

National Sea Grant College Program Biennial Report 1996-1997



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U.S. Department of Commerce
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TABLE OF CONTENTS

Message From The Director	2
Sea Grant: Reflecting on Two Years of Progress	6
Economic Leadership	
Investigating the Potential of Marine Biotechnology	8
Providing Solutions to Bycatch Problems	12
Coastal Ecosystem Health and Public Safety	
Protecting and Restoring Coastal Habitats	16
Education and Human Resources	
Investing in Graduate and Undergraduate Student Education	20
Traveling the Sea Grant Information Superhighway	24
Sea Grant Web Addresses	28
Financial Report	30
Sea Grant Program Directors	38

Message from the Director

T TO OUR CONSTITUENTS :

It is a rare privilege and honor to have the opportunity to lead the National Sea Grant College Program into the 21st century, a century of enormous challenge to America's coasts. That challenge represents a great opportunity for Sea Grant to provide the science and information base critical to the national coastal agenda.

The year of 1996 marked the 30th anniversary of the signing of the National Sea Grant College Program Act. In celebration of that anniversary, John Knauss, Claiborne Pell, Paul Rogers and Athelstan Spilhaus were honored at the Capitol for their foresight and wisdom in making Sea Grant a reality. Special thanks are also due to those individuals who have led this program so capably over time: Robert Abel, Ned Ostenso, Robert Wildman, David Duane and Chandrakant Bhumralkar. They are all responsible for building upon Sea Grant's beginning structure, leading it to a record of accomplishment and organizational strength. Due to their efforts and the efforts of many other dedicated individuals throughout the Sea Grant community, this organization is well positioned to take a leadership role in the nation's coastal affairs in the next century.

In 1996 and 1997, Sea Grant's programs of research, education, and outreach continued to add achievements to the long list that has gone before. Much of this report is devoted to a summary of that progress. However, this

report also provides us an opportunity to thank the many supporters and partners that make up the Sea Grant community—those in the Congress, state legislatures, universities, industries and myriad other constituencies who provide support for and show confidence in the National Sea Grant College Program.

HIGHLIGHTS OF 1996 AND 1997 INCLUDE:

■ Sea Grant received Congressional appropriations of \$53.3 million in 1996 and \$54.3 million in 1997.

■ Funds from both the Sea Grant appropriation and match from state partners totaled \$83.3 million in 1996 and \$86 million in 1997, a leverage factor of approximately 57 percent on the federal investment in each year. (These figures do not

include additional income from other NOAA and outside agency sources attracted to university Sea Grant programs.)

■ Continued improvements in efficiencies of management:

- reduced the national office FTE's by almost 25 percent.
- reduced, through computer technology, 75 percent of the paperwork for grants and contracts at the national office, which led to a NOAA Administrator's Award to the management team of Freud Park and Geraldine Taylor.
- reduced the cost of national administration to 4 percent of the total federal funds.



Ronald C. Baird

- introduced new guidelines for processing research grants to substantially reduce time and expense of grants management nationally.

- Provided commercial biotechnology investment funds of almost \$12.8 million during 1996–1997. Dr. David H. Attaway of the national office received the coveted Gold Medal Award from the Secretary of Commerce for contributions to progress in marine biotechnology.

- Established an investment fund for grants to Historically Black Colleges and Universities to enhance capabilities of those schools in the marine sciences and to increase interest among graduates in marine-oriented careers.

- Introduced new operating procedures designed to make Sea Grant a more responsive, flexible, competitive and innovative organization.

A recent trend in government is the move toward downsizing, outsourcing, and streamlining operations while reducing scope and influence. While this move is right and necessary for many government programs, *Sea Grant has chosen to position itself for future growth by becoming a more efficient, effective and responsive organization to those we serve.* Why and how we are moving in that direction is the subject of this message to our stakeholders and constituents.

THE COMPETITIVE LANDSCAPE

As we look to the new century, we understand unequivocally that human-induced impacts now chronically affect virtually every marine and Great Lakes coastal environment.

Coastal areas continue to be of enormous economic importance to the country. Indeed,

these areas will face extreme pressures for continued development in response to the anticipated exponential population growth indicated by current demographic trends. These events will create an unprecedented demand for environmental knowledge and understanding. More important, increasing pressure for environmental protection will put a premium on organizations whose products and services reduce the time between knowledge creation and policy response. With a more participatory regulatory climate emphasizing regional ecosystem sustainability and adaptive management practices, local and state entities will assume greater responsibility for public policy.

Consequently, the principal political challenge for the foreseeable future is the reconciliation of environmental protection with coastal development. While discretionary spending at the federal level may continue to be limited, public investment in environmental and associated technologies will, by necessity, increase.

Those programs that are cost effective, relevant, and best able to focus the nation's resources on the critical issues of the day will be favored. With 30 years of solid performance and great fundamentals in research, education and outreach in place with our university partners, Sea Grant is well-positioned for performance in the future.

President Charles Vest of MIT put it best, saying "America has flourished because we have supported a public/private innovation system fueled by research and education at our universities." That research and innovation are the key ingredients to sustainable development

and prosperity. Sea Grant is in the business of university-based research and the transfer of scientific information to those most in need of that information.

Over the years, Sea Grant has played a significant role in U.S. marine science research, education and outreach. Today, Sea Grant is a \$96.5 million annual operation and one of the leading supporters nationally of coastal-related science and outreach. The great potential of the program, however, offers many significant opportunities for the future.

A 1994 study of Sea Grant by the Ocean Studies Board of the National Research Council revealed a number of organizational and management issues impeding the program. Much of this derived from a centrally controlled organizational structure somewhat isolated from the parent agency and with limited integration among participants. Moreover, given the unprecedented rates of change and expansion of knowledge that will characterize the coming decades, effective organizations

must move with greater speed and urgency. There must be flexibility to shift scarce federal funds as priorities change. Yet, the need remains to maintain quality control through strong competition and peer review.

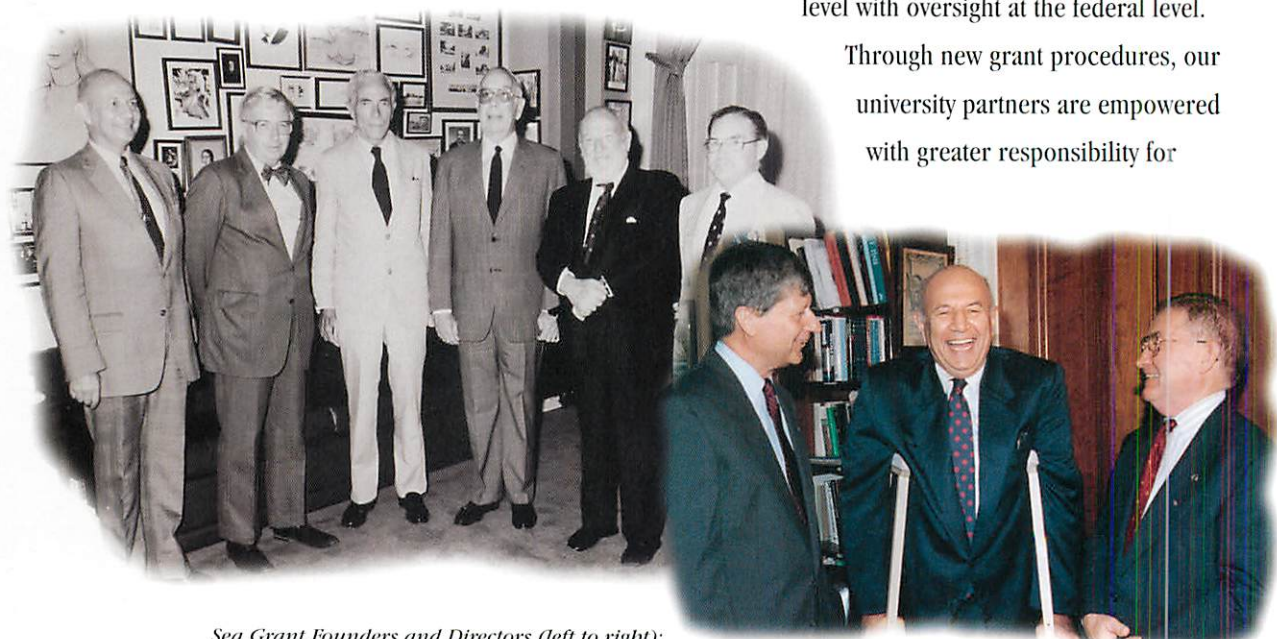
Our challenge is to take the basic Sea Grant model, one that has long demonstrated its effectiveness, and transform it into a more purposeful, efficient organization that is well positioned for leadership and performance in these rapidly changing times. We are committed to making Sea Grant an organization that uses the strengths of a large agency while behaving with the speed, flexibility, efficiency and creativity of a smaller operation in focusing scarce resources on critical issues.

We began that transformation in 1996 by introducing new procedures summarized below.

DECENTRALIZED ORGANIZATIONAL STRUCTURE:

The principles operating here involve devolution of decision-making to the local level with oversight at the federal level.

Through new grant procedures, our university partners are empowered with greater responsibility for



Sea Grant Founders and Directors (left to right): Robert Abel, John Knauss, Claiborne Pell, Paul Rogers, Atbelstan Spilhaus, Ned Ostenseo; Color photo, (left to right): Ronald Baird, Robert Abel, Ned Ostenseo

planning and investment decisions. Investment portfolios in research and outreach can now more rapidly and better respond to both local and national needs. An advisory process is in place to receive input from local constituencies and other agencies (including NOAA) in each state.

ENHANCED PARTNERSHIP PARTICIPATION:

The Sea Grant Association (SGA), which provides self-governance and includes representatives from all Sea Grant universities, has undergone a restructuring with the formation of highly focused committees that have specific missions. Our university partners can now be more effectively involved through the SGA in program-wide planning and policy formulation. Likewise, the National Sea Grant Review Panel has reorganized its committee structure to better focus attention on strategic areas and long-range policy.

SIMPLIFIED, COMPETITIVE PROPOSAL EVALUATION PROCESS:

A rigorous process has been established for planning, soliciting and peer reviewing proposed research projects. In addition to substantially reducing costs and processing time, the procedures give local programs the flexibility to better align research investments with local/national priorities and needs.

CREATION OF A NATIONAL STRATEGIC INVESTMENT FUND:

A revolving fund has been established to support national competitions in specific subject areas of research and outreach. These funds will enable Sea Grant to focus the best researchers in the university community on issues of national import. Funding is also

being provided for collaborative research projects between Sea Grant universities and other programs within NOAA.

MERIT AND PERFORMANCE-BASED EVALUATION:

The conceptual framework for an evaluation protocol based on program performance was developed in 1996. Periodic evaluations of state Sea Grant programs will occur on a four-year cycle and will consider past performance as well as future direction. Evaluation criteria were developed during 1997, and implementation of the new performance-based evaluation will begin in 1998.

In closing, Sea Grant is an organization with tremendous potential for contributing to the national interest by bringing the formidable resources of our finest universities to bear on critical coastal issues. As we look to the next millennium, Sea Grant is focusing on the unprecedented opportunities and challenges represented by a global economy, global scale environmental impacts, the rapid growth of information technology, and the need for rapid, effective communication of scientific knowledge.

Sea Grant is an organization with a distinguished history. It performs well in the present and focuses on the future. In short, Sea Grant is a great investment of taxpayer dollars.

Thanks to our many supporters nationwide.



Ronald C. Baird
Director, National Sea Grant College Program

Sea Grant: Reflecting on Two Years of Progress

When the 89th Congress passed the National Sea Grant College and Program Act of 1966, it created the first federal program mandated to support activity across the full spectrum of the marine sciences. In the act, Congress set forth an approach involving research, education and outreach to promote the wise use of our nation's coastal, ocean, and Great Lakes resources for a sustainable economy and environment.



