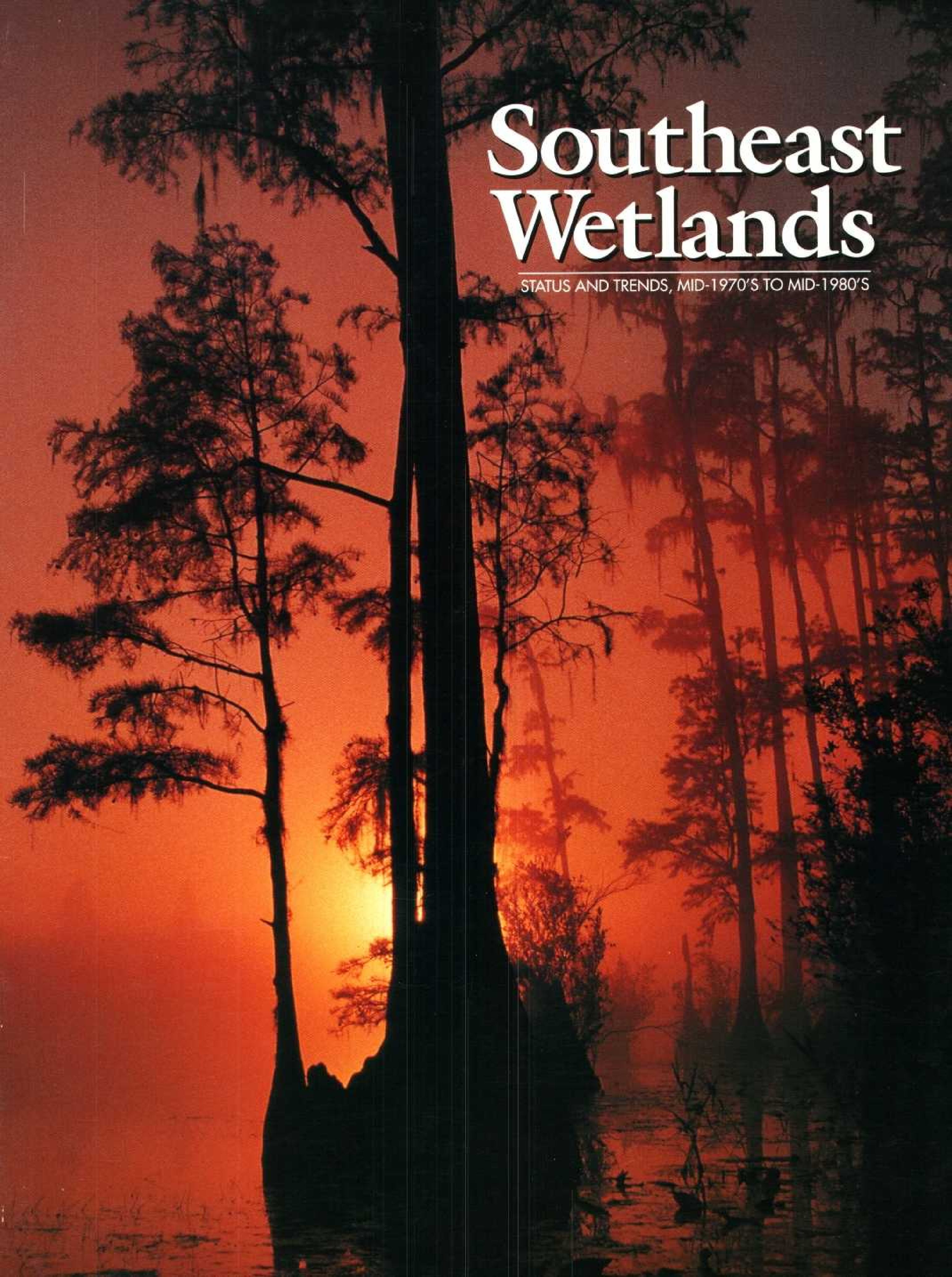
Southeast Wetlands

STATUS AND TRENDS, MID-1970'S TO MID-1980'S



Lutcher Moore Swamp, Louisiana
PALUSTRINE FORESTED
NANCY WEBB©

ACKNOWLEDGMENTS

This report is the result of work by many individuals within the U.S. Fish and Wildlife Service and others. Special thanks are extended to Dr. Donald Woodard, Director and his staff at the National Wetlands Inventory Center in St. Petersburg, Florida; and to Mark Newcastle, Division of Printing in Washington, D.C.; to Keith Patterson and staff at Geonex-Martel, Inc. in St. Petersburg, Florida; to Eric Hughes and Robert Lord with the U.S. Environmental Protection Agency in Atlanta, Georgia.

We are especially grateful for the efforts of Thomas Gale, Gale Communications in St. Paul, Minnesota, for editing, layout and other help in preparation of the final document.

We would also like to thank the many people who shared their wetland photographs with us including John Gahr, Wendel Metzen, Kevin Moorhead, John Oberheu, Larry Ditto, Louis Justice, George Gentry, Nora Murdock, and others with the Tennessee Valley Authority, the Kentucky State Nature Preserves Commission, the United States Soil Conservation Service, and the South Carolina Division of Tourism.

Our very special appreciation is extended to Nancy Webb of Zachary, Louisiana, for providing us with some of the most unusual and beautiful wetland photographs we have seen.

Cover photo:
Okefenokee National Wildlife Refuge, Florida
PALUSTRINE FORESTED
GEORGE GENTRY©

Page 2 photo:
Okefenokee National Wildlife Refuge, Florida
PALUSTRINE FORESTED
GEORGE GENTRY©

This report should be cited as follows:

Hefner, J.M., B.O. Wilen, T.E. Dahl and W.E. Frayer. 1994. Southeast Wetlands; Status and Trends, Mid-1970's to Mid-1980's. U.S. Department of the Interior, Fish and Wildlife Service, Atlanta, Georgia. 32 pages.

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-045537-5

Southeast Wetlands

STATUS AND TRENDS, MID-1970'S TO MID-1980'S

J.M. Hefner
U.S. Fish and Wildlife Service
Atlanta, Georgia

B.O. Wilen
U.S. Fish and Wildlife Service
Washington, D.C.

T.E. Dahl
U.S. Fish and Wildlife Service
St. Petersburg, Florida

W.E. Frayer
Michigan Technological University
Houghton, Michigan

A 1994 Cooperative Publication by

United States Department of the Interior
Fish and Wildlife Service
Southeast Region
Atlanta, Georgia

United States Environmental Protection Agency
Region IV
Atlanta, Georgia

Yellow Fringed-orchid
PALUSTRINE EMERGENT
NANCY WEBB©

Contents

List of Figures

List of Tables

Highlights

- Nearly half (47 percent or 48.9 million acres) of the wetlands in the conterminous United States are in the 10 states of the Southeast — Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina and Tennessee. Wetlands and deepwater habitats comprise 21 percent of the region's area.

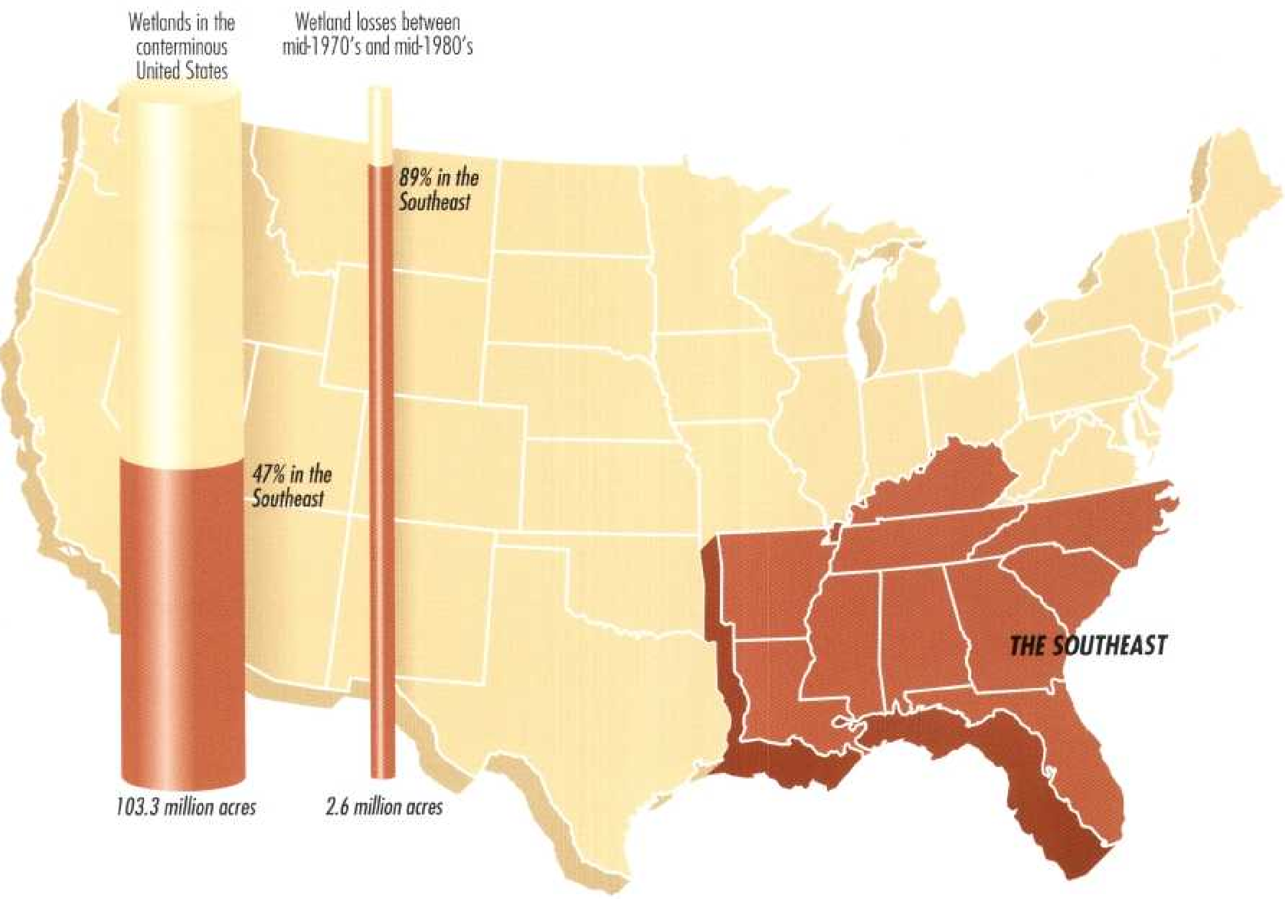
- Wetlands alone cover 16 percent of the region's area, compared to a 5-percent overall coverage in area for the lower 48 states.

- From the mid-1970s to the mid-1980s, the average annual net loss of wetlands in the Southeast was 259,000 acres. Wetland losses within the region accounted for 89 percent of the net national wetland losses for the period.

- Estuarine (saltwater) wetland acreages remained stable throughout most of the region except for coastal Louisiana, where substantial losses were identified.

- Freshwater wetlands declined dramatically. Forested wetlands such as bottomland hardwood swamps and cypress sloughs declined by 3.1 million acres, with heaviest losses in the Gulf-Atlantic Coastal Flats of North Carolina and in the Mississippi Alluvial Plain in Arkansas, Mississippi and Louisiana.

- North Carolina stood out among all southeastern states with an estimated loss of 1.2 million acres in palustrine forested and scrub/shrub wetlands. Although the average annual net loss for all combined wetland types declined compared to earlier periods, the rate at which freshwater forested wetlands were lost and converted increased.



Left: Wood Ducks
LARRY R. DITTO©

Figure 2. Study area: Southeast Region of the U.S. Fish and Wildlife Service

Executive Summary

The U.S. Fish and Wildlife Service prepares reports on the status and trends of wetlands and deepwater habitats of the conterminous United States on a 10-year cycle, in accordance with the Emergency Wetlands Resources Act of 1986 {16 U.S.C. 3931(a)}.

