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Science Serving Coastal Florida: Florida Sea Grant Delivering Results! 2000

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Sea Grant Florida

UNIVERSITY OF FLORIDA

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Florida Sea Grant

Delivering Results!

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Florida Sea Grant College Program

Florida Sea Grant has been serving the people of the State of Florida for more than 30 years. Its mission is to enhance the practical use and conservation of coastal and marine resources in Florida to create a sustainable economy and environment. This publication is designed to explain what Sea Grant is about, to inform its partners and stakeholders of its progress, and to capture some of the essence of its programs. It is also intended to highlight some – a few – of the impacts that Florida Sea Grant has made through the dedication and successful efforts of hundreds of people participating in its activities. For a more thorough look at Florida Sea Grant programs and activities, its Web site is located at: www.FLSeaGrant.org.

Florida Sea Grant is one of 29 programs which together form the National Sea Grant College Program, under the National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce. Each Sea Grant program operates through a university-based network, conducting research, education and outreach programs to solve coastal problems and develop marine resources. Florida Sea Grant does exactly that. It is a program of scientific discovery, technology transfer, and public education that fosters both understanding and the sustainable use of coastal and marine resources for long-term economic growth. Collectively, the Sea Grant programs have helped position the United States as the world leader in marine research and the sustainable development of coastal resources.

In Florida, Sea Grant has a core alliance of 15 participating institutions, including public and private universities and research laboratories. These institutions are organized within the State University System as a Type I Center, based at the University of Florida, with a statewide mandate. This alliance and its representatives collaborate together and with partners in the public and private sector in a strategic planning process to define Florida Sea Grant activity. In all, approximately 200 people are involved in establishing these criteria, including Sea Grant faculty and researchers, with representatives from business, industry, state and federal agencies, counties, districts and municipalities, and from private citizens. Priorities for research and education in 1998 – 2001 are organized into three major strategic areas: economic leadership; coastal ecosystem health and public safety; and, education and human resources. These strategic areas allow Sea Grant to:

• Meet the rapidly growing demand for food and sports fisheries and the broader goals of industry and community growth – consistent with high environmental quality and enhancement – Florida Sea Grant is enhancing Florida's economic leadership in marine industries and products. Research and outreach programs include marine aquaculture, marine biotechnology, and coastal environmental technologies and practices.

• Balance competing needs of a growing population of diverse user interests. Sea Grant researchers provide results that can be used as the basis for scientifically sound, cost-effective, use and conservation of marine and coastal resources, including property and the environment.

• Ensure that future generations are well-trained and capable of making informed decisions about their own future, and about the coastal environment that surrounds them. Florida Sea Grant is active on several fronts. It is involved in programs to help make Florida's citizens, industries and governments preeminent in marine affairs, by establishing a cadre of technicians and professionals skilled in marine sciences, law, policy and trades, as well as informing citizens of all ages about the marine environment and its resources.

Within each of these areas, a set of goals is established to place priorities on research, education and outreach programs.

The Florida Sea Grant Strategic Plan is updated biennially, and guides all activities, statewide. For research, it defines the focused priority areas that receive core program funding. For extension, the plan defines six major state programs covering all educational and outreach programming related to Sea Grant. It also defines the goals that relate to graduate education and community education. For each of these, the strategic plan identifies areas that will be supported through communications products and activities.

Florida Sea Grant is results-oriented. Its strategic plan translates into an implementation plan to carry out its programs and to measure performance. The implementation plan incorporates each research project and educational activity under each of the strategic plan's areas and goals. At the end of each year, projects completed and their accomplishments and benefits are reported back against these goals. These provide measures of performance, and the basis for Sea Grant's annual reports and other publications such as this one.

At the heart of Sea Grant's program is the scientific investigations that it supports. On an annual basis, at least 50 percent of Florida Sea Grant's core federal funding is used to support research. Research funding is provided through grants, and the application process is highly competitive. For 2000 – 2001, for example, 88 pre-proposals were received from 13 of the 15 collaborating institutions. Ultimately, 17 of these were funded, and additional projects were funded through National Sea Grant competitions.

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Marine Biotechnology

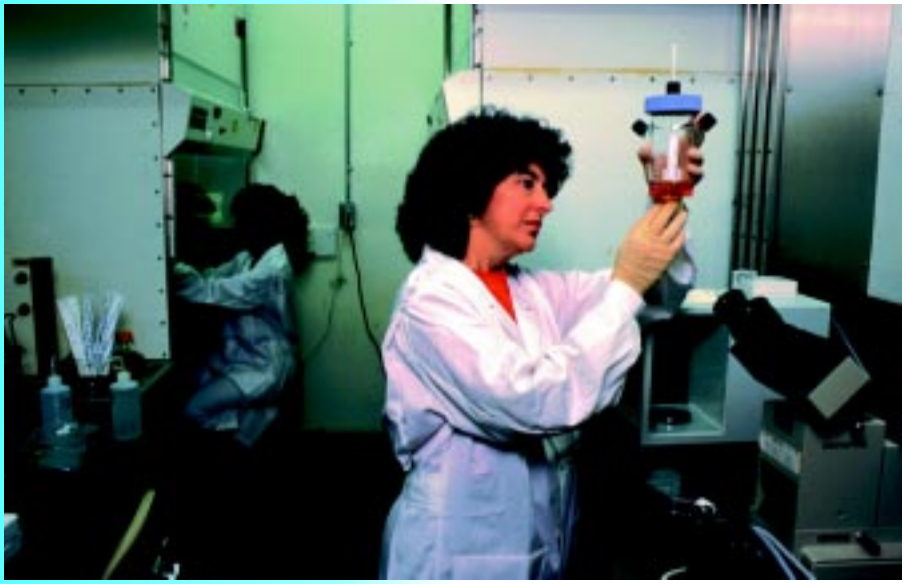
Who ever heard of discodermolide? So far, probably not too many people. But this compound — derived from a deep sea sponge collected by Florida Sea Grant researcher, Dr. Shirley Pomponi, Harbor Branch Oceanographic Institution — is in advanced pre-clinical trials with a major pharmaceutical company that projects an annual product market in excess of $100 million. Discodermolide shows potent antitumor activity and holds great promise in the development of a drug for the treatment of cancer. The key to continued development of this discovery is marine biotechnology.