The Sea Grant network has now grown to encompass more than 200 universities and other marine organizations that work within a core of 29 Sea Grant Colleges and institutions. Providing this network with a strategic underpinning is the *Sea Grant Network Plan 1995–2005* which concentrates on the three broad themes of economic leadership, coastal ecosystem health and public safety, and education and human resources.

To tackle these themes, the Sea Grant network has undertaken research projects in areas as diverse as aquaculture, biotechnology, coastal and estuarine processes, habitat restoration, nonindigenous species, seafood technology, and water quality. Scientific accom-

plishments and outreach impacts within these areas certainly take time to accumulate and cannot be evaluated over a two-year period alone.

Although by no means an exhaustive accounting, what follows is a compendium of some of Sea Grant's significant accomplishments during 1996–1997. The emphasis is on how Sea Grant utilizes the best available academic talent at the local and regional levels to help address national priorities with impacts that exceed its budgetary size.

As it enters its fourth decade, Sea Grant continues to seek productive new avenues to promote the wise use of the nation's ocean and Great Lakes resources which are so central to our health and prosperity.



Economic Leadership

I

INVESTIGATING THE POTENTIAL OF MARINE BIOTECHNOLOGY

Even though 80 percent of all life forms on Earth inhabit the oceans, their potential as the basis for new biotechnologies remains largely unexplored. Because of recent developments in molecular biology, scientists are now able to use new and exciting tools to investigate biological resources from the oceans, Great Lakes and other bodies of water. Using these new tools, Sea Grant scientists are just beginning to tap the enormous potential that marine organisms have for protecting public health, improving seafood production and safety, restoring the environment, and developing an array of new products.



PHARMACEUTICALS

Pharmaceuticals gathered from the seas are growing in importance since the number of new compounds being discovered from traditional drug sources—land plants and bacteria—has declined sharply. This decline comes at an inopportune time because many infectious organisms have developed drug-resistant strains. A good source for new pharmaceuticals are the animals, bacteria and plants that dwell in the seas.

One such source may be either a slow-growing marine invertebrate, the bryozoan *Bugula neritina*, or a bacterium living on it in a symbiotic relationship. California Sea Grant researchers think the bacterium

synthesizes a potentially important drug that is active against leukemia. Currently, the researchers are working to show that the bacterium is producing the drug; this work may contribute to the development of economical processes for the drug's large-scale culture.

Scientists at Hawaii Sea Grant have isolated, from a mollusk and the alga on which it feeds, a new compound that is active against solid tumors of the lung and colon. An industrial collaborator has applied for an investigative new drug license to begin clinical trials of this complex compound.

To inhibit inflammation, California Sea Grant researchers have discovered a unique class of compounds called pseudopterosins,



Caribbean Sea Whip

potent anti-inflammatory drugs that are extracted from the Caribbean sea whip. These novel compounds are being used in the cosmetic industry and, after clinical trials are completed, are expected to be used in the pharmaceutical industry for reducing pain and inflammation associated with arthritis.

CALIFORNIA SEA GRANT

Other anti-inflammatory compounds have been cultured from red algae by Oregon Sea Grant researchers. These compounds mimic the anti-inflammatory actions of specific human hormones; others are toxic to plant and animal pests that plague agriculture and aquaculture.

AQUACULTURE AND AGRICULTURE

The tools of biotechnology also promise significant benefits to both the aquaculture and agriculture industries. Diseases of cultured fish and shellfish cause the aquaculture industry to lose tens of millions of dollars annually. To provide the industry with a new method to fight diseases that attack commercial stocks of oysters, clams and abalone, California and Connecticut Sea Grant researchers have developed a technique for adding an inheritable gene into a mollusk. An industrial collaborator has a license to tailor this technique for commercial use.

To revitalize the flagging oyster industry, a Delaware Sea Grant biologist is creating DNA markers to help scientists search among thousands of oyster genes for the handful that may confer resistance to MSX and Dermo, two diseases that have decimated the oyster fishery in the mid-Atlantic region. These disease-resistant genes could then be used to advance breeding programs.

Delaware Sea Grant researchers are also working to develop crops that can be grown in coastal environments or on farmland that has become salty from many years of fertilizer application. Through a decade of research to genetically select salt-tolerant marine and

estuarine plants that have high nutritional value and taste, the scientists have developed hay, grain and vegetable crops that are being tested in China, Egypt, Israel, Pakistan, Thailand and the United States.

In addition, the researchers are working to understand the complex mechanisms of salt tolerance so that this ability can be infused into traditional crops such as corn and wheat.

SEAFOOD SAFETY

The safety of seafood products remains a concern among scientists, policy-makers and consumers. To meet this concern, Sea Grant programs are developing rapid and sensitive methods to detect contaminated seafood. Mississippi-Alabama Sea Grant researchers have developed fast and highly specific polymerase chain reaction techniques for detecting several specific pathogens not only in shellfish but also in meat products, cooked sausage and milk.

Louisiana Sea Grant researchers are using antibody-based reagents for identifying and detecting a bacterium, *V. vulnificus*, in food and environmental samples. Their work suggests that, among a large and unknown number of *V. vulnificus* strains associated with seafood-producing environments, a relatively small number account for illnesses associated with this bacterium. Because these strains can be easily



DELAWARE SEA GRANT
Studying Salt-Tolerant Plants



NEW JERSEY SEA GRANT

detected and monitored, it may now be possible to better monitor seafood so that consumers can buy and consume safe, wholesome shellfish.

CLEAN WATER AND HUMAN HEALTH

In addition to assuring public health through providing safe seafood, Sea Grant researchers are developing tests to assure safe coastal waters for recreational purposes.

Hawaii Sea Grant researchers have developed immunological methods for detecting human pathogens. They are testing the effectiveness of these methods to identify marine recreational waters contaminated with pathogens from land-based discharges.

Also addressing the issue of harmful bacteria in coastal waters, California Sea Grant researchers have turned to DNA technology as a substitute for current, slow monitoring methods. Because bacteria are present even in healthy coastal waters, knowing normal bacterial profiles will allow researchers to generate accurate maps of naturally occurring bacteria in these waters, thereby providing a means of monitoring them for bacterial contamination.

NEW PRODUCTS

The innovations emerging in the pharmaceutical, aquaculture and agriculture sectors offer only a hint of the enormous potential of biotechnology to provide an array of new products.

South Carolina Sea Grant researchers are exploring how mimics of proteins, which oysters use to control shell growth, can be used as alternatives to the non-biodegradable substances now used by industry and consumers. Donlar Corporation has invested several million dollars and been issued 18 patents related to producing these new, environmentally friendly products. In addition, Donlar has begun making a synthetic form of polyaspartic acid, which is being sold as a fertilizer additive. When used in fertilizer, the material enhances plant growth. The Sea Grant-supported scientist who laid the groundwork leading to these environmentally friendly products was recognized with the Environmental Protection Agency's Green Chemistry Challenge Award in August 1996.



To develop other environmentally friendly products, Virginia Sea Grant researchers are investigating synthetic antifreeze peptides that are biodegradable and that could be used to control icing on aircraft, highways and agricultural crops. These researchers are using the natural antifreeze compound found in the winter flounder as a model.

Washington Sea Grant researchers are investigating organisms called extremophiles for a wide variety of commercial uses. Extremophiles live in extreme environments and thus produce enzymes that function under extreme conditions (very hot, very cold, very acidic or very salty). Enzymes taken from the superheated sea water of deep sea hydrothermal vents are being studied for use in high-temperature processes such as manufacturing fructose syrups and are used for

the polymerase chain reaction method of copying and enhancing DNA.

Cold-loving bacteria, collected during several ice-breaking expeditions in the Greenland and Norwegian seas, are being studied to increase the variety of cold-tolerant enzymes available to industry. One of the largest markets for these enzymes is for use in cold-water detergents. Because of the wide interest in extremozymes and in marine bioremediation, Washington Sea Grant co-sponsored a workshop in September 1996 to bring together researchers, industries and agency managers.

From enzymes of thermophilic bacteria found in oceanic smokers, New Jersey Sea Grant researchers have found new catalysts that could be useful to the agriculture industry. These catalysts may allow the food industry to increase the amount of high-quality protein soy in feeds for animals such as pigs and chickens.

ENVIRONMENT

Through biotechnology, bacteria and plants are being put to work soaking up heavy metals that are contaminating the soil and water as a consequence of industrial processing. Mississippi-Alabama Sea Grant researchers have inserted a mammalian gene into a common cyanobacterium to increase its ability to accumulate heavy metal. Researchers at Ohio Sea Grant have inserted the chicken metallothionein gene into a single-celled alga, allowing it to grow to higher densities in order to soak up more cadmium from contaminated waters.

Biotechnology is being used not only to restore degraded ecosystems but also to provide Sea Grant scientists with new methods to test and manage the environment. For example, using a cyanobacterium that has been genetically engineered, Mississippi-Alabama Sea Grant researchers have developed a new assay that quickly and easily tests for herbicides in soil, ground water and other environmental samples.



SANDRA MACFARLAND / WOODS HOLE SEA GRANT

And to develop information for resource managers, Maine/New Hampshire Sea Grant scientists are developing new techniques using DNA "fingerprinting" methods to look at population fluxes of cod, haddock, flounder, and other traditional commercial stocks in the Gulf of Maine.

OUTLOOK

Sea Grant is only on the threshold of discovering the unlimited applications of marine resources offered through biotechnology. These applications will revolutionize the manner in which these resources are used and will make major contributions to the economic growth of not only the United States but also the entire world.

SEA GRANT HOLDS MARINE BIOTECHNOLOGY BRIEFING

Early in 1997, the National Sea Grant College Program held a marine biotechnology briefing in Washington, D.C., for journalists, policy-makers, industry leaders, and members of Congress and their staff. The briefing, a science education forum, featured 12 Sea Grant-funded scientists who presented the latest developments and issues in their fields of marine biotechnology research. Presentations were grouped into three sessions: fisheries, aquaculture and seafood safety; bio-medicine, pharmaceuticals and natural products; and water quality, bioremediation and habitat restoration.

At the end of each session, panel members were available to reporters for interviews. Stories resulting from these interviews were printed in the *New Orleans Times-Picayune*, *Science News*, *Cape Cod Times*, *Washington Times*, and *San Diego Union Tribune*, as well as in the prestigious journal *Nature Biotechnology* and in the *American Society of Microbiology News*. Stories were also carried on wire services such as the *British Broadcasting System*, *Ottaway News Services*, and *Scripps Howard News Service*.

P

PROVIDING SOLUTIONS TO BYCATCH PROBLEMS

An estimated one-third, by weight, of all fish caught commercially is discarded at sea as bycatch, the inadvertent take of nontarget species in fishing operations. In the United States, the North Pacific groundfish fisheries have the largest volume of bycatch, but it is only a small percentage of the overall catch.

Estimates for the number of marine mammals taken as bycatch are also substantial, and there is growing concern over the number of seabirds entangled in nets. However, calculations of the ratio of discarded to retained catch are highest in the Southeast Atlantic and Gulf shrimp trawl fisheries.

These bycatch problems have captured the attention and scrutiny of the general public, resource managers and environmental interest groups. This attention has led to regulations being imposed to limit fishery operations with significant numbers of bycatch. Whether it involves working long hours onboard fishing vessels to refine fishing gear or using the tools of biotechnology to discover new uses for nontarget species, the Sea Grant network is working to provide solutions to the bycatch problem.



