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Information About Estuaries and Near Coastal Waters

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October 1999 - Issue 9.5

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Using the Clean Water Act to Address Ballast-Borne Invaders

Public beaches and water supply pipes covered in foul-smelling and foul tasting zebra mussels. San Francisco Bay carpeted from shore to shore with thumbnail-sized clams that deplete the annual phytoplankton bloom. Fish screens on water supply intakes designed to protect endangered salmon that are encased and rendered useless by a swarming, clawing mass of mitten crabs. Plummeting fish stocks because of competition from the five-inch long, round-eyed goby. Billions of dollars in annual damages are incurred from exotic species. Such ominous visions are becoming increasingly common as exotic species continue to be introduced into this nation's waters from ocean-going vessels that hail from ports all over the world.

Concurrent with booming global trade, the human race is conducting an unprecedented global experiment in biogeography, and is only beginning to understand its consequences. Thanks to ballast water tanks on fast-moving commercial ships, aquatic organisms located near ports have increasing opportunities for intercontinental travel, crossing oceanic distances that were once insurmountable. When a ship drops off cargo in a port, it may pump local port water and nearby sediment into its ballast tanks to maintain proper buoyancy and balance for safe travel. Often, water and sediment from the local port contain tens of millions of living organisms, ranging from viruses to schools of small fish. Studies by Jim Carlton and others have demonstrated that these organisms can survive transoceanic voyages and become established in other ports, far from their native range. A number of recent harmful arrivals in the United States, such as the zebra mussel (Dreissena polymorpha) and the Asian clam (Potamacorbula amurensis), are believed to have been introduced through ballast water discharges. Hull-fouling organisms transported on the exterior of large ships, commercial fishing vessels, and recreational craft that travel large distances may also be a significant source of exotic species introductions. The April, 1999, invasion of the black-striped mussel in Cullen Bay near Darwin, Australia, was traced to the hull of a yacht inbound from Indonesia.

Biogeography is the study of the geographical distributions of all organisms, and biogeographers seek to interpret and understand past and present movements of organisms. Ecologists have long known the importance of separation of habitats to the development of new species, a process known as speciation. When early naturalists such as Charles Darwin traveled to different parts of the world, they quickly discovered distinct assemblages of species. With increased travel between continents in the late nineteenth century, humans introduced non-native species of plants and animals to new areas on a larger scale than ever before, often causing local extinctions of native species and other unpredictable effects on the economy. As a result of the many lessons learned, most nations have instituted quarantine controls on certain plants and animals, in an attempt to maintain the distances between habitats to protect natural species diversity. But today, the shipping vector continues to grow and is largely uncontrolled and unseen . until it is too late. The invaders keep coming, but nobody is standing at the gates to prevent their entry.

Approximately a decade after voluntary guidelines were adopted by the Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO) of the United Nations and various nations, including the United States, not much has changed. No new technologies have been implemented to treat ballast water, either on ships or onshore. The voluntary guidelines encouraged by the U.S. Coast Guard, effective July 1, 1999, request that ships exchange ballast water with mid-ocean water. In the best-case scenario this method can remove 80-90% of the exotic organisms in a ballast tank, and replace them with mid-ocean organisms that cannot survive in the coastal environment. Mid-ocean water is generally low in biotic content and oceanic organisms generally do not survive in coastal waters. Because of inadequate removals and risk to safety of the crew, the "open ocean exchange" method of

addressing ballast water must be considered an interim solution. But there are no national or state policies in place to push technology development and implementation.

In the absence of mandatory requirements and technological development from the IMO, many countries and states are taking policy matters into their own hands to protect their natural resources and economies from ballast-borne invaders. In May 1999, the U.S. Environmental Protection Agency approved the State of California. s Section 303(d) list of impaired waterbodies. Included on the list was a finding that San Francisco Bay and the Sacramento-San Joaquin Delta are impaired by exotic species, interpreted as a biological pollutant under the Clean Water Act (CWA).

Introduction of exotic species into San Francisco Bay is currently accelerating, with local experts estimating that one new exotic species has become established every 14 weeks since 1961. Considering recent catastrophic experiences with the Chinese mitten crab (Eriocheir sinensis) and Asian clam, these introductions represent a significant threat to many beneficial uses of the estuary. Experts recognize that an exotic species, after it has been established, is extremely difficult to eliminate, because it quickly multiplies. This characteristic of bioinvasions distinguishes exotic species from other forms of pollutants, such as untreated sewage or toxic chemicals, which can be assimilated by natural processes to varying degrees. Once discharged into the environment, deleterious exotic species exhibit exponential growth rates, in sharp contrast to the decay of many pollutants. Instead of causing temporary impacts that gradually subside, exotic species cause permanent impacts that can amplify over time.

Given these characteristics, ballast water and hull-fouling that contain viable exotic organisms are defined to cause pollution under the California Water Code Section 13050(l). Pollution is defined in this state regulation as "an alteration of the quality of the waters of the state by waste to a degree which unreasonably affects either beneficial uses or facilities which serve the beneficial uses." These discharges also meet the definition of point source under the Clean Water Act Section 502(14), because they are "discernible, confined and discrete conveyances, including& vessels and floating craft, from which pollutants are or may be discharged." Under the current federal regulations, however, these discharges do not require a National Pollutant Discharge Elimination System (NPDES) permit (40 CFR 122.3(a). However, a coalition of interested parties has petitioned the EPA to repeal this exemption on the grounds that it is illegal.

The 303(d) listing of the San Francisco Bay and Delta for exotic species has triggered a requirement under the CWA to develop a total maximum daily load (TMDL) for exotic species. The TMDL describes the amount of a pollutant that a waterbody can assimilate and still meet water quality standards, which includes designated beneficial uses. The Asian clam invasion provides an example of a species introduction that has changed the fundamental trophic structure of the bay, and therefore demonstrates that a worst-case bioinvasion cannot be assimilated. Therefore, the state agency responsible for implementing the Clean Water Act, the San Francisco Bay Regional Water Quality Control Board (RWQCB), has proposed a TMDL of zero for exotic species.