Although discodermolide is one of several bioactive molecules that are naturally produced by marine organisms such as sponges, tunicates, soft coral and microbes, supplies of these compounds are available in limited quantities from their natural sources. The natural sponge population could not withstand the massive collection needed to meet the testing and production demands of the pharmaceutical industry for discodermolide. So, Florida researchers followed up on the discovery by focusing on ways to create an alternative natural source of marine-derived bioactive molecules through cell culture of the producing organism to drastically reduce the need to harvest natural populations.

Using another species of sponge as their model, Florida Sea Grant researchers Pomponi and Russell Kerr, Florida Atlantic University, have demonstrated for the first time that this sponge can use amino acid precursors, not normally in its diet or biochemical system, to stimulate production of desired compounds. This opens the door for researchers to use biosynthetic data to design systems previously thought to be unfeasible for *in vitro* production of bioactive molecules.

Such antitumor drug research is one example of the promise that marine biotechnology research holds for scientific achievement in the coming years. This promise of discovery, through the application of the modern tools of biotechnology to marine organisms, prompted Florida Sea Grant to increase its support for this type of research in recent years.

Major outreach activity combining research planning and public education helped “jump-start” Florida’s marine biotechnology efforts statewide during 1997. A special issue on marine biotechnology in Florida Sea Grant’s FATHOM Magazine was produced and distributed; Florida Sea Grant scientists participated in a one-day national media briefing in Washington, D.C.; a roundtable of Florida scientists was convened and Florida Sea Grant was a partner in forming BIO+Florida, the new



Dr. Shirley Pomponi (foreground) and Robin Willouhby prepare sponge and ascidian cells for culture.

Photo Credit: Harbor Branch Oceanographic Institution

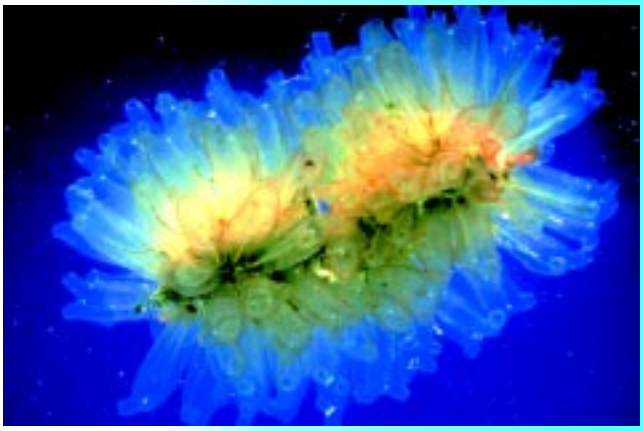
Biotechnology Industry Organization in the State.

During 1998, at the invitation of BIO+Florida, Florida Sea Grant conducted a statewide workshop "Solutions from the Sea: The Health and Future of Marine Biotechnology Research, Development Training and Business Opportunities in Florida." At the national level that year, Florida Sea Grant helped plan and conduct the Marine Biotechnology Workshop at BIO98, the annual meeting of the International Biotechnology Association.

Biotechnology has proven to be a formidable set of scientific tools to speed the research process. Since 1995, a superior sea oat for dune restoration was developed through Sea Grant research by Dr. Mike Kane, University of Florida, and Dave Crewz, Florida Marine Research Institute. Further work by Kane and colleague Nancy Philman, University of Florida, refined micropropagation procedures using tissue culture, that provided the means for commercial growers to clone and produce these superior sea oats.

Other Sea Grant successes through marine biotechnology research include work with snook by Dr. Ray Wilson, University of South Florida. He worked on a process of genetic tagging to identify hatchery-derived genetic markers in fish. This has potential to eliminate the technical barriers to using genetic "tags" to identify generations of hatchery-raised fish as a tool for monitoring and managing populations in the wild.

Another result of marine biotechnology at work evolved through the effort of Sea Grant researchers Drs.Cheng Wei and Marty Marshall, University of Florida. The pair identified proteins present and exclusive to red snapper. The practical result was a test kit developed to determine whether the fillet before you is snapper or not.



The mangrove tunicate, *Ecteinascidia turbinata*, is the source of the antitumor compound ecteinascidin 729 (exclusively licensed to PharmaMar S.A. and currently in Phase II clinical trials).

Photo Credit: Harbor Branch Oceanographic Institution

In 1999, Florida Sea Grant continued to expand its role in marine biotechnology research, through its core budget, but also through the receipt of three, new, national strategic investment project grant awards. These include DNA microassay technology for marine invertebrate cell culture and marine natural products propagation, molecular detection of enteroviruses, and methods to increase microbial recovery from deepwater sponges, building on previous work.

Marine biotechnology remains a priority area for Sea Grant research funding for 2000-2002 and into the coming decade. Emphasis continues on research, education, and technology transfer, to develop or recover new products and processes from organisms of the sea in sustainable ways. With industry partners, Florida Sea Grant seeks to promote the development of commerce that means higher paying jobs in Florida, and that offers Florida-trained students opportunities for employment.

Sustainable Fisheries

Keeping Florida's fishery stocks sustainable and economically viable requires management decisions based on hard science. Florida Sea Grant has a tradition of funding work on economic and stock modeling, and prototype habitat development for fisheries research.

For more than a decade, Florida Sea Grant has funded a continuum of research projects focusing on Florida's spiny lobster; an economically important species but a heretofore little understood crustacean found in Florida's southern waters. Through a collaboration between Drs. Bill Herrnkind at Florida State University and Mark Butler at Old Dominion, this research team has documented the life-cycle and habitat needs of the spiny lobster.

This information has confirmed the importance of hard bottom and seagrass beds in the developmental life-cycle of the spiny lobster. Hard bottom is the substrate necessary for sponges which in turn provide protection for spiny lobsters at a critical stage in their life-cycle. A sponge die-off during the mid-nineties due to other environmental factors placed the whole fishery at risk. Further research documented that to a lesser degree, artificial habitats such as concrete structures, could indeed provide the crucial habitat necessary for the spiny lobster's development.

Another project, led by Rich Novak, Charlotte County marine agent, has resulted in the placement of 360 reef balls under private docks and piers in Charlotte Harbor which should increase nursery habitat for estuarine species. Over 50 tons of concrete, a 70-foot barge and 200 reef balls have been sunk in the Gulf of Mexico to increase fishery habitat for reef fish such as grouper and snapper.