STEPHAN MYERS / TEXAS SEA GRANT

FINFISH BYCATCH

Studies by Washington Sea Grant researchers proved that using large meshes in trawl nets reduced the catch of unwanted or unusable fish in the West Coast black cod and sole fisheries. However, researchers didn't know if these techniques could be used in the Bering Sea pollock fishery, where nets and catches are among the largest in the world.

At the request of fishers, Washington Sea Grant researchers tested experimental, big-mesh pollock trawls during a study managed by the Alaska Fisheries Development Foundation and funded by NOAA's National Marine Fisheries Service (NMFS) Saltonstall-Kennedy Program in collaboration with the University of Alaska Fisheries Industrial Technology Center. Partly as a result of this research, the North Pacific Fishery Management Council adopted regulations to increase the mesh size in pollock trawls.

In southern New England waters, the traditional gear used by fishers relies on small mesh to harvest squid, butterfish and whiting. However, this gear also has a bycatch of juvenile groundfish, including flounder. Therefore, Rhode Island Sea Grant scientists are working on species-specific, small-mesh bottom trawls for use in those waters. Researchers have evaluated several modifications to the traditional gear, and a Saltonstall-Kennedy grant from NMFS will allow them to continue their work.

SHRIMP FISHERY

The otter trawl, the traditional choice of North Carolina shrimpers, caught large amounts of shrimp, but it also caught sea

turtles and other non-targeted finfish and shellfish species. To reduce this bycatch, North Carolina Sea Grant researchers investigated the skimmer trawl as an alternative to the otter in estuarine waters.

With funding from NMFS and the Gulf and South Atlantic Fisheries Development Foundation, data was collected through the cooperative efforts of fishers, netmakers, and Sea Grant outreach specialists and supporters in Louisi-

testing the use of fisheye BRDs sewn into various positions on shrimp trawls.

This cooperative effort involves industry, government agencies and several universities. To record fish and shrimp activity around the BRD while under tow and during net haul-back, Texas Sea Grant is using a state-of-the art, compact underwater camera mounted on the shrimp net near the BRD. The footage is used to show shrimpers the most efficient location for

BRDs in their nets, and it will also be used for training and research purposes at bycatch reduction workshops.

Texas does not require bay and nearshore shrimpers to use BRDs now, but the state may mandate their use in the bays. Therefore, a Texas Sea Grant extension specialist is helping evaluate three types of BRDs in the bays. At the request of the bay shrimping industry, another

Texas extension specialist is in the midst of a multi-year bay bycatch characterization study. He is trying to find out how much bycatch bay shrimpers catch and the number of each different species that end up in bay shrimp nets.

Georgia Sea Grant researchers are working on methods to increase fish exclusion rates when TEDs are installed on trawl nets. They are working with the Georgia Department of Natural Resources to give "credit for TEDs" to fishers and to forego the addition of a second excluder device on their nets, when the existing TEDs satisfy the finfish exclusion rates mandated by the state.



Extension Specialists Test BRDs

STEPHAN MYERS / TEXAS SEA GRANT

ana and North Carolina. This data showed that the skimmer trawl not only reduced bycatch but also increased the catch of white shrimp. These studies have led to the adoption of skimmer trawls by 95 percent of North Carolina's inshore fleet.

The turtle excluder devices (TEDs) that Gulf of Mexico shrimpers are required to use have considerably reduced sea turtle mortality. Because of growing concern over finfish bycatch, lawmakers stand poised to require that shrimpers also use bycatch reduction devices (BRDs) in federal waters. In one of the largest cooperative efforts in the history of the Gulf shrimp fishery, a Texas extension specialist is

Florida Sea Grant is complementing the work being done to build better BRDs by providing a computer tool for fishery managers. Through the American Fisheries Society



Testing TEDs

Software Depository, Sea Grant has developed a multispecies-multigear, PC-based simulator for analyzing shrimp bycatch impacts on single species management options. This simulator will allow fishery managers to evaluate management options for king and Spanish mackerel, red drum and red snapper at three levels of bycatch.

MARINE MAMMAL BYCATCH

Sea Grant programs in both the Northeast and Alaska are developing bycatch reduction strategies to preserve marine mammals. In the Northeast, experimental studies by MIT have indicated that midwater trawling for tuna in pairs results in larger catches and reduces both general and marine mammal bycatch. In addition, the data demonstrate that pair trawling lands a significantly larger fish. In Alaska, a Sea Grant education and awareness program has successfully reduced net

entanglements of marine mammals in the state's Copper River fishery.

Originally developed with assistance from Maine/New Hampshire Sea Grant to address the problem of harbor porpoises becoming entangled in gillnets, acoustic devices called "pingers" are now being incorporated into research on a variety of bycatch species. In cooperation with NMFS, Rhode Island Sea Grant researchers are testing the use of these pingers to eliminate marine mammal bycatch in the swordfish fishery and drift net fishery. Researchers will also redesign the acoustic devices for greater reliability and serviceability. These devices will be tested at the acoustic facility at the Naval Undersea Warfare Center in Newport, Rhode Island.

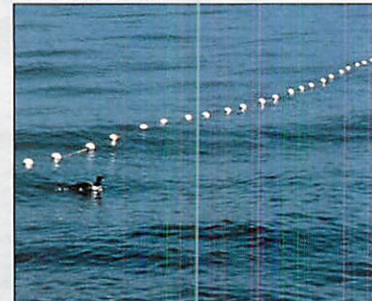
SEABIRD BYCATCH

A Washington Sea Grant outreach specialist is testing the effect of highly visible, opaque netting in the upper portions of gillnets as a visual deterrent to birds. His research has shown that visually modifying salmon gillnets and adjusting fishing schedules can reduce entanglements of seabirds.

This work, coupled with a required observer program coordinated

by Washington Sea Grant, has been credited with preventing closure of the Puget Sound sockeye salmon fishery, saving hundreds of jobs and millions of dollars in revenue to the region's economy.

WASHINGTON SEA GRANT



Visible Netting

BYCATCH MORTALITY

In 1994 alone, North Pacific trawlers discarded halibut worth approximately \$43 million. Because of bycatch quotas, these discards caused fishing closures that cost North Pacific fleets millions of dollars in lost opportunity. To more accurately calculate the mortality of bycatch, Washington Sea Grant researchers are holding the halibut that come up in a trawl in an underwater cage for three days to see which fish survive. Preliminary results indicate that halibut are most likely to survive if they spend a short time in the net and are returned to the water promptly. These methods are now being used on the West Coast to estimate the bycatch mortality of trawl-caught black cod.

NEW MARKETS

Another alternative to bycatch quotas is to develop new markets for the incidental take. Alaska Sea Grant research in biotechnology played a pivotal role in finding a use for one of the state's biggest bycatch species, arrowtooth flounder. The research, which led to a U.S. patent, developed a processing method to halt enzymatic degradation, allowing industry to market some 386,000 tons of arrowtooth flounder, a fish once tossed overboard as trash because the flesh was of poor quality.

OUTLOOK

The ultimate solution to the bycatch problem will come about only through the cooperative efforts of resource managers,

conservationists, scientists, and fishers. To provide a common forum for these constituencies and to stimulate both international and domestic research on bycatch reduction methods and gear devices, the Alaska, Georgia and North Carolina Sea Grant programs sponsored a two-day symposium in 1996 on "Consequences and Management of Fisheries Bycatch," held in conjunction with the annual



SOUTH CAROLINA SEA GRANT

meeting of the American Fisheries Society and as a follow-up to a previous workshop on solving bycatch. Proceedings from the workshop, *Solving Bycatch: Considerations for Today and Tomorrow*, were published by Alaska Sea Grant. A more recent publication, *Fisheries and Bycatch: Consequences and Management*, the proceedings of the 1996 American Fisheries Society symposium on bycatch, was also published by Alaska Sea Grant. And in an effort targeted to general audiences, Texas Sea Grant devoted its Fall 1997 issue of *Texas Shores* magazine to a comprehensive overview of the bycatch issue.

ANGLERS ABLE TO RECYCLE FISH

Reef fish reeled up from depths by recreational anglers are often weakened due to the extreme pressure changes that can cause the fish's air bladder to expand. This expansion can be so intense that it can cause severe injury to fish. If the fish is not a "keeper," upon release it may remain on the surface where it is eaten by predators or dies of exposure.

To help these released fish grow large enough to keep the next time they are caught, Florida Sea Grant has developed an inexpensive venting "tool." Anglers can use this tool to relieve fish of excess gas pressure by inserting a hollow needle into the fish at the proper location. The small hole made by the needle quickly heals. Use of this tool has been promoted through statewide workshops and the production and distribution of thousands of colorful "how-to-do-it" brochures and weather-proof placards.

P

PROTECTING AND RESTORING COASTAL HABITATS

Wetlands are among the most important ecosystems on earth. They remove wastes from both natural and human sources, store flood waters and minimize damage from severe storms, provide a home for a wide variety of plants and animals, and produce food for many commercially important fish and wildlife species.

Unfortunately many of our nation's wetlands have disappeared due to development and other human activities. Likewise, these activities and coastal storms have caused many of the sand dunes found along the coasts to all but vanish.

Dunes protect the shoreline from erosion and high tides. In addition, they protect wetlands and lagoons and properties located behind them. To help in the efforts to maintain, restore and create these valuable wetlands and sand dunes, Sea Grant researchers and outreach specialists are working with both the public and private sectors.



SOUTH CAROLINA SEA GRANT

SEAGRASS HABITATS

In early seagrass restoration projects, biologists collected seagrass plants from undisturbed areas and moved them to the mitigation sites. Since these transplant efforts are costly and often unsuccessful, California Sea Grant researchers are studying eelgrass to determine whether transplants used at restoration sites have sufficient genetic diversity for new populations to persist. Transplants, which are often selected from nearby sources, currently come from a single genetic stock. Researchers believe that low genetic diversity may contribute to the inability of populations to respond to environmental changes over time and may also contribute to their eventual loss.

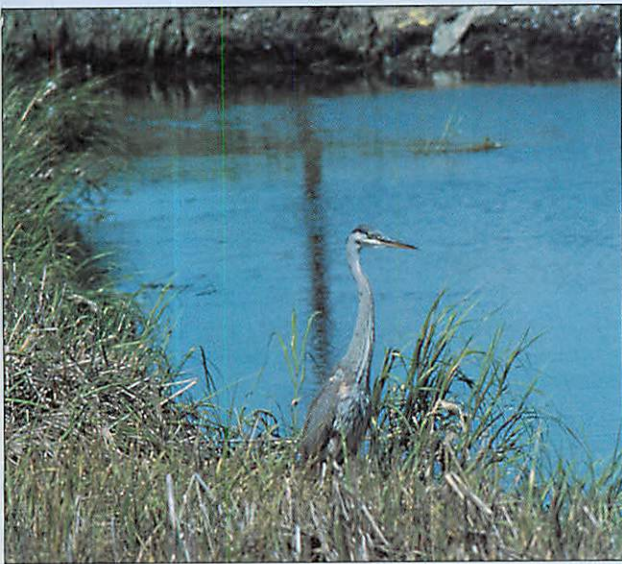
Preliminary research results suggest that seagrass beds with relatively high genetic diversity should be given priority for conservation. Cooperators in this project included environmental consulting firms, NOAA's National Marine Fisheries Service, the California Department of Fish and Game, the U.S. Navy, and the City of San Diego. Preliminary results from this project have led to the development of a complementary project by NOAA's Coastal Ocean Program.

In addition to genetic diversity, other aspects of seagrass beds are important in determining the success of restoration efforts. In the Gulf of Mexico, a Mississippi-Alabama Sea Grant researcher is looking at how small a seagrass patch can be and still function effectively as a source of food and refuge for fish and shellfish.