The first step in establishing the zero-TMDL will be amending the Region. s Basin Plan to prohibit the

discharge of viable exotic organisms from vessels, allowing time to develop and implement appropriate technologies. These policies set the stage for two neglected areas: (1) development of ballast water treatment technology and (2) development of port-specific plans that include baseline biological surveys and characterization of the port. s unique shipping traffic. As states and ports develop this information, the correct technological solution will be developed for each port consonant with the risks of introduction at each port. The TMDL and Basin Plan prohibition are intended to prevent introductions of viable exotic organisms in discharges from vessels. Species that have already become established in this region are not the focus of control efforts by the San Francisco Bay RWQCB.

Globally, there is widespread dissatisfaction with efforts to allow the maritime industry to "voluntarily" address ballast-borne and hull fouling invasions. There is a pressing need to set policy in this arena based on the biological realities of the matter . a single organism can potentially devastate a local ecosystem, a local economy, or introduce a water-borne epidemic. To address exotic species, we can look to successful regulatory and technical tools that exist in our regulation of sewage, industrial wastewater, and drinking water. As a result of these tools, pollution and water-borne disease have been significantly reduced in this nation. It is reasonable to explore the ability of these existing tools to stem the rising tide of exotic species in our nation. s waters and it is consistent with their original intent.

For further information, contact Steven Moore, P.E., Policy and Planning Division, California Regional Water Quality Control Board, San Francisco Bay Region, 1515 Clay St., #1400, Oakland, CA 94612; Phone: (510) 622-2439, Fax: (510) 622-2459,

E-mail: smm@rb2.swrcb.ca.gov

The opinions expressed in this article are those of the author and not necessarily those of the State of California.

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The European Register of Marine Species Project

The foundation of biodiversity research and management is correct identification and naming of species. A two-year project is underway in Europe to produce a register of marine species, linked with a bibliography of identification guides, a register of European marine species identification experts, locations of reference specimens, and an Information Pack on European marine biodiversity (based on the project's results). The project is funded by the European Union Marine Science and Technology (MAST) program.

The combination of geographic extent (see map), range of taxa covered, and use of the World Wide Web for publication and networking is a novel approach to documenting European biodiversity. While the emphasis is on nearshore coastal species, deep-sea and offshore species will be included as well, though not as comprehensively. The list will be drafted by experts, using published literature and existing species lists, circulated to a wider range of experts for comments, and revised and verified before publication as a book. The quality of the finished product and its wide availability to users are key elements of the project. Both the draft and final versions will be in the public domain and accessible through the World Wide Web.

Geographic Extent of the European Marine Species Register Project

Long term management of the species lists

An innovative solution has been found to deal with the problem of ownership and long term management of the species list. As the project developed, it became clear that there were both issues of authorship and ownership of data to be resolved. The first phase of the European Register for Marine Species (ERMS) project has produced an Intellectual Property Rights agreement between contributors and the project. This forms the basis for the establishment of a new learned society to be founded as a company limited by guarantee, which will manage the Register after the project ends. The proposed "Society for the Management of European Biodiversity Data," will consist of individuals who contributed to the project. Members will elect a governing council that will authorise maintenance of the electronic species lists, web site, and revision and updating of taxa lists. This allows contributors to have a say in how their information is used, and a single body which can lead the development and publication of the results. It also provides for a single management body, which can develop and publicize the results.

Progress

So far, the project involves over 50 experts from over 30 organizations. Project leaders have contacted 36 European, North American, and other national organizations to promote awareness of the project and to foster exchange of information and consistency in classification. The European project is one component of a global taxonomic inventory project, called Species 2000, which seeks to list all species in the world. Diversitas, another international program promoting the science of biodiversity, has also benefited from the information collected for this project.

Draft lists of species in selected taxonomic groups are being displayed on the project web site to facilitate external peer review. To date, draft lists of 24 groups are available on the project web site, 19 lists are in an advanced stage of preparation and will be sent to the web site, and 18 are in preparation. Though it was not intended that protists (single-celled organisms) be included, lists of most groups have been

volunteered by several experts and a list of Foraminifera is already complete. While the project excludes bacteria and viruses, a list of fungi has been prepared.

Databases by over 1,300 marine taxonomists and a bibliography of over 500 publications on the identification of marine species in Europe, have been established, when verified, the results are expected to stimulate new research into species biology, ecology, and biogeography on a European scale. The results will be used to identify gaps in expertise, species knowledge, and identification, and will provide a basis for focusing new research.

It is anticipated that the Register will become a standard reference for marine biodiversity training, research and management in Europe. The project started in April, 1998, and will end in March, 2000. Interested people, especially those with expertise in marine taxa, are invited to contact the coordinator or other participants to be placed on the project circulation list.

For further information, contact Mark J. Costello, Project Coordinator, Ecological Consultancy Services Limited (EcoServe),17 Rathfarnham Road, Terenure, Dublin 6W, Ireland; Phone: (353) 1-490 3237; Fax: 492 5694; E-mail: mcostello@ecoserve.ie or visit the project web site at http://www.erms.biol.soton.ac.uk

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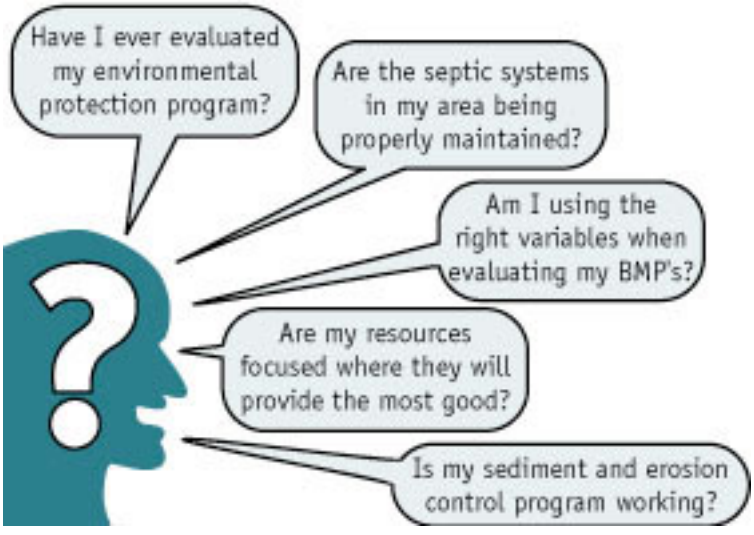
Attention County, City and Township Environmental Officials--

EPA Seeking Towns to Test BMPs for Nonpoint Source Runoff Pollution



If you would like help answering these and other BMP implementation questions, check out EPA's new guidance on "Techniques for Tracking, Evaluating, and Reporting the Implementation of Nonpoint Source Control Measures." This manual can assist a community in determining whether their goals, standards, and management practices are being used as designed. It also can help officials assess and focus environmental protection programs.