On the state level, Florida Sea Grant marine agents have developed and delivered artificial reef management workshops. Twenty-four individuals, including eight artificial reef coordinators from Florida's west coast, learned underwater mapping techniques and participated in a field trip where the techniques were applied. Further applications of these techniques should result in a uniform approach to developing and mapping future artificial reef sites in this geographic region.

At the international level, Florida Sea Grant has been active for more than a decade in advancing the science and technology of artificial habitats. From organizing international conferences, converging working groups and presenting invited keynote speeches, to the publication of a new book on evaluation of reef performances, Florida Sea Grant faculty continue to provide leadership in this field.

Florida Sea Grant has also established itself as a source of new and innovative research areas. For

The Florida Spiny Lobster is one of Florida's principal recreational and commercial species.

instance, modeling can play a critical role in predicting the health of a fish stock and its tolerance to fishing efforts. A 1998 analysis led by Drs. Wally Milon, University of Florida, and Nelson Ehrhardt, University of Miami, determined the volume issued and the price of transfers between certificate holders under the Florida Spiny Lobster Trap Certificate Program. The project results were instrumental in shaping the Florida legislature's decision to establish a minimum transfer fee for originally-issued certificates to non-family members and the prohibition of leasing the certificates. This model has applications for other species such as stone crabs with proposed limited entry programs.

Another Florida Sea Grant research project, led by Dr. Suzanna Smith, University of Florida, documented the effect of fishing regulations not on the fish stocks, but on the fishing families. A pre-net ban and post-net ban analysis documented a 20 percent decrease in the number of full-time fishermen and a 21 percent decrease in income from fishing. Coping strategies, personal and financial stress levels, social interactions and problems within the family and other changes related to the traditional family fishing business were also documented. This information will now allow fishery management councils and commissions to predict the human and social impacts of fishery regulations before they are implemented.

Another avenue impacting fishery stocks is the role of the recreational fishermen. For instance, Florida Sea Grant marine agents and researchers have developed a technique for venting the reef fish that are brought up too quickly from deep waters. These fish often suffer from overextended swim-bladders that erupt allowing the gases to escape into the fishes gut cavities. Deep-sea fishermen were often frustrated to see undersized fish and others returned to the water in catch-and-release programs floating on top of the water and becoming easy prey for other fish and birds. The venting technique and tool developed by Florida Sea Grant marine agents, aided with research by Dr. Karen Burns, Mote Marine Laboratory, when properly utilized, allows the gases to escape from the over-inflated gut cavities and increases the fishes' chance of survival. This technique works well for most grouper species and some snapper species.

Proper techniques and proper tools allow a fish to be vented and returned to the water with a greatly increased chance of survival.

Marine Aquaculture

Although the Florida aquaculture industry is characterized by a wide variety of production technologies and cultured species, only a small proportion of this industry, less than 10 percent of value, is marine-related. There are many constraints to the development of marine aquaculture including economic, regulatory, and technical issues. This has led Florida Sea Grant to work toward the sustainable productivity of existing commercial activity, and to assist industry in achieving production of selected additional coastal and ocean species with the fewest constraints and highest economic potential.

Florida Sea Grant support to marine aquaculture has grown considerably over the past five years, through core funding, National Sea Grant initiatives, and industry demand. Still, its program focuses on a limited number of issues. Following a thorough assessment of information needs for the state's aquaculture commodities, Florida Sea Grant addressed its marine aquaculture research and outreach toward three potential growth areas: edible finfish and shellfish; stock enhancement; and ornamentals.

Sea Grant sponsored research into the biology of species, and the requirements for rearing them in an artificial or contrived environment. It explored the arena of seafood safety for processing and handling of selected commodities in depth. Sea Grant researchers also delved into economics and marketing potential of these commodities.

These efforts resulted in Sea Grant being well-poised to assist with a statewide effort that began in 1994, when an amendment to the Florida Constitution was passed by voter referendum making it unlawful to use entangling nets (gill and trammel) in Florida waters. The action, known as the Florida Net Ban, had far-reaching effects for Florida fishermen and related businesses. On the heels of the ban, several programs were offered by the State of Florida to provide assistance to small businesses that suffered losses as a result of the Net Ban. Sea Grant rallied behind a collaborative effort with state and private agencies to promote alternative livelihoods for fishing families, exploring the potential for commercial production of scallops, clams, and soft-shell blue crabs. By being part of the educational process that ensued, Sea Grant helped to align displaced fishermen with alternative water-related livelihoods through marine aquaculture. Sea Grant specialists

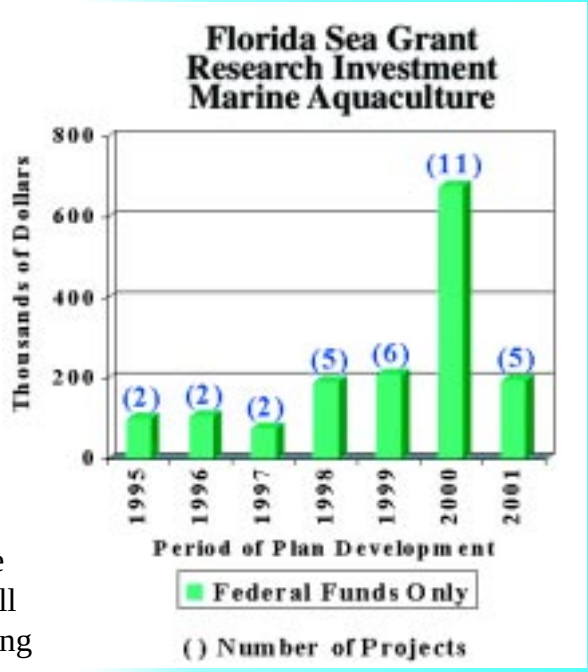
Over the past few years, a number of different bag technologies have been developed and tried for growing clams and oysters in coastal waters.

in economics and seafood safety, Drs. Charles Adams and Steve Otwell, led workshops on financial feasibility and product quality. Their work included the publication of a popular Sea Grant report that discussed the economic considerations for potential aquaculture investors, as a guide to understanding risks in this emerging area. Sea Grant provided a basis for displaced families to use sound judgement in making a decision about entering into new commercial enterprises.