In conjunction with the field work on this project, the researcher has completed a

National Park Service scientific survey of seagrass resources in Gulf Islands Seashore areas of Mississippi and Alabama. The survey results include a baseline from which the park service can keep a check on the health of seagrass beds.

In the past three decades, about 50 percent of the *Vallisneria americana* seagrass beds



NEW JERSEY SEA GRANT

have disappeared from Alabama's Mobile Bay. *V. americana*, also known as tape grass, is a common flowering plant once found abundantly in the shallow, low-salinity waters of the Bay and other northern Gulf estuaries.

To reintroduce these seagrass beds where they previously flourished, researchers at Mississippi-Alabama Sea Grant are investigating the use of propagules such as the grass's own fruits, seeds, and winter buds or tubers. They are working not only to determine the best environmental conditions for successfully establishing new tape grass beds but also to provide guidelines for collecting and using propagules, which will be helpful in both public and private seagrass restoration efforts.

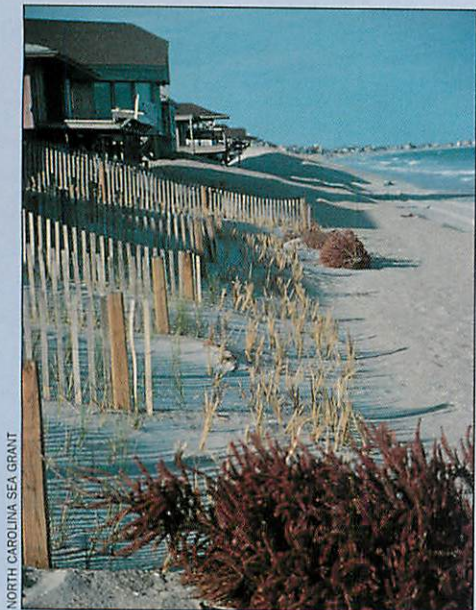
SALT WATER MARSH HABITATS

Coastal saltwater marshes produce more plant and animal life than any other natural habitat known. Smooth cordgrass, a vigorous native grass found chiefly in the intertidal areas of brackish and saline marshes, is an ideal choice for replanting denuded areas. However, its production of seeds is limited.

In a project supported by Louisiana Sea Grant and the Natural Resources Conservation Service, a scientist has developed a cloning system in which laboratory-cultured cells were induced to imitate the embryos of cordgrass seeds and grow into mature plants. More than 3,000 cloned plants have been produced and field-tested. From the plants that exhibited superior growth performance, artificial seeds were developed and then germinated in greenhouses.

Hand planting these seeds would be costly and time-consuming, and much of Louisiana's coastal marsh is inaccessible. Therefore, to speed up the natural revegetation process, these artificial seeds will be sown by air into a natural marsh in the spring of 1998 to test their growth rate and hardiness. If successful, these seeds can be widely used to reclaim lost marsh and offset the damage done to new plants by nutria predation.

Native California cordgrass, which is central to marsh restoration projects, provides key habitat for a variety of saltwater marsh plants and animals. But it is threatened by a recently introduced alien cordgrass species, which is spreading in San Francisco Bay.



Recycling Christmas Trees

To determine the extent of hybridization between the two cordgrass species, California Sea Grant scientists are using genetic markers. By comparing hybrid growth, herbivore susceptibility, and fertility with the parental species, the

researchers hope to determine the potential for these hybrids to spread. They will also survey cordgrass populations throughout California to determine the extent of local genetic variation. Information from these studies will help habitat managers and agencies in their efforts to control the recently arrived species.

S A N D D U N E H A B I T A T S

Sea oats help stabilize storm-ravaged dunes and beaches by binding sand to their root systems, retarding wind and water-driven erosion. But efforts to restore dune habitats with plants and seeds collected in the field have been restricted by concerns about dwindling natural stands and the possible introduction of poorly adapted plants.

Working with the Florida Department of Environmental Protection, a Florida Sea Grant researcher is using modern techniques of DNA fingerprinting, plant tissue culture, and comparative field tests to determine the range of genetic variability in the natural sea oat populations. The research goal is to select sea oats that have superior capacities for shoot and

root growth, which increases dune stabilization.

An earlier research project, which resulted in a process for mass production of sea oat clones, will enable researchers to clone individual sea oat strains from different geographical locations in order to evaluate them for superior growth characteristics under different field conditions. These results then can be transferred quickly and easily to commercial growers.

Horticultural Systems, Inc. of Parrish, Fla., is a commercial grower whose plants are helping to restore coastal ecosystems and to protect fragile beach environments from New Jersey to Texas, in Mexico and throughout the Caribbean. The president of HSI credits much of his business's success to Florida Sea Grant research and the support of its outreach specialists.

In return for this support, HSI has made its nursery, field projects and personnel available to Sea Grant researchers nationwide who are working to develop better methods for producing vegetation needed to help protect America's increasingly threatened shorelines.

To promote the development of sand dunes, both the Texas and the North Carolina Sea Grant programs encourage recycling of Christmas trees. Soon after the holidays, volunteers in these states, under the leadership of Sea Grant outreach specialists, stake down the recycled trees. These trees then trap wind-blown sand to help establish a strong, protective frontal dune line.

M O N I T O R I N G A N D A S S E S S M E N T

To ensure that restoration and mitigation efforts for seagrass beds, saltwater marshes and

sand dunes are progressing satisfactorily, it is important to establish an efficient monitoring system. Several Sea Grant programs are developing remote sensing technologies that will dramatically enhance resource managers' capabilities to view, monitor and improve coastal ecosystems.

In Maryland, Sea Grant researchers are using aerial photographs, surface level surveys and historical data from 1850 to 1989, to prepare land cover maps for the Blackwater River watershed on Maryland's Eastern Shore. From these maps, they will develop computer

parameters derived from satellite images, space shuttle photographs, acoustic profilers and other sources. These techniques will significantly enhance resource managers' capabilities to view an entire ecosystem.

PUBLICATIONS

Supported by both California Sea Grant and NOAA's Coastal Ocean Program, *Tidal Wetland Restoration: A Scientific Perspective and a Southern California Focus* was published in response to the unique challenges of restoring

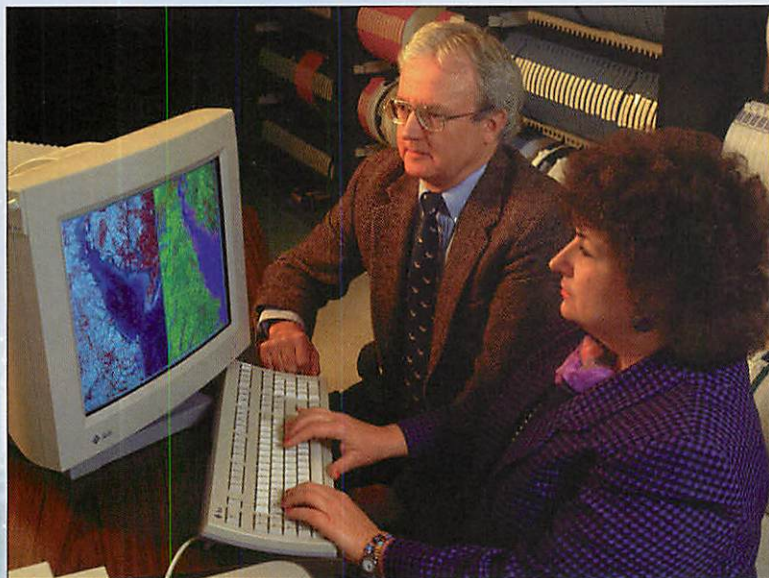
estuarine wetlands on the Pacific Coast. The book reviews several wetland restoration efforts from British Columbia to the Mexican border, with emphasis on work in San Diego County. It also describes some of the problems that constrain restoration and recommends methods to improve the design of restoration projects in order to

models to project future changes under various management and climate scenarios.

In Delaware, Sea Grant researchers are creating a Geographical Information System to help managers more easily assess changes in land use affecting wetlands—from encroachment by urban development to invasion of nuisance plants. Delaware Sea Grant is also developing a remote sensing observing system, incorporating data on water temperature and salinity, suspended sediments and other

accelerate the development of ecosystems.

To help those involved in the restoration of wetlands and dunes, North Carolina Sea Grant has recently published *Wetland Plants from Test Tubes*. This publication contains results of a workshop jointly funded by North Carolina Sea Grant and NOAA's Coastal Ocean Program. It describes the current state of micropropagation technology to produce marine, wetland, and dune plants for habitat restoration.



Assessing Coastal Ecosystem Health

DELAWARE SEA GRANT

PROTECTING CORAL REEFS

It has been estimated that 10 percent of the world's potential marine fishery production originates in coral reef systems. However, the productive potential of these systems has been drastically reduced through overexploitation and habitat degradation.

Marine Fisheries Reserves have been suggested as management tools for these complex and fragile ecosystems. Therefore, in 1994, Puerto Rico Sea Grant began a multifaceted and multi-disciplinary research initiative to answer biological, environmental and socioeconomic questions surrounding the design, function and implementation of reserves as a management tool for coral reefs.

One long-term goal of this initiative is to construct a mathematical model that can provide information to resource managers on the size, location and number of reserves necessary to achieve management objectives. The model would include aspects of the production of spawning-stock biomass, the dispersal/retention capabilities of larvae relative to current flow, and the emigration and immigration of juveniles and adults across reserve boundaries.

I

INVESTING IN GRADUATE AND UNDERGRADUATE STUDENT EDUCATION

The original National Sea Grant College and Program Act of 1966 charged the program with training the scientists, engineers and technicians necessary for the development of the nation's coastal and ocean resources. To fulfill this mandate, the Sea Grant network supports graduate and undergraduate students while they work alongside many of today's leading research scientists, receiving hands-on experience and learning practical skills they will use throughout their careers. In addition, Sea Grant supports graduate students through several national programs that have been created to address specific needs. Consequently,



MAINE-NEW HAMPSHIRE SEA GRANT

Sea Grant has trained many of the marine and Great Lakes scientists who currently hold research and policy positions across the nation.

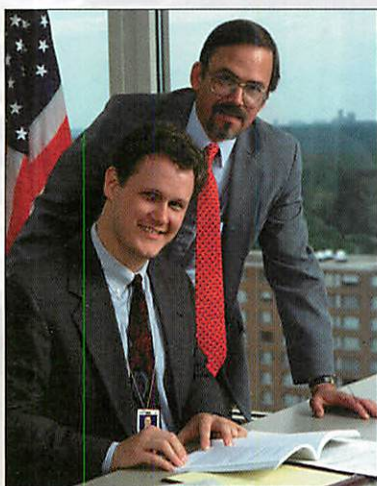
GRADUATE STUDENTS

By far, Sea Grant's major educational investment lies in its support of graduate research assistantships. During 1996 and 1997, Sea Grant supported an estimated 400 of these students while they worked on cutting-edge coastal, ocean, and Great Lakes related research.

For example, Florida Sea Grant allocates 25 percent of its research funding to support assistantships. This federal support is multiplied through private partnerships with two St. Petersburg organizations—the Aylesworth Foundation for the Advancement of Marine Science and the Old Salt Fishing Club. In the past 10 years, these partners have provided \$267,000 in scholarships that were awarded to 49 students in eight Florida universities. In 1996, three students received these scholarships and, in 1997, three more were recipients.

Since 1983, the North Carolina Sea Grant Program has sponsored a Sea Grant Marine Policy Fellowship to support a graduate student in cross-disciplinary marine policy and marine affairs studies. This is a nationally advertised fellowship designed to attract outstanding students to the East Carolina University-based program. Fellowship recipients are able to choose a program of study that will lead to a master's degree in political science, economics, geography and planning, sociology or anthropology.