The manual helps to establish a program to track the implementation, operation, and maintenance of specific water pollution control practices. It provides statistical approaches needed to properly collect and analyze data in an accurate and defensible manner. Examples of chapters include:

- Methods to Inventory BMP Implementation

- Sampling Design and Variable Selection
- Methods for Evaluating Data
- Conducting the Evaluation
- Presentation of Results

Although this manual does not address monitoring effectiveness of individual BMPs, it will help you design a BMP implementation monitoring program that can save time and money. It will assist you to establish a statistical sampling of representative BMPs to yield conclusions at a fraction of the cost of a comprehensive inventory, and allow you to effectively focus limited resources.

Help Test Techniques in the Field

EPA is looking for help from small communities (less than 50,000 residents) to field test techniques for tracking, evaluating, and reporting BMP implementation. EPA will provide technical guidance and other support. To download the guidance manual, visit the website at http://yosemite.epa.gov/water/owrccatalog.nsf/ under the technical documents section.

For further information, please contact Rod Frederick, US EPA, Nonpoint Source Pollution Control Branch, 401 M Street, SW, Washington, DC 20460; Phone: (202) 260-7054 or E-mail Frederick.Rod@epa.gov

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The Cordgrass is Not Always Greener on the Other Side

If you're on the Atlantic or Gulf Coasts of the United States, your vision of coastlines more often than not includes a nearshore meadow of tall green Smooth Cordgrass (*Spartina alterniflora*). Pacific Northwest estuaries, however, contain unvegetated mudflats which stretch seaward from a narrow salt marsh fringe consisting of salt bush, pickleweed, and salt grass.

Spartina alterniflora was introduced to the Washington coast both accidentally and intentionally. The introduction of *S. alterniflora* in Willapa Bay on the outer coast of Washington was accidental, most likely when east coast oysters were packed in Spartina for shipping. *Spartina alterniflora* was also intentionally planted in Padilla Bay in northern Puget Sound, Washington, by a gun club sometime between 1941 and 1946 to stabilize erosion of a long narrow island. In Willapa Bay, *S. alterniflora* is an aggressive invader. In Padilla Bay, *S. alterniflora* flowers very late in the season (October/November) and has not spread rapidly through vegetative growth. Padilla Bay, designated a National Estuarine Research Reserve (NERR) in 1980, also has S. anglica, which is spreading by way of seeds carried on ocean currents from infestations to the south. Spartina anglica was introduced to the eastern shore of Port Susan Bay (south of Padilla Bay) in 1961 to stabilize dikes and provide forage for cattle.

Invasive *Spartina alerniflora* on an open mudflat begins to take hold.

Over time *Spartina alerniflora* leaves no open mudflat.

West Coast infauna, birds, and plants have not adapted to the invasive species of Spartina, and the plant appears to be disruptive as it invades open mudflat areas or encroaches into native salt marsh vegetation. In 1997, researchers found that both uncolonized mudflats and areas with *S. alterniflora* had dense, diverse assemblages of benthic macroinvertebrates. However, the assemblages were clearly significantly different in overall density of animals, species densities, and trophic groups. Chum salmon, wading birds and shorebirds may be negatively impacted while chinook salmon and shiner surf perch might benefit from more feeding opportunities. *S. alterniflora* had a significant effect on the structure of habitat available to two intertidal clams, such as the Bent–nosed clam and the Japanese littleneck clam. Bent-nosed clams were significantly reduced within large stands of Spartina while the abundance of the Japanese littleneck were enhanced within stands of Spartina. A literature review suggested that West

Coast wading birds are less likely to use areas colonized by Spartina. *Spartina alterniflora* completely encompassed an area in Padilla Bay that historically was used by brant for gravelling. Recent control efforts have vastly reduced the amount of Spartina at that site, but the root mass will take years to decompose.

The primary impacts of the Smooth Cordgrass invasion include the following:

- Spartina traps sediment from the water column, causing increased elevation of the mudflat
- Vegetative growth occurs in a previously unvegetated mudflat

Secondary impacts are:

- Increased elevation and root mass can affect which animal assemblages can live in the mud
- Loss of open mudflats, which provide foraging habitat for fish and shorebirds and other waterfowl
- Loss of eelgrasses (Zostera sp.) could impact brant, small seageese, which feed on eelgrasses.

Because of the potential negative effects on native flora and fauna, Washington state natural resource agencies and Padilla Bay NERR have implemented programs to control the spread of Spartina in Washington state. Thus, in a national system where many Reserves on the east coast are protecting Spartina as a native species, the Reserve at Padilla Bay has been working to control introduced Spartina.

Early control efforts in North Puget Sound were carried out by noxious weed boards using what little information existed about control in other places (such as New Zealand and Australia). Control efforts in the state are now coordinated by the Washington State Department of Agriculture. The state Environmental Impact Statement for Noxious Emergent Plant Management suggested Integrated Weed Management (IWM) as the preferred control alternative. IWM essentially uses the best mix of methods for any particular site. Those methods include physical (e.g., pulling, digging), mechanical (e.g., mowing, crushing), and chemical (herbicides). The herbicide approved for use in aquatic environments in Washington state is Rodeo® in which the active ingredient is glyphosate. Approved adjuvants are LI-700®, R-11®, and X-77®. There has been some research regarding the use of a biological method (a species-specific leafhopper, Prokelisia marginata) but use has not yet been approved in Washington state.