The most recent report in the series (Dahl and Johnson 1991) evaluated wetland trends for the period from the mid-1970's to mid-1980's. The national study design was such that region-specific — and in some cases state-specific — information also could be developed. The present report analyzes data collected for the 10-state Southeast Region of the Fish and Wildlife Service (Fig.1).

The design of this regional study consisted of a stratified random sample of 2,204 plots drawn from the national sample of 3,629 plots. Aerial photography from the mid-1970's and mid-1980's (mean dates 1974 and 1983) for each of the plots was analyzed to detect changes in wetlands and deepwater habitat acreage.

Changes were determined to be either natural or human-induced. The wetland acreage estimate for the mid-1980's was subtracted from the estimate for the mid-1970's and divided by the nine-year study period for an estimate of average annual net loss.

Results show an estimated 51.2 million acres of wetlands in the 10 Southeast states in the mid-1970's. By the mid-1980's, wetlands were reduced to 48.9 million acres, including 44.6 million acres of freshwater wetlands and 4.3 million acres of estuarine wetlands. The net loss within the region was more than 2.3 million acres, making the average annual net loss approximately 259,000 acres. Nearly all the losses were from freshwater wetlands.

In the mid-1980's, wetlands comprised 16 percent of the regional landscape. By contrast, wetlands covered only 5 percent of the total area of the lower 48 states. Southeast wetlands represented 47 percent of the total wetlands in

Cat Island, Louisiana
PALUSTRINE FORESTED
©NANCY WEBB

the conterminous United States. Nearly half of the freshwater wetlands and over three-quarters of the estuarine wetlands of the lower 48 states are in the region. Wetland losses within the Southeast represented 89 percent of the net national losses during this period.

Estuarine (saltwater) wetlands declined by about 1 percent, with an estimated net loss of 50,000 acres. The loss rate for estuarine wetlands was substantially less than estimates for previous decades. However, the estuarine loss did not encompass all coastal wetland losses, because some coastal areas also contain extensive freshwater wetlands that had losses. Most estuarine wetland losses occurred along the northern Gulf Coast, especially in Louisiana. Estuarine wetland acreage remained stable throughout the rest of the region.

Palustrine (freshwater) wetlands showed a net decline of 2.3 million acres (4.8 percent). Over 3.1 million acres of forested wetlands (bottomland hardwoods, cypress sloughs, etc.) were lost or converted to other wetland types. Losses were particularly acute in the Lower Mississippi Alluvial Plain (Louisiana, Mississippi and Arkansas) and in the Gulf-Atlantic Coastal Flats of North Carolina (Fig. 2).

Palustrine nonvegetated wetlands increased by 400,000 acres. Most of the increase came from conversion of non-wetlands to farm ponds, ponds in residential areas and other small impoundments.

Although urban development increased, the effect on wetlands was relatively small compared to other factors. Wetland conversions to non-wetlands were distributed nearly evenly between agriculture and "other" land, such as forests and barren lands. This is a change from previous decades when agricultural development was the primary cause of wetland loss.

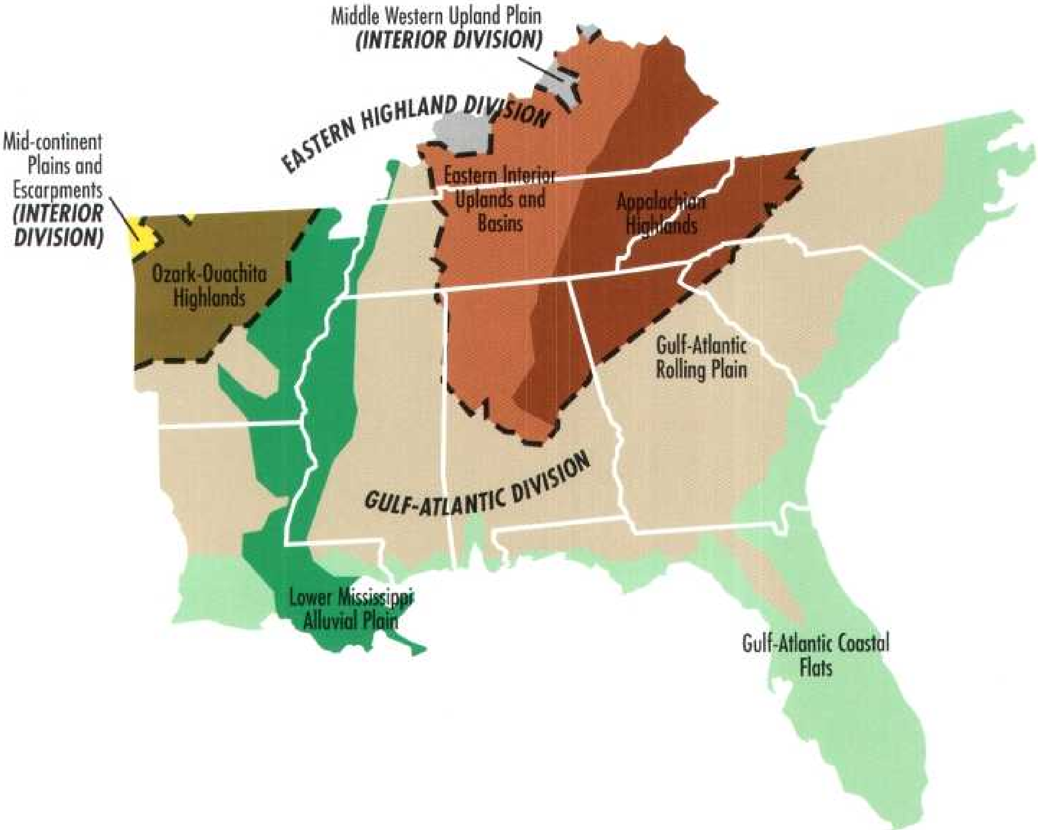


Figure 2. Map of the physical subdivisions of the Southeast (Hammond 1970).

Introduction

Extensive floodplains, wide coastal plains and abundant rainfall have created rich and diverse wetland resources in the Southeast (Fig. 1). At the time of European settlement, wetlands may have occupied a third of the land surface within this portion of the United States (Dahl 1990). Nearly half of Louisiana and Florida may have been wetlands.

The landscape in this region, as in most of the eastern United States, has been altered dramatically over the past 200 years. Wetlands have been drained to develop agricultural and forestry resources; they have been filled or otherwise altered to construct commercial and urban developments, transportation networks and navigational facilities (Tiner 1984).

Southeast wetlands play an integral role in the region's quality of life — maintaining water quality and quantity, supporting diverse and plentiful fish and wildlife habitat, and providing economic livelihood and recreation for millions of people.

A few specific examples of the contribution of wetlands to the region are noted here.

A single 2,300-acre Georgia floodplain wetland naturally provides pollution control benefits worth an estimated $1 million each year (Wharton 1970). The 552,000-acre Green Swamp complex northeast of Tampa, Florida, stores water for eventual aquifer recharge with an estimated value of $25 million annually (Brown 1984). The value of standing timber in southern wetland forests has been estimated at $8 billion (Tiner 1984).

The wetlands of the Gulf Coast from Alabama to Louisiana provide winter habitat for more than 400,000 geese and three million ducks (Mississippi Flyway Council 1991). Louisiana is second only to Alaska in volume of commercial fishery landings with a harvest of over 1.2 billion pounds, with a value of $264 millon in 1989 (National Marine Fisheries Service 1991). Louisiana's catch is made up primarily of wetland-dependent species such as brown shrimp, white shrimp, blue crab, seatrout and spot (Gosselink 1984).

KEN TAYLOR/N.C. WILDLIFE RESOURCES COMM.

ENVIRONMENTAL QUALITY SUPPORT

Water Quality Maintenance
- Pollution Filter
- Sediment and Toxicant Trapping
- Oxygen Production
- Nutrient Cycling
- Chemical and Nutrient Absorption

Biogeochemical Cycling
Primary Productivity
Microclimate Regulation
Biospheric Stabilization
Biodiversity

JOHN GAHR

FISH AND WILDLIFE HABITAT

Fish and Shellfish
Waterfowl, Wading Birds, Shorebirds and Other Birds
Furbearers and Other Mammals
Reptiles and Amphibians
Plant Communities
Endangered Species

Freshwater fishes of the region also depend on wetlands. For example, 53 species of fish are known to use flooded bottomland hardwood wetlands during their life cycles (Wharton et al. 1981).

Wetlands provide the region with a variety of recreational opportunities as well. In 1985 alone, more than two million people fished Florida's fresh waters. Nearly one million people each year visit Everglades National Park, America's largest wetland park and a designated Wetland of International Importance (Ramsar Convention Bureau). Table 1 provides a representative list of wetland values.

To manage wetlands resources effectively, it is important to understand their extent and the influences that may be affecting them. Hefner and Brown's (1984) report on wetland trends in the Southeast Region estimated the rate of wetland conversion in the Southeast from the mid-1950's to the mid-1970's, a time immediately preceding governmental wetland protection efforts.

The present report covers a period in which government programs and policies — and environmental awareness — were beginning to influence wetland management decisions. This regional information can serve as an indicator of the effectiveness of public policies and programs intended to reduce the loss of the nation's wetlands and to identify areas experiencing wetland change.

GEORGE GENTRY©

SOCIO-ECONOMIC VALUES

- Product Source
  - Timber
  - Peat
  - Forage
  - Fish and Shellfish
  - Fur and Other Wildlife Products
  - Food
  - Medicine
  - Aquaculture
- Recreation
- Wastewater Treatment
- Water Supply
- Aesthetics
- Education and Scientific Research
- Bank Stabilization
- Cultural Heritage
- Archaeological Resource
- Uniqueness

HYDROLOGIC FUNCTIONS

- Flood Control
- Wave Dampening
- Erosion Control
- Groundwater Recharge
- Groundwater Discharge
- Flow Stabilization
- Saltwater Intrusion Prevention

SOUTH CAROLINA DIVISION OF TOURISM

Table 1 (both pages). Major wetland functions and values: Fish and wildlife habitat, environmental quality support, socio-economic values, hydrologic functions.

Survey Methods

Survey procedures for this study were first used by Frayer et. al. 1983. The method was reviewed and approved prior to its use by statisticians from the Fish and Wildlife Service, Forest Service, Soil Conservation Service and the Army Corps of Engineers. It has been employed for a series of national (Frayer et al. 1983, Dahl and Johnson 1991, Frayer 1991) and regional wetland status and trend studies (Frayer et al. 1989, Hefner and Brown 1984).

The Southeast regional status and trends study consists of a stratified random sample of 2,204 plots. Each plot is four square miles, or 2,560 acres, and is permanently established for periodic reevaluation. The samples are stratified based on physical subdivisions (Hammond 1970)(Fig. 2), and state boundaries (Fig. 1) with the addition of a coastal stratum along the Gulf of Mexico and Atlantic coasts. The coastal stratum was added to incorporate estuarine and marine wetlands that extended beyond the continuous land mass. Sample plots were allocated to each stratum in proportion to the expected wetland density based on estimates by Shaw and Fredine (1956). Table 2 shows the number of plots within each state. Table 3 shows plot distribution within the physical subdivision strata.

Aerial photography was the basic information source. Two sets of photographs were analyzed for each study plot. The mean years of the aerial photography for the study were 1974 and 1983 (Table 2). This nine-year interval was used for calculating average annual wetland change estimates. The 1970's photography was primarily black and white at 1:80,000 or 1:60,000 scale, while the 1980's images were principally color infrared at 1:58,000 scale.