Marking its 25th anniversary, Wisconsin Sea Grant conducted a survey of the almost 400 graduate students it has supported through the years. These students reported that they have moved into the executive suites of major corporations, become senior scientists in government laboratories, started their own business, become professors and been elected to public office.



Knauss Fellowship

DEAN JOHN A. KNAUSS MARINE POLICY FELLOWSHIP

At the federal level, the Dean John A. Knauss Marine Policy Fellowship, also known as the Sea Grant Fellows Program, was established to provide a unique educational experience to graduate students who have an interest in ocean and Great Lakes resources and the national policy decisions affecting those resources.

This program matches candidates with offices in the executive or legislative branches of the federal government in the Washington, D.C., area. From its modest beginnings in 1979 with a class roster of 10 fellows, the size of the yearly class now averages 25. The 341 fellows

who have participated in this program have gotten an insider's look at the national policy-making process.

About one-third of these fellows have stayed in the Washington area working in government offices or the halls of Congress. The remainder work in industry and trade associations, in state government as managers, or in academia as teachers and university researchers.

INDUSTRIAL FELLOWS PROGRAM

Begun in 1995, the Sea Grant Industrial Fellows Program is an exciting addition to Sea Grant's portfolio of educational investments. Created to strengthen ties between academia and industry, this program provides, in cooperation with specific companies, support for highly qualified graduate students who are pursuing research on topics of interest to a particular industry/company.

In a true partnership, the student, faculty adviser, and industry representative work together on a research project from planning to end product. Unlike the Knauss Fellowship, which lasts for only a year, the Industrial Fellowship can last for up to three years. During the pilot year, four fellows were selected to participate in this program.

In 1996, two new industrial fellows were added to the program. One was sponsored by MIT Sea Grant and Ocean Spar Technologies. The other, sponsored by Washington Sea Grant and Weyerhaeuser, is working on a research project in the Willapa River basin to study the behavior of wild and hatchery salmon fry in

streams. This project is part of a larger Weyerhaeuser program to restore habitat in salmon spawning streams.

In 1997, five more fellows were selected to receive the industrial fellowship. This current



Mentoring Students

class of fellows is sponsored by Sea Grant programs in Ohio, North Carolina, South Carolina, Texas and Washington. The industrial partners of these programs are Proctor and Gamble, StarKist Seafood, State Farm Fire and Casualty Company/National Association of Home Builders, Archer Daniels Midland, and Texas Instruments respectively. Fellows working with these companies will work on projects ranging from maximizing the case yield and quality of processed canned tuna to facilitating the creation of a network of field measurement installations that monitor wind speeds, wind characteristics, wind loads and building performance in severe wind events.

HISTORICALLY BLACK COLLEGES AND UNIVERSITIES

Sea Grant has a long history of working with minorities to increase diversity in the marine sciences. A valuable new addition to this work was begun in 1996 when the National Sea Grant Office developed a pilot program in cooperation with five Historically Black Colleges and Universities (HBCU).

The goal of this project is to significantly enhance the capabilities of HBCUs to offer education in the marine sciences to their student bodies. Universities participating in this pilot program are Delaware State, Clark Atlanta and Savannah State in Georgia, Maryland Eastern Shore, and Hampton University in Virginia. Sea Grant programs in the four states are working with these universities to develop projects of mutual interest.

R E S U L T S

The training of future marine scientists is a Sea Grant mandate that pays off. These scientists have created helpful new products, identified ways to conserve resources, and provided knowledge to help people live better. For example, a former graduate student funded by Wisconsin Sea Grant is working in collaboration with a South Carolina Sea Grant scientist, investigating how nature regulates the growth of crystals that form the shells of oysters and other marine creatures. This work has led to the development of new chemicals that work better

WOODS HOLE SEA GRANT

and keep the environment cleaner. Another graduate student who received support from New York Sea Grant and worked as a Knauss Fellow is now president of Bon Secour Fisheries, Inc. He is working to revive Alabama's oyster production in Mobile Bay. In the early stages of this project, he worked with Mississippi-Alabama Sea Grant.

In addition, a graduate student who formerly received support from North Carolina Sea Grant was recently named alumnus of the year by North Carolina State University. He owns and operates Cherrystone Clam Farm, one of the largest clam aquaculture operations on the East Coast.

As these examples illustrate, educating future marine scientists is a Sea Grant investment that pays big dividends.



HBCU Students Gaining Field Experience

GEORGIA SEA GRANT

ALASKA LANDS MORE THAN FISH

Since Alaska lands more than half of all U.S. fisheries, Alaska Sea Grant invests heavily in fishery issues and especially fishery management issues. Prospective students from around the nation and the world looking to a career in fisheries-related fields often contemplate studying in Alaska because of its proximity to many such jobs.

Not surprisingly, 80 percent of the students supported by Alaska Sea Grant move directly into marine-resource related jobs in either government or industry, and most of those jobs are in Alaska. Thus, Alaska Sea Grant benefits from fresh new ideas brought to its graduate program, and the nation benefits by the quality of graduate training these students receive, bolstered by hands-on research focused on important issues and funded by Sea Grant.

T

TRAVELING THE SEA GRANT INFORMATION SUPERHIGHWAY

Where can you find the latest Great Lakes sea-surface temperatures, information on the fish-killing *Pfiesteria* dinoflagellate, peer-reviewed research on zebra mussels, educational materials for schoolchildren, and field guides on maintaining septic tanks or preventing seabird bycatch? All of this information and more can be found on the wide variety of World Wide Web pages sponsored by the Sea Grant network.



The web is a natural environment for the 29 Sea Grant programs and the network of over 200 colleges, universities, research institutions and marine organizations that constitute the National Sea Grant College Program. This information superhighway helps the network accomplish its mission of conducting research, education, and outreach to use and conserve coastal, ocean, and Great Lakes resources for a sustainable economy and environment.

An important milestone for the Sea Grant network was reached in 1996. That marked the first year that all Sea Grant directors, communicators, extension specialists, educators, and national office staff could keep in touch through the electronic mail system. It was also the first year that every Sea Grant program as well as the National Media Relations Project and the National Office could be found on the web. In addition, the National Sea Grant Depository came online (<http://nsgd.gso.uri.edu/>). The Depository houses the only complete collection of Sea Grant-funded work and now includes 72,000 documents. It lends these documents all over the world to aid scientists, teachers, fishers, and many other individuals in their research, studies, and jobs.

PROGRAM SITES

Recently, the toxic dinoflagellate, *Pfiesteria piscicida*, has been implicated in fish kills and fish disease events in coastal estuaries and coastal areas from the mid-Atlantic to the Gulf Coast. To address public, media, and government concerns about this organism, Maryland Sea Grant teamed up with the Aquatic Pathobiology Center (Department of Pathology, University of Maryland at Baltimore) to sponsor a *Pfiesteria piscicida* information site (<http://www.mdsg.umd.edu/fish-health/pfiesteria>). This site provides accurate information about *Pfiesteria* and other harmful algal blooms, and it is also linked to other *Pfiesteria* sources including the web site created by a North Carolina Sea Grant researcher who pioneered work on the dinoflagellate.

Sea Grant clients such as charter fishing captains and sport anglers on Lakes Michigan and Huron are using Michigan Sea Grant's CoastWatch web site (<http://www.msue.msu>).



MINNESOTA SEA GRANT / MICHIGAN TRAVEL

Charter Fishing Boat

edu/seagrant) to help them find fish quickly, safely, and efficiently. Everyday, these clients use this site to bring them the latest lake-surface temperature readings compiled from advanced, very high resolution, radiometer satellite data collected by NOAA's CoastWatch program at the Great Lakes Environmental Research Laboratory. Besides recreational anglers, who use the temperature data to predict the movement of popular species such as coho and chinook salmon, commercial fishers, science teachers, chambers of commerce, and fisheries biologists use this information.

South Carolina Sea Grant (<http://www.csc.noaa.gov/SCSeaGrant>) is using its web site as an educational tool in the fight against marine and riverine debris. Beach Sweep/River Sweep, organized annually by South Carolina Sea Grant and the state's Department of Natural Resources, brings nearly 7,000 residents out on the third Saturday of each September to clean the state's beaches and inland waterways. Sea Grant has expanded this one-day activity into a

year-round message about the dangers of and solutions to aquatic debris by establishing a web site for groups, particularly schoolchildren, to post pictures showing their participation in the sweep. Teachers and schoolchildren can download data provided by the non-profit Center for Marine Conservation on the types and quantity of debris collected during the nationwide clean-up. This raw data can then be incorporated into the curricula to demonstrate mathematical concepts such as percentages. Students, encouraged by the opportunity to explore the results from the sweep, can then explore other coastal and marine issues using links provided onsite.

Citizens wanting to obtain information about southern California beaches need only to access the web site of the University of Southern California Sea Grant (<http://www.usc.edu/go/seagrant>). There they will find "clickable" maps that provide information on access and facilities for beaches in both Los Angeles and Orange counties. Internationally recognizable pictograms show recreational uses, beach features and amenities at beach locations, including lifeguard services and parking. For visitors as well as Los Angeles area residents, the pictograms are translated into English, Spanish, Chinese, Korean and Vietnamese. Current weather and surf conditions for southern California are provided via a link to NOAA's National Weather Service.

The Sea Grant program at Woods Hole Oceanographic Institution (WHOI) along with the Rhinehart Coastal Research Center at WHOI and the U.S. Geological Survey Woods Hole Field Center are sponsoring a "Coastal Briefs" prototype (www.whoi.edu/coastal-briefs). This

electronic mini-journal is available on the Internet and consists of a series of short articles that synthesize the results of recent research concerning all aspects of coastal oceanography. The intended audience includes the professional, scientific, regulatory and research management communities as well as college and high school teachers.

NETWORK SITES

Sea Grant's Coastal Recreation and Tourism pages (<http://seagrants.orst.edu/crt>) are hosted by Oregon Sea Grant. These pages provide a home for the Marina Network (MarinaNet), a collaborative project spearheaded by investigators at Rhode Island Sea Grant. This project is coordinated by outreach staff from Sea Grant programs in seven states: Florida, Louisiana, Michigan, New Jersey, Oregon, Rhode Island and Texas, and involves additional staff from the entire Sea Grant network. MarinaNet was created for the efficient exchange of information and experience—including technical advice, ideas for management, and information on regulations—among academia, the marina industry, regulatory agencies, and other marine-related organizations. By its third month of operation, the MarinaNet site was receiving more than 2,000 “hits” each month, drawing inquiries from around the world.

The **Sea Grant Nonindigenous Species (SGNIS)** web site (<http://www.ansc.purdue.edu/sgnis/>) provides one-stop shopping for information about zebra mussels and other aquatic nuisance species. Hosted by Illinois-Indiana Sea Grant, SGNIS is a multi-program

collaborative effort that involves Sea Grant programs in Michigan, Minnesota, New York, Ohio, and Wisconsin. Developed for use by researchers, students, industrial and recreational water users, outreach professionals and school teachers, this web site contains a comprehensive, searchable collection of research publications and training and educational materials produced by the Sea Grant network. It also includes research findings, newsletters, distribution maps, and a graphics library of slides, illustrations and videos, as well as links to local Sea Grant personnel and related web sites. Although currently focused on zebra mussels, the site



Zebra Mussel

also contains Sea Grant information on four other invaders—the Eurasian ruffe, round goby, sea lamprey, and spiny waterflea. Brief introductory written and pictorial descriptions of the exotics are available onsite for users unfamiliar with them.

