE Basin.
- Research for Emerging Management Issues – There is a shortage of site-specific, reliable scientific information for much of the ACE Basin. This was demonstrated through the prototype Otter Island Characterization (SCDNR 1996), where detailed information at the ecosystem level was not available. Managers are, consequently, uncertain what species exist on the outer coastal plains islands and thus are unable to precisely define relationships among plant and animal communities and their respective environments. Effective management of these islands would be enhanced considerably by adequate site-specific data from research and monitoring programs.

Three types of management-related studies are recommended for the maritime islands in the ACE Basin:

- Resource Inventories: baseline studies will better define the spatial and temporal distribution of species, habitats, and biological processes on these islands. Initial studies have been conducted (TNC 1992), but otherwise site-specific data are scarce;
- Monitoring Investigations: this includes long-term monitoring of ecosystem components and their interactions through time. It will provide managers with tools to better predict the effects of disturbances and on-going descriptions of the ecological health of these sensitive island habitats. Monitoring will subsequently allow analysis of trends in resource abundance and quality over time; and
- Impact Studies: this includes short-term studies for specific management needs and shows how the maritime island's ecology is affected by management decisions. Such studies will provide information on which future management decisions may be evaluated.

Specific research needs for these island communities include:

- Management of Problem Species: the removal of raccoons from barrier islands to protect sea turtle eggs poses interesting management questions. Ultimately, their removal would disrupt the natural ecology of the island and we must ask: What are the long-term ecological effects of their removal? What population levels or damage thresholds are acceptable? And how do we go about making these determinations?
- Sustainable Use: Can research help managers determine which uses and how much use

protected areas like the ACE Basin can sustain without degradation of resources? This is a critical question for managers throughout the watershed area. Decisions should be based on reliable scientific information but managers need to know whether techniques such as zoning, closures, use windows or scheduling, and other prescribed actions will effectively limit impacts of multiple uses. The question of overuse is particularly important when considering the carrying capacities for compatible activities, especially those for which there is high demand, like nature-based tourism. How much damage can be sustained by an ecosystem without affecting its function? How much effort should be devoted to artificially elevating and sustaining visitorship (increasing carrying capacity) on these island communities? There is a need to conduct fundamental research on the determinants of carrying capacity such as frequency and density of public use; and
- Sensitive Communities: Where are the sensitive plant and animal communities in the ACE Basin? Some of the plant communities were identified by TNC in a 1993 survey in the Basin area, but animal communities have not been systematically surveyed. GIS technology should allow managers to maintain current spatially-explicit inventories of sensitive species and communities to assist management decisions.

The above list is not intended to be a complete list of research projects but only to serve as an example of the many types of special studies that should be conducted. The list will expand in time with experience and funding opportunities.

Back to Top

Monitoring

Introduction


NERR weather station

An important function of the NERRS is to provide baseline information to researchers, managers and coastal decision-makers at the local, state and federal levels. Degrees of change in regional estuarine ecosystems can be measured by comparing standardized sampling parameters and conditions in different reserves. The ACE Basin monitoring program is based on the NERRS Strategic Plan (NOAA 1995). The overall goal is to collect environmental data which would allow scientists to detect, quantify and predict short-term and long-term changes in the health and viability of estuarine ecosystems and to enhance the management of coastal resources. The monitoring of physical, chemical and biological aspects of habitats and communities of organisms can indicate "how things are" within the system and the effects of many environmental factors. Chronic environmental disturbances are usually indicated through changes in quality of habitat, biodiversity, population numbers, distribution, growth and mortality rates. The monitoring of baseline conditions provides an early warning system for ecosystem changes. The ACE Basin monitoring program is designed to monitor local variables and measure the effectiveness in maintaining reserve integrity. Data generated from the monitoring program is linked into the national network through the Centralized Data Management Office (CDMO) at North Inlet/Winyah Bay NERR. This program allows the reserve to develop new research priorities as needed and measure the success of existing research efforts.

Phased Monitoring

The NERRS has developed a three-phase monitoring program that incorporates information of direct relevance to the individual sites, the region and the national system. It is the policy of the ACE Basin NERR to follow this plan as outlined in the NERRS Strategic Plan (NOAA 1995).

- Phase I: This is a comprehensive water quality monitoring program in which each reserve monitors a uniform suite of physical and chemical processes that reflect the general health of an estuary, including basic water quality indicators, atmospheric conditions, and specific processes such as tidal and ground water flow and contaminants. These data are measured consistently across the national network and are compiled, synthesized, summarized and disseminated by the CDMO. In the ACE Basin NERR, monitoring has occurred since 1995 at two stations (Big Bay Creek and St. Pierre Creek) in the South Edisto River (See the Water Quality section for additional information).
- Phase II: This is a broad-based biodiversity monitoring effort where sites in the national network design ecological surveys to assess the status and trends of locally, regionally, and nationally important critical habitats, species and functions.
- Phase III: This is a long-term Land Use Change Analysis in which sites assess patterns of change in human uses of surrounding watersheds, and relate those activities to environmental processes of immediate management concern.

The ACE Basin monitoring program is integrated where appropriate and beneficial with other environmental monitoring programs conducted by state and federal agencies, local government, and non-profit conservation organizations. This includes fisheries surveys and harvests, shellfish sanitation, game and non-game wildlife, and threatened/endangered species. The ACE Basin is also participating in the Protected Areas Geographic Information Systems (PAGIS) project supported by Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) and has made substantial progress in compiling these data in GIS format.

Back to Top

Coordination of Research and Monitoring Efforts

The Nature Conservancy (TNC), Ducks Unlimited (DU), and U.S. Fish and Wildlife Service (USFWS) are also conducting research and monitoring activities in the ACE Basin study area. It has been the policy of the NERR to forge an alliance with these groups and communicate planned activities and results of research and monitoring. Each organization has its own special strengths to contribute to the overall conservation effort in the ACE Basin.

TNC’s "Last Great Places" initiative combines science, creative action and effective partnerships in preserving large, self-sustaining natural systems. Their involvement in the ACE Basin effort has been invaluable to the overall success of the project. DU’s new International Institute for Wetland and Waterfowl Research has recently launched a long-term research initiative in the ACE Basin. Coordination of research with this group complements and strengthens the overall program. USFWS has also established a National Wildlife Refuge in the ACE Basin and the exchange of information with this group on a regular basis has been beneficial.

NEXT SECTION: Education Programs

Authors

M. McKenzie, SCDNR Marine Resources Division

W. McMillan, SCDNR Marine Resources Division

References

National Oceanic and Atmospheric Administration. 1995. Conserving the nation's coasts and estuaries, a strategic plan for the NERRS: A state and federal partnership. U.S. Department of Commerce, Washington, DC.

Prevost, M. 1992. pers. comm. The Nature Conservancy.

South Carolina Department of Natural Resources and U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Coastal Services Center. 1996. Ecological characterization of Otter Island, South Carolina: A prototype for interactive access to coastal management information. National Oceanic and Atmospheric Administration, Coastal Services Center, Charleston, SC. CSC/7-96/001.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

M
E
N
U

Education and Interpretation

Ongoing Programs

School Involvement

Vision of ACE Basin Educational Network

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Resource Management
Education Programs

Education and Interpretation

Education, training, and outreach activities are conducted at the national, regional, state, and local levels in the ACE Basin. These include a broad spectrum of activities designed to enhance public awareness and opportunities for public education and interpretation. A critical aspect of this mandate is the linkage of education to science and stewardship. Although there is no one entity charged with the responsibility of coordinating education activities, the ACE Basin NERR has taken a leadership role in providing the crucial linkage between research and coastal management. The overall goal is to translate scientific information into language that can be understood and applied by decision-makers, professionals and the public. The NERR coordinates with federal and state agencies, national education, scientific and environmental organizations, private industry, landowners, and special interest groups and also is an active member of the local and regional education community.

Education Goals

- Develop education programs that will further community understanding of estuaries and the ACE Basin watershed,
- Provide on-site and outreach educational experiences.
- Educate about estuaries holistically to include ecological, cultural, historical, sociological, aesthetic, and economic perspectives.
- Promote a sense of stewardship and individual responsibility.
- Address local, regional, state, and national coastal issues.
- Approach estuarine education through a perspective that includes watersheds and bio-regions.
- Target a culturally diverse audience of educators and students, environmental professionals, coastal resource decision-makers, and resource users.
- Coordinate estuarine education efforts.
    - Promote partnerships, leverage funds and resources, and coordinate with federal, state, and local agencies and organizations.
- Develop the ACE Basin as a resource center specializing in estuarine and watershed education.
    - Ensure that education programs incorporate innovative and appropriate technologies and education practices.
    - Secure resources for effective and efficient programs.
- Capitalize on the ACE Basin NERR's ability to directly link education, research, stewardship, and resource management.
    - Facilitate an understanding of the scientific process and research results.
    - Provide information and expertise to decision-makers for wise use of coastal

resources.
    - Use education as a proactive tool of resource protection and stewardship.
    - Ensure that education programs are compatible with resource management.
    - Use historical information on cultural resources and coastal archaeology to illustrate the traditional uses of ACE Basin habitats.
- Continually assess and evaluate education programs and products and implement changes where needed.

Back to Top

Ongoing Programs

- South Carolina Department of Natural Resources
- South Carolina Parks, Recreation, and Tourism
- U.S. Fish and Wildlife Service and the Nature Conservancy
- Other Educational Resources

Educational programs exist for a wide range of audiences throughout the ACE Basin. Several agencies and organizations including the South Carolina Department of Natural Resources (SCDNR), the U.S. Fish and Wildlife Service (USFWS), The Nature Conservancy (TNC), and the South Carolina Department of Parks, Recreation and Tourism (SCPRT) offer programs at various times throughout the year. Descriptions of individual programs and activities, along with the sponsor, are listed below. The reader is encouraged to contact the sponsor because many of the programs described are available on a seasonal basis or by prior arrangement only. In addition, a discussion of South Carolina school participation in programs offered by or in connection with the ACE Basin is provided.

South Carolina Department of Natural Resources

Minorities in Marine Environmental Science Program

The SC Marine Resources Division of SCDNR in association with the National Science Foundation (NSF) sponsors the Minorities in Marine Environmental Science Program (MIMES). The primary goals of this program are to increase the number of minorities choosing marine or environmental science as a profession and to increase the number of minorities who are qualified for employment with the Marine Resources Division. The program recruits undergraduate minority students to participate in a research-oriented summer training program. Each student is matched with a qualified mentor who provides guidance in the completion of an independent research project. Because of its diversity of habitats and communities, the ACE Basin is an excellent study area in which to conduct these research projects. Since the program's inception, several students have completed research projects in the ACE Basin. Most recently, in the summer of 1999, a student studied distribution of juvenile horseshoe crab populations on one of the barrier islands in the ACE Basin.

For further information about the MIMES program, contact Donnia Richardson at (843) 762-5000 ext. 2233.

ACE Basin National Estuarine Research Reserve

The ACE Basin National Estuarine Research Reserve (ACE Basin NERR) offers a wide range of educational opportunities for teachers, students, lawmakers and the general public. Educational programs provide a "hands-on" look at estuarine ecosystems, plant and animal life, as well as the history and culture that are unique to the South Carolina Lowcountry. Promoting a greater understanding and stewardship of the habitats and animals found in the Lowcountry is essential for long-term protection of coastal resources. Classes, workshops and outreach activities are structured for all age groups either on or off site and are available throughout the year.

The following are the educational programs offered through the ACE Basin NERR:

- The Coastal Adventure Cruise Program provides an opportunity for high school and college students as well as teachers to experience sampling estuarine habitats from aboard a research vessel. A SCDNR marine biologist demonstrates various water quality sampling techniques and collects animals to give the participants a first-hand glimpse of the organisms inhabiting the estuary. Descriptions of important habitats and life history information are provided for organisms sighted and collected during the cruise.
- Nature walks, conducted by a biologist, are available seasonally. These cover a variety of topics including vegetation, birds and wetlands ecology. Communities and habitats are addressed on these walks, along with good stewardship practices.
- Workshops covering salt marsh ecology and the life history of estuarine organisms are offered during the summer to interested teachers, students, lawmakers, and business and community leaders.
- A traveling touch tank program is conducted by ACE NERR staff to provide hands-on contact with common estuarine organisms found in the ACE Basin. This program is available for schools, science fairs and community events.
- Audio-visual presentations are regularly made by ACE NERR staff to civic clubs and for other groups. The ecological diversity of the ACE Basin is addressed in these talks.
- A monthly Seminar Series brings well-known researchers and educators to communities surrounding the ACE NERR to speak on a variety of topics of interest to South Carolina residents and visitors. This series offers opportunities for a community dialogue with coastal decision makers and natural resource managers.
- ACE NERR staff also help sponsor special programs during nationally recognized events such as Estuaries Day and CoastWeeks. These programs are designed to increase awareness of the ACE Basin and the NERR system, promote stewardship and a conservation ethic, and increase understanding of estuaries and their value. Cooperative workshops with other state and federal agencies have also been sponsored by the ACE NERR staff to focus attention on coastal wetlands and their importance in the ACE Basin.
- The NOAA NERR program sponsors a national competitive fellowship program for graduate student research. The program provides funding for two graduate research fellowships at the ACE Basin NERR. The program is designed to fund high quality research focused on enhancing coastal zone management while providing students with training in ecological monitoring.

For further information about educational programs at the ACE Basin NERR, contact Kim Iverson, ACE Basin Education Coordinator, at SCDNR/Marine Resources Division Charleston office. You may contact her at (843) 762-5437 or iversonk@mrd.dnr.state.sc.us.

Donnelley Wildlife Management Area

The Donnelley Wildlife Management Area (WMA) offers tours for civic organizations and adult groups including teachers. Tours are guided and feature a diversity of wetland and upland habitats including managed rice fields, forested wetlands, tidal marshes, and many types of upland

Upland habitat at Donnelly Wildlife Management Area

forests. The tours offer an opportunity for wildlife viewing, discussions of the complex ecosystems found in the Lowcountry, and understanding wildlife management practices. In addition, self-guided tours are possible on two trails at the Donnelley WMA.

For further information about educational programs at the Donnelley WMA, contact their office at (843) 884-8957.

South Carolina Parks, Recreation and Tourism

Edisto Beach State Park

Programs at Edisto Beach State Park EXIT are offered mainly in the summer, but special arrangements may be made at other times of the year. Programs focus on the island's natural environment and history. Schools may arrange to visit the park for various programs. The following educational opportunities are available at Edisto Beach State Park.

- Nature programs focus on a variety of habitats found on Edisto Island and explore various parts of the park. Sea turtle programs offered in the summer give visitors a unique view of these animals which nest on the ACE Basin's beaches. A slide show and walk are offered seasonally.
- The beach is also explored in organized walks, which allow visitors to find and identify shells and other artifacts. Summer seining programs allow participants to discover what organisms occupy the nearshore tidal zone.
- The salt marshes are home to a wide variety of interesting organisms including fiddler crabs, snails and many species of birds. Salt marsh programs enable participants to explore the marsh and focus on the plants, animals and the role of this unique habitat.
- The maritime forest on Edisto Beach is a unique environment and is home to many of the over 150 species of birds found on Edisto Island. Visitors can observe birds and learn about the role of the maritime forest in the ecosystem.
- The Edisto Island area is rich in both natural and cultural history. Programs focusing on fossils, which are abundant on the beaches, make participants aware of the organisms that roamed the area millions of years ago. Native American history programs also allow visitors a glimpse of ancient cultures that were present in coastal South Carolina.
- Skills classes are available to enhance enjoyment of the ACE Basin environment. Programs on recreational crabbing and seafood preparation help participants develop necessary skills to catch and prepare their own meal.
- The Carolina Explorer program for young visitors to the park offers a patch to participants who complete the requirements.
- Opportunities for self guided tours are available.
- Other programs may be offered at other times of the year.

For further information about educational programs at the Edisto Beach State Park, contact their office at (843) 869-2156.

Hunting Island State Park

The [Hunting Island State Park](#) EXIT offers a variety of programs year round which permit visitors to explore the varied habitats of a coastal barrier island and learn more about the animals and plants inhabiting barrier islands. Public program frequency increases during the summer, with some available by special arrangement for educational groups. Examples of programs available are discussed below.

Hunting Island lighthouse

- A wide selection of programs designed to increase the visitor's knowledge of barrier islands and Hunting Island are offered at various times throughout the year. Programs in Barrier Island ecology allow for discovery of the diverse habitats found within the park while the Hunting Island slideshow enables an "armchair" view of this unique park.
- Tours of the Hunting Island Lighthouse allow visitors to learn about the history and renovation of the only lighthouse in South Carolina which is open to the public.
- Various programs are also available on specific organisms inhabiting coastal South Carolina. For example, in "Reptiles of the Coast" participants view various snakes, lizards, alligators and turtles that inhabit the ACE Basin area. In addition, sea turtles are the focus of programs during nesting season (May-August), while programs are also available on coastal birds and creatures active at night.
- Specific habitats such as beaches and salt marshes are discussed in programs specifically designed to explore these sensitive areas. Beach walks, coastal kayaking, sea safari, and beach seining are some examples of these.
- Skills and craft classes allow visitors to develop or improve outdoor skills such as recreational crabbing, surf fishing, and cast netting. Fish printing classes give participants a hands-on experience with coastal organisms using the unique Japanese art form of Gyotaku.
- Opportunities for unguided exploration of nature trails and the lighthouse are also available.

For further information about educational programs at the Hunting Island State Park, contact their office at (843) 838-2011.

U.S. Fish and Wildlife Service and The Nature Conservancy

The Grove Plantation

Grove Plantation is headquarters of the U.S. Fish and Wildlife Service (USFWS) [ACE Basin National Wildlife Refuge](#) and the Bioreserve Office of The Nature Conservancy ([TNC](#)). Educational tours are given by representatives of the USFWS and TNC. Educational programs include not only the history of the Grove Plantation and the ACE Basin Task Force Project, but also discussions of wildlife management within the Basin. The newly renovated 170-year old plantation house, one of only

A typical plantation manor house in the ACE Basin

three surviving rice plantation homes in the ACE Basin, is open for public visitation from 7:30 a.m. - 4:00 p.m., Monday - Friday, excluding federal holidays.

Other Educational Resources

Several other educational opportunities exist in the ACE Basin including:

- The Colleton Museum in Walterboro offers exhibits on the resources and history of the ACE Basin.
- The Discovery Museum in Hilton Head offers boat trips into the ACE Basin which are open to the public.
- The Edisto Museum on Edisto Island features the history of the Edisto area.
- Ecotourism businesses in the ACE Basin offer trips for educational purposes and may be available at a reduced rate for educational groups. Contact individual operators or local chambers of commerce for information.

Back to Top

School Involvement

The ACE Basin National Estuarine Research Reserve (NERR) offers educational activities on site in the ACE Basin in an effort to increase awareness of the value of coastal habitats and resources as well as the value of protecting them. In 1996, the SCDNR, through the ACE Basin NERR, participated in the ACE Basin Economic Forum, which was a community effort to prepare the ACE Basin and the surrounding communities for the future and to encourage sustainable development. As an outcome of the ACE Basin Economic Forum, the SCDNR was specifically tasked with leading community-based efforts to develop primary and secondary environmental and heritage education programs and with promoting awareness of and opportunities to demonstrate the benefits of sustainable development.

The presence of the ACE Basin NERR and the proximity of Colleton County to the MRD headquarters in Charleston provide opportunities for Colleton County schools to participate in SCDNR educational activities. Special activities are directly targeted toward Colleton County, such as teacher workshops and essay contests on the ACE Basin, with the goal of increasing involvement from Colleton County schools in educational programs about the Basin.

Traditional methods for recruiting schools to ACE Basin programs involve direct mailing of information to all school principals statewide. While these methods often meet with a good response, new methods are being explored to reach teachers and students in Colleton County. Given the success of community-based programs in land protection within the study area, a similar approach for marine education is being pursued. The ACE Basin NERR has developed several products such as posters, teacher guides, slide presentations which could enhance school curricula in Colleton County, if community involvement efforts are successful. New products currently under development should be highly useful to teachers and students who are interested in technology- related endeavors. Contact the Education Office at (843) 762-5112 to receive these materials.