Aerial photographs were interpreted and cover types delineated according to procedures developed by the National Wetlands Inventory (U.S. Fish and Wildlife Service 1990a; 1990b). Wetlands, deepwater habitats and uplands identified on the photographs were assigned to one of 16 categories listed in Table 4 and described in Appendix A. All changes were determined to be either natural (e.g. scrub/shrub wetland succeeding to forested wetland) or human-induced (e.g. conversion of wetland to residential development or agricultural usage). Non-wetland areas were assigned to one of three general land-use categories: agricultural, urban and "other."

Delineations on the interpreted aerial photographs were transferred to overlays on 1:24,000-scale U.S. Geological Survey topographic maps. Measurements of the various categories were made and acreages recorded for analyses. Changes in wetland area from the mid-1970's to mid-1980's for each sample plot were also determined from these maps, measured and recorded. Regional and state estimates were developed from the sample plot data using the statistical procedures presented by Frayer et al. (1983). As with previous status and trends studies by the Fish and Wildlife Service, this study is a quantitative measure of wetlands. No assessment of wetland quality other than changes in areal extent was made.

Table 2. Distribution of sample plots and mean dates of aerial photographic coverage, by state.

State	Plots	1970's Date	1980's Date
Alabama	76	1975	1981
Arkansas	127	1974	1983
Florida	644	1974	1984
Georgia	206	1975	1982
Kentucky	17	1972	1982
Lousiana	637	1974	1983
Mississippi	96	1973	1982
North Carolina	235	1973	1983
South Carolina	133	1973	1983
Tennessee	33	1972	1981

Table 3. Distribution of sample plots within physical subdivisions (Hammond 1970).

Physical Subdivision	Sample Plots
Appalachian Highlands	21
Eastern Interior Uplands and Basins	17
Gulf-Atlantic Coastal Flats	762
Gulf-Atlantic Rolling Plain	440
Lower Mississippi Alluvial Plain	335
Mid-Continent Plains and Escarpments	3
Middle Western Upland Plain	4
Ozark-Ouachita Highlands	12
Coastal Zone	610

Table 4. Wetland, deepwater and upland habitat categories used in this study. (Detailed description in Appendix A)

Saltwater Habitats**	Common Description
Marine Intertidal	Ocean beaches, bars, and flats
Estuarine Subtidal*	Open water of bays and sounds
Estuarine Intertidal Emergents	Salt marshes
Estuarine Intertidal Forest/Shrub	Mangroves & other estuarine shrubs
Estuarine Intertidal Unconsolidated Shore	Beaches, bars and flats

Upland Land Use***	Common Description
Agriculture	Croplands and pastures
Urban	Cities, towns and other built-up areas
Other Uplands	Forest, range land and barren land

Freshwater Habitats**	Common Description
Palustrine Forested	Swamps, bottomland hardwoods, etc.
Palustrine Scrub/Shrub	Shrub wetlands
Palustrine Emergents	Fresh marshes, wet meadows, etc.
Palustrine Unconsolidated Shore	Beaches, bars, and flats
Palustrine Unconsolidated Bottom	Open water ponds
Palustrine Aquatic Beds	Floating or submerged vegetation
Riverine*	Open water within river channels
Lacustrine*	Lakes and reservoirs

* *Deepwater Habitats*
** *Adapted from Cowardin et al. (1979)*
*** *Adapted from Anderson et al. (1976)*

Norris Dam, Tennessee
LACUSTRINE
TENNESSEE VALLEY AUTHORITY

Results

Estimates for acreage changes from the mid-1970's to the mid-1980's were developed for 13 wetland and deepwater habitat categories within the Southeast Region (Fig. 1). Data tables for the region are presented in Appendix B.

Regional Status

There were an estimated 51.2 million acres of wetlands in the Southeast Region in the mid-1970's. An estimated 48.9 million acres remained by the mid-1980's. The average annual net loss for the period was 259,000 acres. In the mid-1980's, 91 percent of the region's wetlands (44.6 million acres) were palustrine (freshwater). The remaining 9 percent (4.3 million acres) were estuarine wetlands (Fig. 3).

The estuarine intertidal emergent category accounted for 73 percent of estuarine wetlands. Another 16 percent were estuarine forested/shrub, principally mangrove-dominated habitats. Approximately 11 percent of all estuarine wetlands were nonvegetated, e.g. saltflats, mudflats and sandbars (Fig.4).

Palustrine forested wetlands represented 74 percent of all freshwater wetlands in the region. Freshwater emergent wetlands made up 13 percent. Wetlands dominated by shrubs comprised 10 percent. Palustrine unconsolidated bottom (freshwater ponds) were 3 percent of the total (Fig.5).

Wetlands covered approximately 16 percent of the Southeast landscape in the mid-1980's. Deepwater habitats occupied an additional 5 percent of the area for a combined total of 21 percent of the region's acreage (Fig. 6).

Wetlands are present in every physical subdivision of the Southeast. The highest wetland density occurred in the combined area of the Gulf-Atlantic Coastal Flats and Coastal Zone, where wetlands covered 31 percent of the landscape. Although these two areas represent less than a fourth of the region, nearly half of the region's wetlands occur there. More than three-quarters of the deepwater habitat acreage in the Southeast was estimated within these physical subdivisions, primarily due to extensive estuarine subtidal habitats in the Coastal Zone.

Figure 3
Wetlands of the Southeast

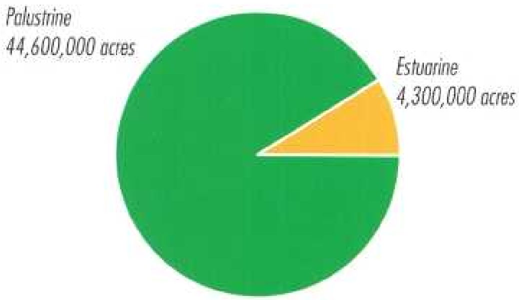


Figure 4
Estuarine wetlands of the Southeast

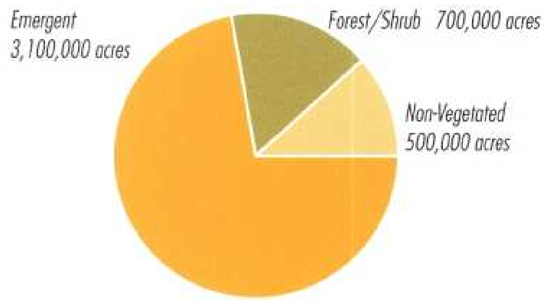


Figure 5
Palustrine wetlands of the Southeast

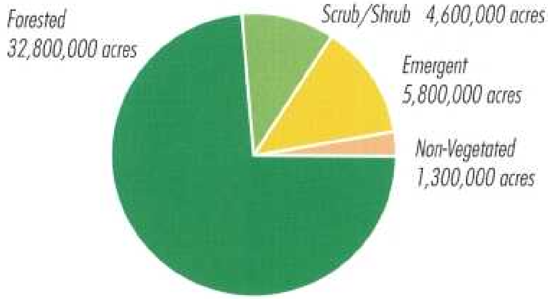
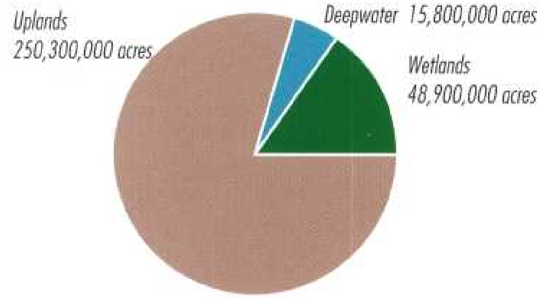


Figure 6
Wetlands, deepwater habitats and uplands of the Southeast



Regional Trends

Estuarine Wetlands

Estuarine wetlands declined by 1.2 percent, a net loss of 50,000 acres. This does not include all of the coastal wetland losses during the study period because most coastal areas also contain extensive palustrine wetlands that may have experienced losses. Therefore, the overall loss of coastal wetlands in states like Louisiana cannot be derived exclusively from losses of estuarine wetlands.

An increase in estuarine intertidal nonvegetated habitats partially masked a 60,000-acre decrease in estuarine intertidal emergent wetlands (saltmarshes). Nearly all saltmarsh loss and most of the increase in nonvegetated habitats occurred in Louisiana. There was little change in mangrove-dominated habitats. Estuarine subtidal (bay bottoms) increased by 27,000 acres; virtually all the increase was the result of saltmarsh loss in Louisiana. Except for coastal Louisiana, the acreage of estuarine wetlands and deepwater habitats remained stable from the mid-1970's to mid-1980's.

Figure 7

Palustrine wetland gains and losses in the Southeast

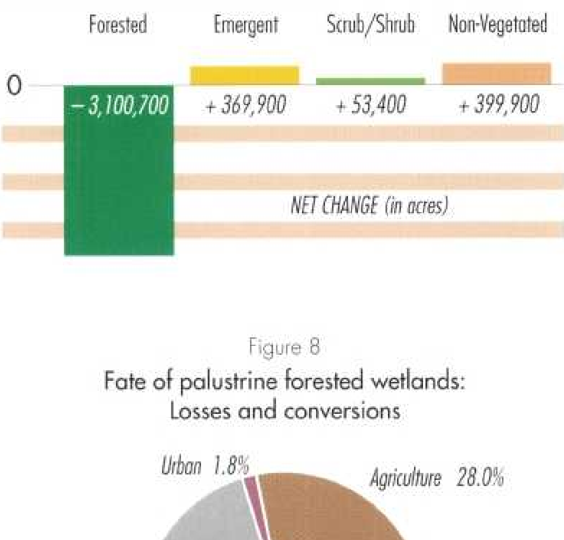
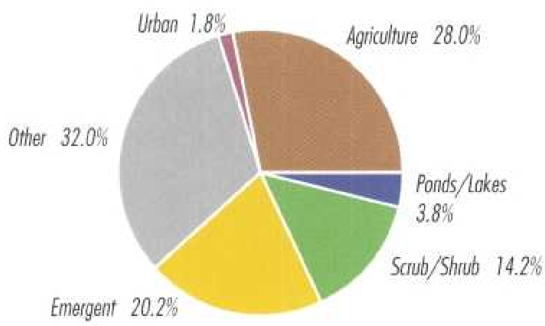


Figure 8

Fate of palustrine forested wetlands: Losses and conversions



Palustrine Wetlands

Freshwater wetlands declined by 4.9 percent, a net loss of 2.3 million acres, from the mid-1970's base. Palustrine forested wetlands suffered large losses. All other freshwater categories showed slight net increases from conversions of palustrine forested wetlands to those categories (Fig. 7).

Approximately 3.1 million acres of palustrine forested wetlands (9 percent) were lost or converted. Nearly two-thirds of this decrease was actual wetland loss to agriculture and the "other" (i.e. forest, range land and barren land) upland category. Most of the remaining decrease resulted from conversions to other wetland types, particularly palustrine scrub/shrub and emergent wetlands (Fig. 8).

More than two-thirds of the palustrine forested wetland loss took place in the Lower Mississippi Alluvial Plain (Louisiana, Mississippi and Arkansas) and the Gulf-Atlantic Coastal Flats, especially in North Carolina. Nearly 900,000 acres were lost to agriculture in the Lower Mississippi Alluvial Plain. Within the Gulf-Atlantic Coastal Flats of North Carolina, 887,000 acres were lost, nearly all of which went to the "other" category. There were no identifiable gains to palustrine forested wetlands within the region.

Palustrine emergent wetlands showed a net increase, with losses offset by conversion (i.e. cleared but otherwise unaltered) of palustrine forested to the palustrine emergent category (Table 5).

Table 5. States with large conversions from palustrine forested to palustrine emergent wetlands.