In post-Net Ban studies sponsored by Florida Sea Grant, social scientists examined the ways in which family-owned commercial fishing businesses have been affected. Their findings provide a set of considerations for policy makers and legislators about the consequences of legislation affecting marine businesses.

Following a statewide survey in 1996, Florida Sea Grant convened an invited group of experts to assess Florida's marine aquaculture needs. Sea Grant's collaborating universities and research laboratories participated with representatives from industry and state agencies. As a result, Florida Sea Grant increased its research funding and extension outreach commitment to marine aquaculture, at the same time, maintaining its selection criteria and focus on a limited number of issues.

The strategy has paid off. Florida Sea Grant efforts have helped to increase the production of soft-shell crabs in Florida by 15 percent. Post-Net Ban educational programs offered through Sea Grant, in a series of 43 workshops around the state, provided start-up information and kits for 114 out of 150 eligible individuals interested in becoming soft-shell crab shedders.



Based on an evaluation of the training program, 60 soft-shell crab producers started shedding crabs in 1998. Approximately 21,180 dozen crabs were shed by the new producers in the first half of 1998, worth as much as $561,270 in gross income to these 60 producers. Another 44 people started operations in 1999. The Florida Sea Grant Extension Program continues to work with the soft-shell crab industry in Florida as additional new shedders request assistance.

In Florida, commercial harvest of bay scallops is banned by the Florida Fish and Wildlife Conservation Commission. Marine aquaculture may provide an alternative for growing scallops commercially, and for replenishing depleted stocks. Drs. Norman Blake, University of South Florida, Robert Degner and Charles Adams, both University of Florida, have been working with Marine Agent Don Sweat to determine the feasibility of bay scallop culturing and marketing. A total of 50,000 scallops were placed on a two-acre lease site offshore at Crystal River, Florida beginning in 1997.

Subsequent re-stocking of seed scallops in 1998 and 1999 have shown the viability and risks associated with scallop culture. Following the 2000 growing season, the project expects to increase private sector opportunities in marine aquaculture by facilitating farm trials with bay scallops in Florida near-shore waters.

A companion project was initiated in 1999, to advance developing hatchery-release technology to replenish bay scallop populations, testing the relative efficiency of cage, versus free-planting cultured bay scallops. Preliminary work shows promise that scallop enhancement could rapidly rebuild depleted spawning stocks. By fully developing this technology, researchers expect to create a new sea-ranching technology for Florida growers, and one that would serve as a model for other states.

Florida Sea Grant has also provided research results that support the hard clam industry. Sales of hard clams in Florida increased from virtually nothing ten years ago to $5.4 million in 1995 to $12.7 million in 1997. An example of Sea Grant's contribution is the work of Extension Agent Leslie Sturmer, together with Dr. Steve Otwell, in a combined research-extension effort. Findings in 1999, that showed the need to incorporate dry-tempering methods to enhance shelf life of clams during the summer harvesting season, have been presented to clam growers and processors statewide. The benefit is better quality for the consumer. Another outcome has been that six processors in five counties successfully petitioned the Florida Department of Environmental Protection to amend the dry tempering process into the current time/temperature-harvesting matrix (now under the jurisdiction of the Florida Department of Agriculture and Consumer Services).

The culture of marine ornamental species is a new priority area for Florida Sea Grant, based on local opportunities and national priorities in this area. Florida is the nation's leading freshwater tropical fish state, while marine ornamentals lag far behind. During 1998, the National Sea Grant program endorsed aquaculture as a high priority area, and created special research funding initiatives in this area. Florida Sea Grant created a Marine Ornamental Species Advisory Committee, with members from commercial enterprises, to provide guidance for Florida Sea Grant to assist in the development of the marine ornamental culture industry.

Early collaboration with private industry has been fruitful. Dr. LeRoy Creswell, Harbor Branch Oceanographic Institution, and Dr.

The culture of some species requires laboratory technology to produce food, or tank growout under controlled environmental conditions.

Junda Lin, Florida Institute of Technology, examined the cultivation of ornamental marine shrimp indigenous to Florida and the Caribbean for the saltwater aquarium industry. As a result of this research, a private company *Oceans, Reefs, and Aquaria, Inc.* is commercially producing and marketing peppermint shrimp as tank-reared ornamentals. They are also engaged in pilot production of the golden-banded coral shrimp. The company attributes much of their success to information provided by the research results of this project.

As part of Florida Sea Grant's commitment to ornamental species aquaculture, it helped support two international conferences in 1999. It co-sponsored a session on "Culture and Conservation of Marine and Freshwater Ornamentals" at the World Aquaculture Society meetings in Australia. It also co-sponsored the First International Conference on Marine Ornamental Aquaculture: Marine Ornamentals 99 – Collection, Culture and Conservation, in Hawaii, and coordinated participation of a 15-member delegation of scientific and business interests. Florida Sea Grant is hosting the second international conference of this group, in Florida, in 2001.

(Above and below) Special equipment is necessary to operate and maintain a clam culture site.

Seafood Quality and Safety

In recent years, some media reports have focused on illnesses and even deaths due to contaminated seafood. The entire issue of proper storage and recommended cooking methods has made consumers more savvy about selecting and handling all types of seafood.

In 1992, Dr. Steve Otwell, Florida Sea Grant Program, led the initiation of a national HACCP (Hazard and Critical Control Point) training program known as the Seafood HACCP Alliance. This alliance was formed to develop training guidelines and materials for seafood processors and inspectors so that they could become compliant with the FDA-mandated processing procedures. The alliance is comprised of representatives from state and federal agencies as well as commercial processors. The Alliance is built around a core of six Sea Grant Programs serving on the Alliance Committee. The Alliance has developed and delivered the necessary guidelines for trainers and instructional materials for students to support the implementation of the mandatory federal seafood safety HACCP programs required by law for both domestic and international seafood producers.

Over 10,000 domestic processing plant employees and regulators have been trained. Additional training has taken place in Costa Rica, Argentina, Brazil and Puerto Rico. A recent survey of 144 commercial firms across eight states indicated the value and timeliness of the training. The survey participants indicated that: by the end of the course, they understood what they needed to do to comply (98 percent). Likewise, 93 percent felt the industry benefitted from the Alliance HACCP training and 83 percent indicated that they would not have been able to develop a HACCP plan to comply with FDA regulations without the training course.