AquaNIC (<http://ag.ansc.purdue.edu/aquanic/>), which stands for **Aquaculture Network Information Center**, was developed by Illinois-Indiana Sea Grant in cooperation with the U.S. Department of Agriculture's Extension Service. AquaNIC is the gateway to the

world's electronic resources in aquaculture for thousands of users including researchers, current and prospective fish farmers, outreach specialists, government agency personnel, teachers, and students. In addition to technical and government reports and extension publications, AquaNIC offers an image directory holding hundreds of pictures, videos, and slides in a variety of user-friendly formats. Visitors to this web site can also be linked to other aquaculture databases on the Internet.

U S A G E

The popularity of these and other web sites in the Sea Grant network is underscored by the sheer volume of usage reported by individual programs. Minnesota Sea Grant's web site (<http://www.d.umn.edu/seagr/>), home to the *Glossary of the Great Lakes*, the *Ruffe Bibliography*, and the image catalog "Visualizing the Great Lakes" receives over 2,000 visits a week. The Wisconsin Sea Grant site (<http://www.seagrants.wisc.edu>), which includes the Great Lakes Sea Grant network home page, averages nearly 110,000 hits per month.

C D - R O M S

Potential users who do not have access to the web can have many of the same search and information tools provided to them on CD-ROM. Minnesota Sea Grant has produced a CD-

ROM containing a searchable database of the information and images found on the SGNIS web site. Washington Sea Grant has also developed a CD-ROM in conjunction with the Applied Physics Lab at the University of Washington. A reference document for high school students, "The Sound: Puget Sound CD-ROM" has become a model teaching tool that functions at virtually all grade levels. Seven pull-down menus cover properties, ecosystems, species, status, marine affairs, solutions and recreation, all emphasizing how individuals can make a difference for Puget Sound, Washington. Since its publication in May 1997, 5,000 copies have been distributed free to schools and another 5,000 are available for sale to individuals and businesses with an interest in marine ecosystems.

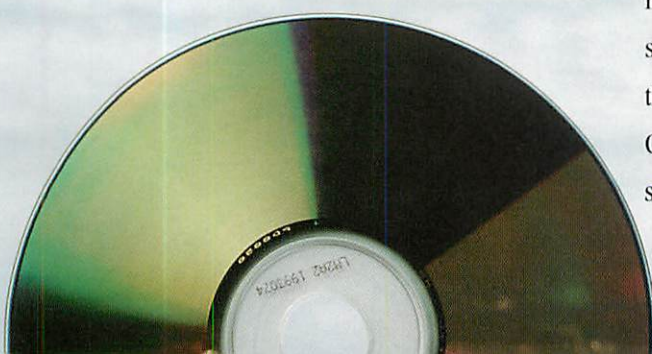
S T A R T I N G P O I N T S

For those wanting to travel the Sea Grant information superhighway, two important sites can be used as jumping-off points for exploration. The National Sea Grant site (<http://www.mdsg.umd.edu/NSGO/>) has an interactive location map with links to regional and state programs. The **National Sea Grant Media Resource Center** (<http://www.mdsg.umd.edu/seagrantsmediacenter/>) is a comprehensive source for news, facts and figures, radio transcripts, program newsletters and magazines, calendars of activities, and research publications. It also provides links to individual programs as well as network-wide sites such as MarinaNet and AquaNIC. Using these two onramps, any traveler can reach Sea Grant-related destinations on the information superhighway.

SEA GRANT WEB SITES SNARE AWARDS

The high quality and creativity of Sea Grant web sites have received national recognition. The Wisconsin Sea Grant WWW home page and the National Sea Grant Network web page, which is hosted by Maryland Sea Grant, were both named in 1996 as Magellan 4-star sites (Magellan is an online directory of over 1.5 million reviewed and rated Internet sites, only 40,000 of which are fully reviewed and given a rating, "4 stars" being the highest rating.)

The Wisconsin Sea Grant Madison-Area JASON site garnered two awards in 1996. It was named one of the National Center for Supercomputing Applications "Top Five Sites of the Day." In addition, the National Council for Advancement and Support of Education (CASE) gave the site one of only two Gold Medals awarded in its 1996 "Circle of Excellence" WWW competition. In 1997, for the second year in a row, the JASON site won the CASE gold medal award. It was one of three gold medal recipients from a field of 116.





Sea Grant Web Addresses

NOAA/NATIONAL SEA GRANT COLLEGE PROGRAM

<http://www.mdsg.umd.edu/NSGO/>

LOCATION MAP WITH REGIONAL AND STATE PROGRAM HOT LINKS

[http://www.mdsg.umd.edu/NSGO/
NationalSeaGrant.html](http://www.mdsg.umd.edu/NSGO/NationalSeaGrant.html)

NATIONAL SEA GRANT MEDIA RESOURCE CENTER

<http://www.mdsg.umd.edu/seagrantmediacenter/>

NORTHEAST REGION

Northeast Site

<http://seagrant.gso.uri.edu/region/>

Connecticut Sea Grant

<http://www.ucc.uconn.edu/~wwwsgo>

Maine-New Hampshire Sea Grant

<http://unhinfo.unh.edu/seagrant/>

MIT Sea Grant

<http://web.mit.edu/seagrant/www/>

New York Sea Grant

<http://flounder.seagrant.sunysb.edu>

Rhode Island Sea Grant

<http://seagrant.gso.uri.edu/riseagrant/>

Woods Hole Sea Grant

<http://www.whoi.edu/seagrant>

MID-ATLANTIC REGION

Mid-Atlantic Site

<http://www.mdsg.umd.edu>

Delaware Sea Grant

<http://www.udel.edu/cms/seagrant>

Maryland Sea Grant

<http://www.mdsg.umd.edu/MDSG>

New Jersey Sea Grant

<http://www.mdsg.umd.edu/NJSG/index.html>

North Carolina Sea Grant
http://www2.ncsu.edu/sea_grant/seagrant.html

Virginia Sea Grant
<http://www.people.virginia.edu/~gmsc-web/>

SOUTHEAST REGION

Southeast Site
<http://gnv.ifas.ufl.edu/~seaweb/homepage/seagul.htm>

Florida Sea Grant
<http://gnv.ifas.ufl.edu/~seaweb/homepage/fsg.htm>

Georgia Sea Grant
<http://alpha.marsci.uga.edu/gaseagrant.html>

Puerto Rico Sea Grant
<http://gnv.ifas.ufl.edu/~seaweb/homepage/upr.htm>

South Carolina Sea Grant
<http://www.csc.noaa.gov/SCSeaGrant/>

GULF REGION

Gulf Site
<http://gnv.ifas.ufl.edu/~seaweb/homepage/seagul.htm>

Louisiana Sea Grant
<http://www.lsu.edu/guests/wwwosgd>

Mississippi-Alabama Sea Grant
<http://www.waidsoft.com/seagrant/>

Texas Sea Grant
<http://texas-sea-grant.tamu.edu>

GREAT LAKES REGION

Great Lakes Site
<http://www.seagrant.wisc.edu/greatlakes/glnetwork/glnetwork.html>

Illinois-Indiana Sea Grant
<http://www.ansc.purdue.edu/il-in-sg/>

Michigan Sea Grant
<http://www.engin.umich.edu/seagrant>

Minnesota Sea Grant
<http://www.d.umn.edu/seagr/>

Ohio Sea Grant
<http://www.sg.ohio-state.edu/osgrant/f-osgrant.html>

Wisconsin Sea Grant Institute
<http://www.seagrant.wisc.edu/>

PACIFIC REGION

Alaska Sea Grant
<http://www.uaf.alaska.edu/seagrant/>

California Sea Grant
<http://www-csgc.ucsd.edu/>

Hawaii Sea Grant
<http://www.soest.hawaii.edu/SEAGRANT>

Oregon Sea Grant
<http://seagrant.orst.edu>

University of Southern
California Sea Grant
<http://www.usc.edu/go/seagrant>

Washington Sea Grant
<http://www.wsg.washington.edu>

OTHER SEA GRANT RESOURCES

AquaNIC (Aquaculture Information)
<http://ag.ansc.purdue.edu/aquanic>

MarinaNet
<http://seagrant.orst.edu/crt/>

National Sea Grant Depository
<http://nsgd.gso.uri.edu/>

Northeast Network Aquatic Exotic News
<http://www.ucc.uconn.edu/~wwwsgo/aen.html>

Pfiesteria Piscicida Information Site
<http://www.mdsg.umd.edu/fish-health/pfiesteria>

Sea Grant Nonindigenous Species Site
<http://www.ansc.purdue.edu/sgnis/>

Financial Report

In FY 1996, the annual operating budget for the National Sea Grant College Program was \$92.1 million. About 58 percent of these funds came from federal appropriations of \$53.3 million. Matching funds from state partners accounted for about 33 percent of the total. Pass-through funds coming from NOAA and other agencies and carryover funds from FY 1995 accounted for the remaining 9 percent of the total.

In FY 1997, the annual operating budget for the National Sea Grant College Program was \$96.5 million. About 56 percent of these funds came from federal appropriations of \$54.3 million. Matching funds from state partners accounted for about 33 percent of the total. Pass-through funds coming from NOAA and other agencies and carryover funds from FY 1996 accounted for about 11 percent of the total.

Sea Grant FY 1996 & FY 1997 Financial Report

(In thousands)

Fiscal Year	1996	1997
Appropriation	\$53,300	\$54,300
Prior year deobligations and carryover (net)	629	181
Available Funding*	53,929	54,481
Sea Grant Core Programs**	36,121	43,283
National Strategic Investments (NSIs)		
Marine Biotechnology**	7,591	0
Nonindigenous Species	3,492	3,843
Oyster Disease Research	1,540	1,487
Fellows – Industrial	123	242
HBCU Program	252	250
NCRI	950	950
Program Development Funds	95	150
Special Projects***		
Fellows – Legislative	360	360
SBIR	500	650
Network Communications	367	435
Miscellaneous	385	447
Total Grants Awarded	51,776	52,097
NSGO Program Management Costs	2,153	2,384
Total Expenditures	\$53,929	\$54,481

*Pass-through funds, which are received from NOAA components and other federal agencies, are not included in these figures. These funds, which were managed by Sea Grant programs, amounted to an additional \$8,226,112 in FY 1996 and \$10,352,057 in FY 1997.

**Funds listed under Marine Biotechnology include projects awarded in special biotechnology competitions and biotechnology projects funded within the FY 1996 core program. Due to change in program start dates, FY 1997 special competition biotechnology projects were funded in FY 1996. In FY 1997, \$5.2M in biotechnology was funded under the core program total of \$43.3M. Additional projects utilizing biotechnology were funded under the oyster disease research program; this funding amounted to \$632K in FY 1996 and \$763K in FY 1997.

***For further information regarding these special projects, plus all other grant awards, please see the "Financial Report Explanatory Notes" section that follows.