Georgia	184,000 acres
Mississippi	101,000 acres
Louisiana	89,000 acres
Arkansas	86,000 acres

There were large losses of palustrine emergent wetlands at specific locations. For example, nearly 108,000 acres were lost to agriculture in Florida. Regionwide, agriculture claimed 209,000 acres of palustrine emergent wetlands. More than 13,000 acres of palustrine emergent wetlands were lost to urban development — mainly in Florida — and 89,000 acres went to the category "other," mostly in North Carolina.

Palustrine scrub/shrub wetlands showed no measurable net change. As with palustrine emergent wetlands, scrub/shrub losses were offset by conversions of palustrine forested wetlands.

More than 719,000 acres of palustrine forested wetlands were converted to scrub/shrub wetlands. A third of this conversion took place in Georgia. More than 181,000 acres of palustrine emergent wetlands succeeded to scrub/shrub wetlands — more than half of this in Florida.

During the study period, 112,000 acres of palustrine scrub/shrub wetlands were lost to agriculture. Florida accounted for approximately half of this loss with the remaining losses spread among North Carolina, Mississippi, Georgia and Arkansas. About 272,000 acres of scrub/shrub wetlands were lost to "other," predominantly in North Carolina.

Palustrine nonvegetated wetlands, e.g. mudflats, beaches, sandbars and small water bodies, increased by 43 percent, or 400,000 acres. Water bodies such as farm ponds, mine pits, golf course and residential ponds accounted for most of the increase in nonvegetated freshwater wetlands. More than half of the increase occurred in Arkansas. Most of the increases came from upland areas, predominantly from the "other" category. In general, these wetland increases did not affect the acreage totals of vegetated wetlands or agriculture.

Deepwater Habitats

There was a net increase of 199,000 acres of lakes (lacustrine habitat) during the study period. Most of the increased acreage came from the upland categories of agriculture and "other," with some increases from palustrine scrub/shrub and forested wetlands.

State Analyses

The number of sample plots within each state was based on the anticipated density and variability of the wetlands (see Survey Methods). The reliability and extent of the state-specific estimates varies. Precise estimates were possible for states with large sample sizes (Louisiana and Florida), while estimates were much less reliable for states with very small sample sizes (Kentucky and Tennessee). State trend information is summarized in Table 6. Wetland acreage estimates, the percent of land surface occupied by wetland and net wetland losses for each state are summarized in Figure 9.

Alabama

Wetlands covered approximately 2.7 million acres or nearly 8 percent of Alabama. Palustrine forested wetlands made up over 80 percent (2.2 million acres) of the total. The net loss of wetlands was estimated to be 42,000 acres. The principal cause of the net wetland loss was agricultural development.

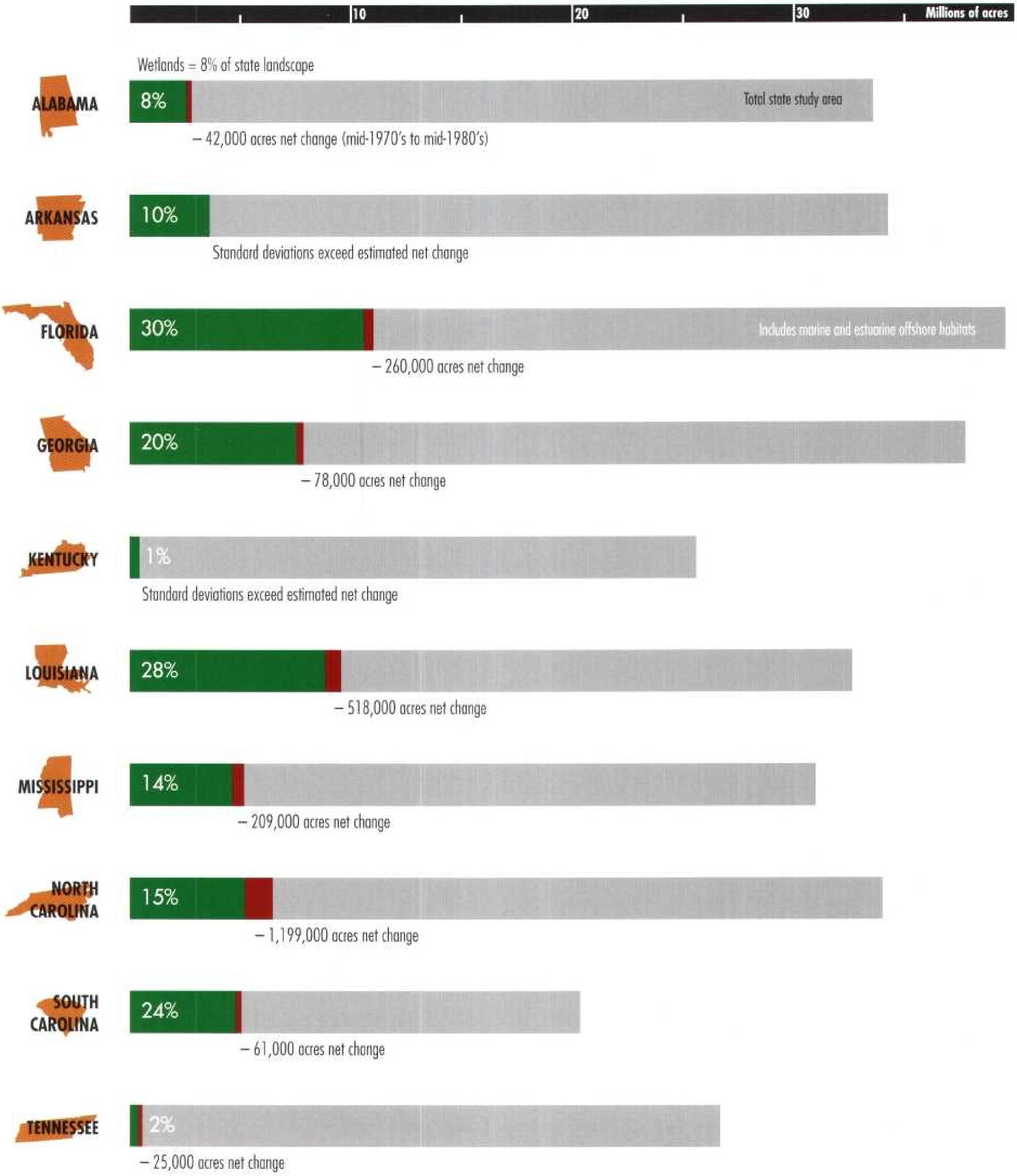
Table 6. Wetland trends for the Southeast states, mid-1970's to mid-1980's. Standard error percent is shown as SE%.

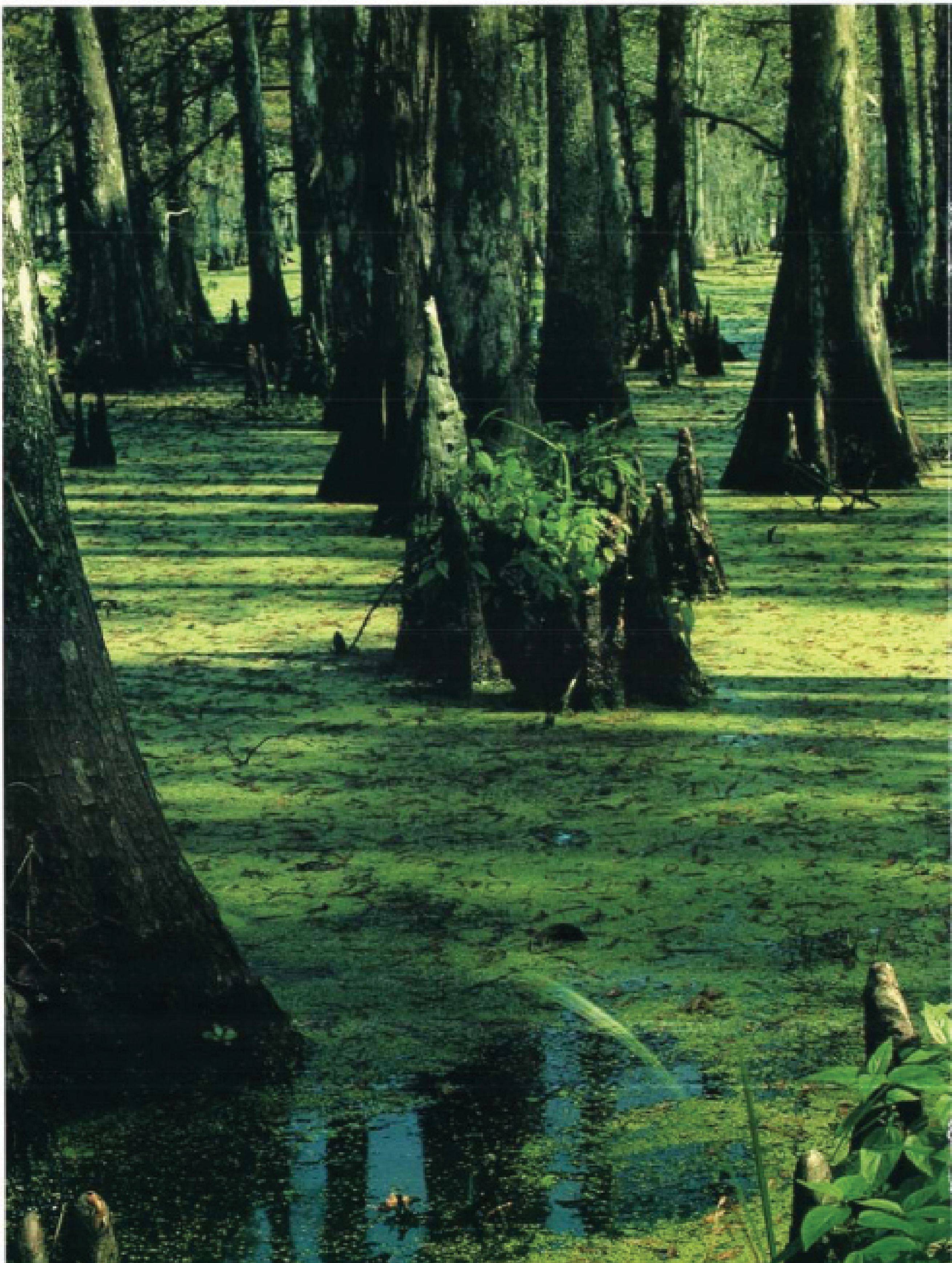
	Mid-1970'S Acres (SE%) in thousands		Mid-1980'S Acres (SE%) in thousands		Net Change (SE%) in thousands	
Alabama	2,693	(15.0)	2,651	(15.2)	−42	(42.1)
Arkansas	3,516	(9.2)	3,573	(10.4)	57	*
Florida	11,299	(3.7)	11,039	(3.7)	−260	(20.6)
Georgia	7,792	(5.4)	7,714	(5.4)	−78	(27.8)
Kentucky	381	(46.7)	388	(45.6)	6	*
Louisiana	9,303	(3.8)	8,784	(3.9)	−518	(21.0)
Mississippi	4,574	(14.8)	4,365	(15.0)	−209	(35.8)
North Carolina	6,247	(12.6)	5,048	(13.3)	−1,199	(19.5)
South Carolina	4,749	(11.5)	4,689	(11.6)	−61	(38.8)
Tennessee	657	(22.4)	632	(22.8)	−25	(88.8)

** Standard deviations exceed estimated totals*

Figure 9

Wetland acreages, percentage of state landscapes and net losses, by state, mid-1970's to mid-1980's





Cardinal flower in Lutcher Moore Swamp, Louisiana
PALUSTRINE FORESTED
NANCY WEBB

Forested wetland conversion in Florida
PALUSTRINE FORESTED TO PALUSTRINE EMERGENT
JOHN HEFNER

Arkansas

Arkansas contained nearly 3.6 million acres of wetlands, more than 10 percent of the state's land surface. Approximately 2.8 million acres were palustrine forested, the majority of which were located in the Lower Mississippi Alluvial Plain. Although a reliable estimate of net wetlands change could not be determined, there was an estimated forested wetland decrease of 210,000 acres.