The training materials have been translated into six other languages. National recognition has come in the form of many awards including Vice President Al Gore's National Performance Review "Hammer Award" for innovations in government and the recent USDA Secretary's Honor Award.

The Alliance is currently producing a Seafood Sanitation Operations Procedure (SSOP) Manual for both domestic and international seafood processors. These efforts raise the bar on producing safer seafood for consumers and providing safe and sanitary conditions for seafood processing employees.

International attention has been focused on these issues as well. Dr. Jim Cato, the Director of the Florida Sea Grant program spent four months working in the Fisheries Utilization Section,

Florida Sea Grant annual blue crab and shrimp "schools" provide hands-on training to students from industry. They learn the latest scientific techniques to ensure safe seafood for consumers.

Fisheries Industries Division at FAO, Rome, Italy. Six publications and some FAO training materials on the economic aspects of seafood safety were developed during this period. A focus of the work was the Bangledash shrimp processing sector and the safety of Bangledash shrimp imports into Japan, the European Union and the United States.

Another Florida Sea Grant seafood safety education program presents annual "schools" featuring blue crab, shrimp, tuna and mahi-mahi. The presentations vary from year to year but frequently cover such topics as decomposition evaluation, *vibrio vulnificus*, processing equipment, marketing, and industry evaluation. These schools provide quality control, hands-on training for hundreds of seafood processors both nationally and internationally.

The annual schools are enhanced by state-of-the-art facilities in the new Aquatic Food Products Laboratory which was dedicated in 1997. Florida Sea Grant faculty, led by Drs. Steve Otwell and Jim Cato, drove the effort to raise the necessary 1.6 million dollars to build the facility. The funds were donated by over 30 Florida-based, national, and international seafood business owners based upon the years of collaborative efforts between Florida Sea Grant faculty and this ever evolving industry. Matching funds were provided by the Florida Legislature through the Capital Facilities Matching Funds program. An additional 3 million dollars generated through a combination of funding sources was used to renovate the seafood pilot plant which was completed in 1999.

Techniques are developed for both commercial processors and recreational harvesters to use in increasing the safety and improving the quality of seafood.

These facilities provide more than just a venue to perform research and outreach efforts. They provide space for two Florida Department of Aquaculture and Consumer Services Seafood Bureau consultants, as well as lab space for graduate students and faculty. Research project results are reported through theses, dissertations, journal articles and the mass media as well as providing critical information for industry.

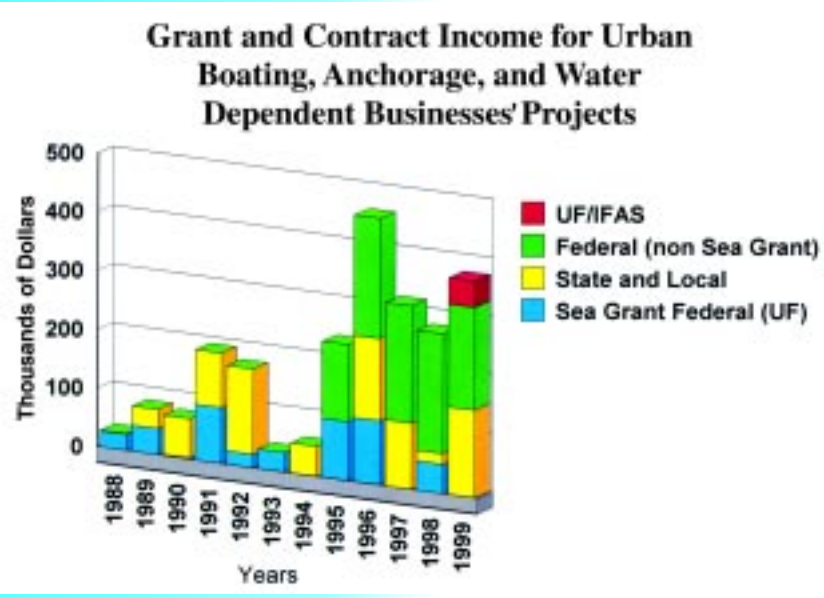
Water-Dependent Businesses

Managing coastal development continues to be one of the critical challenges facing Florida, now and into the future. Nearly a million boaters, residents and visitors keep Florida waterways congested. Combined with that, demographic forecasters indicate that foreseeable population growth predictions remain high, while a preference for coastal living prevails in the state. As marine resources are used to their capacity, and as natural environments decline, there is a compelling need to foster coastal business growth and community development strategies that are compatible and sustainable.

Florida Sea Grant has its work cut out in this area. The program is concentrating its resources for research where science can provide results to help shape the development process. Led by Dr. Gustavo Antonini, University of Florida, the program aims to improve decision-making methods and planning models by providing policy makers with information needed to make informed choices in managing natural resources and their use.

Dramatic progress has been made in the boating aspects of urban bay water management. Utilizing a combination of research and outreach in a program designed to guide the management of Florida's coastal waterways, this may be one of the most innovative Sea Grant programs in existence. Florida Sea Grant's partners in this activity include, among others, the NOAA Coastal Services Center and NOAA Marine Chart Division, the Florida Department of Environmental Protection, the Florida Fish and Wildlife Conservation Commission, Manatee, Sarasota, Charlotte and Lee Counties, and the West Coast Inland Navigation District (WCIND). Their combined effort in waterway and anchorage management is designed to test the feasibility of a self-regulatory approach to anchorage management. This approach to anchorage management is expected to save millions of dollars in enforcement efforts and enhance the tourist economy by encouraging environmentally friendly boating and anchoring practices in Florida waters.