Native American tribes in North Puget Sound have opted to not use herbicides on tribal lands and have focused their efforts on digging and mowing. Control efforts in Padilla Bay include, pulling seedlings, digging small clumps (less than 1 foot in diameter) of Spartina, mowing and applying herbicide to meadows. Communities in North Puget Sound have found that mowing to ground level a month prior to spraying herbicide reduces stem densities and improves herbicide uptake by providing a softer, cleaner leaf. Mowing to the mud again two weeks to a month post herbicide application also appears to improve kill by plugging dead stems that provide oxygen to the roots over the winter. In 1997, Padilla Bay had a

little over 17 (consolidated) acres of Spartina. As control begins this year there are between 3-5 acres remaining. In order to control S. anglica in the bay, active monitoring of about 2,000 acres of shoreline and mudflat to locate new seedlings and clumps must be undertaken each year. Staff from the Padilla Bay NERR, the Washington State Department of Ecology, Washington Department of Fish and Wildlife and volunteers continue to manage and monitor Padilla Bay. Spartina control is an expensive, laborious, and time-consuming task that, once started, must be continued to prevent re-invasion of the mudflats.

For further information, contact Sharon Riggs, Environmental Specialist, Padilla Bay National Estuarine Research Reserve, Mount Vernon, Washington; Phone: (360) 428-1558, E-mail: sriggs@padillabay.gov

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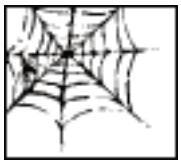

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Genetic Pollution?

A new hybrid species of Spartina in San Francisco Bay

Washington State is not alone in its fight against introduced Spartina. Approximately twenty five years ago an introduction of *Spartina alterniflora* occurred in south San Francisco Bay via purposeful planting of rooted plants and dispersal of seeds on the tides. *Spartina alterniflora* has since hybridized with the native California cordgrass, S. foliosa. Recently, DNA markers diagnostic for each species were used to detect the parental species and nine categories of hybrids. Hybrids are found principally near sites of deliberate introduction of the exotic species. The proliferation of hybrids could result in local extinction of S. foliosa. Moreover, as in Padilla Bay, *S. alterniflora* has the ability to greatly modify the estuary ecosystem to the detriment of other native species and human uses of the bay.

Spartina alterniflora and hybrids with S. foliosa are "ecosystem engineers," capable of growing far down the intertidal gradient, accreting sediment, and converting much of the open mudflat habitats of San Francisco Bay into the vast intertidal stands of cordgrass that are typical of eastern salt water marshes. These large cordgrasses impede water flow, and channel blockage is a particular threat in narrow upriver channels.

The ecosystem changes caused by large cordgrasses were illustrated by the rapid accretion of shorelines

as English cordgrass, S. anglica, spread around the United Kingdom. Spartina anglica arose in England in the nineteenth century as the result of the hybridization between the exotic *S. alterniflora* and the English native, S. maritima. Marsh elevation increased by as much as 4 centimeters per year in British estuaries, and periodic dieback of this cordgrass resulted in drastic releases of silt into navigation channels. Similar sediment accretion was also seen under *S. alterniflora* swards in New Zealand. Spread of English cordgrass across open mud above and below the native vegetation grossly altered habitats to the detriment of plants, invertebrates, and shorebirds.

For further information regarding the hybrid species, contact Donald R. Strong or Debra Ayres, Evolution and Ecology, University of California, Davis 95616 or The Bodega Marine Laboratory, Box 247 Bodega Bay, CA 94923, E-mail: drstrong@ucdavis.edu

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Indian River Lagoon Species Inventory Goes On-Line

The Indian River Lagoon

The Indian River Lagoon (IRL) is one of the most highly diverse estuaries in North America. It extends 155 miles from Ponce de Leon Inlet south of Daytona Beach, Florida, to Jupiter Inlet near West Palm Beach, and it occupies approximately one third of the east coast of Florida. The unusually high biodiversity of the IRL is a result of overlapping temperate and subtropical provinces, allowing flora and fauna from both these regions to mingle. The estuary is a valuable ecological and economic coastal resource, not only to the east coast of Florida, but to the entire state and nation. However, because of rapid and expansive population growth and development of the region, particularly since 1970, watershed alteration has resulted in declining water quality and elevated sediment levels in the lagoon. Consequently, this fragile ecosystem is currently threatened and various state and federal agencies have listed 75 species in the IRL as needing protection.

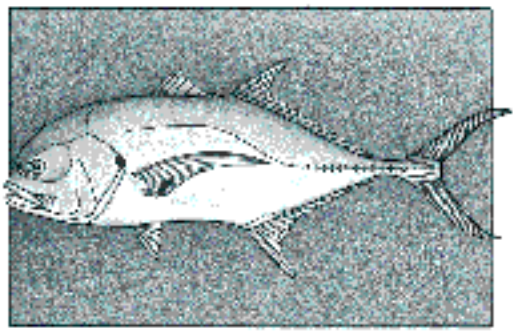
The Indian River Lagoon Species Inventory

A 1994 conference on biodiversity in the Indian River Lagoon documented the species richness of the

IRL, resulting in an initial taxonomic listing of over 2,450 species. However, the incomplete state of knowledge for many groups of plants and animals was a key finding of the conference.

To better document biodiversity, funding for a pilot study was given to the Smithsonian Marine Station at Fort Pierce to demonstrate the utility of expanding the Indian River Lagoon Species Inventory. Funding was provided through several agencies in cooperation, including the St. Johns River Water Management District through its Indian River Lagoon National Estuary Program, the National Aeronautics and Space Administration, the United States Environmental Protection Agency, and the Smithsonian's Seidell Fund.

The goal of the pilot project was to make the inventory more useful as a tool for research, education and management by expanding the database, providing better and more comprehensive information, adding bibliographic citations, and making the information easily accessible on the Internet. Providing easy access to current scientific information on species, through an expanded species inventory database, would provide an invaluable educational resource and would greatly facilitate decision-making by resource managers.