Florida

Florida contained more than 11.0 million acres of wetlands, approximately 30 percent of the state. Among the southeastern states, Florida had the greatest wetland acreage and density. Palustrine (freshwater) wetlands predominated, covering more than 9.6 million acres.

Palustrine forested wetlands covered 5.5 million acres, 50 percent of the state's wetland total. Palustrine emergent wetlands covered 2.9 million acres (26 percent). Palustrine scrub/shrub wetlands covered 1.2 million acres, or about 10 percent of the state's wetland total. Florida showed a net wetland loss of 260,000 acres, mainly from the destruction of palustrine wetlands. Two-thirds of the loss of palustrine wetlands was attributable to agricultural development, with the rest split evenly between urban development and "other" land use.

Estuarine wetlands, most of which were saltmarsh and mangroves, totaled 1.4 million acres. Some losses of estuarine vegetated wetlands were due to urbanization. A precise estuarine wetland loss estimate could not be determined.

Excellent statistical reliability was achieved in a number of other categories due to the large sample size. Complete results of the Florida analysis are in Frayer and Hefner (1991).

Georgia

Georgia followed Florida and Louisiana with a total wetland area of 7.7 million acres, covering 20 percent of the state's landscape. This total included nearly 367,000 acres of estuarine wetlands and 7.3 million acres of palustrine wetlands. The state's net wetland loss was estimated at approximately 78,000 acres.

Palustrine forested was the predominant wetland type, approximately 6.1 million acres. Nearly 500,000 acres of palustrine forested wetlands were converted (i.e. cleared but otherwise unaltered), with virtually the entire change to palustrine scrub/shrub or emergent wetland.

Kentucky

The estimated total wetland acreage was 388,000 acres, covering about 1 percent of the land surface. The predominant type was palustrine forested wetland. A statistically reliable estimate of wetland change could not be determined.

Louisiana

Louisiana was second to Florida with a total wetland area of 8.8 million acres, 28 percent of the state's surface area. Estuarine wetlands, consisting mainly of saltmarshes and some mangroves, totaled 1.9 million acres. Palustrine wetlands totaled 6.9 million acres, of which 4.9 million acres were forested and 1.5 million acres were emergent.

The net loss for all Louisiana wetland types was 518,000 acres. Approximately 57,000 acres of estuarine vegetated wetlands were changed to other habitats. Nearly three-quarters of the estuarine wetland change was the conversion of vegetated wetland to deepwater habitat, i.e. from marsh to open water. Palustrine forested wetlands declined dramatically, with net losses and conversions of 628,000 acres. Most palustrine forested wetland losses in Louisiana took place in the Lower Mississippi Alluvial Plain and were directly attributable to agricultural development.

Mississippi

Mississippi had 4.4 million acres of wetlands, about 14 percent of the state's land surface. Of the total wetland area, 3.7 million acres were palustrine forested. A net loss of 209,000 acres of wetlands was estimated. More than 365,000 acres of palustrine forested wetlands were lost or converted to other wetland types. Over half of the change can be attributed to agricultural development in the Lower Mississippi Alluvial Plain.

North Carolina

North Carolina had 5.0 million acres of wetlands, 15 percent of the landscape. This total included 154,000 acres of estuarine emergent wetlands. Palustrine wetlands held 4.9 million acres, of which 3.4 million acres were forested, 1.3 million acres were scrub/shrub, approximately 119,000 acres were emergent wetlands, and 81,000 acres were unconsolidated bottom (ponds).

North Carolina stood out among all southeastern states with the highest acreage of net wetland loss. An estimated 1.2 million acres of wetlands were lost to the "other" (forest, range land and barren land) non-wetland category. Nearly all the losses were from palustrine forested and palustrine scrub/shrub wetlands, and were concentrated in the Gulf-Atlantic Coastal Flats.

South Carolina

South Carolina had 4.7 million acres of wetlands, nearly 24 percent of the state. This acreage included 418,000 acres of estuarine emergent wetlands (saltmarsh). Palustrine wetlands held 3.6 million acres of forested wetlands, 369,000 acres of scrub/shrub wetlands, and 218,000 acres of palustrine emergent wetlands.

The state's net loss of wetlands during the study period was estimated at 61,000 acres. The greatest acreage change occurred in the palustrine forested wetland category. About one-third of the 125,000 acres of forested wetlands altered was lost to non-wetland categories.

Tennessee

There were an estimated 632,000 acres of wetlands, covering about 2 percent of the state. Most of this total was palustrine forested wetlands. The net loss of wetlands was estimated at 25,000 acres.

Cumberland Island, Georgia
MARINE INTERTIDAL
©GEORGE GENTRY

Discussion

Wetlands represent an important component of the southeastern landscape, comprising 16 percent of the study area. By comparison, wetlands cover only about 5 percent of the lower 48 states (Dahl and Johnson 1991).

Nearly half (47 percent) of all wetlands and more than three-quarters (78 percent) of all estuarine wetlands occur in the Southeast (Fig. 10 & 11), even though the region is only 16 percent of the conterminous United States. Nearly half of the estimated wetland acreage in the Southeast is located in the Gulf-Atlantic Coastal Flats and Coastal Zone physical subdivisions. These two subdivisions account for less than a quarter of the region's total area.

Wetland loss in the Southeast strongly influences overall wetland trend estimates for the conterminous United States. The region's wetland losses represented 89 percent of the net national loss (Fig. 12). For example, 84 percent of the net losses/conversions of saltmarshes and mangroves (estuarine vegetated wetlands) (Fig.13) and 91 percent of all losses/conversions of freshwater (palustrine) forested wetlands occurred in the Southeast Region (Fig. 14).

Just as wetlands are not evenly distributed across the landscape, neither were sites of significant wetland losses. Over 62 percent of the region's wetland loss took place in the Gulf-Atlantic Coastal Flats and Coastal Zone. Wetland loss in this portion of the region was five times greater than the combined total losses for the 38 conterminous states outside the Southeast Region (Fig.15). Almost 69 percent of the region's palustrine forested wetland loss was recorded within the Gulf-Atlantic Coastal Flats and Lower Mississippi Alluvial Plain.

Specific locations within these physical subdivisions stood out as exceptionally vulnerable to wetland conversion. Large acreages of palustrine forested wetlands were lost in the Gulf-Atlantic Coastal Flats of North Carolina and the Lower Mississippi Alluvial Plain in Louisiana. Nearly 1.2 million acres of wetlands were lost in North Carolina, presumably by a combination of silvicultural and agricultural activities. In the Lower Mississippi Alluvial Plain, nearly one million acres of bottomland hardwood wetlands were destroyed, mostly converted to farm land. Over half of this change took place within the Louisiana portion of the plain.

Peninsular Florida and coastal Louisiana also experienced notable losses. Nearly all of the 110,000 acres of freshwater marshes lost in Florida were altered for agricultural purposes. Along coastal Louisiana, about 42,000 acres of estuarine marsh were changed to nonvegetated bay bottom due to a variety of causes including erosion, saltwater intrusion, subsidence, sea-level rise, sediment deprivation and physical alteration.

Eastern Tennessee
RIVERINE
JOHN HEFNER

Figure 10

Wetlands of the conterminous United States

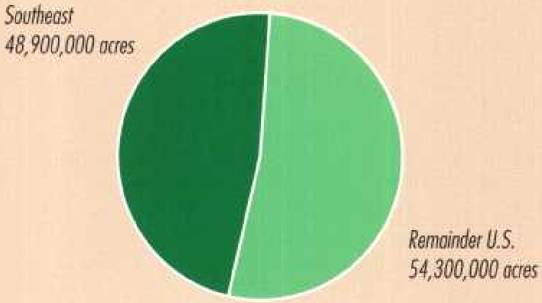


Figure 11

Estuarine wetlands of the conterminous United States

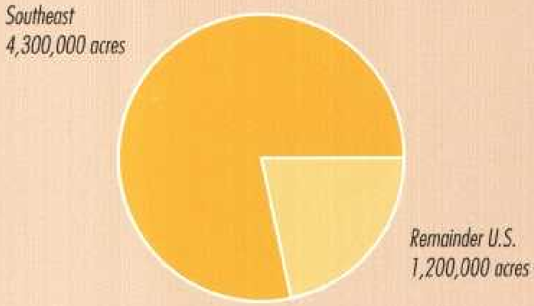


Figure 12

Wetland losses in the conterminous United States

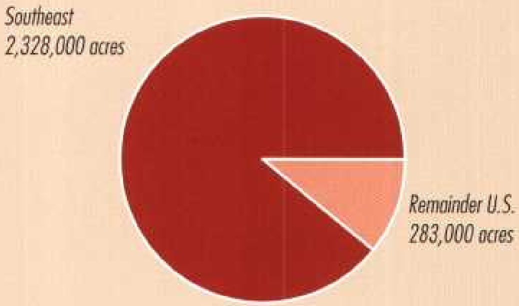


Figure 13

Estuarine vegetated wetland losses in the conterminous United States

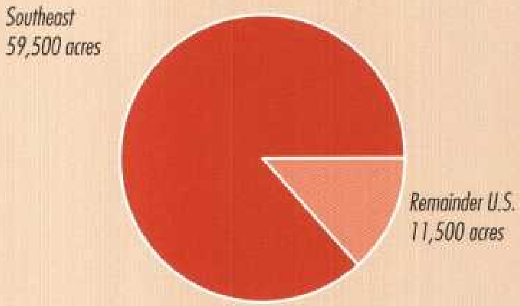


Figure 14

Palustrine forested wetland losses and conversions in the conterminous United States

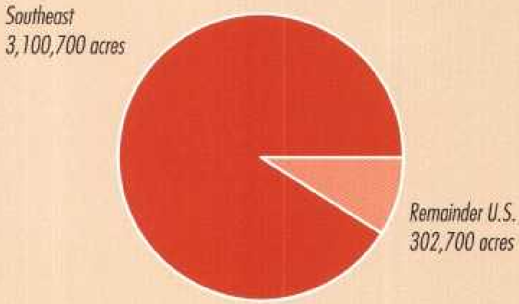
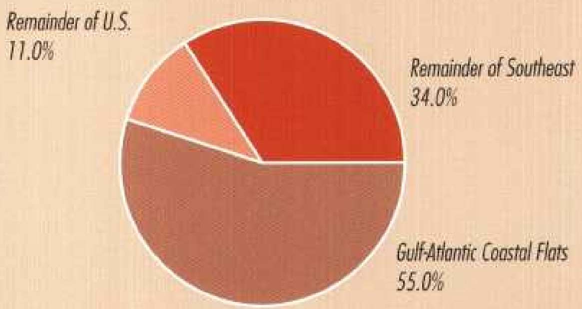


Figure 15

Wetland losses in the Gulf-Atlantic Coastal Flats compared to the rest of the United States



Annual wetland loss rates were variable due to economic conditions, demographic patterns, land values, and farm and timber prices, among other factors. From the 1950's to the 1970's, wetlands of the Southeast were lost at an average net rate of 386,000 acres per year (Hefner and Brown 1984). During the study period from 1974 to 1983, the net rate of regional wetland losses declined to 259,000 acres annually. This is a one-third reduction compared to the rate of the previous two decades (Fig. 16). The loss rate for estuarine wetlands showed particular improvement. And the rate of gains in small open-water bodies accelerated.

Although the overall wetland loss rate declined, the rate at which freshwater forested wetlands were lost or converted accelerated (Fig. 17). Forested wetlands of the region were lost or converted to other wetland types at an average rate of 276,000 acres per year from the mid-1950's to the mid-1970's (Hefner and Brown 1984). However, this rate increased to 345,000 acres per year from the mid-1970's to the mid-1980's.