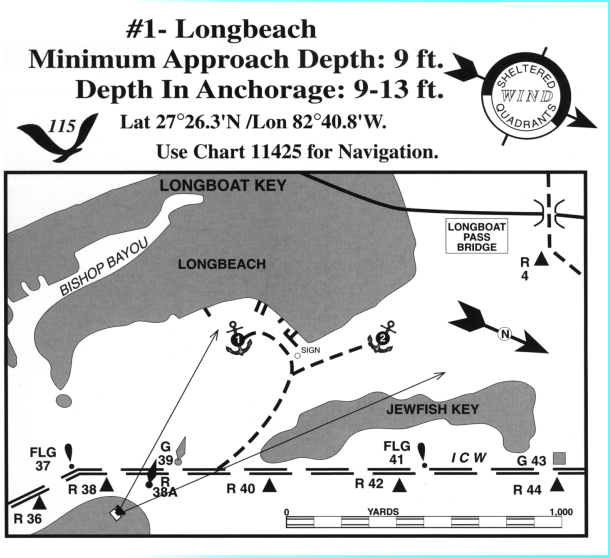
So far, it is working. The State of Florida has adopted the regional waterway management protocol developed by this Florida Sea Grant program, through a memorandum of understanding. The Florida Department of Environmental Regulation has placed a moratorium on new anchorage regulations in five Southwest Florida counties to further assess the accompanying educational process underway. An educational program to develop and disseminate information, such as detailed maps and guide materials, has been implemented through a five-year cooperative agreement with the Boater's Action and Information League, the Florida Department of Environmental Protection, the Southwest Florida Regional Planning Council and WCIND. The effort intends to influence boater behavior and encourage peer pressure to



promote self-regulated anchorage management. A Regional Harbor Board, made up of representatives of county governments, shore residents and boaters, has been created to promote sustainable anchorage practices.

Florida Sea Grant and its partners have produced an anchorage guide to Southwest Florida including boater information, anchorages, environmental sensitivities and conditions of each anchorage. Placemats were produced for use in coastal restaurants, providing environmental information on bays and anchorages in the immediate area. Large-scale maps have been developed for resource managers, containing detailed information on seagrass conditions, mangrove coverage, bottom sediment type, water depth, shore facilities and boat concentrations and patterns. A similar set of maps has been prepared and distributed to boaters. A Historical Geography of Southwest Florida Waterways was published and distributed in 1999. Waterway management projects have been completed in Manatee and Sarasota Counties, and a multi-year effort is currently being conducted in Lee County. And, in addition, Nautical Chart 11425 (Intracoastal Waterway): Florida: Charlotte Harbor to Tampa Bay was developed as a prototype photo-chart, working jointly with NOAA's Marine Chart Division and Coastal Services Center. This novel "picture-chart" is being market-tested by a statistically valid sample of volunteer boaters in Southwest Florida. The project has been prolific in the generation of educational and informational materials.

An anchorage web site developed by Sea Grant accommodates the wealth of information that resulted from this work. The site has expanded substantially over time, and, among other things, includes anchorage maps and site descriptions, sketch maps and oblique aerials, tables describing site ratings, recreational characteristics and local restrictions. The web site is located on the same server as the Florida Sea Grant web site at www.FlSeaGrant.org.



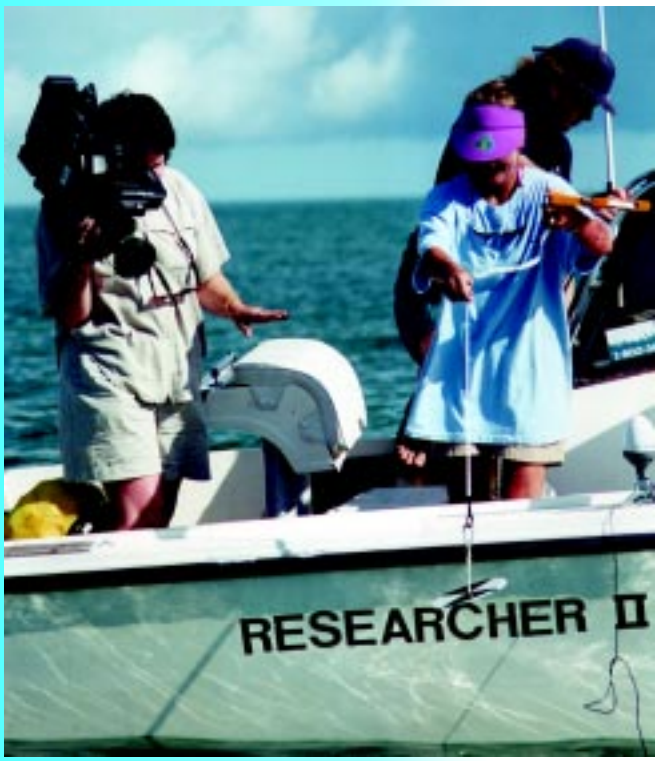
Coastal areas are mapped showing proper navigation routes and anchoring locations that keep boaters in safe water and out of sensitive habitat areas.

Marinas statewide have benefited from other Florida Sea Grant activities, including its support for the creation of a MarinaNet web site. Florida Sea Grant personnel participated in the first MarinaNet Collegium in 1997, and helped facilitate the 4th Annual Applied Marina Research Conference, sponsored jointly by Sea Grant and the International Marina Institute. Florida Sea Grant was asked to produce an emergency contingency plan for marinas, and did. Now known as the "Panic Preventer File," more than 300 Florida marinas received these notebooks the following year, together with instructions on their use. Florida Sea Grant and the Florida Department of Environmental Protection followed up on the effort with the development of a "Clean Marina" program. Florida Sea Grant was involved in the first of four phases: Education and Awareness; Incentive Grants; Award Recognition; and Clean Marina Designation. During 1999, Florida Sea Grant held workshops statewide to introduce the Best Management Practices that were developed for the program.

Water Quality and Safety

In the State of Florida, water and water quality are compelling issues. With more than 20 major estuaries, where the fresh water from the land mixes with the salt water from the sea, Florida sports a coastal diversity unmatched by any other state. One reason that estuaries are so important is that from 80 to 90 percent of the state's recreationally and commercially important fish and shellfish species must pass through an estuary at some stage of their life cycle. Today, more than ever, pressures of growing population and coastal development have placed these ecosystems at risk. Water quality in all these systems directly depends on what the water is carrying from the nearby uplands, which includes most of Florida's landmass. But the fate of many pollutants, once they get into these ecosystems, is not well understood.

Over 250 scientists from both agencies and universities are engaged in a major research program designed to aid in improving the health and vitality of Florida Bay.



Surveys consistently show that Floridians are acutely aware of problems associated with water, and the importance of water quality. In a 1999 statewide survey, Florida residents identified water quality as the State's second greatest educational need – second greatest, of all the things that might concern people.

Florida Sea Grant is persistent in its research and outreach on water quality and related issues, through program activity responding to needs of resource managers and municipalities. Florida Bay provides a good example.