Ecological Expansion of the Indian River Lagoon Species Inventory

In order to increase the utility of the inventory, an ideal list of ecological variables was devised and these included:

- Photographic image
- Abundance
- History in the IRL: (collector, date)
- Physical Tolerance
- Mapped Distribution
- Life History
- Habitat and Associated Species
- Invasion History
- Community Ecology
- Economic Impact
- Trophic Status

A Master List for initial expansion was prioritized using the following criteria:

- rare, threatened or endangered species;
- species which depend on the IRL for key life history stages;
- common, representative species;
- ecologically important species that regulate coastal food webs and/or habitat structure; and
- indicator species, economically important species, nuisance species, and introduced species.

To provide information for the database, over 100 scientists with taxonomic and ecological expertise on Indian River Lagoon biota were contacted and asked for their input. Efforts were made to attain an even representation of species from all major taxonomic groups. The resulting master list consisted of approximately 175 species selected for initial database expansion.

A relational database was then created to expand the inventory with the additional ecological information. Design features such as "pull-down" menus and data entry "templates" with instructions for the user were incorporated into the design, ultimately making it more user-friendly.

Status of the Inventory

To date, reports on approximately 50 species have been written and incorporated into the database and exported onto the web page. These species reports may be accessed via the web site at http://www.sms.si.edu by querying directly, using the scientific or common name or by taxonomic hierarchy. Certain taxa may also be accessed by special status, for instance endangered, exotic, fisheries, etc.

Future Plans

Plans for continued expansion of the Indian River Lagoon Species Inventory include: creating an evolving ecological database that will provide a technologically advanced, comprehensive record of IRL biodiversity, expanding the inventory, and providing a model for other biological inventories.

Ecological information for priority species will also assist management of biodiversity resources in the context of environmental and evolutionary change. Expanding the ecological database to include mapped distributions will facilitate management and conservation of IRL biodiversity, database expansion will allow for regional comparisons of biodiversity and environmental degradation. Mapping species distributions will also make it easier to identify critical locations or "hot spots" of particularly high biodiversity, locations of rare, threatened or introduced species, and locations of species indicators of environmental stress or habitat quality.

For further information, contact Joseph Dineen, Anson Hines, Gregory Ruiz or Mary Rice at The Smithsonian Marine Station at Fort Pierce, 701 Seaway Drive, Fort Pierce, Florida; Phone: (561) 465-6630 Ext. 128, FAX: (561) 465-6630, or E-mail: dineen@sms.si.edu,

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Guide to the Clean Water Act

Overwhelmed by complicated regulatory language? A new book has been designed to translate complicated legal jargon into easily understandable language. The Clean Water Act: An Owner's Manual explains critical sections of the Clean Water Act, tells how to get involved in regulatory decisions, and provides useful references, websites, and other resources. The book contains 157 pages and is available for $25. To order, contact The River Network, 520 SW 6th Avenue, Suite 1130, Portland OR 97204-3506; Phone: (503) 241-3506.

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Georgia City Pioneers Stormwater Utility Fee

Many cities and towns across the nation are faced with overstretched budgets, aging infrastructure, and new regulations regarding stormwater runoff and nonpoint source pollution. The city of Griffin, a small urbanized community 30 miles south of Atlanta, Georgia, has found the solution to their stormwater problems through the development of the first Stormwater Utility in Georgia.

Worn out infrastructure, neighborhood flooding and a requirement to comply with EPA's National Pollution Discharge Environmental Standards (NPDES) Phase II regulations left Griffin no choice but to seek alternative funding sources to manage their stormwater runoff. The new NDPES Phase II regulations, which will be issued in October of this year, will require approximately 3,500 U.S. cities with populations less than 100,000 to obtain permits for their stormwater discharges. In response to these impending challenges, Griffin staff developed a program to benefit the community and to seek funding options to address the water quantity and quality problems. The program needed to have a sound ecological approach, as well as be fair, equitable and create a stable funding source. The program developed is a "User Fee System" known as a Stormwater Utility.

The program took 18 months to establish and cost approximately a quarter of a million dollars. But the carefully crafted program is paying off—the revenue generated is $1.2 million dollars per year. The money is funding two additional crews for maintenance, an environmental science unit, the generation of a capital improvements program, and the establishment of a GIS division with GPS equipment to

inventory Griffin's 10,000 drainage structures for mapping.

The utility is based on a user fee of $2.95 per month per residence or, for non-residential landowners, per 2200-square feet "equivalent runoff unit" (ERU). Griffin's population is approximately 24,000. The city has 15.5 square miles of highly impervious area. The utility has an estimated 33,685 ERU's. Credits can be given for those who participate in environmental education, to be applied against the ERU limit. For instance, the Spalding County public school system receives a 50% credit on their stormwater bill for teaching the "WaterWise" conservation curriculum in kindergarten through grade twelve. An additional 50% is credited against their water/wastewater bill because the school's curriculum will emphasize the interrelationship of groundwater, surface water, stormwater and water conservation, and wetland management.

Establishing the Stormwater Utility involved five phases. These phases were:

1. **Preparation** - Characterizating the city's needs, which were found to be flood control, failed infrastructure, erosion and sedimentation control, and lack of funding and programs to address water quality issues.

2. **Concept development** - Evaluating the various alternatives and selecting the most appropriate ones.

3. **Detailed analysis** – Developing policy, fee generation, the level of service to be rendered and program planning. Secondary funding sources were also explored and include the general fund, revenue bonds, grants, and low interest loans.

4. **Data systems and implementation** - Setting up accounts and integrating the stormwater utility fee into the billing system for water, wastewater, electricity, solid waste and gas services already rendered.

5. **Public information and education** - Distributing brochures, production of movies, television shows, and radio spots, forming a watershed council and a speakers bureau and holding public meetings.

The user fee system is an important part of a total watershed management system. Monies are utilized for ecological restoration, hazard mitigation, and non-point source monitoring. Promotion and publicizing of various projects ensured that the general public and the city's commission were involved early in the process. Public information, involvement and education has been and will continue to be the key to the success of this stormwater utility.