Vision of ACE Basin Educational Network

The ACE Basin Visitor/Discovery Complex, as envisioned, will be a hub facility, located in the heart of the ACE Basin near U.S. Highway 17, that will provide interpretive exhibits and galleries, as well as a range of educational and recreational experiences. A network concept will encompass not only the visitor/discovery center, but also its five satellite facilities and research station located in the ACE Basin. Maps at the hub will show these satellite sites and schedules of educational programs will reinforce the suggestion of an invitation to visit those sites. Over time, connections between the various venues in this network will be strengthened.

The network's coordinated approach to environmental education, and the method in which it links separate sites to gain an integrated understanding of the ACE Basin will showcase the high quality and diversity of the region. This complex will:

- Build the foundation for long-term protection of the ACE Basin and its wealth of natural and cultural resources by fostering appreciation through education.
- Provide casual visitors, especially children and families, with general education about the Basin. Through the on-site experience, encourage them to understand that people are a "part of" and not "apart from" nature.
- Provide school children with opportunities for class outings and hands-on experiences in order to encourage personal involvement with nature.
- Offer teachers on-site experiences that will give them a better understanding of the resource and encourage the development of innovative and enriching learning activities based on the many natural and cultural elements consistent with the ACE Basin.
- Create an "address" by developing visitor receptive and educational facilities that establish Colleton County as the "gateway" to the ACE Basin.
- Provide host facilities and a focal point for organizing a volunteer-based "Friends" group.

Additionally, the complex is expected to enhance service-based economic development activities and encourage the growth of small businesses. As the first true visitor destination within the ACE Basin, the complex is expected to attract a plethora of visitors and provide attendant consumer demand needed to stimulate entrepreneurial activity within the region.

NEXT SECTION: Regulations

Author

M. McKenzie, SCDNR Marine Resources Division

W. McMillan, SCDNR Marine Resources Division

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

MENU
Colleton County
City of Walterboro
Beaufort County
Charleston County

General Introduction | Cultural Resources | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perceptions | Image Atlas | Bibliography | Glossary | About This CD-ROM | Site Map | Search

Land Use Module
County Land Use Plans

Colleton County


New construction on Edisto Beach

The Current Plan

As the County Council had not put in place a comprehensive plan or regulatory ordinances by the required date, the state granted an extension to allow the current plans and ordinances to remain in effect for a limited period. The current land use plan for the county is implemented through the Development Standards Ordinance codified and reprinted in September 1988, and revised and reprinted in March 1993. The stated objectives of the ordinance were:

- To improve land values through good and responsible development of Colleton County.
- To help implement the recommendations of the county's Land Use and Development Plan.
- To conserve and insure access to the county's natural and scenic resources for future generations to enjoy.
- To secure safety from floods and other hazards.
- To enhance the development process and improve the siting of new development in Colleton County.
- To protect and conserve the character of existing neighborhoods and subdivisions.

The county was divided into four development districts: an Urban Development District, Neighborhood Conservation Districts, a Resource Conservation District, and a Control Free District.

The Urban Development District was intended to accommodate most of the projected growth in the unincorporated areas of the county to the year 2000. The District is a large area east of Interstate 95 on either side of US Highway 17A to the Dorchester County boundary and includes Walterboro and Cottageville. It was anticipated that it would have most public facilities and infrastructure such as schools, sewers, water, and highways. It was intended to provide the regulations and the capital improvements to attract development, generally of a suburban character, with a full range of residential uses as well as commercial, institutional, and industrial uses. The ordinance did not attempt to segregate land uses, but anticipated the likelihood and desirability of mixed uses, with performance and development standards to minimize or buffer potential nuisances and conflicts. Dimensional requirements -- minimum site and lot areas, minimum yard and building setbacks, maximum impervious surface ratios, common open space requirements, and maximum height of buildings -- were specified and given for all uses except for agricultural land, expansions of non-residential uses of less than 60%, and outdoor advertising signs.

Neighborhood Conservation Districts were intended to preserve and protect existing neighborhoods. The ordinance provided for in-filling and expansion of “like development” consistent with the character of the neighborhoods. Permitted uses were single-family detached dwellings, but not mobile homes; horticulture and agriculture, but not including the keeping or raising of poultry or livestock; and family day care and home-based occupations. These districts had to be initiated by the majority of the property owners through a petition to the Joint Planning Commission for designation. As of 1999, no neighborhood conservation districts have been so designated.

The Resource Conservation District was intended to protect from misuse and to insure for future generations the county’s environmentally sensitive wetlands, marshes, beaches, sand dunes, rivers, creeks, and other natural resources critical to the ecosystems they support. The aim was not to stop development “but to better fuse it” into environmentally sensitive areas. The District covered the southeastern third of the county beyond US Highway 17. The ordinance permitted a wide range of uses, albeit with higher standards of performance and development than for other parts of the county. Marinas and shoreline projects, residential resort complexes, and trailer and recreational vehicle parks were permissible subject to a public hearing.

The remainder of the county was designated as a *Control Free District*. As little in the way of development pressure was anticipated, all proposed development and land use was exempt from the requirements of the ordinance.

The main means of ensuring compatible development were through the establishment of buffer yards, special regulations for certain potentially incompatible and temporary uses, requirements for off-street parking, site analysis, and road design and construction.

The Task Force Recommended Plan

The process of preparing a new planning framework for Colleton County began with a community visioning process initiated by the ACE Basin Economic Forum. This was an initiative sponsored by the Colleton County Resource & Development Board, the Walterboro-Colleton Chamber of Commerce, the Colleton County Council, and The Nature Conservancy. Its purpose was to devise an action agenda for economic development for Colleton County that would be compatible with the conservation of the ACE Basin ecosystems. The agenda published in the Forum’s report *Healthy Economy, Healthy Environment* in July 1996, comprised three strategies:

- Creating a framework for responsible growth.
- Enhancing the awareness, understanding, and appreciation of the ACE Basin.
- Promoting environmentally compatible business development.

A Colleton County Land Use Planning Task Force was established in June 1995 and charged with devising a comprehensive land use plan for Colleton County, and to do so in ways which sought the active involvement of the community. Initially, it was set up as an *ad hoc* group of the ACE Basin Economic Forum, under the chairmanship of a local developer known for his interest in environmentally sensitive housing projects. It initially comprised 13 people representing a range of perspectives in the community — business owners, farmers, foresters, lawyers, developers, teachers, government officials, and citizens.

Subsequently, when the group was constituted as a sub-committee of the Colleton Area Joint Planning Advisory Commission, the membership expanded to 21 people.

An outside facilitator and consultant was hired to guide the community-based process. The process included interviews with key players in the county, a series of public meetings in different parts of the county, a program of information gathering and research, and the distribution of newsletters. From the outset, the local press was very supportive of the need for effective planning.

From the public meetings, it was clear that few people were familiar with land use planning. There was much concern about additional government in their lives, and particularly about being told what they can and cannot do with their own land. Yet, at the same time, there was anxiety about changes that were happening around them and which they felt powerless to influence. The public saw threats to their quality of life from new development (and from new taxes to pay the costs of this development), increasing traffic, and a lack of concern for the natural environment. They were anxious about the lack of job opportunities in the county and the continuing pressure of poverty on many families.

The Task Force, having looked at the available information on what is happening and what is likely to happen to the county in the coming 20 years, saw some major challenges ahead. These included a significant growth in population and a consequent change in the county's rural character. The Task Force foresaw farmland and forests eaten away by scattered developments of mobile homes, commercial and retail outlets, and "the trashing of roadsides as we build."

In March 1997, a draft land use plan was submitted to the Colleton Area Joint Planning Advisory Commission. The report set out the critical issues for the County:

- coping with population growth;
- protecting what makes Colleton a special place;
- upholding property rights while maximizing public benefit;
- tackling poverty and creating more jobs;
- balancing development pressures;
- building adequate infrastructure;
- demanding better quality development;
- providing affordable homes;
- capitalizing on the strengths of the forestry industry;
- supporting farming as away of life;
- conserving the county's unique environment;
- recognizing sustainable development as a necessary goal;
- safeguarding the county's history and culture; and
- improving the planning system.

The plan itself was concise and to the point. All new development, wherever located in the county, would be expected to comply with a set of zoning regulations relating to design, density, and layout. The objectives were to improve the quality of development, minimize the loss of farmland and forestland, discourage sprawl, provide better affordable housing, safeguard wetlands, and protect historic and cultural resources. Implementation was to be through the application of performance standards, differing in their scope and severity according to district. The aim was to provide a degree of flexibility for landowners and developers in terms of land use, but to make clear the standards that have to be met or exceeded before a use is changed or intensified or a development is permitted.

These standards would seek to:

- Improve development quality through controls over size, height, and density of buildings and structures.
- Protect the beauty of the county's rural highways, and minimize intrusion on neighboring properties through landscaping and buffers, and preservation of existing trees.
- Reduce sprawl and improve public safety through limitations on curb cuts.
- Provide for open space and, where appropriate, off-street parking.
- Govern the development of land and the construction of buildings within the 100-year floodplain as defined by the Federal Emergency Management Agency.

It was expected that there would be higher development densities in areas served by public water and sewer, and lower densities in areas dependent upon individual wells and septic tanks. It was also intended that future densities would broadly reflect current patterns of development.

Three types of zoning districts reflected different futures in terms of scale and intensity of development over the planning period: Growth and Community Development Districts, Rural Community Districts, and Rural Character Districts.

Growth and Community Development Districts
These occur where the majority of the county's anticipated growth was to be concentrated. Within the boundaries of these districts, there would be a range of urban and suburban densities and land uses —residential, commercial, institutional, and recreational. There would be no minimum lot size for residential development where there are connections to public water and sewer.

The Walterboro District - centered on the City of Walterboro and extending out to a radius of approximately three to four miles, would take full advantage of access to, and available capacity of, the city's water and sewer systems. Within the district there would be detailed land use zones patterned after and compatible with the City's zoning ordinances.

The Cottageville District - centered on the Town of Cottageville, and extended out to a radius of approximately two to three miles, primarily to the north of US highway 17A. As there is no public water or sewer, the South Carolina Department of Health and Environmental Control's minimum lot size of 30,000 square feet would determine densities within the district.

The Edisto Island District - is the unincorporated area within Colleton County adjacent to the Town of Edisto Beach. Growth potential is limited by the capacity of the town's sewer system and by the need to create an appropriate and attractive entranceway to the town.

Rural Community Districts
These were to be those established community settlements that function as cultural, historical, social, or economic focal points for their immediate surrounding area. They included the incorporated towns of Lodge, Smoaks, and Williams, and the unincorporated settlements of Bennetts Point, Canadys, Green Pond, Jacksonboro, Hendersonville, Jonesville, and Ruffin (See map of towns and settlements). They were expected to remain predominantly residential in character. Some of the districts have public water, although none have public sewer service and were deemed suitable only for limited expansion of compatible, low-density, rural uses. The extent of development would be determined in each case in consultation with the local jurisdiction and/or local residents, but not expected to extend beyond a half-mile radius of the community's center.

Rural Character Districts

Sea island agriculture - tomato fields in Edisto Island

These were to be all the remaining areas of the county neither designated as Growth and Community Development Districts or Rural Community Districts. They were to be areas of predominantly forestry and farming uses, compatible natural resource-based industries, nature-based recreation and tourism, and very low-density residential and small-scale commercial development. The emphasis was on safeguarding the rural and natural character of the county, and providing the conditions to allow sustainable forestry and farming to flourish. Very little development was anticipated in these districts.

Overall gross residential density within the Rural Character Districts was to be a maximum of one unit per three acres. Encouragement would be given to the clustering of development on any given tract to preserve natural features, such as trees, waterways, and wetlands, up to a minimum lot size as required for the provision of water and sewer. Consideration would be given to higher densities as an incentive to achieve a goal of fifty percent (50%) open space within a development. The intention was to maintain the rural character while enabling landowners and developers the flexibility to derive an economic value from their land.

Overlay Zones

In addition, the plan provided for higher levels of performance standards for development within two types of areas, known as “overlay zones.”

Salt marsh habitat

*Environmentally Sensitive Areas***.** The Army Corps of Engineers and the South Carolina Office of Ocean and Coastal Resource Management already control development of any wetland within the county. The only additional standards to be added related to areas within 100 feet of the edge of any navigable waterway as defined by the Army Corps of Engineers. Any development within these areas had to be clearly environmentally compatible, provide buffer strips, and limit clearance of natural vegetation.

Highway Corridors - The efficiency and appearance of the main highway corridors are crucial to realizing the economic and tourism potential of the county. They were to be the focus of higher performance standards relating to curb cuts, set backs, screening, landscaping, and size and location of billboards and signs. The highway corridors were Interstate 95 and its intersections within the county, US highways 15, 17, 17A, and 21; SC highways 61, 63, 64, and 303; and County route 26.

Specific Standards
For historic sites and buildings, mobile home parks, and junkyards, specific standards were to apply.

Historic sites and buildings**.** - All changes of use or new development which adversely impacted on the integrity of historic sites and buildings, as listed or approved for listing in the National Register of Historic Places, were to be subject to review by a newly constituted Advisory Committee for Architectural and Environmental Review.

Mobile home parks - The siting of individual mobile homes, or the creation or extension of mobile home parks, would have to comply with specific standards governing foundations, tie downs, skirting, water supply and waste disposal, location, steps and entrances, parking, roadways, lot size, density, and landscaping.

Junkyards - All junkyards would be subject to standards governing access, screening, buffers, and compliance with all federal, state, and local public health and safety codes.

Outcome

The Colleton Area Joint Planning Advisory Commission was not prepared to accept the Task Force's recommendations. A range of concerns were raised by Commission members and by people who attended their public meetings. These included the perceived infringement of property rights, a dislike of density restrictions, an unwillingness to put constraints on commercial development, and an unwillingness to accept development restrictions on wetlands or river banks. The Commission submitted an amended version of the plan to the County Council who rejected it for being incomplete.

Subsequently, a firm of land use consultants has been hired to revise and expand the current Development Standards Ordinance and to finalize the comprehensive plan. This time the Planning Commission has been deeply involved in the process and there is a possibility that they will be in a position to submit a draft plan and ordinances to the County Council in summer 1999. It is understood that the outcome will be a blend of the original plan and the Task Force recommendations. Some of the terminology used in the original plan will be retained — urban development districts and resource conservation districts — and a new category, rural development districts will be created. The Control Free Districts will disappear. It seems likely that the resource conservation district area will be expanded, affording a greater measure of protection for the ACE Basin.

City of Walterboro

During the protracted process for the Colleton County land use plans, the Colleton Area Joint Planning Advisory Commission dissolved and was replaced by separate Planning Commissions for the County and for the City of Walterboro. With clear direction from the City Council, the preparation of the Walterboro Comprehensive Plan proved to be far less controversial and was adopted in December 1997. The plan addressed policy areas such as residential

Downtown Walterboro

development and redevelopment opportunities, commercial and economic development opportunities, design standards and themes, capital facilities planning, historic preservation, and annexation. Ordinance revisions were approved during 1998.

Back to Top

Beaufort County

Beaufort County began the process of revising its Comprehensive Plan in July 1995. It embarked upon an ambitious public consultation effort over a period of 18 months. Public meetings were held in each of five planning areas within the county, backed by intensive use of print and broadcast media, and a written survey of 22,000 households. The number one issue was a concern about water quality and the impact that rapid development (3,000 newcomers every year) was having on shellfish. An important finding was that the county is becoming increasingly environmentally aware, although there are clear divisions between large landowners who tend to be against planning and environmental controls, and the generally pro-environment newcomers.

The Comprehensive Plan was approved and adopted in December 1997. Its goals are to:

· *Preserve the natural beauty of Beaufort County*. Examples of actions include: requiring a vegetative buffer along all waterways and tidal wetlands, promoting a public/private partnership to develop Special Area Management Plans for Port Royal and St. Helena Sounds, and developing county-wide standards that improve the quality of stormwater runoff to pre-development levels.

· *Create new industries and jobs to keep the economy strong*. Sample initiatives include: preserving and enhancing tourism, recruiting aggressively high technology and clean industries, creating a small business incubator program, and expanding partnerships with the school districts, private businesses, technical colleges, and USC-Beaufort to upgrade workforce skills.

· *Build better roads and encourage two-wheeled and two-footed traffic*. The county intends to build bikeways and pedestrian walkways into future road plans, as well as develop sufficient long-term highway capacity during peak tourism seasons.

· *Preserve Beaufort County's cultural heritage*. Potential actions include: enforcing the county archaeological and historic impact assessment ordinance, maintaining the historic character of the Beaufort National Historic Landmark District, and establishing a special Cultural Protection Overlay District on St. Helena Island.

· *Create parks and preserve open spaces*. The Plan recommends these and other actions: preserving greenway-natural areas that follow rivers, streams, highlands, etc., establishing a nature center centrally located in the ACE Basin, and expanding the local recreational park system.

· *Permit development while maintaining Beaufort County's sense of place*. The future land use plan seeks to achieve five specific goals: (1) keep rural and developing areas in the county separate; (2) protect the character and quality of existing communities and ensure that new developments share the characteristics and quality unique to Beaufort County; (3) foster smart economic development; (4) manage the cost of growth to the taxpayers by directly linking infrastructure to new development; and (5) understand the limits of growth, such as soil quality, wetlands and coastal geography, and the presence of military installations.

· *Ensure affordable housing for all Beaufort Residents*. Proposed actions include: creating a community-wide consensus on the importance of developing affordable housing, encouraging the construction of affordable housing through incentive programs; and fostering a variety of affordable housing opportunities near job centers and community facilities.

· *Provide public services without breaking the bank*. The plan identifies a series of specific actions, regarding water supply and wastewater treatment, solid waste management, public safety, and educational facilities. In addition, it seeks to encourage growth in areas that already have proper public services.

The County Council approved the accompanying zoning ordinance in April 1999. The emphasis is on performance-based zoning where the onus is on the developer to show how the proposed development takes into account the site's natural features and preserves significant proportions of open space. In addition, there are river protection provisions for every river in the county that require set backs of 50 feet for residential development, 100 feet for commercial uses, and 150 feet for industrial development.

Throughout the process, the planning and zoning ordinances have been the object of intense opposition from homebuilders' groups, "takings" advocates, the Farm Bureau, and particularly from large property owners. Indeed, some landowners are exploring the possibility of taking their land out of reach of the new planning regulations through securing their annexation by municipalities not covered by the county plan. One such move by the Union Camp Corporation has transformed the town of Bluffton overnight into the fifth largest municipality by area in South Carolina (1.82 square kilometers, 0.7 square miles).

Back to Top

Charleston County

The process began in February 1997 when the County Council appointed a group of citizens to assist the County Planning Board and the County Planning Department with the preparation of the Comprehensive Plan. The group, known as the Joint Planning Policy Committee, comprised 25 people representative of the different communities and various interests in the county. They were assisted in their work by a firm of Philadelphia planning consultants, Wallace, Roberts, and Todd. Stakeholder interviews with community leaders, citizens, agency officials, business owners, and landowners, and two sets of public meetings were held to obtain input on goals, objectives, issues and trends, and to plan alternatives. The County Council adopted the County of Charleston Comprehensive Plan in April 1999, and it is anticipated that zoning ordinances will be adopted by October 1999.

The plan is based on the recognition that a balance needs to be maintained between fostering growth and development and preserving the county's natural and cultural resources. In particular, the plan embraces the vision of Thomas Heyward, Jr., a Charleston signer of the Declaration of Independence who said, "Agriculture is the parent of commerce; and both together form the great sources from which the wants of individuals are supplied." In addition, the plan notes that the county's recreational activities, quality of life, and tourist attractions are derived from the beaches, waterways, scenic beauty, historic preservation, and abundant natural resources. "These should be preserved for future generations."