Financial Report Explanatory Notes

SEA GRANT CORE PROGRAM

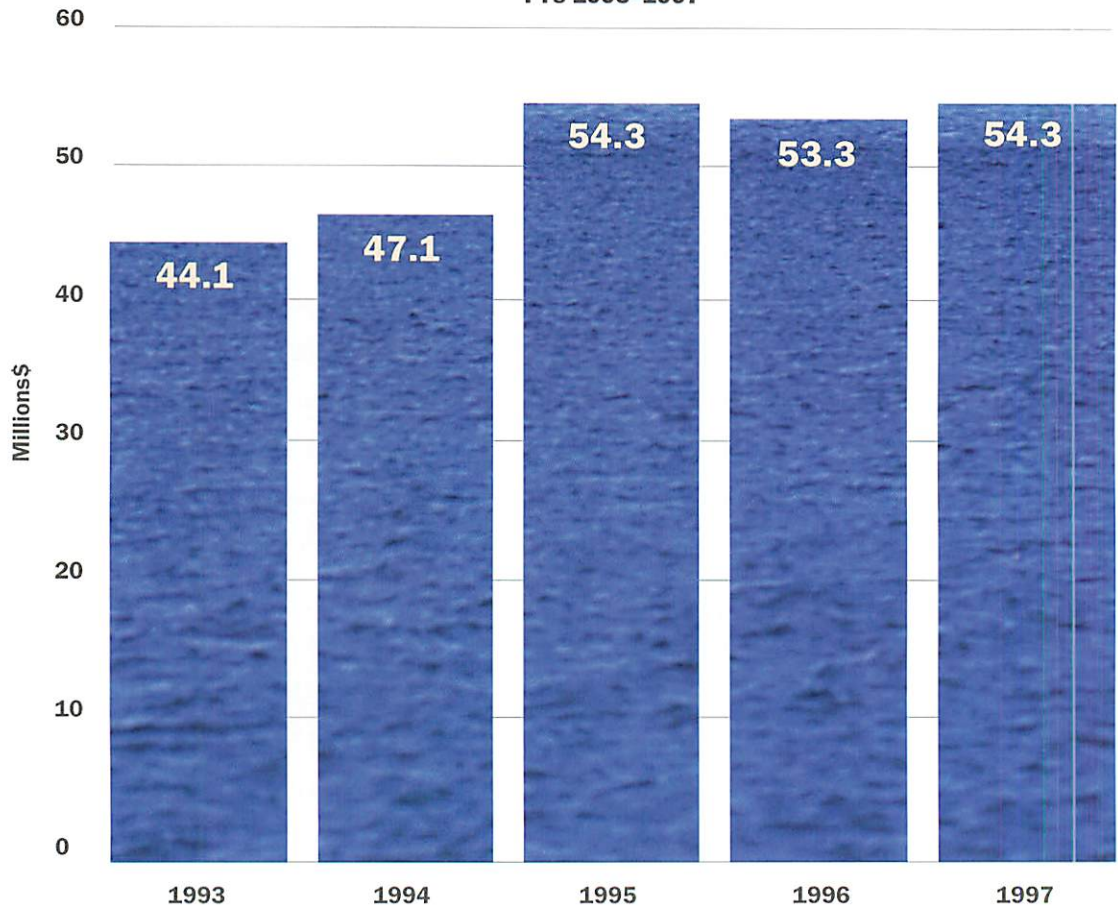
Sea Grant invested \$79.4 million during FYs 1996 and 1997 in the core program, which is composed of 29 Sea Grant colleges and institutions. Each of these 29 individual programs is responsible for developing an integrated approach to solving marine and coastal problems through merit-reviewed research, education, and outreach activities. The core programs draw upon the academic talent not only in their institutions but also through a wider network that has grown to encompass over 200 participating universities and other marine organizations throughout the nation. Federal oversight of the program is conducted by NOAA's National Sea Grant Office.

NATIONAL STRATEGIC INVESTMENTS

Sea Grant's marine biotechnology program totaled \$12.8 million in FYs 1996 and 1997 and emphasized the following areas: bioengineering, environmental remediation, molecular genetics, natural products, policy and technology transfer, and seafood and aquacultural pathogens. Funds listed under Marine Biotechnology include projects awarded in special biotechnology competitions and biotechnology projects funded within the FY 1996 core program. Due to change in program start dates, FY 1997 special competition biotechnology projects were funded in FY 1996. In FY 1997, \$5.2M in biotechnology was funded under the core program total of \$43.3M. Additional



**Sea Grant Appropriations
FYs 1993-1997**



projects utilizing biotechnology were funded under the oyster disease research program; this funding amounted to \$632K in FY 1996 and \$763K in FY 1997.

Sea Grant invested \$7.3 million in FYs 1996 and 1997 in research and outreach to address the problem of nonindigenous species invasions of marine and Great Lakes coastal ecosystems. The goals of this program are to prevent new introductions, control the spread of established species, and provide information to mitigate the damage from established populations.

Sea Grant invested \$3 million during FYs 1996 and 1997 on oyster disease research to address diseases that have severely impacted the U.S. oyster industry. The goal of this program is to develop a better understanding

of oyster diseases and to develop new measures to protect the industry from the effects of disease.

Sea Grant invested \$365,000 in industrial fellowships during FYs 1996 and 1997. Created to strengthen the ties between academia and industry, this program provides, in cooperation with specific companies, support for highly-qualified graduate students who are pursuing research on topics of interest to a particular industry/company. The industry partner provides matching funds.

Sea Grant invested \$502,000 in FYs 1996 and 1997 to develop a pilot program in cooperation with several Historically Black Colleges and Universities (HBCUs). The goal of this program is to significantly enhance the

ability of the HBCUs to offer education in the marine sciences to their student body.

Sea Grant invested \$1.9 million in support of the National Coastal Resources Research & Development Institute (NCRI). To help diversify the coastal economy of the U.S., NCRI sponsors research and demonstration projects primarily in the fields of aquaculture, technology development, seafood processing, and marine biotechnology.

The National Sea Grant Office invested \$245,000 of program development funds in FYs 1996 and 1997 to develop new initiatives and to respond to opportunities throughout the network.

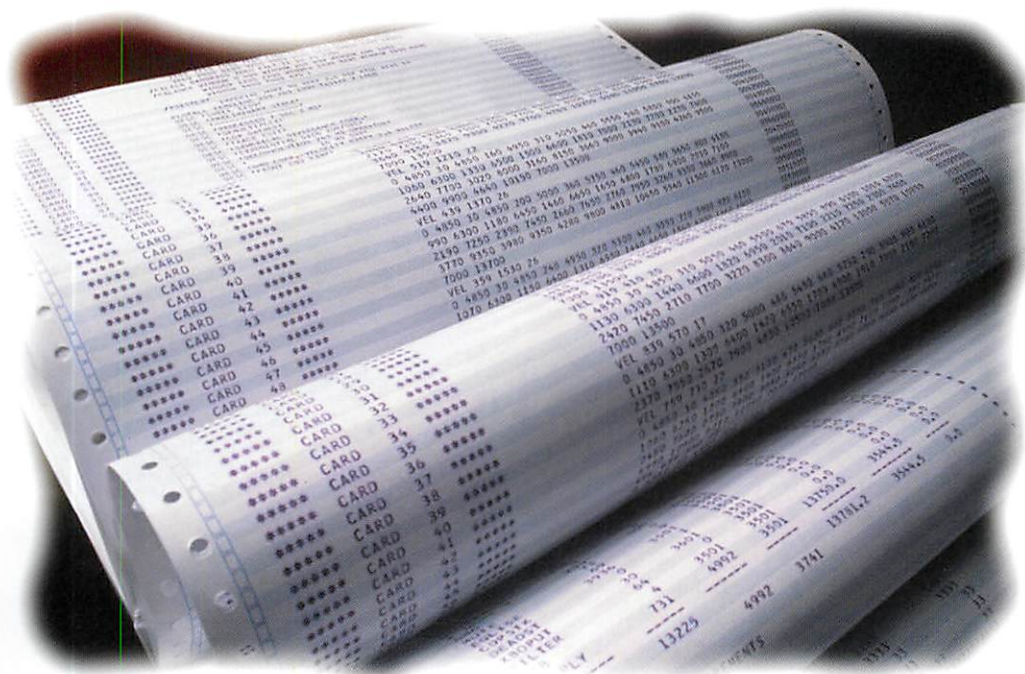
SPECIAL PROJECTS

Sea Grant invested \$720,000 in FYs 1996 and 1997 to support the Knauss Fellowship program, established to provide an opportunity for graduate students to work in government agencies and Congress on national policy decisions affecting ocean and Great Lakes resources.

Sea Grant invested \$1.2 million during FYs 1996 and 1997 in NOAA's Small Business Innovation Research (SBIR) Program. This Congressionally mandated program provides funding for research projects to assist small businesses in developing commercial products. Principal investments were made in areas such as algal bloom sensor technology, aquaculture filter systems, autonomous underwater vehicle mapping systems, and pompano aquaculture.

Sea Grant invested \$802,000 during FYs 1996 and 1997 to support network communications projects such as the *Sea Grant Abstracts* quarterly, the National Sea Grant Depository, the National Media Relations Project, and network publications.

Sea Grant invested \$832,000 during FYs 1996 and 1997 for several miscellaneous projects including the network's HACCP seafood outreach effort, the Operation Pathfinder network education project, and marine-related work conducted by university investigators in non-coastal states.



SEA GRANT FUNDING BY STRATEGIC PLAN

The following charts show the level of effort within the Sea Grant network during FYs 1996 and 1997 according to the *Sea Grant Network Plan*. This plan was developed in conjunction with the strategic planning efforts of the Department of Commerce's National Oceanic and Atmospheric Administration. The plan, which identifies priorities and charts the Sea Grant network's direction for the decade 1995–2005, focuses on three broad portfolios: Economic Leadership; Coastal Ecosystem Health and Public Safety; and Education and

Human Resources. Following are the key action areas identified within these portfolios:

ECONOMIC LEADERSHIP:

commercial biotechnology; environmental technology; commercial fisheries; sustainable aquaculture; seafood technology; coastal business and community development; and revitalizing marine infrastructure.

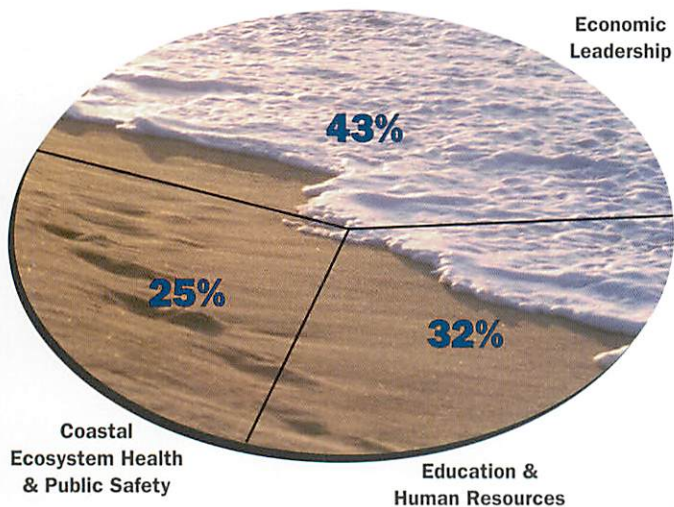
COASTAL ECOSYSTEM HEALTH AND PUBLIC SAFETY:

coastal ecosystems; coastal and Great Lakes habitats; sustainable development; coastal hazards; and safety at sea.