The stormwater utility has opened up other avenues for additional funding. Voters recently approved an additional $1.0 million dollars in a Special Purpose Local Options Sales Tax that will allow a portion of taxes to be used for stormwater system improvements. The utility also helped the state pay back loans from the state revolving loan fund and provided a match for grants from the Georgia Emergency Management Agency and EPA's section 319 program.

For further information, contact Brant Keller, Director of Public Works and Stormwater Department, City of Griffin Stormwater Department, Post Office Drawer T, Griffin, Georgia 30224; Phone: (770) 229-6603, Fax: (770) 229-6613 or E-mail: bkeller@griffinpower.org

(Modified from Nonpoint Source News-Notes, May 1999, Issue#57)

A new report entitled: "Stormwater Strategies: Community Responses to Runoff Pollution," was produced by the Natural Resources Defense Council (NRDC) in May of 1999. This report provides more than 150 examples of successful stormwater management programs across the country. The report presents key strategies used by local governments that are currently being used to control stormwater runoff. Detailed case studies, organized by region, highlight everything from urban retrofitting to volunteer monitoring and storm drain stenciling.

For a copy of this report, send $14.00 plus $13.00 shipping and handling to NRDC Publications Department, 40 West 20th Street, New York, NY 10011.

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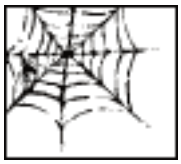

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Biodiversity, Taxonomy & Systematics

Where Have All the Taxonomists Gone?

Biodiversity -- nearly everyone has heard the word. Taxonomy and systematics--though not as familiar--are inextricably linked to biodiversity. First, what does biodiversity mean? The diversity of organisms can be studied in different ways and at various levels. For example, diversity can be the numbers of all species of fishes in the sea, or all the species of bottom-feeding fish in a particular region. In Buzzards Bay, Massachusetts, the most abundant benthic (bottom-dwelling) invertebrates belong to seven species out of a total of seventy-nine and account for 91% of all individuals, with 9,000 individuals in 1 sqare meter! In contrast, in the deep sea off of the New Jersey coast, at 1,500 to 2,500 meters, the seven most abundant benthic invertebrate species out of a total of 798 species are only 28% of all individuals, which numbered 90,677 in a 21 square meter area or about 4,300 individual per square meter. Because of these differences it is difficult to quantify what is meant by "biodiversity," or compare two very different habitats.

No matter how biodiversity is defined, its building blocks come from the fields of taxonomy and systematics. Taxonomy can be loosely defined as the recognition, naming, description, and classification of species. Once a species is named with a species and genus name (Crassostrea virginica for the common edible oyster) and described in published form--usually a scientific journal--one specimen is chosen as the "holotype" and deposited in a museum. This single specimen locks the name to a particular

organism that can be examined by a taxonomist to determine whether a newly collected specimen is the same or a different species, especially if the original description is not clear.

The first step in protecting biodiversity is to know whether an organism that has been collected is already named and described or is new. This is not difficult for elephants or giraffes or whales--indeed, for most large mammals and the well-studied birds--but plants, insects and many invertebrates of the benthos are quite a different matter. Oyster species from our coastlines are well known, but mussel species over large geographic areas can still be a puzzle. In the deep sea, on the other hand, almost every invertebrate benthic animal that comes up in the collecting gear from a region not previously sampled belongs to a new species.

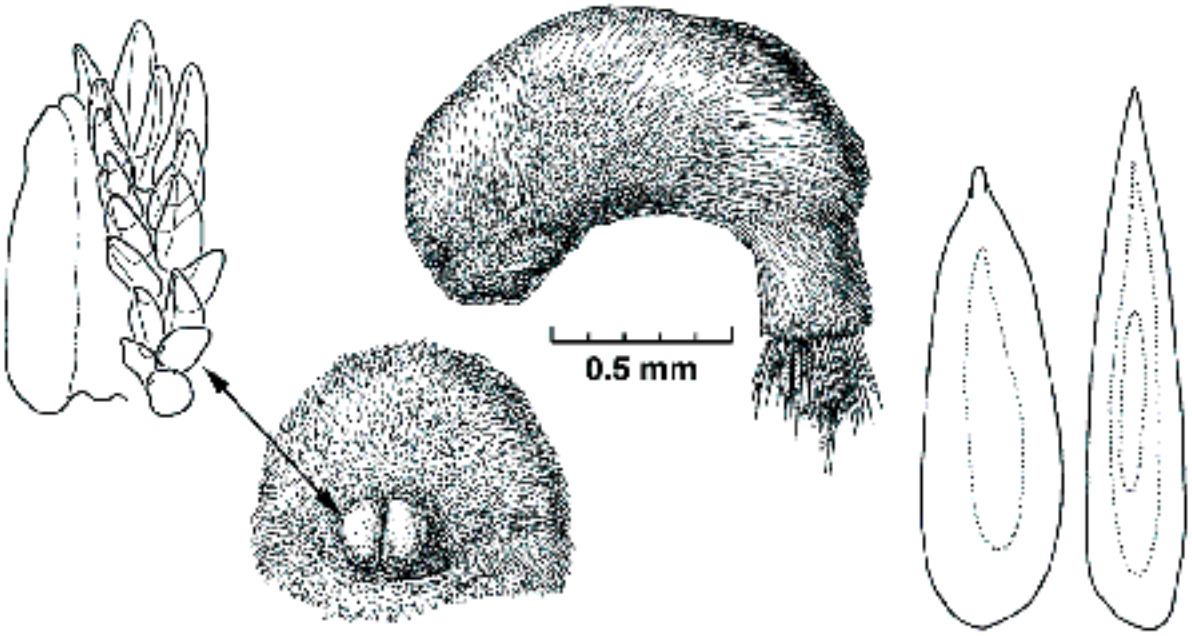
Systematics covers a much broader field of study than taxonomy and is concerned with several areas of inquiry. One is understanding the relationships of organisms to each other by trying to discover how they evolved over geologic time. New methods using DNA sequencing are giving us important new insights into the paths of evolution of many groups of organisms whose relationships to other groups has not been clear. For example it appears that brachiopods are more closely related to molluscs than once thought. Another closely related field of study is biogeography, the study of the distribution of species over space, and how that distribution occurred. Systematics can also incorporate the ecology or behavior of a species, or the interactions of all the species in a population of, say, a single mud flat.