The plan's twin themes are to encourage economic growth, while protecting agriculture and rural character from the effects of sprawl. It describes itself as a "call to action" identifying planning actions that will:

- discourage sprawl;
- encourage growth within designated urban and suburban areas where it can be efficiently provided with public facilities and services;
- encourage land uses and development densities within the rural and agricultural areas of the county that are compatible with the community's agricultural preservation and resource management goals;
- implement development regulations aimed at preserving and enhancing community character;
- encourage compact development and mixed uses;
- apply appropriate consistent development regulations;
- implement workable farmland and forest land protection techniques;
- implement innovative land development regulations and incentives to achieve quality design in future development;
- seek ways to reduce the costs of providing public facilities and services;
- accomplish regional intergovernmental coordination; and
- promote public-private partnerships that will help to accomplish economic development goals as well as resource protection and preservation goals.

The land use plan proposes four distinct areas defined by generally concentric rings of declining population and density out from the City of Charleston: the Urban area, the Suburban area, the Rural Landscape/Rural area, and the Rural Landscape/Agricultural area.

The planning process raised a number of land use issues for Edisto Island, which have direct relevance to the future of the ACE Basin, and which were recognized in the adopted plan. These can be summarized as follows:

Preservation of Rural Character. There was an overwhelming desire by local people to protect the island's rural character from the threat of tourism development at Edisto Beach.

Water Supply and Wastewater Treatment. Any extension of supply and services was opposed as this would encourage higher density development out of character with the island's rural setting.

Waterfront Protection. The local community wanted to severely restrict the erection of docks, gazebos, and homes on the waterfront and to prohibit any new marinas, as these were seen as a major threat to the scenic character of the shoreline.

Preservation of Historic and Architectural Resources. Although Edisto Island has more recognized and documented historic and archaeological sites than any other planning area in the county, there is no plan or ordinance in place to protect these resources.

Farmland Preservation. With 300 years of farming history, there was a strong interest in taking action through land use regulation and incentives to preserve farmland.

Preservation of Scenic and Historic Rural Roadways. The use of buffers, tree preservation standards, and signage standards were seen as essential to protect the rural character of scenic and historic roadways on the island.

Family Lands. The preservation of farmland had to be balanced by the ability of farmers to subdivide their properties to create lots for family members, thus maintaining cultural patterns considered critical to the rural heritage.

Use of Rural/Scenic Roads to Serve Existing and New Development. Rural character might be preserved if new low density developments incorporated rural/scenic roads, albeit to county standards.

Back to Land Use Module

Zoning Ordinances

Non-Regulatory Zoning Tools

Development Standards and Controls

Recreational Facilities, Open Space and Protected Lands

Board of Architectural Review

Land Development Regulations

References

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Land Use Module

Planning and Zoning Tools

Zoning Ordinances

- Overlay Zoning
- Planned Unit Development
- Performance Zoning
- Agricultural Zoning

Newly constructed homes on Edisto Beach

Zoning regulations are tools that govern how land can be used in a community. The Comprehensive Planning Enabling Act requires that a zoning ordinance should be the primary tool for carrying out a land use plan. Generally, any agreeable and well-documented plan is enough to uphold the legality of a zoning ordinance. For instance, if landowners want to use their land for purposes that conflict with a local zoning ordinance, they can apply for a special-use permit or a rezoning. Each case is reviewed by the zoning board and then ruled upon by elected officials. In another example, if a landowner feels that the adopted zoning plan is causing undue hardship, the owner may apply for a variance. This particular permit provides the owner with an outright exemption from the specified zoning requirements. Finally, zoning ordinances can also be rendered ineffective if not properly enforced.

While each county's comprehensive land use plan is different and unique and reflects a community's vision and goals, the zoning regulations used to enforce land use controls also vary for each county and municipality. For instance, Edisto Beach is divided into ten different zoning districts, with specific regulations that apply to each district. Examples include the low-density residential district and the multifamily residential district. The low-density residential district provides for low-density, single family neighborhoods, and the multifamily residential district provides for medium and high density residential neighborhoods on the town's sanitary sewer system.

In addition to standard zoning regulations, there are also specific ordinances and tools used to enforce land use controls. Some specific examples of these tools are given below and include overlay zoning, performance zoning, planned unit development, agriculture zoning, purchase of development rights, and transfer of development rights. The examples were cited specifically from county land use plans and zoning ordinances. A zoning ordinance usually comprises a text and a map. The text includes the regulations and permitted uses that will apply in each zoning district, together with the requirements and procedures governing administration, enforcement, and future amendments to the text and map. The role of the map is to set out graphically the location and boundaries of the zoning districts. Within each zoning district, the ordinance may regulate:

- The use of buildings, structures, and land.
- The size, location, height, bulk, and orientation of buildings, structures, and signage.
- The density of development, use, and occupancy of buildings, structures, and land.
- The areas and dimensions of land, water, and air space to be occupied by buildings and structures, and the size of yards, courts, and other open spaces.
- The amount of off-street parking and loading to be provided, and restrictions related to entry or use of motor vehicles on the land.
- Other aspects of the site plan such as tree preservation, landscaping, buffers, lighting, and curb cuts.

Overlay Zoning

These are not separate zoning districts but identify areas where supplemental regulations apply. Examples of their application include flood plains, conservation areas, highway corridors, and sign regulation. Overlay zoning takes conventional zoning a step further by restricting development in environmentally important areas identified in a master plan. Generally, it is necessary to establish priorities for protection with an inventory of the natural and cultural features of the community before the local planners can map out the areas that require additional protection. Overlay zones don't change the underlying zoning, but they may add additional protections for resources such as stream corridors, prime agriculture land, ridgelines, wetlands, wildlife habitats, large areas of mature forests, historically significant areas, scenic road corridors, trail corridors, buffers to parkland, or whatever else the community has determined is worthy of preservation (Arendt and Brabec 1994).

While no specific ordinances have yet been adopted, Colleton County's Draft Comprehensive Land Use plan recommends establishing overlay zones to identify where supplemental regulations apply. Two types of overlay zones recommended in the draft plan include environmentally sensitive areas and highway corridors. The plan suggests additional standards for areas within 100 feet of the edge of any navigable waterway as defined by the Army Corps of Engineers. Such standards include ensuring environmentally compatible development, providing buffer strips, and limiting clearance of natural vegetation. Additional standards suggested for highway corridors include set backs, vegetative screening, landscaping, and size and location of billboards and signs.

Beaufort County has established a River Protection Overlay District designated to protect the quality of water by requiring more open space and a head waters buffer to filter runoff. According to their zoning ordinance, "the standards of this district are intended to reward more intensive clustering and the protection of the maritime buffer through slightly higher densities than the general underlying district would provide."

Planned Unit Development

Planned unit development focuses on infrastructure reduction and allows compatible commercial development to be included in the overall development plan. The planning commission is continually involved in recommending alternatives from conventional zoning in order to offer a broader range of design and construction options (Arendt and Brabec 1994).

A Planned Unit Development (PUD) District has been established for the town of Edisto Beach. According to the Town of Edisto Beach 1998 zoning regulations, “The purpose of the PUD planned unit development district is to permit development for specialized purposes where tracts suitable in location, area, and character are to be planned and developed on a unified basis. Suitability of tracts for the development proposed shall be determined primarily by reference to the land use plan, but due consideration shall be given to the existing and prospective character of surrounding development.”

Performance Zoning

This zoning specifies a minimum requirement or maximum limit on the effects of a land use, rather than specifying the use itself. The intention is to assure that the development is compatible with its neighbors and increases a developer’s flexibility. Also known as impact zoning, performance zoning provides protection for specific natural resources that are not explicitly safeguarded under existing land-use regulations. It evaluates prospective developments based upon their projected impact on the local region. The zoning ordinance has to specify detailed standards. In some instances, performance zoning ordinances provide greater flexibility for developers than traditional zoning measures, since they are not told how to draft their site plan but rather what particular performance standards they must meet. Local governments can deny a developers' application if he does not appropriately address the potential harmful impacts of his design. Performance zoning can be very costly for local governments, however, as it requires more time and greater expertise to develop and administer than other zoning regulations (Arendt and Brabec 1994). The Draft Colleton County Land Use Plan recognizes performance zoning as a potentially relevant zoning technique for Colleton County (Colleton County Land Use Task Force 1997).

Beaufort County’s draft zoning ordinances establish basic performance standards to protect natural resources. Developments are required to conduct a carrying capacity analysis which regulates the maximum intensity based on actual site conditions. Some of these ordinances include standards for tidal wetlands, non-tidal wetlands, beach-dune, headwaters, rivers, forests, trees, endangered species, and flood hazard areas.

Agricultural Zoning

Agricultural zoning is used to separate farms from conflicting land uses such as commercial and residential development. This can be an effective technique in protecting farmland in areas with intense development. It is most effective when implemented before non-farm development moves into the area (Thompson 1997).

According to Charleston County's Draft Comprehensive Land Use Plan, Edisto Island is designated an agriculture area, meaning that the permitted land uses within this area include those that support the preservation of farming and forestry. The plan identifies agriculture zoning as a recommended tool for limiting the development of farmland.

Back to Top

Non-Regulatory Zoning Tools

Purchase of Development Rights

Purchase of Development Rights (PDR) is a non-regulatory incentive program whereby a government agency or private conservation organization purchases the development rights to a piece of land. PDR programs have been used throughout the United States since the early 1970s to preserve farm and forest lands and open space. PDR programs have become very popular and widely used as forty-six states, including South Carolina, have passed legislation allowing local governments to acquire development rights to private property.

A PDR program was suggested in the Charleston County Comprehensive Plan as one of five principal features of the Farm and Forest Land Protection Program. Similarly, Beaufort County's Draft Land Use Plan suggests setting aside a certain amount of money each year for a PDR program targeted for rural land.

Transfer of Development Rights

Transfer of Development Rights is another voluntary technique recommended in the Charleston County Comprehensive Plan. The purpose of the TDR Program is to contribute to the preservation of farm and forest land and open space through the transfer of development rights from farm and forest land to other areas more suitable for development within the same geographical areas. This program allows landowners to transfer the right to develop one parcel of land to a different parcel of land.

Cluster Development

This allows residential, commercial, or industrial uses to be grouped within a subdivision or development site in ways which preserve open space, improve aesthetics, and allow flexibility in development densities, layout, and road construction, which may not be possible under conventional zoning regulations.

Conditional Uses

These are permitted uses that have to meet certain conditions, restrictions, or limitations to minimize their adverse impact on an adjacent district.

Back to Top

Development Standards and Controls

In addition to zoning, counties and municipalities may also enact ordinances for special development standards. These ordinances are usually designed to reflect the community's goals and visions for the future of their county or municipality. These ordinances may include specifications for signage, landscaping, buffers, trees, roads, etc.

Specific examples can be cited from Beaufort County's Ordinance. Division 04.300 of Beaufort County's ordinance provides standards for bufferyards between uses and districts and for special purposes. As stated in the ordinances, the purpose of bufferyards is to "ameliorate nuisances between certain adjacent zoning districts or land uses."

Another example is the Edisto Beach Code of Ordinances which provides regulations for signs. Under this regulation, a permit is required for the "erection, alteration or reconstruction of any sign....". Also contained under this ordinance, are specific provisions for prohibited signs. Some examples of prohibited signs include, "Signs painted on or attached to trees, fence posts, telephone or utility poles, or signs painted on or attached to rocks or any other natural features" or "Signs in salt marsh areas or on land subject to periodic inundation by tidal salt water."

Back to Top

Recreational Facilities, Open Space and Protected Lands

Each county or municipality's land use plan also specifies the communities' desires and goals for preserving open space or developing land for recreational use. Below are specific examples taken from the respective land use plans that describe current trends and future visions for recreational opportunities.

Edisto Beach

Edisto Beach State Park serves as a very unique open-space asset for the town of Edisto Beach. Located at the east end of the island, and extending north of the town's limits onto Edisto Island, the 1,255 acre park offers camping and day recreational activities on both the beach and the marsh as well as in interior areas (Wood 1996).

Day picnic area at Edisto Beach State Park

The six mile undivided stretch of beach is Edisto Beach's most significant resource which serves as a public space for recreational use. The Town of Edisto Beach currently maintains 38 public beach accesses, and the town's land use plan recommends promoting and improving beach access. Additionally, the plan recommends pursuing the acquisition of land for public beach facilities such as showers and bathrooms. The town does discourage any disconnection of the beach strand, and has enacted a Beach Management Overlay Zoning District. This special zoning ordinance requires any structure built seaward of the setback line to be permitted by OCRM, and thus, allows for public input if a fence or other dividing structure was attempted.

Presently, Edisto Beach has no town park, green, or other community gathering space. The town's land use plan recommends using lands adjacent to the municipal complex for a town "center". The Edisto Beach Comprehensive Plan even includes a site plan for such a community space with areas for playing, relaxing, and gathering.

Charleston County

Although no county park currently exists on Edisto Island, in 1994 Charleston County Park and Recreation Commission acquired 265 acres on Pine Landing Road on Edisto Island as a site for a future county park.

Beaufort County

Besides Hunting Island State Park, the portion of Beaufort County located in the Characterization study area includes very little managed parkland. In addition, the Hunting Island State Park offers the only public beach access in the northern part of Beaufort County. Beaufort County has conservation rights on 1700 acres and its comprehensive draft plan includes provisions for transferring development rights which is intended to protect 40,000 acres of rural greenspace from future development.

Aerial photograph of Hunting Island, SC

Colleton County

According to Colleton County's Draft Land Use Plan, few recreational facilities are available in the rural areas of the county. Besides a large county recreational complex in the industrial park in Walterboro, parks and playgrounds are limited to school facilities.

Back to Top

Board of Architectural Review

The Comprehensive Planning Enabling Act allows the local government to create a board of architectural review or similar body in the zoning ordinance. Its purpose can be the preservation and protection of historic and architecturally valuable districts and neighborhoods, natural scenic areas, and other areas of special character.

Back to Top

Land Development Regulations

Land development is defined as a change in land characteristics through redevelopment; construction; subdivision into parcels, condominium and apartment complexes, commercial and industrial parks, shopping centers, mobile home parks, and other similar developments. Land development regulations require “harmonious, orderly, and progressive land development to promote the public health, safety, economy, good order, appearance, convenience, and general welfare.” They may include requirements for:

- Coordinating street improvements with existing or planned streets.
- Installing the development water system or wells.
- Installing the development sewer system or septic tanks.
- Ensuring population and traffic is distributed in the interest of health, safety, convenience, appearance, prosperity, or the general welfare.
- Requiring dedication of land for streets, schools, recreation, utility easements, and public services and facilities.
- Regulations for building on sites subject to flooding.

Back to Land Use Module

References

Colleton County Land Use Planning Task Force. 1997. Report to the Colleton Area Joint Planning Advisory Commission, Draft Colleton County Land Use Plan.

Arendt, R. and E.A. Brabec. 1994. Rural by design: maintaining small town character. American Planning Association, Planning Press, Chicago, IL.

Thompson, M. 1997. A forested tract-size profile of South Carolina's NIPF Landowners. Southern Research Station, Asheville, NC.

Wood, L. (ed). 1996. Edisto Beach Comprehensive Plan. Town of Edisto Beach, SC and Lowcountry Council of Governments. Town of Edisto Beach, SC.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Land Use Module

Stakeholders

Introduction

There is a diverse public perception of the value of ACE Basin resources. Many of the basin residents rely on traditional land uses for their livelihood and regard the land as home. Some focus on the economic possibilities of such a large natural area so close to rapidly growing coastal population centers. Others are interested in recreational opportunities, retreats from city bustle, and country homes, while some see the area as one of the few remaining large natural regions along the east coast which must be preserved. There are as many unique views of the area's value as there are individuals who have pondered its future. Education and economic status play a major role in forming these views. Each perspective may be biased due to differences in economic status as well as a shortage of information about the area's ecological, cultural and economic systems and interactions. The diversity of perceptions becomes an issue in planning the future of the area.

The process of formulating a comprehensive plan and for devising zoning ordinances that turn the plan into regulation have become the battleground for these diverse and often divergent public perceptions. To complicate matters, it is not always clear where the battle lines are drawn, for many participants have multiple and sometimes conflicting interests. The dilemma and affordable rural housing dilemma are two examples that arose from public discussion on planning issues in Colleton County. (See related section: Examples of Public Discussion on Planning Issues in Colleton County.)

Planning for Growth and Development

There are many other examples of potential conflicts that can emerge during a planning process. County residents, particularly those who would like improved employment opportunities, tend to support growth and are prepared to accept a trade-off, such as reduced amenity or a loss of open space to attract a commercial or industrial prospect. Recognizing this, county officials are reluctant to impose conditions that might deter new investment or to enter into negotiations that might lead to higher development standards. Some expressed concern that the publicity being given to the ACE Basin might attract attention from the Environmental Protection Agency who would in turn impose stricter controls over production processes and thus limit the attractiveness of the County to development. In many ways this represents a view of development that has been overtaken in recent years. More and more areas are concerning themselves with the quality and pace of development – smart growth – and are less willing to accept that development and environment are incompatible. Indeed, quality of life and a pristine environment are becoming powerful factors for business recruitment as more companies link these to their ability to attract and retain high quality workers.

The ACE Basin, with nearly 300 species of birds, is a popular spot for birdwatchers

The possibility that tourism, based on the ACE Basin's attractions and the county's historical connections, may be an important economic generator has met with mixed reactions from different parts of the community. Those concerned with protecting the environment are enthusiastic about nature-based tourism that is educational and low-impact, but are not at all comfortable with large numbers of visitors that could place stresses on the environment or give rise to commercial pressures to provide tourism facilities and services. Hotel and restaurant owners, particularly those located close to the I-95 intersections, want increased traffic to fill rooms and seats. Their focus is on attracting business and vacation travelers driving to and from Florida and much less on creating facilities within Colleton County. Others such as farmers and local residents are concerned about the impact of traffic and perhaps of possible increases in crime resulting from more strangers in their county.

The provision of infrastructure is another contentious issue. Sound public investment policies require that new development is located where it can hook into water and sewer lines, and that line extensions should be made only where there is sufficient density of development to make an economic case. Cottageville in Colleton County provides a good example of the issues involved. Currently growth is spreading out (in the control free zone) from the core of Cottageville at low densities and the County is faced with a difficult choice. County officials can accept that dispersed development without public water and sewer in the Cottageville area is inevitable and that it should attempt to mitigate the impact through performance standards to raise the quality and appearance of new development. This is highly inefficient from a public services provision standpoint, and damaging to the rural character and farming economy of the county. Even so there will be strong property owner resistance to increased planning regulations in this area. Alternatively, the County can aim to build a community at Cottageville linked to public water and sewer, and backed by strong zoning ordinances that limit development to a three-mile radius and significantly increase densities within those limits. If done with some urgency, then the long-term community, environmental, and economic benefits could be considerable, but taxpayer resistance to the capital investment, and even greater opposition from surrounding property owners, prevented from realizing the value of their land through development, would be difficult to overcome.

It is the recognition that in any community there are multiple stakeholders with strong vested interests in the way land is used and regulated that has given rise to community-based vision framing and strategic planning across the country. The intention is to see whether it is possible to agree on a vision for the community to which most, if not all parties, can commit and to mobilize the stakeholders around implementation and action. It can be an important counterpoint to “business as usual” where long-established interests in the community, often bankers, lawyers, developers, and large property owners, dictate policy and politics. This was attempted in Colleton County through the ACE Basin Economic Forum and the land use planning process, but was unsuccessful in achieving consensus. Nevertheless, it did work in the neighboring counties of Beaufort and Charleston, and may yet in Colleton County.

Back to Top

The Role of the Public in Land Use Planning for Sustainable Growth and Development

Consensus among community members is an important part of the land use planning process, especially when the community must deal with issues of growth and development. These issues are complicated by a need to bring together various factions within a community in order to achieve consensus on the future of the area. One of the components of a “competent community” is that it be able to cope with changes or problems and that it “achieve a working consensus on goals and priorities” (Ayres and Potter 1989). It is important to obtain and maintain complementary views among residents of the community concerning the nature and level of development in order to achieve a consensus on growth issues (Cooke 1982, Murphy 1983, Liu et al. 1987, Ritchie 1988).