The health and viability of the Florida Bay ecosystem is a national issue. It is tied to, and inextricably intertwined with, the Everglades restoration effort. Approximately 10 million dollars in scientific research projects are ongoing in the bay, funded by at least nine different state and federal agencies. Many are university-based projects. Since 1996, Florida Sea Grant has served as the official extension/outreach partner in this effort, providing science-based communication to scientists, resource managers, and the public through the Florida Bay Education Project.

The project has organized a series of Florida Bay Science Conferences, where more than 250 researchers, resource managers and policy makers exchange information on the latest scientific findings related to the bay. The Florida Bay outreach effort employs science communicators to reach the public with information on the needs of the bay, and how to restore it. Synthesis and analysis of science is presented in newsletters, press releases, radio interviews, and through participation in a wide range of public meetings. A home page was established on the World Wide Web to feature research and progress towards Florida Bay

restoration. The project also initiated low power radio programming in the Florida Keys to educate visitors and vacationers through science-based stories broadcast daily about research ongoing in the bay.

Elsewhere in the state, and throughout the coastal corridor, Florida Sea Grant's investment in water quality is evident through the outreach efforts of the marine and coastal agents and their citizen focused activities. Sea Grant supports one of the State Major Programs through Cooperative Extension with a team of experts charged with the task of disseminating scientific information pertaining to coastal environmental and water quality issues. Led by Dr. William Seaman, Associate Sea Grant Director, the team exercises statewide leadership in designing appropriate education programs and materials to increase awareness and understanding about the impact of people on water quality. As a result, hundreds of decision-makers, and thousands of residents continue to benefit from the educational programming that Sea Grant offers.

Sea Grant has organized, led and taught marine programs on estuaries and environmental ethics. It has conducted programs on coastal water quality, habitat restoration, and coastal management. It has organized and led dune restoration programs using the very micropropagated sea oats that became a reality through Sea Grant research.

Estuaries are critical for Florida's fish and shellfish species. Maintaining estuaries and the water quality in them, and coastal habitat, means marine fishing in Florida will be a part of our future, not a part of our past.

Statewide, water and water quality concerns also receive a boost through the "Florida Yards and Neighborhoods Program" and "When the Gulf is Your Backyard." In collaboration with Florida Sea Grant marine agents, and with input from their coastal marine education programs, more than 10,000 citizens have been educated on how to change yard and landscape practices. They have learned to employ those that do not have an adverse impact on the environment through runoff contamination of adjacent estuaries. These combined efforts have created a demand for native plants, stimulating nursery production and economic growth.

Coastal Ecosystem Habitats

Florida's 1,350 mile coastline and marine habitats are prone not only to the impact of the state's 14 million residents and 43 million annual visitors, but to occasional bouts of mother nature's fury. Florida Sea Grant is involved on many fronts ranging from the application of biotechnology in industrial settings to advising citizen groups in enhancing the practical use and conservation of the state's coastal and marine resources.

One of the program's most significant research projects resulted in the development of a commercially viable technique for cloning sea oats. Developed by Dr. Mike Kane, University of Florida, this technology has been adapted by a commercial nursery operation in southwest Florida. Cloned sea oat seedlings have been used by resource managers throughout the state of Florida and the Gulf of Mexico region in an effort to restore the coastal dune structures ravaged by Hurricanes Opal and Erin during the 1990s.

Sonya Wood-Mahler, former Escambia/Santa Rosa counties marine agent, has led citizen work groups in planting these sea oats to restore the coastline in that area. Requests for the commercially available sea oats have been received from each state bordering the Gulf of Mexico.

Another ecologically important plant species found in Florida is seagrass. Seagrass beds provide food and shelter for juvenile species which are economically important such as the spiny lobster. Seagrass beds have been on the decline in Florida due to a variety of negative influences ranging from algal blooms to boats running aground. Seagrass distribution is controlled by a combination of factors including sediment depth, water temperature and clarity, salinity, and water motion. Its biomass density however, is controlled by nutrient conditions within the sediments of the seagrass beds. A 1995-97 Florida Sea Grant research project led by Dr. Jeff Chanton, Florida State University, took the premise of the positive relationship between submerged aquatic vegetation, such as seagrass, and groundwater discharge a step further. The study determined that groundwater serves as a conduit and driving force for the movement of both new and recycled nutrients from seagrass beds into the nutrient-poor overlying waters which, in turn, can affect the density of the

Citizens, agencies and commercial interests are actively seeking ways to use native plants in the control of dunes and shorelines.

seagrass beds. The techniques developed during this study were later used in conjunction with a Department of Health project to establish setback guidelines for septic tanks in the Florida Keys in seasonally inundated waters. These guidelines have been presented to the Florida Legislature and are being considered during the Spring 2000 session.

The state's marine and coastal systems are also at risk from non-indigenous species. Each year hundreds of plants and animals are imported into Florida with no negative repercussions. But, it only takes one instance of hyacinths or melaleucas to create a costly problem. Dr. Ernie Estevez, Mote Marine Laboratory, determined which of Florida's water bodies are most susceptible to a zebra mussel infestation. Based on this information, the Florida Sea Grant Extension Program developed and targeted a proactive outreach project designed to prevent an invasion by this species. Three low-power radios have been installed at the Florida/Georgia border to inform motorists trailering their boats into the state each year about how to prevent the introduction of non-indigenous species into Florida waters.