It is clear that the basic building blocks for systematics and for understanding biodiversity, however it may be defined, is knowing the species involved, and that is the province of taxonomy. But where have all the taxonomists gone? They are becoming a rare breed in the field of biology. Many are close to retirement age or already retired. New taxonomists are not entering the field because of the recent lack of support, that is, the availability of jobs and funding in taxonomy. One new program of the National Science Foundation is, however, addressing this "extinction" of professional taxonomists. The program is called PEET: Partnerships for Enhancing Expertise in Taxonomy. To date, this program is supporting 45 taxonomic projects in all fields of biology, for plants and animals. A major goal of these grants is to train new people in the taxonomy of a particular group and to make taxonomic data and descriptions available on the web.

The future of taxonomy will ultimately rest on citizens and those in government at all levels, from national to local. The necessity of knowing and being able to identify all the organisms of our fragile planet is of pressing importance.

For further information, contact:

Dr. Amélie H. Scheltema, Woods Hole Oceanographic Institution, Biology Department, Woods Hole, MA 02543; Phone: (508) 289-2337, Fax: (508) 457-2134, Email: ascheltema@whoi.edu or visit the PEET website at http://www.nhm.ukans.edu/~peet/



A new species of a worm-like, deep-sea mollusc belonging to the family Prochaetodermatidae in the class Aplacophora. The genus name is Prochaetoderma, and the species name will be named after the French biologist Philippe Bouchet, who provided us with many similar specimens from the Mediterranean Sea. The description is based on the shape of the whole organism, the shape of the calcium carbonate spicules shown on the right that cover the body like fur, and the special sensory spicules that surround the mouth shield, shown to the left and below. The drawing is of the species holotype and will be deposited in the Paris Museum of Natural History as soon as the manuscript, which has been submitted to a journal, has been accepted. (Drawing by Dmitry L. Ivanov, visiting colleague from the Moscow State University Zoological Museum.)

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Washington State Takes Aim at Aquatic Nuisance Species

Washington is the fourth state in the nation to adopt a plan to minimize the introduction of non-native aquatic nuisance species and eradicate alien species already present. These alien species can severely disrupt the habitat of important native species.

The Washington State Aquatic Nuisance Species Management Plan, adopted last year, is based on a 1996 strategy of the Puget Sound and Georgia Basin Task Force to reduce the introduction of non-indigenous marine species to our waters.

Coordination, prevention, eradication, education, monitoring, research, and legislation are key elements of the plan. The plan focuses on several non-indigenous species of concern to Puget Sound habitat, such as the European green crab, Chinese mitten crab, zebra mussel, Eurasian milfoil, purple loosestrife, and Spartina cordgrass. An interagency coordinating committee, chaired by the Washington Department of Fish and Wildlife, will oversee implementation and updates to the plan. The goal is to have a coordinated strategy by the year 2002 to stop the spread of species already present and to control and eradicate species to minimize their impacts.

A copy of the Washington State Aquatic Nuisance Species Management Plan is available at: http://www.wdfw.wa.gov/fish/nuisxsum.htm EXIT disclaimer or contact Scott Smith, Washington State

Department of Fish and Wildlife at (360) 902-2724 or E-mail: smithsss@dfw.wa.gov.

(excerpted from Sound Waves, Summer 1999)

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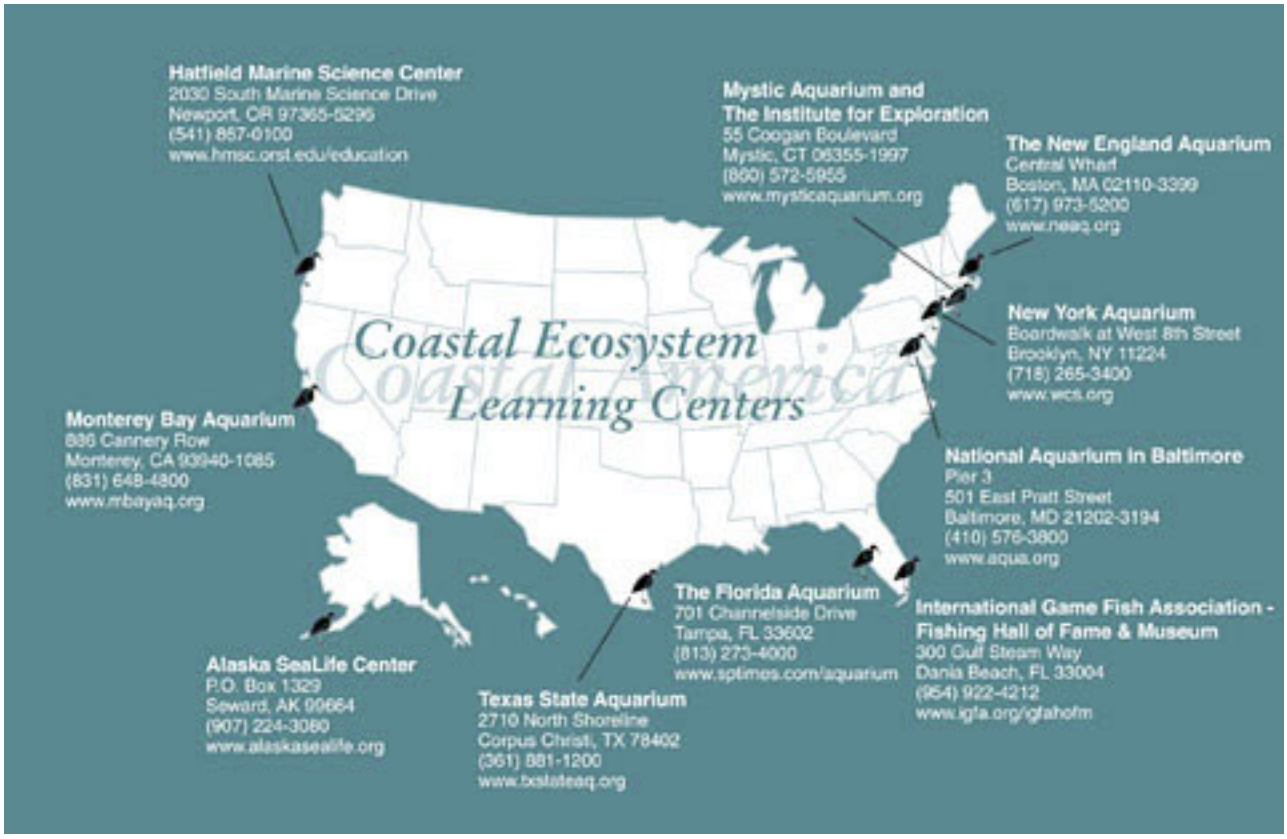
Coastal America's Coastal Ecosystem Learning Centers