Great Egret
LARRY R. DITTO©

Figure 16
All wetlands in the Southeast: Average annual loss
(Wetlands ► Non-wetlands)

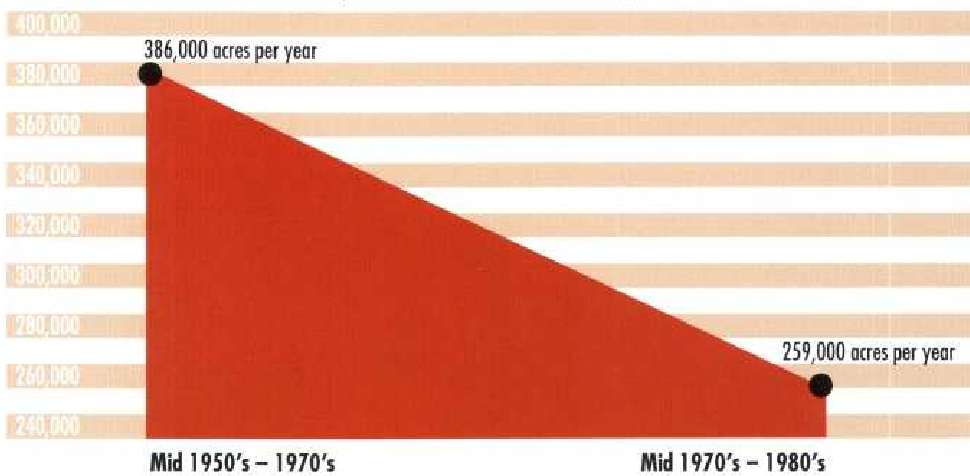
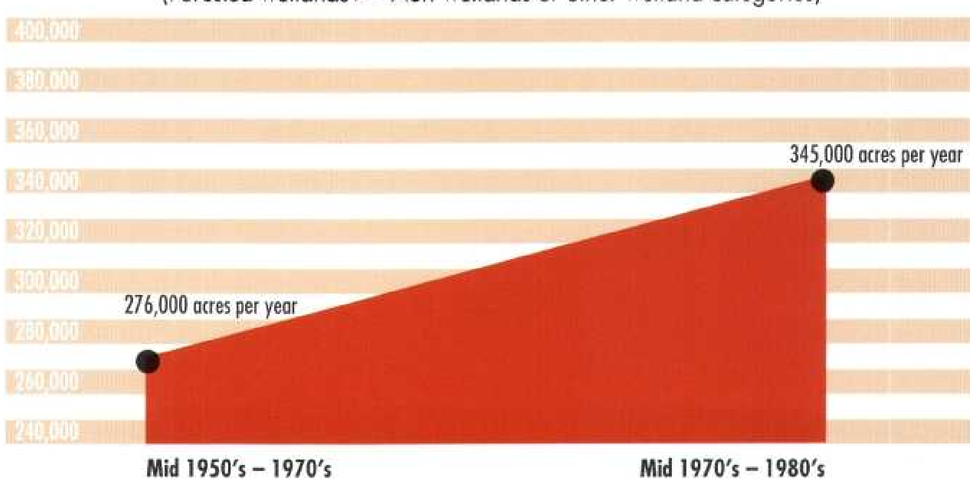


Figure 17
Palustrine forested wetlands in the Southeast: Average annual loss/conversion
(Forested wetlands ► Non-wetlands or other wetland categories)



Conclusion

Wetland losses in the Southeast during the study period far exceeded losses for the remainder of the conterminous United States. Losses were concentrated in a few specific areas within the region: the Mississippi Alluvial Plain, coastal Louisiana, the Gulf-Atlantic Coastal Flats of North Carolina, and in Florida. One wetland type — palustrine forested — showed the greatest decline. Although large acreages were lost to agriculture and other upland categories, nearly as many additional acres were converted to palustrine scrub/shrub and emergent wetland types. Scrub/shrub and emergent wetlands also would have displayed net losses without these conversions (Fig. 18).

The Fish and Wildlife Service currently is collecting data to develop trend estimates for the period from the mid-1980's to the mid-1990's. Based on the findings of the current report, sampling has intensified throughout a large portion of the region. The number of upland categories has been increased to identify more specifically the causes of wetland change.

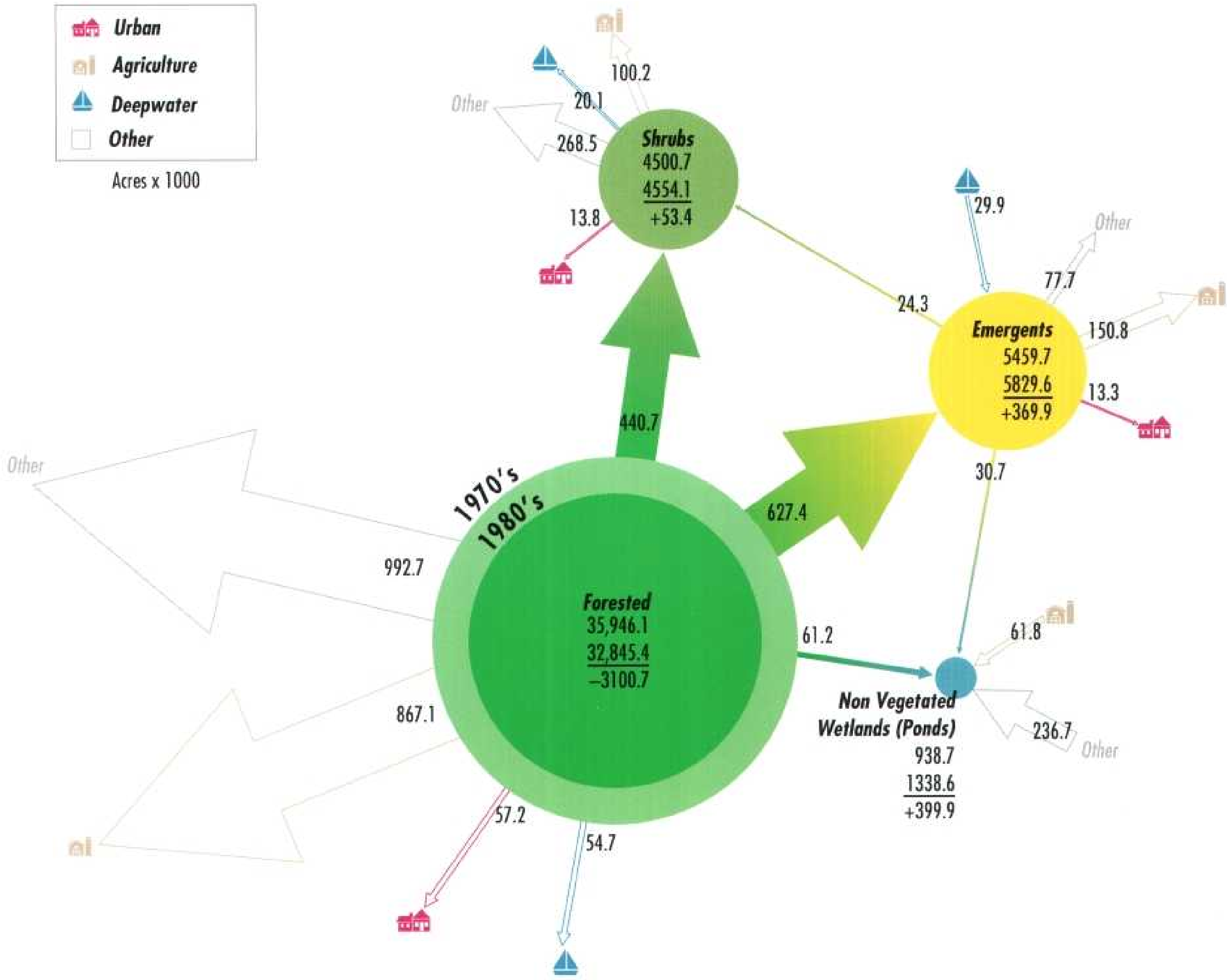
In recent years, public awareness of the relationship between wetlands and environmental quality has increased; wetland conservation efforts have been bolstered. Federal legislation such as the Federal Water Polution Control Act; the 1985 Food Security Act; the 1990 Food, Agriculture, Conservation and Trade Act; Public Tax Reform Act of 1986; and the 1986 Emergency Wetlands Resources Act include provisions that positively influence wetland management.

These laws have stimulated wetland programs that include regulatory enforcement, wetland restoration, public outreach and education, direct assistance to private landowners, disincentives for agricultural drainage, and public acquisition. Clearly, these programs could be maximized in the Southeast to achieve real gains in wetland conservation nationally. The national wetland trend study now in progress should provide an index for measuring these achievements.

Lutcher Moore Swamp, Louisiana
PALUSTRINE FORESTED
©NANCY WEBB

Figure 18

Palustrine forested wetland losses and conversions in the Southeast



A complete analysis of forested wetlands in the Southeast, which showed a loss of 3.1 million acres during the study period, has to include the impact of human activities and conversion to other wetland categories. Human activities converted more than one million acres of forested wetlands to other wetland types. Without these conversions, scrub/shrub and emergent wetlands would have experienced net losses in acreage.

Nearly two million acres of forested wetlands were lost to upland categories — mostly "other" and agriculture. Large forested wetland acreages were converted to other wetland types: 627,400 acres to emergents, 440,700 acres to shrubs, and 61,200 acres to nonvegetated wetlands.

Although scrub/shrub wetlands lost more than 400,000 acres to upland categories, these losses were completely offset by conversions from forested wetlands.

The net gain of 369,900 acres of emergent wetlands similarly is deceptive. The nearly 250,000-acre loss to agriculture, "other" and urban categories was more than offset by conversion of 627,400 acres of forested wetlands.

Literature Cited

Anderson, J.R., E. Hardy, J. Roach, and R. Witmer. 1976. A land use and cover classification system for use with remote sensor data. U.S. Geol. Surv. Prof. Paper 964. 22 pp.

Brown, S.L. 1984. The role of wetlands in the Green Swamp. *In:* Cypress Swamps, K.C. Ewel and H.T. Odum, eds. University Presses of Florida. Gainesville, Fla. pp. 405-415.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish Wildl. Serv. 103 pp.

Dahl, T.E. 1990. Wetlands losses in the United States, 1780's to 1980's. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 21 pp.

Dahl, T.E. and C.E. Johnson. 1991. Status and trends of wetlands in the conterminous United States, mid-1970's to mid-1980's. U.S. Fish Wildl. Serv., Washington, D.C. 28 pp.

Frayer, W.E. 1991. Status and trends of wetlands and deepwater habitats in the conterminous United States, 1970's to 1980's. Michigan Technological Univ. Houghton, Mich. 32 pp.

Frayer, W.E., and J.M. Hefner. 1991. Florida wetlands: Status and trends, 1970's to 1980's. U.S. Fish Wildl. Serv., Atlanta, Ga. 32 pp.

Frayer, W.E., T.J. Monahan, D.C. Bowden, and F.A. Graybill. 1983. Status and trends of wetlands and deepwater habitats in the conterminous United States, 1950's to 1970's. Colorado St. Univ. 32 pp.

Frayer, W.E., D.E. Peters, and H.R. Pywell. 1989. Wetlands of the California Central Valley: Status and trends, 1939 to mid- 1980's. U.S. Fish Wildl. Serv., Portland, Ore. 29 pp.

Gosselink, J.G. 1984. The ecology of delta marshes of coastal Louisiana: a community profile. U.S. Fish Wildl. Serv., FWS/OBS-84/09. 134 pp.

Hammond, E.H. 1970. Physical subdivisions of the United States of America. *In:* National Atlas of the United States of America. U.S. Geol. Surv., Washington, D.C. Page 61.