Achieving consensus can be difficult for several reasons. Various factions within a community may have different visions for the future which affect their views of growth and development. Business owners may see the positive economic benefits that can be gained from business expansion. Those residents who are not dependent on increased local economic development (e.g. retirees) may see increased growth and development as an impingement on their quality of life, as well as being socially and environmentally undesirable.

Growth and Development

The major benefit of growth is usually considered to be economic. Employment, better infrastructure, more recreational and shopping opportunities can all be benefits of economic development. However, negative impacts can also result from growth. The quality of life of residents can be negatively impacted due to increased crowding, traffic, and litter. Degradation of the environment and increased stress on infrastructure can also be negative impacts of growth. Therefore, sustainable development must be a priority of land use planning for any area in which growth is occurring. The control of growth and development must be a major goal for communities wishing to achieve a level of development that is economically profitable but also socially and environmentally acceptable (Martin et al. 1998).

Sustainable development commonly refers to “development which meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland 1987). The emphasis of sustainable development is on human needs rather than the trade-offs between economic and environmental systems. Sustainable development also has a political agenda, in that it is a process in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change should all be in harmony, and enhance both current and future potential to meet human needs and aspirations. The important thing to notice about this approach is that sustainable development is regarded as a policy objective, rather than a methodology (Redclift 1991). Thus, this view places the responsibility for problems and the political will to overcome them in the hands of the public.

Growth management plans are vital for sustainable development but public involvement is essential for plan development (Gill and Williams 1994). Growth management is a planning tool that is used to offer a guidance system to implement the vision that a community has of its desired growth. The goal of growth management is to enhance the benefits of growth while mitigating the consequences. Recognition that growth is a local concern is central to the concept. While there is no one set of appropriate techniques for growth management, land use planning in which various aspects of growth (rate, amount, type, location and quality) are used to enhance the positive and limit its negative impacts is the central component of a growth management approach. Other growth management tools include impact analyses (social impact analysis, environmental impact analysis, carrying capacity analysis) and regulatory systems (environmental controls, development right transfers, and zoning).

A local example of the growth management approach is the Wadmalaw Island Land Use Plan. Wadmalaw skirts the edge of the ACE Basin study area and provides an interesting example of citizen-based land use planning. In the late 1980s, a group of 18 citizens of Wadmalaw Island formed a committee to develop a land use plan, with the blessing of the Charleston County Council. Potential development by an Arizona-based company spurred interest of the residents in developing the plan. It was decided at the first meeting of the committee that there was a need for more than a plan that would be a guiding framework. In addition, the committee wanted any plan they developed to become an ordinance. Although first told that this was not possible, the plan did indeed become an ordinance and won a national award for excellence in community planning. Although the plan has recently been revised under the 1994 Comprehensive Planning Act, overwhelming support from residents who were interested in protecting their quality of life was instrumental in approval of the revised plan by Charleston County Council (Hay, L. pers. comm.).

Within the ACE Basin itself, a group of landowners, government officials, hunters and environmentalists began in 1987 to look for ways to conserve that area. The ACE Basin Focus Area Task Force was formed with a mission to conserve land primarily through private ownership. They sought to conserve property where traditional use could prosper, while also attracting nature-based tourism. In 1993, county leaders commissioned a study by the University of North Florida in which it was recommended that local leaders establish a strategic plan for Colleton County. In 1996, Colleton County established an economic plan after a year of discussions among 100 residents and other interested individuals (ACE Basin Economic Forum 1996). The plan had three priorities : to create a framework for responsible growth; to enhance the awareness, understanding and appreciation of the ACE Basin; and to promote appropriate development. However, residents have yet to develop a comprehensive growth management plan or a supportive ordinance for Colleton County. This is vital in order to insure environmentally appropriate development.

Obviously, once interested leaders of the community instigate the land use planning process, it is important to determine public opinion on the issues. Public hearings can be valuable at that point. Another method of involving the general public in the decision process is through surveys. An example of the benefit of resident surveys for development of growth management plans is the recent study of resident attitudes in the Greater Charleston Area (Martin et al. 1997). This study was a successful attempt to involve the public in development of a land use plan for the area. Ascertaining the views of the public in developing the Growth Management Plan for the Greater Charleston Harbor Area provided valuable information about resident attitudes toward various natural, social, and environmental resource issues. Residents' views of the importance of various scenic, cultural, and natural resources of the area aided in development of the plan.

It was found that residents were in favor of protecting wetlands and the habitat of shoreline nesting birds, even if it would incur a cost to themselves in terms of less access to these areas. They were in favor of development restrictions when necessary to protect wetlands and local fisheries. There was concern about the water quality of the harbor and surrounding rivers and creeks because it is important to these respondents that there be locally caught fish and shellfish that are safe for human consumption. In general, residents of the area did not think that the benefits of growth and development outweighed negative consequences to wetlands, water quality, and fisheries. They believed that growth should only be supported if it is done in an ecologically acceptable manner. Residents were supportive of tourism because of its contributions to the economy and wanted to see it continue as a major industry in the area. They were in favor of a growth management plan that would protect environmental resources while allowing for growth and development.

Consensus of Stakeholders

Development of a growth management plan through consensus of the various stakeholders within a community can help bring together those community members with conflicting views of growth. Since political and sociological differences among residents may make it difficult to reach a consensus on the future of any given community, the planning process is the time to bring together community members to discuss issues of importance to each of them. This process can help identify differences and assist in reaching collaborative agreements. It may be found that the basic disagreement is whether to support growth and development or not.

There is often a coalition within the community whose agenda is to promote growth (Molotch 1976). This coalition is usually made up of those who can benefit economically from promoting growth of the community. According to Logan and Molotch (1987), landholders dominate local government and seek to influence local political leaders to bring them around to the pro-growth point of view. Other members of the growth faction tend to be local businessmen, particularly property owners and investors in locally-based financial institutions. Those favoring growth also make a concerted effort to convince the general public that growth is important to their economic well being (Logan and Molotch 1987).

Government plays a dichotomous role in dealing with the growth issue. Government leaders generally believe that growth must be supported on the grounds that it increases job opportunities for residents and makes land more valuable. On the other hand, since it represents people in local neighborhoods, city government frequently finds itself playing an intermediary role in conflicts that arise when residents oppose particular development projects (Harrigan 1989).

Opposition to development by some residents may indicate an anti-growth movement. This usually occurs when it becomes obvious to residents that increased growth leads to negative effects such as traffic congestion, high levels of pollution, higher tax rates and a higher per capita cost of government. Localities that have imposed growth controls in the past tend to be places of “high amenity values” (Molotch 1976). A desire to protect the environment and the community from the negative effects of growth is generally the rationale of those opposed to growth and development.

Back to Land Use Module

References

ACE Basin Economic Forum. 1996. ACE Basin economic forum: healthy economy, healthy environment. An action agenda for compatible economic development. ACE Basin Economic Forum. Walterboro, SC.

Ayres, J. S. and H. R. Potter. 1989. Attitudes toward community change: A comparison between rural leaders and residents. Journal of the Community Development Society 20:1-18.

Brundtland, G. H. 1987. Our common future. The Brundtland Report, WCED.

Cooke, K. 1982. Guidelines for socially appropriate tourism development in British Columbia. Journal of Travel Research 21:22-28.

Gill, A. and P. Williams. 1994. Managing growth in mountain tourism communities. Tourism Management 15:212-220.

Harrigan, J.J. 1989. Political change in the metropolis. Scott Foresman and Company, Illinois.

Hay, L. pers. comm. Wadmalaw Island Land Use Planning Committee. 1999.

Liu, J. C., P. J. Sheldon and T. Var. 1987. Resident perception of the environmental impacts of tourism. Annals of Tourism Research 14: 17-37.

Logan, J. R. and H. L. Molotoch. 1987. Urban fortunes: the political economy of place. University of California Press, Berkley, CA.

Martin, B. S., F. A. McGuire, and L. A. Allen. 1998. Retirees' attitudes toward tourism: Implications for sustainable development. Tourism Analysis 3:43-51.

Martin, B.S., W. Hammitt, and A.G. Sheppard. 1997. Charleston Harbor project: Resident attitude study. South Carolina Department of Natural Resources.

Molotch, H. 1976. The city as a growth machine: Toward a political economy of place. American Journal of Sociology 82:309-331.

Murphy, P. E. 1983. Perceptions and attitudes of decision-making groups in tourism centers. Journal of Travel Research 21: 8-12.

Redclift, M. 1991. The multiple dimensions of sustainable development. Geography 76:36-42.

Ritchie, J. R. B. 1988. Consensus policy formation in tourism: measuring resident views via survey research. Tourism Management 9: 199-212.

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

MENU
History
Uplands
Forest
Agriculture
Wetlands
Wildlife
Access

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

Protected Lands

Donnelley Wildlife Management Area

History

The Donnelley Wildlife Management Area (WMA) is located east of Green Pond, South Carolina and includes 8,048 acres of wetland and upland habitats (Donnelley WMA). As part of the overall Ashepoo, Combahee, Edisto (ACE) Basin protection effort, a total of 9,155 acres was acquired in 1990 by Ducks Unlimited and other contributing partners consisting of the Nature Conservancy, the National Fish and Wildlife Foundation, and Dow Chemical. At this time, the property was named the Mary's Island Reserve. Subsequent to the purchase by Ducks Unlimited, a decision was made by the organization to retain the western half of the property, which contained the most extensive wetlands, and sell the rest with easements to conservationists. In 1992, Ducks Unlimited transferred operational and managerial functions of its portion of Mary's Island Reserve to the South Carolina Wildlife and Marine Resources Department (SCWMRD, now the South Carolina Department of Natural Resources [SCDNR]). Two tracts totaling approximately 1,000 acres were resold to private landowners subject to conservation easements held by Ducks Unlimited. Two additional tracts (an approximately 3,408-acre mitigation tract owned by U.S. Corps of Engineers and a 332-acre tract purchased by the National Wild Turkey Foundation and donated to SCWMRD) were combined with the Ducks Unlimited portion and named the Donnelley WMA. Management of Donnelley is focused on:

- Protecting and enhancing wetland and upland habitats for wildlife;
- Providing quality recreational opportunities, including hunting and wildlife observation
- Maintaining and restoring natural plant communities
- Providing a site for public education, research, and land management demonstration programs for waterfowl, upland game, non-game and endangered species

---

Uplands

Upland communities comprise most of the acreage at Donnelley. These include: natural pine forest (1,564 acres), pine-hardwood (917 acres), pine plantation (1,949 acres), upland hardwood forest (725 acres), and fields (270 acres).

Upland habitat at Donnelly Wildlife Management Area

The pine forest community is typically dominated by relatively mature stands of loblolly pine. Some portions are dominated by other pine species, including longleaf pine, shortleaf pine and slash pine that occur as monotypic stands or as a mixture of these species. Hardwoods occur sporadically in these pine communities. The pine plantation community, dominated by loblolly pine, comprises the largest portion of the upland area. It is managed for timber production.

The pine-hardwood forest is an intermediate community between the pine forest and upland hardwood types. Canopy trees that dominate this community are water oak, black gum, loblolly pine, and live oak. Understory species are laurel oak, sweet gum, bull bay, and dogwood. A spruce pine and mixed hardwood forest occurs on Donnelley and has been recognized as a unique community type. The upland hardwood community on Donnelley is characterized by high species diversity and structural complexity. The canopy is generally dominated by oaks, with willow oak, laurel oak, water oak, sweet gum, hickory, southern red oak, live oak, and black oak present. An understory and herbaceous layer is also present in this community. Several sites within Donnelley have unique examples of the upland hardwood forest. These include a mesic oak-hickory forest, southern mixed hardwood community, and a beech-magnolia forest. (see Plants: Upland Community .)

Back to Top

Forest Management

Forest management at Donnelley emphasizes maintenance of a forested landscape and improvement of wildlife habitat through proper timber management and harvesting techniques. Staff at Donnelley, with cooperation from the South Carolina Forestry Commission, have completed a comprehensive five-year forest management plan and a long-range plan is being developed. Prescribed harvests will meet or exceed current Best Management Practices (BMPs for the State of South Carolina and will emphasize wetland protection through establishment of 100 feet buffer zones around wetlands. Management techniques vary depending upon the community type; however, in bottomland hardwood, upland hardwood, and spruce pine-mixed hardwood, harvest occurs only for the purpose of improving wildlife habitat by the release of hard mast bearing trees. In the loblolly and longleaf pine communities, selective thinning will be used to achieve a canopy dominated by older age class trees. Prescribed burning is a technique that is used to control hardwood competition in pine stands and enhance production of desirable wildlife foods. Whitetail deer, wild turkey, bobwhite quail, and eastern bluebird are just a few of the species that benefit from annual burning in older age pine stands.

Back to Top

Agriculture

Agricultural land on Donnelley Wildlife Management Area

Donnelley maintains fields for both row crop agriculture and openings as food plots for wildlife. These sites provide fall and winter foods for seed-eating birds and are beneficial as supplemental food sources for other wildlife species. Openings are particularly important foraging sites for quail, turkey, deer, and songbirds. Field transition zones are also maintained parallel to forest edges, ditches, hedgerows, and roadsides to provide habitat for edge dwelling species. These zones are important feeding, nesting, and travel corridors for bobwhite quail, eastern wild turkey, rabbit, and passerine birds.

Back to Top

Wetlands

Wetlands at Donnelley encompass nearly 2,500 acres and are distributed throughout the property. Using the wetland classification system of Cowardin et al. (1979), the following wetland types have been delineated: palustrine emergent (1,164 acres), palustrine forested (327 acres), estuarine intertidal emergent (282 acres), palustrine scrub shrub (272 acres), and palustrine aquatic bed (99 acres).

Both managed freshwater wetlands and brackish /intermediate marsh types occur on Donnelley. Presently, Donnelley has 2,046 acres of managed wetlands with water control provided by 32 structures. Dikes and water control structures allow water control and circulation throughout the various impoundment units. Wetland management focuses on enhancing the diversity of naturally occurring wetland plant communities that provide food and cover for wetlands-dependent wildlife, such as migratory waterfowl and non-game and endangered species (e.g., bald eagle, wood stork, and American alligator). Management guidelines follow techniques described by Harrigal et al. (1993).

Freshwater impoundments are occupied by a diverse assemblage of rooted floating aquatics, such as white waterlily, American lotus, and pondweeds. Emergent plants such as cattails, southern wildrice, and pickerel weed are common. Submerged and free-floating aquatic plant

Aerial view of impoundments

species also occur and include duckweed, bladderwort, waterfern, and fernwort.

The managed brackish and intermediate emergent wetlands principally contain widgeongrass, saltmarsh bulrush, and dwarf spikerush. Estuarine emergent or brackish wetlands also occur along the Old Cheeha River and are subject to tidal fluctuations. Dominant plant species include giant cordgrass and black needlerush.

Forested wetlands occur along small, seasonally ephemeral drainages that meander throughout the uplands and along the two large drainage systems that traverse the property and empty into the Old Cheeha River. Overstory species vary with the moisture gradient, but some characteristic species include water tupelo, swamp tupelo, sweet bay, wax myrtle, water hickory, and live oak. Managed wetlands occur in the forested wetland ecosystem and include a dense stand of mature water and swamp tupelo that has been continuously flooded for a number of years.

Isolated freshwater wetlands, known as depression meadows, are scattered throughout the uplands. These are functionally coupled with the surrounding pine flatwoods and are characterized by emergent stands of maidencane, sedges, soft rush, and spike rush. Some of the larger depression meadows have low areas that are semi-permanently flooded.

Back to Top

Wildlife

Associated with the wetland and upland habitats on Donnelley are a diverse assemblage of terrestrial, aquatic and avian wildlife. Whitetail deer are the dominant large mammal, with a population estimated at 750 to 800 animals. Birds are particularly numerous, with approximately 172 species documented and as many as 250 species possibly occurring. The wetlands at Donnelley attract many species of waterfowl, wading birds, shorebirds, raptors, and songbirds. Managed wetlands are especially important as wintering and migration habitat for waterfowl. Wading birds use the wetlands on Donnelley for feeding, loafing, roosting, and nesting. These wetlands also provide important foraging habitat for the southern bald eagle on a year-round basis. The uplands also support a diverse avifauna that includes a variety of songbirds, raptors, and gamebirds. Agricultural fields provide forage for large numbers of doves.

A total of 44 species of reptiles and amphibians have been reported on Donnelley. Most are associated with freshwater emergent, forested, and depression wetlands. The American alligator is the dominant reptilian species found on Donnelley.

Back to Top

Access

The goal of the public use program at Donnelley is to provide balanced recreational opportunities for the hunting and non-hunting public. The following is a summary of public use activities on Donnelley.

Hunting: Archery hunting for deer is restricted to certain areas and is available on a first come first served basis. Still gun hunts (hunters in deer stands as opposed to using dogs to drive deer) are by lottery drawing only. Waterfowl and turkey hunts are by drawing. Hunting for dove and small game is provided according to designated schedules.

General Public Use: Casual visitation is Monday through Saturday, from 8:00 am to 5:00 PM. Donnelley is closed on Sunday and during special hunts. Managed wetlands are off limits from November 1 to January 21. Guided tours and presentations are offered by reservation and are based on staff availability.

For more information on Donnelley WMA call (803) 844-8957.

Back to: Protected Lands

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

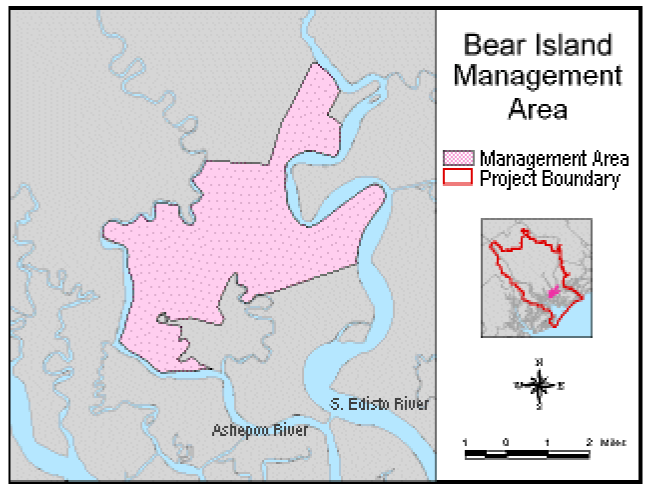
M E N U
History
Uplands
Forest
Agriculture
Wetlands
Managed Wetlands
Wildlife
Access

General Introduction | Cultural Resources | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perceptions | Image Atlas | Bibliography | Glossary | About This CD-ROM | Site Map | Search

Protected Lands

Bear Island Wildlife Management Area

History



The Bear Island Wildlife Management Area (WMA) is located in southern Colleton County. Bear Island is owned and managed by the South Carolina Department of Natural Resources (SCDNR) with state and federal funds through the Federal Aid in Wildlife Restoration Act. It is within the boundaries of the Ashepoo, Combahee, Edisto (ACE) Basin National Estuarine Research Reserve (NERR). The area is managed for a diversity of wildlife species with management objectives to provide: quality habitat for waterfowl and other migratory game birds, resident game species, and non-game and endangered species; public hunting and fishing opportunities; and opportunities for natural resource-related general public use, including wildlife observation and the demonstration of sound wildlife habitat management practices. The management area consists of the following habitat types and approximate acreages: marsh impoundments (5,385 acres), tidal marshes (5,005 acres), woodlands (1,227 acres), and agricultural lands (404 acres).

Uplands

Upland habitat on Bear Island consists mostly of maritime influenced mesic pine-mixed hardwood communities Dominant tree species include loblolly pine, shortleaf pine, live oak, sweetgum, and hickory. (See related subsection: Plants: Upland Communities.) Understory species include yaupon, sparkleberry, and greenbriers, while common groundcover species include panic grass, paspalums, Florida beggerweed, partridge pea, and ragweed. These woodlands provide habitat for upland game species such as whitetail deer, raccoons, marsh rabbits, bobwhite quail, and mourning doves. Bear Island's uplands provide nesting areas for passerine birds and raptors, including the protected southern bald eagle.