The Coastal America program is a federal agency partnership that was established in 1992 to improve coastal resource restoration and protection. The partnership achieves this goal by leveraging the resources, expertise and authorities of federal natural resource agencies and military agencies with state, local, tribal, and nongovernmental organizations. To date, the partnership has facilitated implementation of several hundred projects across the country. Examples include removing dams to restore anadromous fish passage, using dredged materials to restore wetlands habitat, protecting the Northern Right Whale from ship strikes, and implementing best management practices to prevent nonpoint source pollution.

While coastal restoration and protection continues to be a primary focus of the partnership, in the last several years it has become increasingly clear that public education and involvement in coastal protection is critical to achieving long-term protection of our nation's ocean and coastal resources. The individual federal agencies realized they had limited resources and expertise dedicated to education and outreach specifically targeted to protecting ocean and coastal resources. Acknowledging these constraints, the federal partners sought to form an alliance with selected aquariums and marine learning centers around the country.



In 1996, the first Coastal America Coastal Ecosystem Learning Center was designated at the New England Aquarium in Boston, Massachusetts. Now there are ten Learning Centers designated around the country (see map).

Together, these Coastal Ecosystem Learning Centers attract millions of visitors every year from around the country and around the world. The centers entertain and educate visitors about coastal and marine wildlife and habitats through exhibits and shows. Educational programs for teachers and students are provided and each center assists in organizing and training volunteers to clean up beaches, restore coastal habitats, rescue marine animals and monitor water quality.

A wide variety of resources and expertise is available to the Coastal Ecosystem Learning Centers from the various federal agency partners. For example, the Environmental Protection Agency, National Oceanic and Atmospheric Administration and other agencies provide access to research and survey vessels and facilities. Learning Centers may use these facilities as part of their education/outreach or volunteer training programs. The U.S. Fish and Wildlife Service and National Marine Fisheries service can provide endangered and threatened species materials and products for educational and display purposes. All agencies can provide various educational materials such as curricula on coastal and marine issues, coloring books, CD-ROMS, videos and posters.

All agencies can also provide subject matter or technical experts who can serve as guest lecturers, field guides or exhibit and project advisors. For example, the Jacksonville District of the U.S. Army Corps of Engineers provided the Florida Aquarium with technical assistance to develop an exhibit on the Restoration of the South Florida Ecosystem and the U.S. Geological Survey and National Marine

Fisheries Service assisted the New England Aquarium with an exhibit on the decline of the George's Bank fishery.

These are just a few ways in which the Coastal America federal agency partners have collaborated with the Coastal Ecosystem Learning Centers to support their education and outreach programs. The alliance between the Learning Centers and federal agencies is still in its infancy and additional ways to collaborate are continually being sought. Regional meetings take place each year between the Learning Centers, federal agencies, National Estuary Programs, National Estuarine Research Reserves, National Marine Sanctuaries and other state, local and nongovernmental partners to identify new opportunities and learn from previous efforts.

Recent meetings have identified several new issues to be emphasized, including:

- Improving marine animal rescue, rehabilitation and release programs
- Developing a unified message about the importance of our oceans and coasts to be delivered by all the Learning Centers and federal agency partners
- Sharing data and coordinating data management for coastal eco-regions
- Providing federal personnel to work at the Learning Centers on rotating temporary assignments on collaborative projects
- Expanding volunteer involvment in habitat restoration and monitoring

A recent regional meeting on the Gulf of Mexico was held at the Florida Aquarium in Tampa, Florida, on September 21-23, 1999. On October 21–22, 1999, the West Coast Regional meeting will be held at the Hatfield Marine Science Center in Newport, Oregon.

For further formation on Coastal America and the Coastal Ecosystem Learning Centers, contact Betsy Salter, Education/Outreach Coordinator, Coastal America Partnership, 300 7th Street, S.W. Washington, DC 20250-0599; Phone: (202) 401-9928, Fax: (202) 401-9821, E-mail: salter@fas.usda.gov, or please visit our website: http://www.coastalamerica.gov/

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Invasive Species Education

The Morro Bay National Estuary Program (MBNEP) funded an action plan demonstration project that involved developing brochures, signage and educational talks to teach the public about invasive marine species in Morro Bay. The demonstration project provides information for increasing public awareness of the ecological consequences of marine species introductions into Morro Bay. Examples include two species recently discovered in the bay, the Tortellini Slug (Philine aurifomis) and the European Green Crab (Carciunus maenus), which both feed on shellfish and potentially compete with shorebirds for food resources.

The brochures and signs provide useful information for potential vectors of invasive species, such as boat owners. Some examples of suggested management include:

- Ensuring boat hulls are clean;
- Ensuring that bilge water is drained prior to entering or launching a boat into different water bodies;
- Not transporting and releasing live animals into local streams and oceans;

- Ensuring that bait that has been purchased from stores and items used to package bait (such as seaweed) should not be discarded into the water.

For further information, contact the Morro Bay National Estuary Project Office at (805) 528-8126. (Excerpted from Turning the Tide, June 1999)