Hefner, J.M., and J.D. Brown. 1984. Wetland trends in the southeastern United States. Wetlands 4:1-11.

Mississippi Flyway Council (MFC). 1991. Technical section minutes of a meeting held in Nashville, Tenn. (February 22-27, 1991). MFC. 138 pp.

National Marine Fisheries Service (NMFS). 1991. Fisheries of the United States, 1990. U.S. Government Printing Office, Washington, D.C.

Shaw, S.P., and C.G. Fredine. 1956. Wetlands of the United States. U.S. Fish Wildl. Serv., Washington, D.C. 67 pp.

Tiner, R.W. Jr. 1984. Wetlands of the United States. U.S. Fish Wildl. Serv., Washington, D.C. 59 pp.

U.S. Fish and Wildlife Service. 1990a. Cartographic conventions for the National Wetlands Inventory. St. Petersburg, Fla. 73 pp.

U.S. Fish and Wildlife Service. 1990b. Photo interpretation conventions for the National Wetlands Inventory. St. Petersburg, Fla. 45 pp. and appendices.

Wharton, C.H. 1970. The southern river swamp: A multiple use environment. School of Business Administration, Georgia State Univ. Atlanta, Ga. 48 pp.

Wharton, C.H., V.W. Labou, J. Newsom, P.V. Winger, L.L. Gaddy, and R. Mancke. 1981. The fauna of bottomland hardwoods in Southeastern United States. In: Wetlands of Bottomland Hardwood Forests. J.R. Clark and J. Benforado, eds. Elsevier, Amsterdam. pp. 87-100.

Habitat Categories

Appendix A

Wetlands and deepwater habitat categories used in this study were adapted from Cowardin et al. (1979). In general terms, wetland is land where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. Technically, wetlands are lands transitional between terrestrial and aquatic systems where the water table usually is at or near the surface or the land is covered by shallow water. For the purposes of this classification, wetlands must have one or more of the following attributes: 1) at least periodically, the land supports predominantly hydrophytes; 2) the substrate is predominantly undrained hydric soil; and 3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.

Deepwater habitats consist of certain permanently flooded lands. The separation between wetland and deepwater habitat in saltwater areas coincides with the elevation of the extreme low water of spring tide. In other areas, the separation is at a depth of 6.6 feet below low water. This is the maximum depth in which emergent plants normally grow.

Within the Cowardin et al. (1979) classification structure, wetlands and deepwater habitats are grouped according to five systems: Marine, Estuarine, Riverine, Lacustrine and Palustrine. A system consists of environments of similar hydrological, geomorphological, chemical and biological influences. Each system is further divided by the driving ecological force, such as the ebb and flow of the tide, and by substrate material and flooding regimes, or on vegetative life form. Groupings of categories were made to accommodate the special interests of the study and the detail to which aerial photography could be interpreted.

An overview of the Cowardin et al. (1979) classification system and general descriptions of the category types can be found in Dahl and Johnson (1991) and Frayer (1991). The following are specific examples of the most common Southeastern wetland environments included within the study categories.

Marine Wetlands

Marine intertidal category includes beaches, bars and flats alternately exposed and flooded by tidal action — including the splash zone — of the open ocean.

White-Tailed Deer
PALUSTRINE EMERGENT
LARRY R. DITTO©

Mangroves, Everglades National Park
ESTUARINE FORESTED AND SCRUB/SHRUB
JOHN HEFNER

Estuarine Wetlands

The estuarine intertidal emergent category includes coastal marshes that are flooded periodically by tidal waters with salinity of at least 0.5 parts per thousand. Three types of estuarine marshes are locally recognized throughout the region. They are commonly called saltmarsh, brackish marsh and, along the Gulf of Mexico, intermediate marsh. These types are separated based on degrees of salinity, as reflected by the vegetation. Common plant species of the estuarine marshes include smooth cordgrass (*Spartina alterniflora*), black needlerush (*Juncus roemerianus*), seashore saltgrass (*Distichlis spicata*), and saltmeadow cordgrass (*Spartina patens*). Extensive saltmarshes occur in South Carolina and Georgia; brackish marshes in North Carolina, Florida and Louisiana; and intermediate marshes in Louisiana.

The estuarine intertidal forested/shrub category describes wetlands dominated by woody vegetation and are periodically flooded by tidal waters with ocean-derived salinity of at least 0.5 parts per thousand. This category primarily encompasses the mangrove-dominated wetlands of peninsular Florida and Louisiana. Principal species of mangrove communities include red mangrove (*Rhizophora mangle*), white mangrove (*Laguncularia racemosa*) and black mangrove (*Aviecennia germinans*). Of these species, only black mangroves are found along coastal Louisiana. The most extensive mangrove forests are located along the southern tip of Florida.

The estuarine intertidal unconsolidated shores category includes wetlands with less than 30 percent areal coverage by vegetation and are periodically flooded by tidal waters with at least 0.5 parts per thousand ocean-derived salts. These areas include sand bars, mudflats and other nonvegetated or sparsely vegetated habitats called saltflats. Saltflats are hypersaline environments that generally occur near the interface of saltmarsh and upland habitats. Sparse vegetation of the saltflats may include glassworts (*Salicornia spp.*) and saltwort (*Batis maritima*). This category also includes intertidal sandbars and mudflats.

Palustrine Wetlands

The palustrine forested category includes all freshwater (containing less than 0.5 parts per thousand ocean-derived salts) wetlands dominated by woody vegetation greater than 20 feet in height. Floodplain wetlands locally called bottomland hardwoods make up the predominant portion of this category. Water regimes range from brief periodic flooding to near permanent inundation. For example, communities dominated by oaks (*Quercus nigra*, *Q. michauxii* and *Q. phellos*), along with green ash (*Fraxinus pennsylvanica*), sweet gum (*Liquidambar styraciflua*) and ironwood (*Carpinus caroliniana*) are subject to spring and winter flooding. Old river scars and oxbows vegetated by cypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*) may be flooded nearly continuously. Forested wetland communities with intermediate degrees of flooding are an extensive part of the bottomland hardwood spectrum. Important species of the intermediate zones include willows (*Salix spp.*), maples (*Acer spp.*), overcup oak (*Quercus lyrata*) and water hickory (*Carya aquatica*).

In addition to bottomland hardwoods, non-alluvial forested wetlands cover large acreages. These include pine (*Pinus spp.*) dominated pocosins, savannas and wet pine flatwoods; hydric hammocks; bay (*Magnolia virginiana*, *Gordonia lasianthus* and *Persea borbonia*) heads; Atlantic white cedar (*Chamaecyparis thyoides*) swamps; pin oak (*Quercus palustris*) flats; and cypress or gum (*Nyssa sylvatica var. biflora*) ponds.

The palustrine scrub/shrub category encompasses all freshwater (containing less than 0.5 parts per thousand ocean derived salts) wetlands dominated by woody vegetation less than 20 feet in height. These habitats include formerly forested wetlands that have been cleared, burned or otherwise impacted but are still wetland and are now experiencing regrowth. Also within this category are shrub-dominated bogs vegetated by species such as hollies (*Ilex spp.*), bays, fetterbushes (*Lyonia lucida* and *Leucothoe racemosa*), buckwheat-tree (*Cliftonia monophylla*) and titi (*Cyrilla racemiflora*); accreting river point bars, backwaters of ponds and reservoirs, beaver ponds and sand or gravel pits vegetated by buttonbush (*Cephalanthus occidentalis*), willows or alders (*Alnus serrulata*); and mountain bogs dominated by rhododendron (*Rhododendron maximum*).

The palustrine emergent category includes all freshwater (containing less than 0.5 parts per thousand ocean-derived salts) wetlands dominated by rooted erect soft-stemmed plants. Most habitats in this category are freshwater marshes vegetated by plants such as cattail (*Typha spp.*), arrowhead (*Sagittaria spp.*) and pickerelweed (*Pontederia cordata*). Also included are wet prairies, wet meadows and pitcher plant (*Sarracenia spp.*) bogs, each of which may be vegetated by a diverse assemblage of non-woody plant species.

The palustrine aquatic bed category includes shallow freshwater (containing less than 0.5 parts per thousand ocean-derived salts) wetlands vegetated by floating or submerged vegetation. Typical of the plant species found within this category are floating vascular plants such as duckweed (*Lemna spp.*) and mosquito fern (*Azolla caroliniana*); and rooted vascular plants such as spatterdock (*Nuphar spp.*), water-lilies (*Nymphaea spp.*), pondweeds (*Potamogeton spp.*) and hornworts (*Ceratophyllum spp.*).

Two palustrine nonvegetated (containing less than 30-percent coverage by vegetation) categories were evaluated. These are palustrine unconsolidated shore, which includes periodically flooded freshwater (less than 0.5 parts per thousand ocean-derived salts) beaches, bars and flats as well as palustrine wetlands that may be temporarily devoid of vegetation; and palustrine unconsolidated bottom, which includes all ponds and other permanently flooded open freshwater bodies less than 20 acres in size.

White Water Lilies
PALUSTRINE AQUATIC BEDS
NANCY WEBB©

Deepwater Habitats

Several categories of deepwater habitats were included to encompass the entire aquatic spectrum of which wetlands are a part. Among these are: estuarine subtidal, which includes the permanently submerged area of bays and sounds where ocean-derived salts exceed 0.5 parts per thousand, where there is at least partial obstruction from the open ocean, and there is occasional dilution by freshwater runoff from the land; riverine, which includes all permanently flooded open freshwater (containing less than 0.5 parts per thousand ocean-derived salts) habitats found within a channel; and lacustrine, which includes all permanently flooded open freshwater (containing less than 0.5 parts per thousand ocean-derived salts) areas of lakes and reservoirs exceeding 20 acres.

Upland Categories

All areas not identified as wetland or deepwater habitat were placed in three upland categories. The categories agriculture, urban, and "other" were adapted from the descriptions provided by Anderson et al. (1976). "Other" includes Anderson's Level I classes of forest land, range land and barren land, as well as lands that have been drained and cleared but not put to identifiable use.

Soybeans
AGRICULTURE
POTASH & PHOSPHATE INSTITUTE

Data Tables

Appendix B

Estimates produced include acreages with associated standard errors. Many estimates are not considered reliable enough to recommend their use for making decisions. An indication is given of the reliability of each estimated acreage in the summary tables included in this appendix. The standard error of each entry expressed as a percentage of the entry (SE%) is below each estimate. Reliability can be stated generally as "we are 68 percent confident that the true value is within the interval constructed by adding to and subtracting from the entry the SE%/100 times the entry." For example, if an entry is one million acres and the SE% is 20, then we are 68 percent confident that the true value is between 800,000 and 1,200,000 acres. An equivalent statement for 95 percent confidence can be made by adding and subtracting twice the amount to and from the entry. Therefore, a large SE% indicates low reliability, if any, in the estimate.

This discussion on reliability is meant to aid in interpretation of the study results. It was expected that only certain estimates would be precise enough to be meaningful. However, all entries are included in the summary table for additivity and ease of comparison.

Estimates for the mid-1970's, the mid-1980's and change during the period were produced for categories described in Appendix A. These estimates are summarized in Table 1 of Appendix B. Totals for columns are estimates of total acreage by category for the mid-1980's. Row totals (the extreme right column) are estimates of total acreage by category for the mid-1970's. Entries are interpreted as in the following examples (all from the ninth row or column of Table 1):

- 4,842,400 acres classified as palustrine emergent in the mid-1970's were again classified palustrine emergent in the mid-1980's.
- 208,700 acres are classified as palustrine emergent in the mid-1970's had changed to agriculture by the mid-1980's.
- 156,800 acres classified as palustrine scrub/shrub in the mid-1970's had changed to palustrine emergent by the mid-1980's.
- The estimate of palustrine emergent area in the mid-1970's is 5,459,700 acres.
- The estimate of palustrine emergent area in the mid-1980's is 5,829,600 acres.
- The estimate of net change in palustrine emergent area in the mid-1970's and the mid-1980's is 369,900 acres.