Back to Top

Forest

Forest management of upland areas of Bear Island is directed towards the enhancement and preservation of diversified habitats for game and non-game species. No commercial timber harvesting has been performed on Bear Island. Forest management goals are to improve habitat diversity by increased quality and quantity of browse (leaves, twigs, and young shoots of trees or shrubs), fruit production, and enhancement of seed producing legumes, grasses and forbs. Important mast producing and cavity/den trees are protected along with sensitive habitats utilized by endangered species. The small vernal woodland ponds are protected as they provide important freshwater drinking sources for upland wildlife and habitat for amphibians and reptiles, wood ducks, and numerous songbird species.

Prescribed burning is used in upland habitats to enhance conditions favorable to a variety of wildlife species. Pine stands are burned on a one-to two-year rotation to encourage establishment and growth of seed producing grasses and forbs utilized by bobwhite quail, mourning doves, and songbirds. Browsing habitat for deer and other wildlife is enhanced by burning of pine-hardwood areas on a three-to eight-year cycle. Wildlife openings are planted with crops, such as rye and wheat, to provide both winter grazing and seed production in spring.

Back to Top

Agriculture

The management objective for the agricultural land on Bear Island is to provide fall and winter foods for upland game species, primarily mourning dove and bobwhite quail. Other game species, including whitetail deer, raccoon, and marsh rabbit, benefit from these supplemental food sources. Plants that are cultivated in the agricultural fields of Bear Island include corn, soybeans, wheat, browntop millet, and rye. Most of the agricultural land is planted to provide a source of food for upland game species. Naturally occurring grasses, forbs, and legumes produce an abundance of seeds and provide habitat for insects, both of which are consumed by many species.

Agricultural land on Bear Island

Back to Top

Wetlands

Managed wetlands at Bear Island consist of a complex of impoundments ranging in size from 18 to 454 acres. Water level and salinity in the impoundments are manipulated by a system of dikes and water control structures. Average salinity in the Bear Island impoundments ranges from 0 (freshwater marshes) to 5 to 20 parts per thousand (ppt) (brackish marshes). Occasional droughts can increase salinities to 1-5 ppt in freshwater marshes and to 20 to 30 ppt in brackish marshes.

Tidal wetlands characterized as fresh/brackish or brackish/saline are the most common on Bear Island. Tidal marshes are highly productive and provide nursery grounds and estuarine habitat for a diverse assemblage of fishes and invertebrates. These marshes are also important as feeding, resting, and nesting habitats for numerous amphibians, reptiles, birds, and mammals.

Managed Wetlands

Drawdown of impoundment managed for waterfowl

Waterfowl management is a primary objective on Bear Island, so management efforts are largely directed toward the development and maintenance of suitable habitat within impoundments. Impoundments on Bear Island also provide high quality wintering and migration habitat for several migratory game birds. The wide range of salinity, soil types, and elevations that characterize the managed wetlands on Bear Island provide the potential for successful establishment and growth of aquatic macrophyte assemblages. Manipulation of water levels to control moisture and salinity conditions, prescribed burning, and mechanical manipulations (mowing and soil disturbance) are all used in the production of desirable plant foods.

Primary water level management techniques that provide the desired food and cover plants for waterfowl are summarized below (Bear Island Management Plan, 1996). The principal technique used in the management of brackish marshes (5 to 20 ppt salinity) involves an early summer drawdown of water followed by gradual elevation of water levels. Naturally occurring plant foods encouraged under this regime include widgeongrass, dwarf spikerush, and saltmarsh bulrush. Freshwater and low salinity wetlands (less than 5 ppt salinity) are managed under a moist soil regime in which marshes are dewatered during March through November to encourage the growth of annual seed producing plants. Such plants include panic grasses, smartweeds, wild millets, and flat sedges.

Aerial view of former rice field impoundment

Impoundment dikes function as lanes of travel for upland game species moving to and from isolated and disjunct upland areas. The dikes provide vegetated "edge" habitat that benefits bobwhite quail, mourning doves, marsh rabbits, and raccoons. Bobcats are frequent travelers along the dike lanes and forage in fringing marsh areas. A common furbearer, the river otter, travels across the dikes to feed on fish in the impoundments. One of the more common inhabitants of the Bear Island impoundments is the American alligator. The island has been a major site for alligator research. Bear Island has extensive habitat suitable for alligator nesting, and the variety of water depths in the managed wetlands provides optimal foraging habitat for this species.

Back to Top

Wildlife

Bear Island is located in the center of the most important eagle nesting region in South Carolina. The presence of suitable nest trees, the proximity of rivers and impoundments, and the availability of food contribute to the success of eagle nesting on Bear Island. Raptors and passerines are also commonly associated with marsh impoundments on Bear Island. Ecotonal communities along dikes are important fall and winter habitat and provide foraging opportunities. Grasses and forbs found on the dikes produce seeds and harbor insects that provide food for numerous passerine species such as the painted bunting and eastern kingbird. Shrubs provide nesting and perching sites as well as cover.

Waterfowl are the most abundant group of birds utilizing impoundments on Bear Island. (See related section: Birds: Impoundments.) Wading birds such as herons, egrets, ibises, and storks are the second most abundant group. Wading bird utilization is largely determined by water-level management practices. A gradual drawdown of water level concentrates fishes, crustaceans, gastropods, and insects that are the principal prey of wading birds. Certain species of wading birds also consume small mammals and some reptiles and amphibians commonly associated with the ecotones between marsh impoundments and dikes or adjacent upland habitat.

Aerial and surface divers (gulls, terns, cormorants, kingfishers, anhinga, grebes) are the second most abundant group of waterbirds that utilize the impoundments. These birds feed and rest in open water portions of impoundments.

Shorebirds are the third group of waterbirds found in Bear Island impoundments. The most common species is the greater yellowlegs, which feeds on small fish and benthic invertebrates inhabiting mud flats in shallow water. During most of the year, the impoundments are flooded too deeply for significant utilization by shorebirds; however, drawdown to saturated soil conditions in spring provides extensive feeding habitat for many shorebird species.

Back to Top

Access

Public access to Bear Island is regulated according to time of year**.** Recreational activities include hunting (waterfowl, mourning dove, whitetail deer, and small game), fishing, wildlife observation, and general nature study. A valid license is required for hunting or fishing and hunting also requires a valid WMA permit.

Hunting: Archery and gun hunts for deer; waterfowl hunting by lottery (drawing); dove and small game hunts also scheduled.

Fishing: Fish and blue crabs can be harvested from impoundments from April 1 to September 30.

Camping: Primitive facilities available for deer hunters and conservation groups by appointment.

General Public Use: *General Public Use*: Designated areas open for bird watching, photography, and wildlife observation from January 21 through October 31 (Monday through Saturday 8 AM to 5 PM. From November 1 through January 20, only paved roads are open in the management area. An observation platform is available.

For more information on Bear Island WMA call (803) 844-8957.

Back to: Protected Lands

MENU

Abandoned Shipwreck Act

Antiquities Act

Archaeological Resources Protection Act

Atlantic Coastal Fisheries Cooperative Management Act

Atlantic Striped Bass Conservation Act

Clean Air Act

Clean Water Act

Coastal Barrier Resources Act

Coastal Zone Management Act

Emergency Planning and Community Right-to-Know Act

Endangered Species Act

Federal Agriculture Improvement and Reform Act

Federal Migratory Bird Treaty Act

Fish and Wildlife Coordination Act

Flood Disaster Protection Act

Inland Navigational Rules Act

International Regulations for Preventing Collisions at Sea

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

US Federal Laws

Abandoned Shipwreck Act (43 U.S.C. §§ 2101-2106)

Under the Abandoned Shipwreck Act (ASA), the U.S. asserts title to shipwrecks that are embedded in the submerged lands of a state. The federal government transfers title to the state whose submerged lands contain the shipwreck, except when the wreck is located on public or Indian land, or is a U.S. warship that has not been affirmatively abandoned. The public is given notice of the location of any shipwreck when title is asserted under the ASA.

Pursuant to the ASA, states manage a broad range of living and nonliving resources in their waters and submerged lands. Shipwrecks protected under the ASA offer recreational and educational opportunities for divers, tourists, users of biological sanctuaries, and historical researchers. States are encouraged to provide public access to the shipwrecks through the adoption of guidelines for the creation of underwater parks.

The Secretary of the Interior, through the National Park Service, publishes guidelines to maximize the enhancement of shipwrecks as cultural resources; foster a partnership among sport divers, sailors, and other interests to manage shipwreck resources; facilitate access and utilization of the shipwrecks; and recognize the interests of groups engaged in shipwreck discovery and salvage (Year of the Ocean Discussion Papers 1998).

Antiquities Act (16 U.S.C. §§ 431 et seq.)

The Antiquities Act has two main components: (1) a criminal enforcement component, which provides for the prosecution of persons who appropriate, excavate, injure, or destroy any historic or prehistoric ruin or monument, or any object of antiquity on lands owned or controlled by the United States; and (2) a component that authorizes, through the issuance of a permit, the examination of ruins, the excavation of archeological sites, and the gathering of objects of antiquity on lands owned or controlled by the U.S. The Antiquities Act has been applied in the marine environment. Where the U.S. has ownership or control of the submerged lands in or on which submerged cultural resources are located, the Antiquities Act permitting provision can be used to regulate salvage. It appears, however, that its reach may be limited to regulating salvage only in marine protected areas in which the U.S. has the authority to protect submerged cultural resources (Year of the Ocean Discussion Papers 1998).

Archaeological Resources Protection Act (16 U.S.C. §§ 470aa et seq.)

The Archaeological Resources Protection Act (ARPA) is another historic preservation statute that has been applied to the marine environment. ARPA was specifically designed to prevent looting and destruction of archeological resources. Like the Antiquities Act, ARPA has both enforcement and a permitting component. The enforcement provision provides for the

Land and Water Conservation Fund Act

Magnuson-Stevens Fishery Conservation and Management Act

Marine Mammal Protection Act

Marine Plastic Pollution Research and Control Act

Mineral Lands and Regulations

National Environmental Policy Act

National Fishery Enhancement Act

National Flood Insurance Act

National Historic Preservation Act

National Invasive Species Act

National Wildlife Refuge System Administration Act

Ocean Dumping Act

Oil Pollution Act

Pollution Prevention Act

Ports and Waterways Safety Act

Resource Conservation and Recovery Act

Rivers and Harbors Act

Safe Drinking Water Act

Submerged Lands Act

Surface Mining Control

imposition of both criminal and civil penalties against violators of the Act. ARPA's permitting component allows for the recovery of certain artifacts consistent with the standards and requirements of the Federal Archeology Program. While ARPA is applicable to the marine environment, its reach in this context is limited. Pursuant to the express language of the Act itself, ARPA can only be applied to such areas as national parks (with federally owned submerged lands) and wildlife refuges. Additionally, ARPA specifically states that it does *not* apply to activities occurring on the outer continental shelf (Source: Year of the Ocean Discussion Papers 1998).

Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. §§ 5101-5108)

The purpose of the Atlantic Coastal Fisheries Cooperative Management Act is to support and encourage the development, implementation, and enforcement of effective interstate conservation and management of Atlantic coastal fishery resources. The Secretary of Commerce, in cooperation with the Secretary of the Interior, is responsible for developing and implementing a program to support the interstate fishery management efforts of the Atlantic States Marine Fisheries Commission. The Atlantic States Marine Fisheries Commission is responsible for preparing and adopting coastal fishery management plans to provide for the conservation of coastal fishery resources. States are required to implement and enforce the plans. If the Secretary of Commerce finds that a state has failed to carry out its responsibilities, the Secretary must declare a moratorium on fishing in the fishery in question within the waters of the non-complying state (Year of the Ocean Discussion Papers 1998).

Atlantic Striped Bass Conservation Act (16 U.S.C. § 1851)

The Atlantic Striped Bass Conservation Act is intended to support and encourage the development, implementation, and enforcement of effective interstate action regarding the conservation and management of the Atlantic striped bass. Each year, the Atlantic States Marine Fisheries Commission determines whether coastal states are in compliance with the Interstate Fisheries Management Plan for Striped Bass. If a coastal state is not in compliance with the Plan, the Secretary of Commerce and the Secretary of the Interior must declare a moratorium on fishing for Atlantic striped bass within the coastal waters of that state (Source: Year of the Ocean Discussion Papers 1998).

Clean Air Act

The Clean Air Act (CAA) is a federal law passed in 1970 and amended in 1990 and 1997, which forms the basis for the national air pollution control effort. Basic elements of the Act include national ambient air quality standards for major air pollutants, hazardous air pollutants standards, state attainment plans, motor vehicle emissions standards, stationary source emissions standards and permits, acid rain control measures, stratospheric ozone protection, and enforcement provisions.

Clean Water Act (33 U.S.C. §§ 1251 et seq.)

- **Section 301**-allows for a case-by-case review of treatment requirements for dischargers meeting certain requirements. The applicant must demonstrate that discharges will not exceed water quality standards for the pollutant, discharges will not interfere with pollutants from other sources, with protections of public water supplies, with maintenance of balanced indigenous populations of shellfish, fish, and wildlife, and with allowable recreational activities in the water. As of 1987, waivers are not allowed in urban areas with a population greater than 50,000 without primary treatment and additional pre-treatment or in stressed saline estuarine waters.
- **Section 303**-requires EPA to establish water quality criteria guidelines for use by states

and Reclamation Act

Sustainable Fisheries Act

Water Resource Development Act

Watershed Protection and Flood Prevention Act

in preserving designated uses of lakes, streams, and rivers within their state.

- **Section 307**-establishes the National Pretreatment Program which regulates discharges from industrial facilities to public sewage treatment plants.
- **Section 312**-requires EPA to set standards for the sanitation of boat toilets. The US Coast Guard enforces EPA's standards.
- **Section 319**-requires states to prepare Non-point Source (NPS) Assessment Reports and Management Programs to identify sources of NPS pollution, water bodies unable to meet water quality standards without NPS pollution controls, and best management practices to control NPS pollution.
- **Section 320**-gives EPA the right to establish national estuaries nominated by the state governor. This entitles the estuary to federal research money and assistance in the preparation of a comprehensive management plan.
- **Section 401**-State water quality certification of 404 permits. This enables states to take leadership roles in the distribution of water quality certifications within their state.
- **Section 402**- establishes the NPDES permitting program, which makes it illegal for municipal and industrial facilities to discharge pollution into navigable waters unless obtaining a permit issued by EPA or the state.
- **Section 403(c)**-requires EPA to assess point source discharge effects on the marine environment and create ocean discharge guidelines. Point source discharges to territorial sea, waters of the contiguous zone, and oceans must obtain a NPDES permit and may not unreasonably harm the environment.
- **Section 404**-requires a permit for the discharge of dredge and fill material into waters of the United States, which include tidal, coastal, and fresh waters as well as wetlands. Federal regulations are carried out by the Army Corps of Engineers. EPA retains veto authority over the issuance of discharge permits and prepares wetland permitting guidelines. The US Fish and Wildlife Service and the National Marine Fisheries Service both comment on proposed section 404 permits.

(Reproduced from *Coastal Challenges: A Guide to Coastal and Marine Issues* with permission from the National Safety Council's Environmental Health Center, February 1998.)

Coastal Barrier Resources Act (16 U.S.C §§ 3501-3510)

This Act, sponsored by the US Fish and Wildlife Services, originally addressed barrier islands of the Atlantic and Gulf coasts, and later was amended to include areas in Puerto Rico, US Virgin Islands, Great Lakes, and additional areas along the Atlantic and Gulf. The goal of the Act is to minimize the loss of life and reduce damage to fish and wildlife habitats by forbidding federal funds to be spent on projects that encourage development and economic growth in fragile barrier island coastal systems. A Coastal Barrier Resources System was also established to target areas for protection from the coastlines of Maine to Texas, totaling approximately 1.3 million acres. (Reproduced from *Coastal Challenges: A Guide to Coastal and Marine Issues* with permission from the National Safety Council's Environmental Health Center, February 1998.)

Coastal Zone Management Act, sec. 315 (16 U.S.C. § 1461)

This Act provides incentives for states to adopt a federally approved coastal management program. The program must identify permissible land uses, establish priority of uses, identify areas of concern, protect and provide access to public beaches, control coastal erosion, and prepare a Coastal Non-point Source Pollution Program that meets federal standards. States will then be eligible for federal money and are entitled to review federal activities that affect their coastal zone for consistency with the state coastal program.

In addition, the Act provides for the establishment of National Estuarine Research Reserve System, a federal and state cooperation. The Department of Commerce administers the system, providing funds for site selection, management plan preparation, acquisition, development, research, and educational and administrative programs. Long-term operation is the responsibility of the state. (Reproduced from *Coastal Challenges: A Guide to Coastal and Marine Issues* with permission from the National Safety Council's Environmental Health Center, February 1998.)

Emergency Planning and Community Right-to-Know Act (42 U.S.C. §§ 11001-11050)

The Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 establishes requirements for federal, state and local governments and industry regarding emergency planning and "Community Right-to-Know" reporting on hazardous and toxic chemicals. This law builds upon the Environmental Protection Agency's (EPA) Chemical Emergency Preparedness Program (CEPP) and numerous state and local programs aimed at helping communities to better meet their responsibilities with regard to potential chemical emergencies. The Community Right-to-Know provisions will help increase the public's knowledge of and access to information on the presence of hazardous chemicals in their communities and releases of these chemicals into the environment. States and communities, working with facilities, will be better able to improve chemical safety and protect public health and the environment.

EPCRA (also known as the Superfund Act Reauthorization Amendment Title III) has four major sections: emergency planning (Sections 301-303), emergency release notification (Section 304), Community Right-to-Know reporting requirements (Sections 311-312), and toxic chemical release inventory (Section 313). Information from these four reporting requirements will help states and communities develop a broad perspective of chemical hazards for the entire community as well as for individual facilities (Source: Environmental Protection Agency 1998).

Endangered Species Act (16 U.S.C. §§ 1531-1544)

This Act prohibits the taking of federally endangered or threatened species. A taking is defined broadly and includes harassment, harm, pursuit, hunting, shooting, wounding, killing, trapping, capturing, collecting, or attempting to engage in any of this type of conduct. The Secretary of the Interior and the Secretary of Commerce determine, through regulations, whether any species are endangered or threatened. The Secretaries also are required to designate critical habitat and develop and implement recovery plans for threatened and endangered species. Federal agencies must ensure that any Action authorized, funded, or carried out by such an agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of critical habitat. An incidental take is the taking of a listed species resulting from an otherwise lawful activity. Federal agencies can get an incidental take permit through the interagency consultation process, while private parties can get an incidental take permit through the habitat conservation planning process. The federal government may provide funds and enter into management and cooperative agreements with state governments for the conservation and protection of endangered species. (Reproduced from *Coastal Challenges: A Guide to Coastal and Marine Issues* with permission from the National Safety Council's Environmental Health Center, February 1998.)

Federal Agriculture Improvement and Reform Act of 1996

Also known as the Farm Bill, this Act establishes environmental quality incentives to farmers. Efforts include reducing soil erosion, retaining wetlands, and protecting environmentally sensitive cropland. The Swampbuster provision expands the definition of agricultural lands to include pasture lands, rangelands, and tree farms-excluding commercially forested lands. This gives farmers more flexibility in complying with wetland conservation requirements. The Act also forbids the federal government to provide subsidies to farmers that knowingly fill wetlands. (Reproduced from *Coastal Challenges: A Guide to Coastal and Marine Issues* with permission from the National Safety Council's Environmental Health Center, February 1998.)