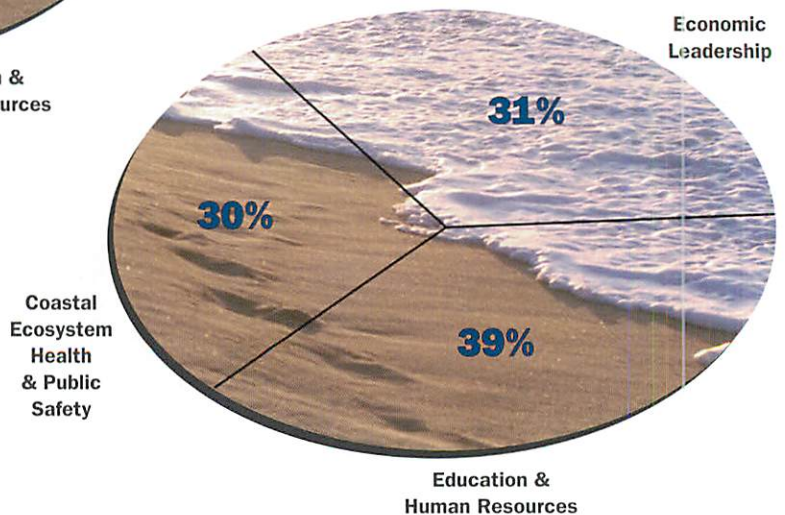
EDUCATION AND HUMAN RESOURCES:

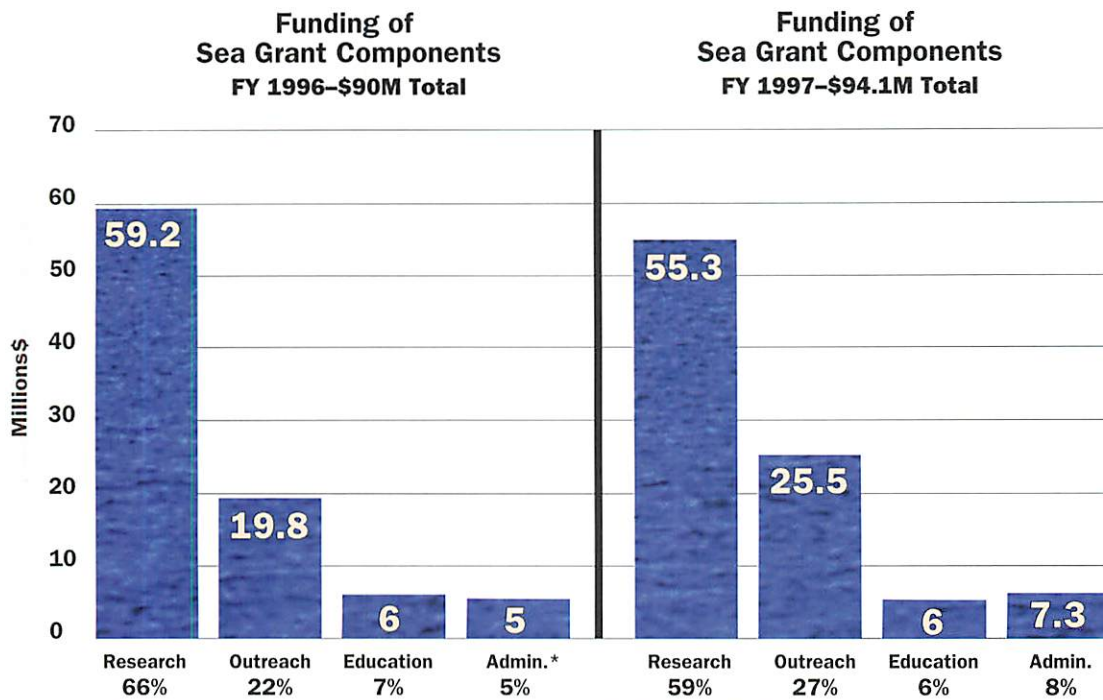
education of scientists, engineers, and resource managers; technical training; precollege education; informal education; extension services; and communications.

**Total FY 1996
Grant Funding \$90M
Federal, Match, & Pass-Through
By Sea Grant Strategic Plan Category**



**Total FY 1997
Grant Funding \$94.1M
Federal, Match, & Pass-Through
By Sea Grant Strategic Plan Category**





*Administration data reflects prorata funding for management costs due to changes in program start dates.

SEA GRANT FUNDING FOR RESEARCH, EDUCATION AND OUTREACH

The chart above shows Sea Grant's level of investment during FYs 1996 and 1997 in the broad areas of research, education, and outreach. In addition, costs of program administration are shown. A few explanatory notes:

■ Research in Sea Grant supports over 500 projects per year across the full spectrum of the marine sciences—from aquaculture, biotechnology, coastal processes, and estuarine studies to fisheries, habitat restoration, ocean engineering, seafood technology, and water quality. Also included here are the regional and program development funds that seed research efforts, and support for graduate research assistants.

■ Education in Sea Grant includes efforts such as development of precollege curricula,

training of K-12 teachers in the marine sciences, fellowship opportunities for policy study in Washington, D.C. and for work with industry, and support for graduate research assistants (except for those cases where such assistants are included in specific research project budgets as above).

■ Outreach in Sea Grant includes both the extension service and the communications activities of the individual Sea Grant programs. These activities facilitate the rapid transfer of scientific information in forms that can be readily understood by coastal clients and other users.

■ Program Administration in Sea Grant relies on individual state Sea Grant directors and their staff who shape and manage programs that draw upon the strengths of academic institutions to tackle coastal and Great Lakes issues and problems.

Funding Summary

FY 1996

	Federal	Matching	Total
Alaska	\$1,227,480	\$1,091,540	\$2,319,020
California—Sea Grant College System	5,422,146	2,733,844	8,155,990
California—Univ. of S. Calif.	358,000	261,628	619,628
Connecticut	843,137	436,067	1,279,204
Delaware	1,951,668	1,525,077	3,476,745
Florida	2,075,158	1,123,551	3,198,709
Georgia	789,141	455,540	1,244,681
Hawaii	1,337,919	942,471	2,280,390
Illinois/Indiana	784,548	483,921	1,268,469
Louisiana	1,519,189	1,152,320	2,671,509
Maine/New Hampshire	2,695,086	1,412,509	4,107,595
Maryland	2,239,555	1,664,638	3,904,193
Massachusetts—MIT	1,976,484	1,478,076	3,454,560
Massachusetts—Woods Hole	1,132,065	518,466	1,650,531
Michigan	929,152	530,741	1,459,893
Minnesota	2,053,185	817,106	2,870,291
Mississippi/Alabama	1,312,496	979,244	2,291,740
New Jersey	935,113	657,168	1,592,281
New York	2,524,278	1,453,047	3,977,325
North Carolina	1,548,936	884,477	2,433,413
Ohio	988,810	712,181	1,700,991
Oregon	2,650,510	1,463,270	4,113,780
Puerto Rico	466,122	618,543	1,084,665
Rhode Island	2,555,650	1,243,989	3,799,639
South Carolina	1,234,676	993,091	2,227,767
Texas	1,546,283	816,115	2,362,398
Virginia	1,733,491	867,383	2,600,874
Washington	2,480,051	1,316,520	3,796,571
Wisconsin	2,783,574	1,220,000	4,003,574
Independent/Other*	1,682,738	136,936	1,819,674
Grand Total:	\$51,776,641	\$29,989,459	\$81,766,100

FY 1997

	Federal	Matching	Total
Alaska	\$1,518,905	\$1,277,217	\$2,796,122
California—Sea Grant College System	4,220,032	2,151,103	6,371,135
California—Univ. of S. Calif.	882,865	464,783	1,347,648
Connecticut	869,897	455,255	1,325,152
Delaware	1,444,858	1,265,600	2,710,458
Florida	2,074,645	1,021,276	3,095,921
Georgia	1,258,646	721,802	1,980,448
Hawaii	1,762,000	1,108,004	2,870,004
Illinois/Indiana	1,259,473	696,188	1,955,661
Louisiana	1,744,044	1,228,911	2,972,955
Maine/New Hampshire	1,846,000	1,052,616	2,898,616
Maryland	2,418,862	1,584,279	4,003,141
Massachusetts—MIT	2,099,324	1,885,527	3,984,851
Massachusetts—Woods Hole	980,000	493,632	1,473,632
Michigan	1,757,472	1,177,163	2,934,635
Minnesota	1,053,908	560,962	1,614,870
Mississippi/Alabama	1,391,242	1,006,490	2,397,732
New Jersey	1,069,708	733,770	1,803,478
New York	2,582,489	1,328,023	3,910,512
North Carolina	1,811,375	897,469	2,708,844
Ohio	1,176,788	878,092	2,054,880
Oregon	2,039,209	1,503,349	3,542,558
Puerto Rico	799,695	616,527	1,416,222
Rhode Island	2,315,055	1,133,786	3,448,841
South Carolina	1,630,911	1,071,359	2,702,270
Texas	1,882,745	990,721	2,873,466
Virginia	1,773,920	949,527	2,723,447
Washington	2,769,565	1,519,615	4,289,180
Wisconsin	1,804,700	1,600,000	3,404,700
Independent/Other*	1,859,261	316,314	2,175,575
Grand Total:	\$52,097,594	\$31,689,360	\$83,786,954

*Funds used to support the National Coastal Resources Research & Development Institute, Small Business Innovation Research Program, and grants to university investigators in non-coastal states.

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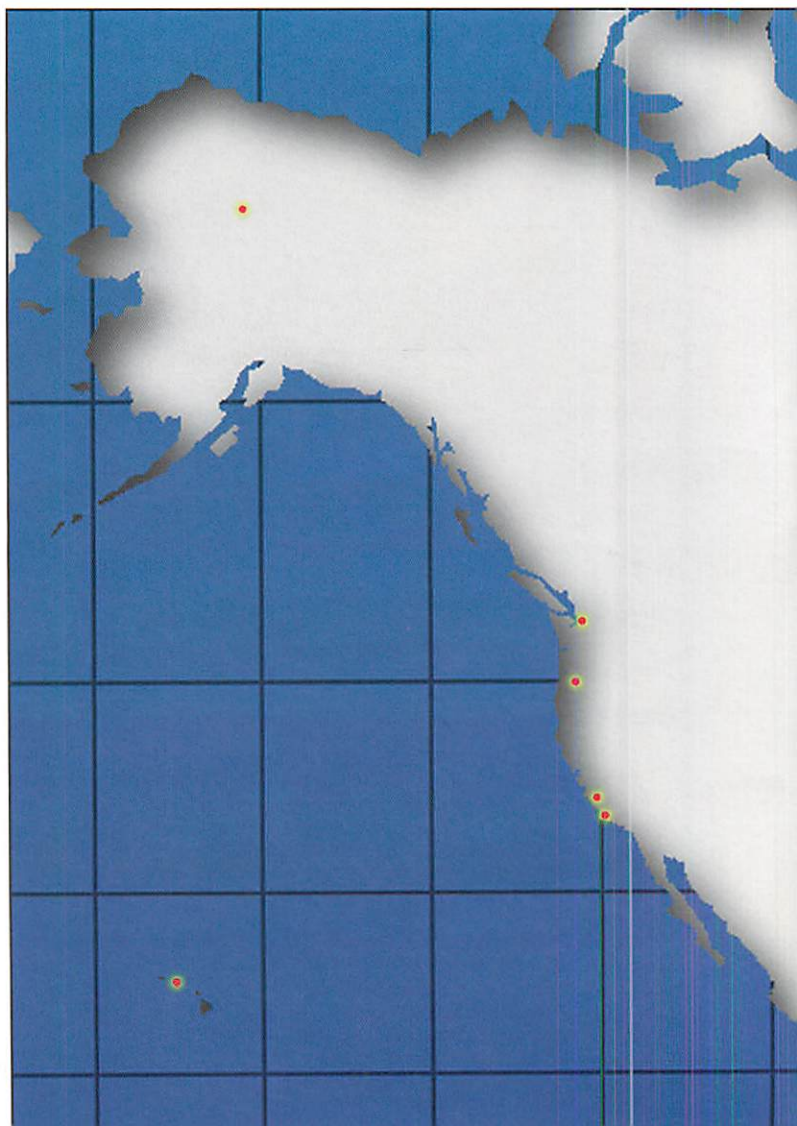
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*Sea Grant College (total 27)
 (ME-NH=1, IL-IN=1)
 +Institutional Program (2)