Pitcher Plants
PALUSTRINE EMERGENT
NORA MURDOCH

Southeast Wetlands, 1970's to 1980's

TABLE 1 Area, in thousands of acres, by surface area classification.

Sampling error, in percent, is given below estimate.

ORIGINAL CLASSIFICATIONS		CURRENT CLASSIFICATIONS																	
		ALL WETLANDS											DEEPWATER HABITATS						
			ESTUARINE INTERTIDAL				PALUSTRINE												
		MARINE INTERTIDAL	UNCONSOLIDATED SHORE	AQUATIC BEDS	EMERGENT	FORESTED & SCRUB/SHRUB	UNCONSOLIDATED SHORE	UNCONSOLIDATED BOTTOMS	AQUATIC BEDS	EMERGENT	FORESTED	SCRUB/SHRUB	ESTUARINE SUBTIDAL	RIVERINE	LACUSTRINE	AGRICULTURE	URBAN	OTHER	ALL SURFACE AREA
ALL WETLANDS	MARINE INTERTIDAL	49.1 26.7	<0.1	0	1.4 90.5	<0.1	0	0	0	0.1 95.1	0	0.8 86.1	0.4 88.2	0	0	0	0	1.4 43.3	53.2 25.1
ESTUARINE INTERTIDAL	UNCONSOLIDATED SHORE	0.1 78.8	223.6 14.2	0.4 70.4	3.1 25.7	1.6 52.4	0	0	0	0	0	0	3.3 26.7	0	0.5 94.9	0	0.1 81.1	0.4 76.3	233.1 13.8
	AQUATIC BEDS	0	6.8 92.1	203.7 25.0	0	<0.1	0	0	0	0	0	0	0.1 96.5	0	0	0	0	0	210.6 24.4
	EMERGENT	1.6 40.7	3.4 27.2	0	3087.3 4.8	7.3 29.8	0	0.4 52.6	0	8.9 57.5	<0.1 92.3	0.9 57.3	45.5 14.9	0	0	3.4 93.7	1.3 43.0	4.7 19.1	3164.7 4.7
	FORESTED & SCRUB/SHRUB	<0.1	0.3 52.7	0	3.7 68.5	694.7 13.7	0	<0.1	0	0.3 94.5	0.3 94.8	0	1.1 40.9	0	0	0.3 94.8	2.5 57.3	1.1 64.4	704.3 13.5
PALUSTRINE	UNCONSOLIDATED SHORE	0	0	0	0	<0.1	12.1 27.7	2.0 42.3	0.1 74.1	0.6 66.3	0.1 90.0	0.7 72.4	<0.1	0	1.2 76.8	<0.1	0.1 84.6	1.0 41.5	17.9 20.8
	UNCONSOLIDATED BOTTOMS	0	0	0	0	0	0.5 46.4	824.9 4.9	1.5 29.8	11.3 16.7	0.3 38.1	1.6 31.2	0.1 96.9	0.2 57.2	1.9 42.5	20.2 36.3	1.0 38.3	7.0 33.1	870.5 4.9
	AQUATIC BEDS	0	0	0	0	0	0	1.7 36.7	47.2 12.4	0.3 50.9	0.1 98.1	<0.1	0	0.2 74.8	0.6 74.6	<0.1	<0.1	0.2 74.1	50.3 11.8
	EMERGENT	0.1 100.8	0	0	0	0	0.1 63.4	39.0 15.1	3.8 33.3	4842.4 7.1	12.4 21.4	181.1 29.4	<0.1	10.1 37.7	60.1 26.6	208.7 16.8	13.3 27.2	88.6 63.3	5459.7 6.7
	FORESTED	0	0	0	<0.1	0	0.4 57.5	48.6 15.1	12.7 41.8	639.8 13.9	32538.2 3.6	719.3 11.1	0	13.3 26.2	49.0 33.5	869.7 13.0	57.3 24.2	997.8 17.7	35946.1 3.5
	SCRUB/SHRUB	0.1 101.4	<0.1	0	0.1 65.1	0	0.1 63.8	11.2 15.8	1.5 29.0	156.8 14.8	278.6 14.5	3616.8 9.8	0	10.3 75.8	27.8 62.3	111.6 31.6	14.0 38.1	271.8 40.5	4500.7 9.2
DEEPWATER HABITATS	ESTUARINE SUBTIDAL	0.5 72.3	14.5 26.5	0.3 90.4	9.1 26.1	0.3 48.1	0.1 96.9	<0.1	0	0.1 90.7	0	<0.1	9882.5 2.2	0	<0.1	<0.1	0.4 55.3	1.2 51.7	9909.0 2.2
	RIVERINE	0	0	0	0	0	0	0.7 56.5	<0.1	15.3 38.5	7.4 36.6	15.1 30.5	0	1588.8 10.9	6.4 99.1	1.3 62.1	0	2.8 60.1	1637.0 10.7
	LACUSTRINE	0	0	0	0	0	0.2 96.7	0.4 63.8	0.3 98.0	84.7 64.8	0.2 63.2	2.9 70.5	0	0.1 95.1	3960.4 13.6	18.0 93.5	0.1 70.3	3.7 78.4	4071.0 13.3
	AGRICULTURE	0	0	0	0	0.3 98.2	1.2 40.3	79.7 29.3	1.1 46.7	57.9 25.1	2.6 55.7	11.4 33.3	0	6.0 45.7	68.9 78.3	82244.8 3.2	306.9 15.9	897.1 21.2	83677.9 3.1
	URBAN	0	0.1 83.7	0	0	0	0.2 77.0	2.0 27.6	<0.1	0.2 39.0	0.1 98.4	0.2 97.8	1.7 91.1	0	0.3 91.3	1.2 94.8	6649.4 8.6	0.4 99.5	6655.8 8.6
	OTHER	0.9 75.1	0.4 44.1	0	0.4 59.0	0.2 65.7	5.6 30.1	238.8 70.1	0.5 34.5	10.9 38.2	5.1 53.7	3.3 38.4	1.2 38.6	12.1 49.7	92.8 64.2	3291.1 12.7	745.6 12.1	153465.6 2.0	157874.5 1.9
	TOTAL SURFACE AREA	52.4 25.2	249.1 13.1	204.4 24.9	3105.1 4.8	704.4 13.5	20.5 18.6	1249.4 15.6	68.7 12.5	5829.6 6.4	32845.4 3.6	4554.1 8.2	9935.9 2.2	1640.3 10.8	4269.9 12.8	86770.3 3.2	7792.0 8.0	155744.8 2.0	315036.3 0
	CHANGE	-0.8 224.4	16.0 46.3	-6.2 101.8	-59.6 20.9	0.1 1314.3	2.6 83.6	378.9 50.2	18.4 30.8	369.9 38.0	-3100.7 8.4	53.4 299.5	26.9 33.9	3.3 596.8	198.9 49.3	3092.4 15.6	1136.2 10.2	-2129.7 26.1	0

Southeast Wetlands, 1970's to 1980's

TABLE 2 Area, in thousands of acres, by selected surface area groups.

Sampling error, in percent, is given below estimate.

CURRENT CLASSIFICATIONS

ORIGINAL CLASSIFICATIONS	All Wetlands													
		Estuarine Intertidal			Palustrine									
	Marine Intertidal	Nonvegetated	Vegetated	Estuarine Wetlands	Nonvegetated	Vegetated	Palustrine Wetlands	All Wetlands	Deepwater Habitats	Wetlands & Deepwater Habitats	Agriculture	Urban	Other	Total Surface Area
MARINE INTERTIDAL	49.1 26.7	<0.1	1.4 89.5	1.4 88.7	0	0.9 77.3	0.9 77.3		0.4 88.2		0	0	1.4 43.3	53.2 25.1
ESTUARINE INTERTIDAL NONVEGETATED	0.1 78.8	434.5 14.2	4.7 26.3		0	0	0		3.9 26.1		0	0.1 81.1	0.4 76.3	443.7 13.9
ESTUARINE INTERTIDAL VEGETATED	1.6 40.1	3.7 26.4	3793.0 4.6		0.4 47.0	10.4 52.2	10.8 50.9		46.6 14.6		3.7 85.8	3.8 40.0	5.8 19.6	3869.0 4.6
ESTUARINE WETLANDS	1.7 38.7			4235.9 4.3	0.4 47.0	10.4 52.2	10.8 50.9		50.5 13.6		3.7 85.8	3.9 39.1	6.2 19.1	4312.7 4.3
PALUSTRINE NONVEGETATED	0	0	<0.1	<0.1	890.0 4.7	15.0 14.6			4.2 34.3		20.2 36.2	1.1 37.0	8.2 30.7	938.7 4.7
PALUSTRINE VEGETATED	0.2 100.5	<0.1	0.1 64.4	0.1 62.5	117.4 9.6	42985.4 3.2			170.6 19.9		1190.0 10.9	84.6 20.2	1358.2 17.4	45906.5 3.2
PALUSTRINE WETLANDS	0.2 100.5	<0.1	0.1 58.1	0.1 56.6			44007.8 3.1		174.8 19.5		1210.2 10.7	85.7 20.0	1366.4 17.3	46845.2 3.1
ALL WETLANDS								48307.9 2.9	225.7 15.4		1213.9 10.7	89.6 19.2	1374.0 17.2	51211.1 2.9
DEEPWATER HABITATS	0.5 72.3	14.8 26.0	9.4 25.3	24.2 20.5	1.7 42.7	125.7 45.9	127.4 45.3	152.1 38.0	15437.4 3.8		19.3 87.3	0.5 43.8	7.7 44.3	15617.0 3.8
WETLANDS AND DEEPWATER HABITATS										64123.1 2.3	1233.2 10.8	90.1 19.1	1381.7 17.1	66828.1 2.3
AGRICULTURE	0	0	0.3 98.2	0.3 98.2	82.0 28.5	71.9 21.0	153.9 19.2	154.2 19.2	74.9 26.5	229.1 15.8	82244.8 3.2	306.9 15.9	897.1 21.2	83677.9 3.1
URBAN	0	0.1 83.7	0	0.1 83.7	2.2 25.7	0.5 40.6	2.7 23.0	2.8 22.5	2.0 78.3	4.8 34.5	1.2 94.8	6649.4 8.6	0.4 99.5	6655.8 8.6
OTHER	0.9 75.1	0.4 44.1	0.6 44.0	1.0 33.7	244.9 68.4	19.3 27.2	264.2 63.4	266.1 63.0	106.1 56.7	372.2 47.9	3291.1 12.7	745.6 12.1	153465.6 2.0	157874.5 1.9
TOTAL SURFACE AREA	52.4 25.2	453.5 13.6	3809.5 4.6	4263.0 4.3	1338.6 14.6	43229.1 3.2	44567.7 3.1	48883.1 2.9	15846.1 3.8	64729.2 2.3	86770.3 3.2	7792.0 8.0	155744.8 2.0	315036.3 0
CHANGE	-0.8 224.4	9.8 39.8	-59.5 21.1	-49.7 26.3	399.9 47.6	-2677.5 10.4	-2277.5 14.8	-2328.0 14.5	229.1 43.9	-2098.9 16.1	3092.4 15.6	1136.2 10.2	-2129.7 26.1	0

PHOTO CREDITS, BACK COVER:

Bobcat: Larry R. Ditto©
Alligator: A.W. Palmisano
River otter: Larry R. Ditto©
Fulvous whistling-ducks: Milton Friend
White-tailed deer: George Gentry©
Florida panther: Wendell Metzen©
Great egret: Nancy Webb©