Federal Migratory Bird Treaty Act

This Act, regulated by the US Fish and Wildlife Service, prohibits the taking of migratory birds protected under treaties with Great Britain, Mexico, and Japan. This Act, originally passed in 1918, provides protection for migratory birds. Under the Act, it is unlawful to take, import, export, possess, buy, sell, purchase, or barter any migratory bird. Feathers or other parts, nests, eggs, and products made from migratory birds are also covered by the Act. Take is defined as pursuing, hunting, shooting, poisoning, wounding, killing, capturing, trapping, or collecting. Exceptions include scientific collecting, falconry, and taxidermy, all of which require a permit. Penalties for violations include fines exceeding $10,000 and imprisonment. In addition, the Migratory Bird Conservation Act,governed by USFWS, acquires areas to manage and protect migratory birds. (Reproduced from *Coastal Challenges: A Guide to Coastal and Marine Issues* with permission from the National Safety Council's Environmental Health Center, February 1998.)

Fish and Wildlife Coordination Act (16 U.S.C. §§ 661-666(c))

The Fish and Wildlife Coordination Act requires that wildlife conservation receive equal consideration with other features of water resource development. The Act requires that federal agencies consult with the National Marine Fisheries Service, the US Fish and Wildlife Service, and the state's wildlife agency before undertaking federal projects or issuing permits for activities that modify any body of water. The National Marine Fisheries Service provides comments and recommendations to prevent loss of, and damage to, fish populations and their habitats (Year of the Ocean Discussion Papers 1998).

Flood Disaster Protection Act (42 U.S.C. §§ 4001-4129)

To address limited participation in the early years of the National Flood Insurance Program (NFIP), Congress enacted the Flood Disaster Protection Act (FDPA), which mandated flood insurance for all federally backed mortgages and loans obtained through federally insured and regulated financial institutions. In addition, disaster assistance grants (public assistance) are not available to local governments not participating in the program (individual property owners need not have flood insurance to be eligible for individual and family grants, however). As a result, community participation has been high, with about 19,000 localities participating (Source: An Introduction to Coastal Zone Management by Timothy Beatley, David Brower, and Anna Schwab 1994).

Inland Navigational Rules Act (33 U.S.C. §§ 2001-2073)

The Inland Navigational Rules provide regulations that govern ship navigation for vessels upon the inland waters of the U.S., and to U.S. vessels on the Canadian waters of the Great Lakes to the extent there is no conflict with Canadian law (Source: Year of the Ocean Discussion Papers 1998).

International Regulations for Preventing Collisions at Sea (33 U.S.C. §§ 1601-1608)

The International Regulations for Preventing Collisions at Sea provides binding comprehensive regulations for the prevention of collisions on the water. The 72 COLREGS apply beyond established demarcation lines. In the U.S., the 72 COLREGS govern ship navigation on non-internal waters. The scope of the 72 COLREGS includes Steering and Sailing Rules (e.g., conduct of vessels in sight of one another, conduct of vessels in restricted visibility); Lights and Shapes; and Sound and Light Signals. The statute also contains special provisions for ships of war, vessels proceeding under convoy, and fishing vessels engaged in fishing as a fleet. Civil penalties may be assessed for violations of the 72 COLREGS (Source: Year of the Ocean Discussion Papers 1998).

Land and Water Conservation Fund Act of 1965

This Act aims to ensure that present and future generations will have continued use of outdoor recreational resources. The Act mandates the conservation and development of natural resources through both government and private interests. The Act organized a fund, entitled the Land and Water Conservation Fund, which is collected from surplus property sales, motor boat fuel tax, user fees at National Park Systems, and other revenues from the Outer Continental Shelf Lands Act.

Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §§ 1801-1883)

This Act, as amended in 1996, aims to prevent over fishing, rebuild depleted stocks, reduce bycatch, and designate and conserve essential fish habitat. Under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), the U.S. claimed sovereign rights and exclusive fishery management authority over all fish, and all continental shelf fishery resources, within the exclusive economic zone. This gives federal agencies jurisdiction 200 miles offshore. Eight regional councils were formed to prepare fishery management plans for those fish species in need of federal management. Any foreign nation wanting to fish within this territory must obtain a Governing International Fishery Agreement that is negotiated by the U.S. Department of State and NOAA. Any agreements may be reviewed by both congress and the president. (Reproduced from *Coastal Challenges: A Guide to Coastal and Marine Issues* with permission from the National Safety Council's Environmental Health Center, February 1998.)

Marine Mammal Protection Act (16 U.S.C. §§ 1361-1421h)

Under the Marine Mammal Protection Act (MMPA), the Secretary of Commerce is responsible for ensuring the protection of cetaceans and pinnipeds (except walruses). The Secretary of the Interior is responsible for ensuring the protection of sea otters, polar bears, walruses, and manatees. The MMPA established a moratorium on the taking and importation of marine mammals and marine mammal products, except:

- for purposes of scientific research, public display, photography for educational or commercial purposes, or enhancing the survival or recovery of a species or stock, or for importation of polar bear taken in sports hunts in Canada;
- when taken incidentally in the course of commercial fishing operations;
- to deter a marine mammal from damaging fishing gear or catch, damaging private property, endangering personal safety, or damaging pubic property;
- when taken incidentally by citizens engaged in a specified activity (other than commercial fishing) within a specified geographical region;
- when the Secretary of Commerce has waived the moratorium; or
- if the marine mammal was taken by an Indian, Aleut, or Eskimo for subsistence purposes or for purposes of creating and selling authentic native articles of handicrafts and clothing.

The MMPA provides for enforcement of the Act and its implementing regulations.

The Secretaries of Commerce and Interior are directed to initiate negotiations with foreign governments to protect and conserve marine mammals. The Secretaries may transfer management authority for a species of marine mammal to a state. The MMPA also established the Marine Mammal Commission composed of three members appointed by the President (Year of the Ocean Discussion Papers 1998).

Marine Plastic Pollution Research and Control Act (33 U.S.C. §§ 1901-1912)

The Marine Plastic Pollution Research and Control Act of 1987 (MARPOL) implemented the provisions of Annex V of MARPOL relating to garbage and plastics. Annex V of MARPOL and the regulations implementing it apply to all vessels, whether seagoing or not, regardless of flag, on the navigable waters of the U.S. and in the exclusive economic zone of the U.S. It applies to U.S. flag vessels wherever they are located.

Under the regulations implementing APPS, the discharge of plastics, including synthetic ropes, fishing nets, plastic bags, and biodegradable plastics, into the water is prohibited. Discharge of floating dunnage, lining, and packing materials is prohibited in the navigable waters and in areas offshore less than 25 nautical miles from the nearest land. Food waste or paper, rags, glass, metal, bottles, crockery and similar refuse cannot be discharged in the navigable waters or in waters offshore inside 12 nautical miles from the nearest land. Finally, food waste, paper, rags, glass, and similar refuse cannot be discharged in the navigable waters or in waters offshore inside three nautical miles from the nearest land. There are some exceptions for emergencies. Under APPS, the definition of ship includes fixed or floating platforms. There are separate garbage discharge provisions applicable to these units. For these platforms, and for any ship within 500 meters of these platforms, disposal of all types of garbage is prohibited. Additionally, all manned, oceangoing U.S. flag vessels of 12.2 meters or more in length engaged in commerce, and all manned fixed or floating platforms subject to the jurisdiction of the U.S., are required to keep records of garbage discharges and disposals (Source: Year of the Ocean Discussion Papers 1998).

Mineral Lands and Regulations

Mineral Lands and Regulations is part of Title 30, Mineral Lands and Mining, which encourages private enterprise in (1) the development of economically sound and stable domestic mining, minerals, metal and mineral reclamation industries; (2) the orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help assure satisfaction of industrial, security and environmental needs; (3) mining, mineral, and metallurgical research, including the use and recycling of scrap to promote the wise and efficient use of our natural and reclaimable mineral resources; and (4) the study and development of methods for the disposal, control, and reclamation of mineral waste products, and the reclamation of mined land, so as to lessen any adverse impact of mineral extraction and processing upon the physical environment that may result from mining or mineral activities.

For the purpose of this section "minerals" shall include all minerals and mineral fuels including oil, gas, coal, oil shale and uranium.

It shall be the responsibility of the Secretary of the Interior to carry out this policy when exercising his authority under such programs as may be authorized by law other than this section.

National Environmental Policy Act (42 U.S.C. §§ 4321-4370d)

NEPA, administered by the US Environmental Protection Agency, requires federal agencies to prepare a detailed environmental impact statement (EIS) for federal and federally permitted Activities that have a significant effect on the environment. (Reproduced from *Coastal Challenges: A Guide to Coastal and Marine Issues* with permission from the National Safety Council's Environmental Health Center, February 1998.)

National Fishery Enhancement Act (33 U.S.C. § 2101-2106)

Under the National Fishery Enhancement Act (NFEA), states may apply to the Federal Secretary of Transportation for obsolete ships that would be designated for scrapping if the state intends to sink such ships for use as offshore artificial reefs for the conservation of marine life. NFEA specifies that, based on the best scientific information available, artificial reefs shall be sited and constructed, and subsequently monitored and managed in a manner that will:

- Enhance fishery resources to the maximum extent practicable
- Facilitate access and utilization by U.S. recreational and commercial fishermen
- Minimize conflicts among competing uses of waters covered under this chapter and the resources in such waters
- Minimize environmental risks and risks to personal health and property
- Be consistent with generally accepted principles of international law and shall not create any unreasonable obstruction to navigation.

(Year of the Ocean Discussion Papers 1998)

National Flood Insurance Act (42 U.S.C. §§ 4001-4129)

Federal flood insurance was made available in 1968 through the enactment of the National Flood Insurance Act. Prior to this program, affordable private flood insurance was generally not available. Under the National Flood Insurance program (NFIP), federally subsidized flood insurance is made available to owners of flood-prone property in participating communities. Coverage is available both for the structure itself (up to $185,000 for a single-family structure) and for contents (up to $60,000). Administered by the Federal Insurance Administration of the Federal Emergency Management Agency (FEMA), participating communities are required to adopt certain minimum floodplain management standards, including restrictions on new development in designated floodways, a requirement that new structures in the 100 - year flood zone be elevated to at or above the 100 - year flood level (known as base flood elevation, or BFE), and a requirement that subdivisions are designed to minimize exposure to flood hazards. For high-hazard coastal zones ("velocity" zones, or "v" zones), additional standards are imposed, including the requirement that buildings be elevated on pilings, that all new development be landward of mean high water, that the BFE include potential wave heights, and that new development not damage dunes or dune vegetation (An Introduction to Coastal Zone Management by Timothy Beatley, David Brower, and Anna Schwab 1994).

National Historic Preservation Act (16 U.S.C. §§ 470 et seq.)

The National Historic Preservation Act (NHPA) is the largest piece of federal historic preservation legislation. It has two major components that affect the responsibilities of federal agencies managing submerged lands. First, under section 106 of the NHPA, federal agencies are to consider the effects of their undertakings (including the issuance of permits, the expenditure of federal funding and federal projects) on historic resources that are either eligible for listing or are listed on the National Register of Historic Places. Section 110 of the NHPA imposes another obligation on federal agencies that own or control historic resources. Under this section, federal agencies must consider historic preservation of historic resources as part of their management responsibilities (Year of the Ocean Discussion Papers

1998).

National Invasive Species Act of 1996

This Act brings attention to the spread of non-indigenous or nuisance species into the US waters via the ballast waters of commercial vessels. This Act examines attributes and patterns of non-indigenous species invasions and the effectiveness of ballast management. EPA authorizes funding for research grants for controlling the spread of nuisance species. The Department of Transportation issues guidelines to control zebra mussels and other aquatic nuisance species. (Reproduced from *Coastal Challenges: A Guide to Coastal and Marine Issues* with permission from the National Safety Council's Environmental Health Center, February 1998.)

National Wildlife Refuge System Administration Act (16 U.S.C. § 668dd)

This section of law consolidates the authorities relating to the various categories of areas administered by the Secretary of the Interior for the conservation of fish and wildlife by designating all such areas part of the National Wildlife Refuge System (the System). The law prohibits knowingly disturbing, injuring, cutting, burning, removing, destroying, or possessing any real or personal property of the U.S., including natural growth, in any area of the system, or taking or possessing any fish, bird, mammal, or other wild animals within any such area without a permit. The Secretary may permit areas within the System to be used for hunting, fishing, and public recreation when the Secretary determines such uses are compatible with the major purposes for which such areas were established (Source: Year of the Ocean Discussion Papers 1998).

Ocean Dumping Act (33 U.S.C. §§ 1401-1445)

Titles I and II of the Marine Protection, Research, and Sanctuaries Act (known as the Ocean Dumping Act (ODA)), as amended, provide the basic authority for the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (COE) to regulate ocean dumping (Title I) and for the Department of Commerce (DOC), through the National Oceanic and Atmospheric Administration (NOAA), to carry out research on the effects on ocean systems of ocean dumping and other anthropogenically-induced changes (Title II).

Title I of the ODA prohibits any person, without a permit, from transporting from the U.S. any material for the purpose of dumping it into ocean waters (defined to mean those waters of the open seas lying seaward of the baseline from which the territorial sea is measured). In the case of a vessel or aircraft registered in the U.S. or flying the U.S. flag, or in the case of a U.S. agency, the ODA prohibits any person, without a permit, from transporting from any location any material for the purpose of dumping it into ocean waters. Title I also prohibits any person, without a permit, from dumping any material transported from a location outside the U.S. into the territorial sea, or the contiguous zone extending 12 nautical miles seaward from the baseline of the territorial sea. EPA issues permits regulating the ocean dumping of all material except dredged material, which is permitted by COE. COE permits are subject to EPA review and concurrence. The specific environmental criteria used to evaluate permit applications are developed by EPA; in the case of dredged material, this is performed in coordination with COE.

In developing criteria for the evaluation of permit applications, the statute provides that the following elements must be considered:

- the need for the proposed dumping;
- the effect of the dumping on human health and welfare, fisheries resources, marine ecosystems, and shorelines;

- the persistence and permanence of the effects of the dumping;
- the effect of dumping particular volumes and concentrations;
- appropriate locations and methods of disposal or recycling, including land-based alternatives; and
- the effect of dumping on alternate uses of the oceans.

Under the ODA, the ocean dumping of sewage sludge and industrial waste is prohibited. In addition, radiological, chemical, or biological warfare agents, high-level radioactive waste, or medical waste may not be dumped. States may generally adopt and enforce requirements for ocean dumping activities that occur in their jurisdictional waters.

Title II of the ODA requires that DOC, in coordination with the department in which the U.S. Coast Guard is operating and EPA, conduct a comprehensive and continuing program of monitoring and research on the effects of dumping of material into ocean or other coastal waters or into the Great Lakes. The title further requires that DOC, in close consultation with other appropriate departments, conduct a comprehensive and continuing program of research into the possible long-range effects of pollution, over-fishing, and anthropogenically-induced changes of ocean ecosystems. The title specifies that the program must include continuing monitoring programs to assess the health of the marine environment, including but not limited to the monitoring of bottom oxygen concentration, contaminant levels in biota, sediments and the water column, diseases in fish and shellfish, and changes in types and abundance of indicator species (Year of the Ocean Discussion Papers 1998).

Oil Pollution Act (33 U.S.C. §§ 2701-2720)

The Oil Pollution Act (OPA) amends section 311 of the Federal Water Pollution Control Act (the Clean Water Act or CWA), 33 U.S.C. §§ 1321 et seq., to clarify federal response authority, increase penalties for spills, establish U.S. Coast Guard response organizations, require tank vessel and facility response plans, and provide for contingency planning in designated areas. OPA, however, does not preempt states' rights to impose additional liability or other requirements with respect to the discharge of oil within a state or to any removal activities in connection with such a discharge.

OPA creates an Oil Spill Trust Fund to pay for removal costs and damages in the event that the liable party is unable to pay for damages. The law, as amended in 1996, expands research and training on oil spill removal, requires the phase out of single-hull tank vessels, and mandates the Coast Guard to establish a National Response Unit. Title I of OPA contains liability provisions governing oil spills modeled after the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. §§ 9601 et seq., and section 311 of the CWA. Specifically, section 1002(a) of OPA provides that the responsible party for a vessel or facility from which oil is discharged, or which poses a substantial threat of a discharge, is liable for:

- Certain specified damages resulting from the discharged oil
- Removal costs incurred in a manner consistent with the National Contingency Plan.

The scope of damages for which there may be liability under section 1002 of OPA includes:

- Natural resource damages, including the reasonable costs of assessing these damages
- Loss of subsistence use of natural resources
- Real or personal property damages
- Net loss of tax and other revenues
- Loss of profits or earning capacity
- Net cost of additional public services provided during or after removal actions.

(Year of the Ocean Discussion Papers 1998)

Pollution Prevention Act of 1990 (42 U.S.C. §§13101)

The Congress finds that the USA annually produces millions of tons of pollution and spends tens of billions of dollars per year controlling this pollution. There are significant opportunities for industry to reduce or prevent pollution at the source through cost-effective changes in production, operation, and raw materials use. Such changes offer industry substantial savings in reduced raw material, pollution control, and liability costs as well as help protect the environment and reduce risks to worker health and safety. Therefore, the Congress has declared it to be the national policy of the United States that pollution should be prevented or reduced at the source whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner. (PACE Law, 1999)

Ports and Waterways Safety Act (33 U.S.C. §§ 1221-1236)

The Ports and Waterways Safety Act (PWSA), as amended by the Port and Tanker Safety Act of 1978 (PTSA), Public Law 95-474, and the Oil Pollution Act of 1990 (OPA), is designed to promote navigation, vessel safety, and protection of the marine environment. Generally, the PWSA applies in any port or place under the jurisdiction of the U.S., or in any area covered by an international agreement negotiated pursuant to section. Title 33 CFR 2.05-30 defines waters subject to the jurisdiction of the U.S. as navigable waters, other waters on lands owned by the U.S., and waters within U.S. territories and possessions of the U.S.

The PWSA authorizes the U.S. Coast Guard (USCG) to establish vessel traffic service/separation (VTSS) schemes for ports, harbors, and other waters subject to congested vessel traffic. The VTSS apply to commercial ships, other than fishing vessels, weighing 300 gross tons (270 gross metric tons) or more. The OPA amended the PWSA to mandate that appropriate vessels must comply with the VTSS.

The PWSA was amended by the PTSA, Public Law 95-474. Under the PTSA, Congress found that navigation and vessel safety and protection of the marine environment are matters of major national importance and that increased vessel traffic in the nation's ports and waterways creates substantial hazard to life, property or the marine environment. In addition, increased supervision of vessel and port operations was deemed necessary in order to:

- Reduce the possibility of vessel or cargo loss, or damage to life, property, or the marine environment
- Prevent damage to structures in, on, or immediately adjacent to the navigable waters of the u.s. or the resources within such waters
- Ensure that vessels operating in the navigable waters of the u.s. shall comply with all applicable standards and requirements for vessel construction, equipment, manning, and operational procedures
- Ensure that the handling of dangerous articles and substances on the structures in, on, or immediately adjacent to the navigable waters of the U.S. is conducted in accordance with established standards and requirements.

Under the PTSA, it was also determined that advance planning is critical in determining proper and adequate protective measures for the nation's ports and waterways and the marine environment, with continuing consultation with other federal agencies, state representatives, affected users and the general public, in the development and implementation of such measures.

The PTSA provided broader regulatory authority over regulated and non-regulated areas. The PTSA provided for improvements in the supervision and control of all types of vessels operating in navigable waters of the U.S., and in the safety of foreign or domestic tank vessels that transport or transfer oil or hazardous cargoes in ports or places subject to U.S. jurisdiction. The PTSA also reflects certain tank vessel standards and requirements accepted internationally, specifically those developed by the International Conference on Tanker Safety and Pollution Prevention (Year of the Ocean Discussion Papers 1998).

Resource Conservation and Recovery Act of 1976

RCRA established a federal program regulating solid and hazardous waste management. The law takes a cradle-to-grave approach in the tracking of hazardous waste from generation to final disposal. All existing landfills are required to meet minimum technology requirements, while all new waste facilities are required to obtain a permit from the Environmental Protection Agency. (Reproduced from *Coastal Challenges: A Guide to Coastal and Marine Issues* with permission from the National Safety Council's Environmental Health Center, February 1998.)

Rivers and Harbors Act (33 U.S.C. §§ 401 et seq.)

The U.S. Army Corps of Engineers (COE) is authorized to regulate the construction of any structure or work within navigable waters under sections 9 and 10 of the Rivers and Harbors Act (RHA). The RHA authorizes the COE to regulate the construction of such diverse activities as wharves, breakwaters, or jetties; bank protection or stabilization projects; permanent mooring structures, vessels, or marinas; intake or outfall pipes; canals; boat ramps; aids to navigation; or other modifications affecting the course, location condition, or capacity of navigable waters. The COE's jurisdiction under RHA is limited to "navigable waters," or waters subject to the ebb and flow of the tide shoreward to the mean high water mark that may be used to transport interstate or foreign commerce. (The definition of navigable waters under RHA is substantially more limited than the definition under section 404 of the Clean Water Act, which extends to inland wetlands. The COE must consider the following criteria when evaluating projects within navigable waters:

- The public and private need for the activity
- Reasonable alternative locations and methods
- The beneficial and detrimental effects on the public and private uses to which the area is suited.

After receiving an application for a section 10 RHA navigation permit, the COE issues a public notice to solicit information from the public; adjacent property owners; and state, local, and federal agencies. COE may conduct a public hearing unless the issues raised are insubstantial or there is otherwise no valid interest to be served by a hearing. COE also conducts "public interest reviews" for both wetland and navigation permits to balance "the benefits which reasonably may be expected to accrue from the proposal…against its reasonably foreseeable detriments." COE is required to consult with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service to protect and conserve wildlife resources (Source: Marine Law Institute, University of Maine 1992).

Safe Drinking Water Act of 1974

This Act aims to protect drinking water systems, by making sure they are properly managed and abide by certain standards. The law requires community drinking water systems to conduct routine monitoring for pollutants, comply with minimal standards, and requires public notification if any standards are violated or monitoring requirements are not met. The Environmental Protection Agency is responsible for establishing national standards and administering the law. The law may be administered by the state once they have demonstrated a program that meets federal regulations. (Reproduced from *Coastal Challenges: A Guide to Coastal and Marine Issues* with permission from the National Safety Council's Environmental Health Center, February 1998.)

Submerged Lands Act (43 U.S.C. §§ 1301 - 1315)

Under the Submerged Lands Act (SLA), the location of the energy and mineral resources determines whether or not they fall under state control. Specifically, the SLA granted states title to the natural resources located within three miles of their coastline (three marine leagues for Texas and the Gulf coast of Florida). For purposes of the SLA, the term "natural resources" includes oil, gas, and all other minerals. State authorities range in the nature and extent of their control over ocean energy and mineral resources on state submerged lands. The range depends on each state's evaluation of different policy interests, such that activities may be restricted in certain areas and allowed in others. State management authority for oil and gas exploration and production on state submerged lands may be implemented by more than one state entity. Also, state management of energy and mineral resources is often addressed within the context of a broader state coastal management plan (Source: Year of the Ocean Discussion Papers 1998).

Surface Mining Control and Reclamation Act of 1977 (SMCRA) 30 U.S.C. §§1201

The Surface Mining Control and Reclamation Act of 1977 establishes a program for the regulation of surface mining activities and the reclamation of coal-mined lands, under the administration of the Office of Surface Mining, Reclamation and Enforcement, in the Department of the Interior.

The law sets forth minimum uniform requirements for all coal surface mining on Federal and State lands, including exploration activities and the surface effects of underground mining. Mine operators are required to minimize disturbances and adverse impact on fish, wildlife and related environmental values and achieve enhancement of such resources where practicable. Restoration of land and water resources is ranked as a priority in reclamation planning.

Sustainable Fisheries Act

This Act represents a bipartisan effort to address the problems facing our Nation's fisheries. The Act includes measures to prevent fish stocks from being over-fished and to ensure that already depressed stocks are rebuilt to levels that produce maximum sustainable yields from fisheries. The Act includes a national standard to minimize the unintentional catch of non-target fish and requires that essential fish habitats be identified in each fishery management plan. User fees are being established as well as individual fishing quota and community development quota programs. The Act aims to refocus management goals and mandate tighter control over the factors affecting fish stocks. The Secretary of State, in cooperation with the Secretary of Commerce, is directed to seek to secure international agreements on the subject of bycatch reduction.

Water Resources Development Act of 1996

This Act provides important cost-sharing reforms, environmental initiatives, and new project authorizations to be undertaken by USACOE. The Act authorizes the Secretary of the Corps of Engineers to carry out water resource and development conservation projects for flood control, storm and hurricane damage prevention and reduction, environmental restoration and protections, erosion protection, hydropower, water supply, and safety improvements. (Reproduced from *Coastal Challenges: A Guide to Coastal and Marine Issues* with permission from the National Safety Council's Environmental Health Center, February 1998.)

Watershed Protection and Flood Prevention Act

Erosion, floodwater, and sediment damages in the watersheds of the rivers and streams of the United States, causing loss of life and damage to property, constitute a menace to the national welfare; and it is the sense of Congress that the Federal Government should cooperate with States and their political subdivisions, soil or water conservation districts, flood prevention or control districts, and other local public agencies for the purpose of preventing such damages, of furthering the conservation, development, utilization, and disposal of water, and the conservation and utilization of land and thereby of preserving, protecting, and improving the Nation's land and water resources and the quality of the environment. (Source: Cornell US Code Library)

General Introduction | History | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perspectives | Image Atlas | GIS Data | Bibliography | Glossary | About This CD-ROM | ACE Contacts | Site Map | Search

M E N U

Introduction

Undirected Recreational Saltwater Fishery

Directed Recreational Fishery

References

General Introduction | Cultural Resources | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perceptions | Bibliography | Glossary | Help | Site Map | Search

Recreational Fisheries
Saltwater Fisheries

Introduction

The principal species that support marine recreational fisheries include finfish, shrimp, crab, and shellfish (primarily oysters and clams). Participation in marine recreational hook and line fishing has remained fairly consistent over the last decade while effort has increased on average (Low et al. 1996). Recreational fisheries landings are compiled by the National Marine Fisheries Service (NMFS)/South Carolina Department of Natural Resources (SCDNR) Marine Resources Division (MRD)\Marine Recreational Fisheries Statistics Survey. Estimates of landings and catch per unit of effort (CPUE) are based on telephone surveys and interviews with fishermen at boat landings, fishing piers and other shore- based access points, and charter boats. CPUE estimates are important because even though catch may be increasing, the condition of the exploited stock may be worsening because the CPUE, that is, number of fish per angler hour, is decreasing.

Saltwater fishing stamp

Funding needed to compile the basic harvest data necessary for proper management and conservation of South Carolina’s marine recreational fisheries resources is generated through the Recreational Fisheries Conservation and Management Act, which became effective July 1992. This law requires that a marine recreational fisheries stamp be purchased by individuals who harvest shellfish (clams and oysters) for personal use in South Carolina marine waters or who catch, attempt to catch, or land marine fishes in the state from privately owned boats. Owners of commercial fishing piers and party boats must also purchase annual permits. A gradual increase in the number of these permits purchased over time shows the expanded utilization of marine resources by the growing coastal population (Fishing stamp purchases). Funds derived from the sale of the stamps are used specifically for enforcement, enhancement, and studies of marine recreational resources.

Preliminary surveys indicate that fishing, followed in importance by shrimping and crabbing, is the main activity of most respondents to questionnaires (Low et al. 1986). In a recent mail survey of recreational stamp holders (Waltz 1996), at least one of the major finfishing activities (inshore, offshore, shore, and pier) was marked on 97% of the responses.

Crabbing, shrimping (non-baiting), and shellfishing were other popular pastimes.

A 1994 survey of South Carolina Fishing Stamp holders revealed that approximately 62% of all coastal county respondents were urban residents (Waltz 1996, SCBCB 1994). Boat ownership in South Carolina is among the highest on the east coast, with approximately 1 registered boat for every 12 people. Boat registrations have increased both statewide and in Colleton County in the last two decades (Boat registration). Although the exact correlation between boat ownership and marine recreational fishing is unknown, 66-75% of the boats using the state's coastal boat ramps in 1986 were engaged in fishing activities (Low et al. 1986).

Back to Top

The Undirected Recreational Saltwater Fishery

- Spot
- Atlantic croaker
- Silver perch
- Hardheaded catfish
- Southern Kingfish

Methods used for catching finfish species in the ACE Basin study area are similar to fishing methods used throughout estuaries along South Carolina's coast. Tackle varies from light spinning tackle and 3.6 to 4.5 kg (8 to 10 pound) test monofilament to heavy boat rods with open-faced reels and 9 to 13.5 kg (20 to 30 pound) test monofilament. Although some anglers cast artificial baits from bridges and banks and in the surf, most use some kind of bait on standard-type bottom fishing rigs. Baits include cut fish such as striped mullet, squid, sea-worms, or shrimp which may be dead or alive, fresh or frozen. By far, shrimp is the bait of choice in the undirected fishery since almost all edible species feed on shrimp and its use will generate a catch when other baits and methods fail. This type of fishery is generally limited to the warmer months of the year when a variety of small edible fish are available. During winter, many of the species harvested in other seasons move from the estuary and seek warmer water either offshore or to the south. Information on the various species that are important to the undirected recreational fishery is provided in the following sections.

Spot: *Leiostomus xanthurus*

Spot *(Leiostomus xanthurus)*

Because of their widespread distribution and abundance in estuaries, spot are harvested by recreational anglers throughout the brackish and salt waters of the ACE Basin study area. Although spot can be caught throughout the year at a variety of locations, they are more available to fishermen during the fall months (September through mid-December), and indeed, during this period, many fishermen target spot. This fall "run" is comprised of maturing fish which form schools that migrate through inlets toward their open-ocean spawning grounds. These fishes are captured by anglers fishing from piers, bridges, and the beaches near inlets. During the time for "golden spot" (the fish moving offshore have a golden hue to their normal silver coloration), the numbers of both small boats fishing deep waters in the mouth of the Edisto and Ashepoo Rivers and anglers fishing from the Paradise fishing pier dramatically increase (W. Roumillat, 1998, pers. comm.).

Spot are caught with baited hooks fished on the bottom. Since spot are benthic "browsers," the bait needs to be placed within their feeding zone. Baits include shrimp and worms. Since spot have small mouths, the sizes of the hooks used to effectively catch them should be small. Spot taken in the recreational fishery are relatively small in size, rarely being larger than .45 kg (1 pound).

Atlantic croaker: *Micropogonias undulatus*

Atlantic croaker are abundant in deep tidal creeks and frequently co-occur with spot. As bottom feeders, they are caught with the same equipment used for spot and are often taken together with spot. They are commonly caught throughout the ACE Basin study area by shore-based fishermen with cut shrimp. It is common to hear people refer to burlap bags as "croaker sacks" because fishermen used to place the croakers that they caught in these sacks for transport home. Atlantic croaker can reach a larger size than spot; however, they rarely exceed .45 kg (1 pound) in the recreational catch.

Atlantic croaker ***(Micropogonias undulatus)***

Silver Perch: *Bairdiella chrysoura*

Since silver perch are an abundant and widely distributed fish in the ACE Basin study area, silver perch are commonly caught in all the high and moderate salinity tidal creeks of the ACE Basin study area. The same baits and tackle used for spot and Atlantic croaker are used for silver perch. These are small fishes, rarely reaching .45 kg (1 pound) in weight (W. Roumillat, 1998, pers. comm.).

Hardhead Catfish: *Arius felis*

Hardhead catfish are both abundant and widely distributed during the warmer months of the year. Since catfish are generalists in their feeding preferences, anglers fishing from bridges, boats, jetties, surf, and bank use live and cut bait as an attractant. Many anglers view this species as a nuisance and do not keep them when caught. They are taken with the same fishing tackle used for spot and Atlantic croaker. Males and females of this species may reach 0.9 kg (2 pounds) in weight (C. Wenner, 1998, pers.comm.).

Southern Kingfish: *Menticirrhus americanus*

Of all the recreational finfish considered here, southern kingfish (locally known as whiting) are the most preferred fish encountered by participants of the

Southern kingfish
(Menticirrhus americanus)

undirected fishery in the ACE Basin study area. This preference results from their high palatability. In general they are not specifically targeted by anglers but are a member of the mixed, small fish assemblage taken during the warmer months in the reaches of the ACE Basin study area near the inlets, as well as in the deeper portions of creeks and rivers in the area. Southern kingfish are also frequently taken in the surf along the front beaches of the barrier islands. The species is well represented in the creels of anglers in the more saline reaches of the ACE Basin study area. Since southern kingfish are benthic foragers, most are caught bottom fishing with cut fish or shrimp as bait. Most southern kingfish caught and retained by recreational anglers weigh less than .45 kg (1 pound); however, on occasion, anglers catch larger individuals. These are referred to as "bull whiting" along the South Carolina coast (W. Roumillat, 1998, pers. comm.).

The Directed Recreational Fishery

- Red Drum
- Spotted Sea Trout
- Southern flounder
- Black drum
- Sharks
- Shrimping
- Crabbing
- Shellfish Gathering

When inshore anglers are questioned concerning the species of fish that they are targeting on a fishing trip, three main species immediately are mentioned: red drum, *Sciaenops ocellatus*; the spotted seatrout, *Cynoscion nebulosus;* and the southern flounder, *Paralichthys lethostigma*. These three species are part of the shallow water estuarine fish fauna that are widely distributed throughout the ACE Basin study area. They are found in a variety of habitats and environmental conditions including small tidal creeks, the surf zone, and high and moderate salinities of the major rivers (Wenner et al. 1990). Although they are the most preferred species, other species targeted by anglers include black drum *(Pogonias cromis*), bluefish *(Pomatomus saltatrix)*, sheepshead *(Archosargus probatocephalus)*, and Spanish mackerel *(Scomberomorus maculatus*).Many anglers usually target one or two of these species and often have specialized gear and boats that increase their ability to fish the preferred habitats. With the exception of bluefish and Spanish mackerel, which are primarily pelagic, open-water predators, these fishes are associated with shallows, including intertidal flats with oyster reefs or other solid structure; intertidal creeks; flooded *Spartina* around high tide; and the shallow flats adjacent to *Spartina* marshes at low tide. All of these fishes are estuarine-dependent species that spend much of their lives within the confines of South Carolina's estuaries. However, large red drum, black drum, and sharks are found in deeper waters and generally require different techniques and gear to be successfully landed. Not only does the ACE Basin study area have a diversity of fishes that vary seasonally, but a variety of different life history stages can be encountered within the basin.

Red Drum: *Sciaenops ocellatus*

Red drum ***(Sciaenops ocellatus)***

The red drum is the most-sought recreational fish species in estuarine and nearshore waters of South Carolina. Red drum in state waters (inside the three mile limit) are managed by interjurisdictional plans that are adopted by North and South Carolina, Georgia and Florida. These plans are administered by the Atlantic States Marine Fisheries Commission (ASMFC). In federal waters, the harvest of red drum is managed by the South Atlantic Fisheries Management Council (SAFMC). Presently, federal law prohibits the harvest of red drum in federal waters because the species is overfished inside the jurisdictions of the individual states. Early in the 1990s, analysis of the status of the population of red drum living along the southeast coast indicated that the species was overharvested throughout its range along the east coast. A gradual reduction in the recreational harvest was implemented at that time by a variety of measures such as size limits and bag limits. Another major assessment is scheduled to be conducted in 1998-1999 to determine if those measures did indeed reduce the mortality of red drum throughout the region. There is a possibility that further restrictions may be put in place (C. Wenner, 1998, pers. comm.).

The South Carolina state law that regulates the harvest of red drum has undergone a gradual evolution from liberal size and bag limits to a much more restricted harvest as a gamefish. Gamefish status means red drum can only be landed by sportfishermen using hook and line gear or with gigs during a restricted season, and the fish can not be sold. As of 1998, there are both size and creel limits for this species in state waters. Recreational anglers can keep five fish per person per day, and these must be within the legal size of 35.6-68.6 cm (14-27 inches) total length.

Because early juvenile red drum (animals 25.4-30.5 cm or 10-12 inches long) school tightly in large numbers, they are very vulnerable to the recreational fishery. Larger juveniles school less tightly, making it more difficult to catch a large number of them in one place. The 35.5 cm (14 inch) lower size limit was established to protect smaller fish from over-harvest. Those greater than 68.6 cm (27 inches) total length are beginning to become sexually mature, and the 27-inch maximum size limit protects the spawners.

Examination of the historical catch records for the recreational fishery indicates that the subadults inside estuarine waters are the primary target of anglers. These fishes, which are mostly age two or less, are generally caught using

Angler with red drum

live (shrimp, mummichogs, striped mullet) or cut (shrimp, fish such as striped mullet) bait around oyster bars inside the estuary or along the front beaches and jetties during the warmer months (April-October). A specialized fishery, shallow water flats fishing, based on tidal movements of red drum has developed in coastal South Carolina. (See related section: Flats Fishing.)

The shallow water fishery that has developed in coastal South Carolina in the past decade is largely catch and release; that is, red drum caught in these areas are released after the battle with the angler. Some of these fish are larger than the maximum legal size (68.6 cm or 27 inches) and must be released, and some are smaller than the minimum legal size of 35.6 cm (14 inches); however, a significant percentage of them could legally be retained but are voluntarily returned to the wild. Red drum taken in the shallow water fishery range from ~ 30.5 to 81.3 cm (12 to 32 inches) in length.

A small complement of anglers fishes for red drum in the surf. They are after the large, mature fish that may weigh as much as 22.7 kg (50 lbs). Peak fishing for these “bull reds” is in spring and fall. Big fish move into the surf in late March and April from off-shore waters where they have over-wintered. Fishermen use bottom rigs baited with cut fish (striped mullet) or blue crab to entice the “bull reds” to bite. These are subsequently released since most are beyond the maximum legal size of 68.6 cm (27 inches) total length. In the fall, between the spawning season and the time of their movement into the offshore waters where they over-winter, the large red drum move into the surf. Fishing techniques are the same, and the baits include cut fish and shrimp. Other large red drum may be caught near deep holes in the various inlets through bottom fishing with cut or live bait. A favorite live bait that is readily available along the coast during all but the coldest months is the Atlantic menhaden, *Brevoortia tyrannus*, and the widely used cut bait is the striped mullet, *Mugil cephalus*.

In the ACE Basin study area, large red drum are seasonally available on the front beaches of Pine and Otter Islands and in the various deeper holes in St. Helena Sound. Also, large fish, as well as those between 2.3 and 6.8 kg (5 and 15 lbs), may be caught on the offshore bars around the mouths of inlets. These may be outside the inlets such as Deveaux Bank off the northeast shore of Edisto Island or Egg and Pelican Banks at the mouth of St. Helena Sound.

Spotted Seatrout: *Cynoscion nebulosus*

The spotted seatrout was designated as a gamefish in South Carolina’s waters in 1986 and is the

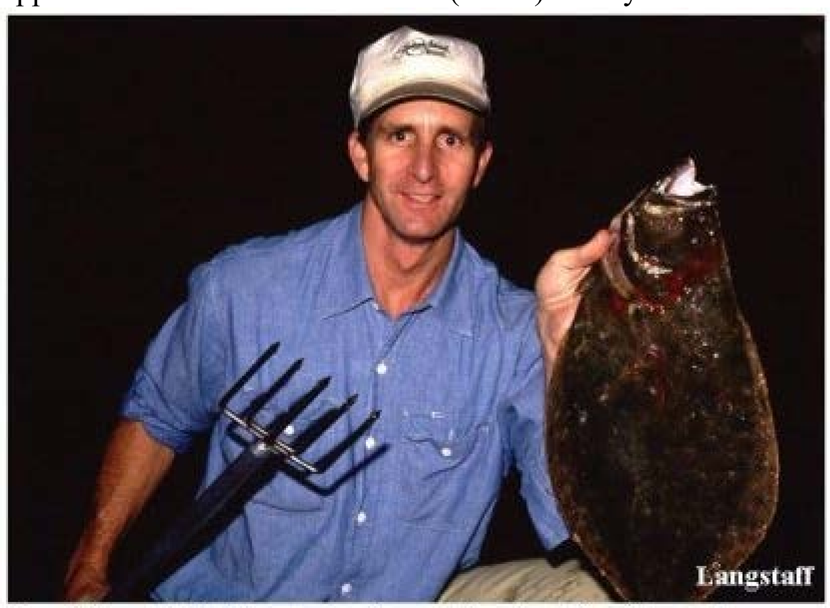
Spotted seatrout *(Cynoscion nebulosus)*

second most popular recreational species. Methods of harvest are limited to rod and reel and gigs. There is no closed season for rod and reel fishing; however, gigging is not allowed in the coldest months (December, January, and February). Other restrictions on the harvest are a 33 cm (13 inch) total length minimum size and a 10 fish per angler per day bag limit.

Although anglers are able to catch spotted seatrout during any month of the year, the greatest part of the catch is landed during fall (September through December). Some fish are caught by shore- based anglers from bridges, but most of the catch comes from anglers in small boats. This species is widely distributed throughout all of the estuarine waters of the ACE Basin study area. Fishermen use light tackle, live and artificial baits to catch this species in the area.

Southern flounder: *Paralichthys lethostigma*

Southern flounder, a favorite target species for recreational anglers, is harvested by rod and reel fishermen and by gigging at night. Regulations on the catch include a minimum size of 30.5 cm (12 inches) total length and a creel limit of twenty fish per day. Unlike red drum and spotted seatrout, the southern flounder is landed commercially as a result of bottom trawl tows made by penaeid shrimp trawlers in the nearshore waters. Their abundance in the bycatch of the penaeid shrimp fishery has declined in recent years due to the requirement that shrimp nets must be equipped with turtle excluder devices (TEDs) and by-catch reduction devices (BRDs).



Traditional fishing practice - gigging for flounder

Recreational fishing methods for this species include slow trolling with a mummichog, finger mullet, or live Atlantic menhaden very near or on the bottom of bars, flats and near the inlets; slow drifting with the tidal currents as live bait is bounced along the bottom in these same areas; drifting baits along the edges of oyster bars around late ebb or early incoming tide; and casting artificial baits in tide rips and along the edge of salt marshes.

Southern flounder are ambush predators that alter their color to blend in with the substrate. They will also flip their fins so that sand and/or mud and shell will cover the fins and break their outline, further disguising themselves. Once they are camouflaged, the flounder wait for fishes and shrimp to swim over them. They will then dart from the bottom and capture the prey. During ebb tide, they will frequently be found at the mouths of tidal creeks and rivulets that drain the flooded marsh surface. Live baits fished in these locations will frequently yield catches of southern flounders, which will also strike artificial baits like swimming plugs, jigs, grubs and spoons. The preferred and most successful method is to fish with live bait, and large mummichogs are the first choice (C. Wenner, 1998, pers. comm.).

Sheepshead: *Archosargus probatocephalus*

Sheepshead *(Archosargus probatocephalus)*

There are no regulations on the harvest of sheepshead in South Carolina's waters. As a result of their dietary regime, sheepshead are most commonly found near submerged structures, such as bridge pilings, rocks, and underwater debris. Man-made structures are uncommon in the ACE Basin study area; however, sheepshead are frequently taken near natural oyster bars in the mid- and high- salinity areas of the basin. Anglers targeting sheepshead use relatively light tackle and float live fiddler crabs (a favorite item) or penaeid shrimp over and around oyster bars. Sheepshead can also be caught by lowering shrimp or fiddler crabs next to bridge abutments and dock pilings. In general, sheepshead will not take artificial bait (C. Wenner, 1998, pers. comm.)

Black drum: *Pogonias cromis*

In South Carolina, there are no regulations in place to restrict the harvest of black drum. Large black drum (fish to 22.5 kg or 50+ pounds) are caught with heavy fishing tackle around bridge caissons and in the deeper holes at the mouths of estuaries where there is irregular bottom (i.e. relief). Since the large black drum feed on mollusks and large crabs and few anglers use these as bait, few of these fishes are caught by recreational anglers.

Sharks

On average, approximately 140,000 sharks and rays were caught each year by recreational fishermen during 1989-1995 (Recreational shark landings). While a small percentage of anglers target sharks, most are caught by individuals who are fishing for anything they can catch or by those targeting other species such as red drum (Moore and Farmer 1981). The most common species caught using hook and line is the Atlantic sharpnose shark, *Rhizoprionodon terraenovae*. There are other shark species frequently or occasionally caught in South Carolina. In general, sharks are caught in high salinity areas, close to the open ocean. However, the bull shark has been known to move into lower salinity areas including freshwater areas. Favorite areas targeted by anglers are deep holes in inlets where high currents and abundant prey species attract sharks.

The large number of shark species in South Carolina precludes a

Sharpnose shark

description of each species. The Atlantic sharpnose shark) is one of the most commonly caught shark in South Carolina waters. In viviparous species, such as the Atlantic sharpnose, the young develop inside the female, who provides nutrients throughout embryonic development. In ovoviviparous species, such as the sand tiger, the fertilized egg develops within the female but derives no nutrients other than those contained in the yolk sac (Castro 1983). Oviparity, occurring in the cat shark, is the most primitive mode of development, in which embryos are enclosed by an egg case that is released by the female and receive nutrients from a yolk formed prior to fertilization. The reproductive capacity of sharks is relatively low when compared to other fishes, with most sharks having between 1 and 70 young at a time, depending on the species. Atlantic sharpnose generally have 4-7 pups in a brood. The young of this species are fully developed at birth and look much like adults except they are smaller in size. Atlantic sharpnose are relatively small sharks, with a maximum size of about 1.2 m (4 feet). This species reaches sexual maturity at about 0.9 m (3 feet) in length. Little is known about growth rates and longevity in sharks, but all indications are that they can live for long periods (decades). The combination of low fecundity and longevity makes them susceptible to overfishing. Most sharks are predators, feeding on a variety of organisms including fish and invertebrates. Large sharks may feed on marine mammals, turtles, and other sharks.

In the past, most recreational fishermen have considered sharks as “trash” fish, a nuisance to contend with while fishing for other species during late spring and summer in high salinity areas. In more recent times, fishermen have begun to recognize that many of these sharks are capable of giving the angler a good fight. Also, if the flesh is handled correctly (bled, gutted, carefully washed, and iced), it has an excellent taste. Hook and line fishing with a variety of natural baits such as cut fish works well. Depending on the size of the target species, many anglers will use wire leaders to prevent escape once the shark is hooked. Bait is usually fished on or near the bottom. Frequently, anglers targeting shark will use a chum slick, which is a scent trail of fish oil and chopped fish that is carried by tidal current from the boat and serves as an attractant to the sharks. Release of shark is encouraged by most fishing clubs and fishery management organizations. The season begins with the warming of the inshore waters in April or May and continues through September or October. During the winter, most of the inshore sharks move into deeper, warmer, offshore waters or move south towards Georgia and Florida.

Shrimping

Excellent opportunities for recreational shrimping occur in the tidal creeks of the ACE Basin study area. Shrimp of the genus *Penaeus* are targeted by recreational fishermen, with white shrimp (*Penaeus setiferus*; recently renamed *Litopenaeus setiferus*) and brown shrimp (*Penaeus aztecus*; recently renamed *Farfantepenaeus aztecus*) being the primary species of interest. During most years, white shrimp make up the bulk of the recreational catch and are primarily caught from May through December. Brown shrimp, which are less abundant than white shrimp and comprise 30% of the harvest (Moore et al. not dated), are most abundant during June-August.

Although penaeid shrimp are relatively euryhaline and are caught throughout the estuaries of the ACE Basin study area, individual species exhibit some preference for habitat based on salinity. Brown shrimp are usually more abundant near inlets and open bays where the water is more saline, while white shrimp tend to be found in mesohaline tidal creeks and brackish water areas. Because of their ubiquity in estuarine waters, shrimp may be recreationally caught in a variety of locations such as along beaches and river banks, from bridges and piers, and from small boats. An ebbing tide appears to be preferred for shrimping since shrimp move out of the marsh as the tide recedes and are concentrated in tidal creeks and shallow margins of open water areas.

Shrimp baiting in the ACE Basin

A variety of gear types are used to catch shrimp, but the most common methods include cast nets, drop nets, and haul seines (Moore et al. not dated). Until the 1970s, the most prevalent method was the use of baited circular drop nets. In this method, shrimp that feed on the bait are captured when the drop net is raised. Casting for shrimp over bait, however, has become the most significant method of recreational harvest in recent years. Shrimp baiting involves deliberate placing of bait, mixed with clay and mud, around poles that are pushed into the sediment along shoal areas of a river or creek. Casting with cast nets begins within minutes after the poles are baited. Most shrimp baiting is done at night. Baiting and casting may also be done from docks, but poles are generally unnecessary in that situation (Theiling 1988).

Shrimp baiting was most likely introduced to South Carolina from Florida. The popularity of this method spread from Beaufort and Jasper counties to Charleston County by 1984 (Low 1991). Casting for shrimp over bait resulted in a large increase in the yield (19.6 times) compared to casting without bait (Whitaker and Wenner 1988). Due to major increases in the number of baiting participants and conflicts between baiters and the commercial fishery, regulations were passed in 1983 which made it illegal to sell shrimp taken over bait. In 1985, a catch limit per boat (50 quarts whole shrimp or 30 quarts with heads removed) was enacted. Additional restrictions were proposed in 1986 due to the eruptive growth of the fishery and increasing conflicts between commercial and recreational interests (Theiling 1988, Low 1991).

Commercial shrimp fishermen argued that capture of shrimp in estuarine nursery areas coupled with a major increase in baiting participants would result in reduced catches by shrimp trawlers. Their concern was that many of the shrimp would be captured prior to reaching the ocean where commercial trawling occurs. Seafood marketers also expressed concern that baited shrimp were being illegally sold, resulting in loss of tax revenue, potential health hazards, and lost documentation of resource harvests. Other arguments against baiting focused on the beliefs that bait poles were a hindrance to navigation, law enforcement was ineffective in enforcing regulations and apprehending lawbreakers, and that territoriality around favored baiting locations was creating conflicts among fishery participants.

Proponents of baiting countered that their activity was not environmentally harmful and did not damage bottom habitat or enhance nutrient loads via bait input, that baiting was selective for commercial grade shrimp and resulted in little by-catch, and that baiting was a fair access to a common property resource. In response to proposals to regulate the fishery, a comprehensive survey of the fall 1987 recreational baiting fishery was conducted (Theiling 1988). The survey documented participation and catch, locations of frequently used boat landings, and demographic aspects of the 1987 fishery. This survey was used in the establishment of legislation to control the shrimp fishery. In 1988 the General Assembly passed legislation to control inshore shrimping and to document usage by establishing a 60-day season between September 1 and November 15, a limit of ten poles to mark bait, a 48-quart (whole shrimp) limit per boat per day (regardless of the number of occupants or permit holders), and a requirement that at least one participant per boat have a license and pole tags.

The licensing provision allowed the SCDNR MRD to directly determine the number of permit holders. The number of licenses has increased over the years in Colleton County and in the state as a whole (Shrimp licenses). Since inception of the license, a number of post-season surveys have been conducted to collect information on the fishery (gear, fishing practices, and areas most frequently utilized) and its participants (residence location, household size, income level and occupation, and trip expenses). In most of the St. Helena Sound area, effort and total catch have increased dramatically since 1991 (Shrimp bait effort and catch). Generally, catch and effort in the southern sound areas of St. Helena and Wadmalaw/Edisto have been lower and less variable than other areas of the coast. Participation and landing figures are evidence of the rapid expansion in popularity, growth, and impact of this recreational fishery.

Crabbing

Recreational capture of the blue crab, *Callinectes sapidus*, is another popular activity in the ACE Basin study area. Fishing for blue crabs occurs year-round, although activity appears to be most intensive during the warmer months (April through November). Crabs may be caught from shore, bridges, piers or boats. Baited hand lines, dip nets, drop nets, and baited crab traps are popular gear used in the recreational fishery. If crab traps are used, no more than two pots per person may be fished without a commercial license. There is no catch limit, but all blue crab retained must meet the minimum legal size of 12.7 cm (5 inches), and egg-bearing females must be returned to the water unharmed.

Egg-bearing blue crab

In 1997, a survey of recreational blue crabbing by marine recreational fisheries stampholders was conducted by the SCDNR Office of Fisheries Management (Low 1998). This survey indicted that 27.4% of the respondents participated in recreational crabbing. Fifty-seven percent of recreational crabbing took place from shore, with crabbing from docks being most popular. Low (1998) also reported that crab pots and handlines were the most popular gear type. The average catch rate for shore crabbers was found to be lower than that indicated by boaters, while the number of trips was greater for the shore crabbers. Recreational crabbers account for approximately 25% of the total crab landings in South Carolina. In the south coastal counties of Allendale, Bamberg, Beaufort, Colleton, Hampton, and Jasper, it was estimated that the recreational crab harvest accounts for 28.8% of the total annual landings (R.A. Low, 1996, pers. comm.). For Beaufort and Colleton Counties alone, the recreational harvest was estimated to be 22.3% of the commercial harvest (Low 1998).

Shellfish Gathering

Shellfish beds

Recreational harvesting of oysters and clams on the state shellfish grounds of the ACE Basin study area is a popular activity. There are 4070 hectares (10,049 acres) of state shellfish grounds within the ACE Basin study area. State shellfish grounds are open to all persons, and commercial harvesting is allowed with a permit. Most of the shellfish grounds are accessible only by boat. Recreational harvest is prohibited on grounds leased to commercial fishermen unless permission in writing has been granted. Other shellfish grounds may be completely closed to harvesting due to pollution. These areas have been closed by the South Carolina Department of Health and Environmental Control and are posted with warning signs indicating that taking of clams, oysters, or mussels is prohibited (See map of closed shellfish areas)(Moore et al. not dated).

Most oysters in South Carolina are intertidal, making them accessible for recreational harvest. Because oysters grow in clusters, a small hammer or pick is generally used to break off the larger oysters. Clams, which are usually buried 2-3 inches in sandy mud, are dug by hand with a shovel or rake. Oyster season opens each year on September 15 and closes on April 30, while clams are harvested from September 1 to May 31. Recreational shellfish harvesting is restricted to a total of two bushels of oysters and one-half bushel of clams per head-of-household in any one day, for no more than two days in any one week, from state shellfish bed.

Little historical information is available on the recreational harvest of shellfish in South Carolina. Several creel and mail surveys were conducted in the 1980s. These studies indicated that respondents averaged from 3 to 5 trips per season and harvested from 0.9 to 1.5 bushels of oysters per person per trip and from 0.05 to 0.3 bushels of clams per person per trip. Based on a recent survey of individuals who purchased a SC Saltwater Fishing Stamp, total recreational catch and number of trips were estimated. Most of the individuals making trips and harvesting shellfish resided in coastal counties (Waltz 1996). Participation and effort were fairly evenly distributed coast wide with the southern counties of Beaufort, Jasper and Colleton accounting for 31% of the participants and 35% of the reported trips. In 1993/94, an average of 0.66 bushels of oysters and 0.196 bushels of clams was harvested per person per trip. Comparisons with the total reported commercial harvest for the state indicate that the recreational harvest amounted to 43% of the total take of 186,018 bushels of oysters and 30% of the 37,063 bushels of clams for the 1993/94 season.

Back to Recreational Fisheries

Authors

C. Wenner, SCDNR Marine Resources Research Institute

W. Roumillat, SCDNR Marine Resources Research Institute

E. Wenner, SCDNR Marine Resources Research Institute

G. Riekerk, SCDNR Marine Resources Research Institute

References

Castro, J.I. 1983. The sharks of North American waters. Texas A&M University Press, College Station, TX.

Low, R.A. 1991. The pros and cons of shrimp baiting. Coastal Perspective (spring 1991):1-4.

Low, R. A. 1995. Survey of the South Carolina Shrimp Baiting Fishery 1997. Marine Resource Division Data Report no. 29. South Carolina Department of Natural Resources, Charleston, SC.

Low, R.A. 1996. Personal communication. South Carolina Department of Natural Resources, Marine Resources Division. Charleston, SC.

Low, R. A. 1997. Survey of the South Carolina Shrimp Baiting Fishery 1996. Marine Resource Division Data Report no. 25. South Carolina Department of Natural Resources, Charleston, SC.

Low, R.A. 1998. Survey of recreational blue crabbing by marine recreational fisheries stampholders. Marine Resource Division Data Report no. 30. South Carolina Department of Natural Resources, Charleston, SC.

Low, R.A., W. Waltz, R. Mattore, and C. Moore. 1986. South Carolina marine recreational fishery survey, 1985 and 1986. Marine Resources Division Technical Report, No. 65. South Carolina Wildlife and Marine Resources Department, Marine Resources Division, Charleston, S.C.

Low, R. A., C.W. Waltz, and D.B. Stone, III. 1992. South Carolina marine recreational fishery survey, 1990. Marine Resources Division Data Report no. 10. South Carolina Wildlife and Marine Resources Department, Charleston S.C.

Low, R. A., C.W. Waltz, and D.B. Stone, III. 1993. South Carolina marine recreational fishery survey, 1992. Marine Resources Division Data Report no. 16. South Carolina Wildlife and Marine Resources Department, Charleston, S.C.

Low, R. A., C.W. Waltz, and D.B. Stone, III. 1995. South Carolina marine recreational fishery survey, 1993. Marine Resources Division Data Report no. 19. South Carolina Wildlife and Marine Resources Department,

Low, R. A., C.W. Waltz, and D.B. Stone, III. 1995. South Carolina marine recreational fishery survey, 1994. Marine Resources Division Data Report no. 17. South Carolina Department of Natural Resources, Charleston, SC.

Low, R.A., C.W. Waltz, and D.B. Stone III. 1996. South Carolina marine recreational fishery survey, 1995. Marine Resources Division Data Report, No. 24. South Carolina Department of Natural Resources, Charleston, SC.

Moore, C.J. and C.H. Farmer. 1981. An angler's guide to South Carolina sharks. South Carolina Marine Resources and Conservation Foundation, Charleston, SC.

Moore, C.J., D. L. Hammond, M. Bell, and E.C. Roland. Not dated. A guide to saltwater recreational fisheries in South Carolina. South Carolina Wildlife and Marine Resources Department, Charleston, SC.

Roumillat, W. 1998. Personal communication. South Carolina Department of Natural Resources, Marine Resources Division. Charleston, SC.

[SCBCB] South Carolina Budget and Control Board. 1994. South Carolina Statistical Abstract. State Data Center, Columbia, SC.

Theiling, D. 1988. Assessment of participation and resource impact of shrimp baiting in coastal South Carolina during 1987. South Carolina Marine Resources Center Technical Report, No. 69. South Carolina Wildlife and Marine Resources Department, Charleston, SC.

Waltz, W. 1996. South Carolina saltwater fishing stamp survey, 1994. Project Report. South Carolina Department of Natural Resources, Charleston, SC.

Wenner, C. 1998. Personal communication. South Carolina Department of Natural Resources, Charleston, SC.

Wenner, C. 1998. Personal communication. South Carolina Department of Natural Resources, Marine Resources Division. Charleston, SC.

Wenner, C.A., W.A. Roumillat, J.E. Moran Jr., M.B. Maddox, L.B. Daniel III, and J.W. Smith. 1990. Investigations on the life history and population dynamics of marine recreational fishes in South Carolina. Part I. Report to Fish Restoration Act under Project F-37. South Carolina Department of Natural Resources, Charleston, SC.

Whitaker, J.D. and E.L. Wenner. 1988. Species and size composition of *Penaeus* taken by baiting in South Carolina estuaries. Unpublished report. South Carolina Marine Resources Center, Charleston, SC.

General Introduction | Cultural Resources | Environmental Conditions | Biological Resources | Species Gallery | Socioeconomic Assessment | Resource Use | Resource Management | Synthesis Modules | Community Perceptions | Bibliography | Glossary | Help | Site Map | Search