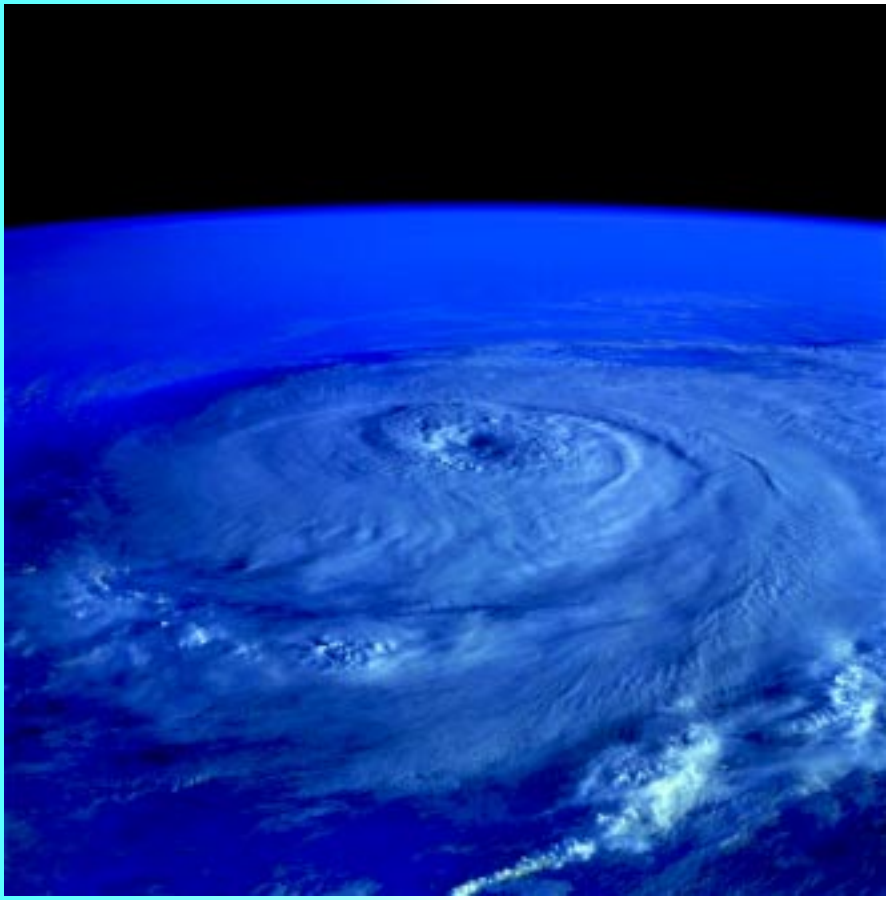
Other Extension education products have targeted hobbyists who have and maintain aquariums and water gardens. Extension personnel have collaborated with their peers throughout the southeast and Gulf of Mexico region to develop websites, posters and brochures addressing the invasive species issues. This information has been distributed to the US Fish and Wildlife Service, the Federation of American Aquarium Societies, Cooperative Extension offices throughout Florida and to various hobbyists newsletters.

Additional extension education efforts reflect a commitment by Florida Sea Grant to actively solicit citizen involvement. Joe Halusky, who recently retired as marine agent for Northeast Florida, developed a reef diver training handbook to train dive club members and other interested citizens on how to properly document and report data related to the state's artificial reefs. This information can then be reported to county reef coordinators in a uniform manner.

The improper operation of boats in Florida's shallow coastal waters can have devastating effects on seagrass beds, as shown by these "propeller scars." Florida Sea Grant is conducting programs to document sensitive habitat areas, to teach proper boating and anchoring techniques in them, and to determine the biological criteria for seagrasses to survive and recover from many causes of seagrass decline.

Coastal Processes and Storms

Coastal hazards are a fact of life in Florida with a coastline exceeding 1,350 miles. Natural disasters such as hurricanes only highlight the effects of high winds, flooding and erosion. Currently, 12 million of Florida's citizens work and live within 10 miles of the coast. There are many reasons people choose to live in the coastal areas of Florida, including proximity to recreational amenities, aesthetic beauty, and economic opportunities. At the same time, this proximity can place residents and tourists in harm's way when mother nature kicks up her heels as well as risking the economic stability within the region.



Hurricanes are not uncommon in Florida, where over 1,350 miles of coastline are vulnerable to high winds, flooding and erosion associated with coastal storms.

Historically, Florida Sea Grant has supported research which provides local and state resource managers, and elected officials with accurate information on which to base sound policy decisions.

Dr. Bob Dean, University of Florida, has identified three previously unrecognized sources of sediment supply along Florida's northeast coast that contribute substantially to the regional sediment budget; the volume of sand and shoreline position found along the state's coastline. Assimilation of this data with previously documented long-term changes in wave direction has provided the Florida Department of Environmental Protection, the agency responsible for establishing long-term policy related to the coastal management of the State's beaches, the most comprehensive data set for understanding shoreline shifting in Florida. This information has been used to evaluate permit applications for erecting new structures along Florida's coastline.

Dr. Gary Zarillo, Florida Institute of Technology, recently developed a personal computer-based wave prediction system, the "Florida Wave Forecast System." This system was developed for use by local and state management agencies to better understand the state's vulnerability to storms and beach erosion on a state-wide basis. With appropriate data, this system can be adapted for use in other coastal states. The U.S. Army Corps of Engineers Coastal Research Center is currently using the model to reconstruct the wave climate of the coastal ocean off east central Florida for the past 50

years and to ultimately determine the impacts of the Cape Canaveral Canal on shore erosion.

Dr. Robert Deyle, Florida State University, developed a model for a risk-based tax mechanism that can be used to determine a resident or business owner's "fair share" of emergency management fees. The assessment is based on two characteristics: 1) the location, and 2) the type of structure. In Lee County, where the data were gathered for use in the assessment model, the median tax change would be an increase of $2.00 per year. Lee County planning and management staff will be trained in the use of the techniques in March, 2000. This study has received national attention from county managers and the insurance industry.

As a precursor to the National Sea Grant theme-team dealing with coastal hazards and mitigation, Florida Sea Grant, in collaboration with other Sea Grant programs throughout the southeast and Gulf of Mexico region, participated in the development of the HazNet website (www.haznet.org). HazNet is a resource site for coastal managers, local government officials, insurance industry representatives, contractors and homeowners. Florida Sea Grant maintains the listserve for this web site.

Proper long-term planning can reduce the millions of dollars of physical damage each year along Florida's coast that results from coastal storms.

Student Support

Recognizing the importance of advancing our knowledge of the sea and the coastal environment, Florida Sea Grant considers education an investment in the future. It has supported hundreds of graduate students and managed scholarship and fellowship opportunities on behalf of both public and private sector entities. This investment in education holds the promise that future leadership can better manage and utilize marine and coastal resources, in sustainable ways. University graduates — including trained scientists and engineers — can also help increase the state's economic competitiveness, both nationally and internationally.

Beginning in 1993, Florida Sea Grant adopted a policy that at least 25 percent of its federal research budget would be used to support graduate students. The intent was to concentrate the program's investment in higher education to help produce highly qualified researchers, educators, and professionals in marine-related fields. At the same time, these graduate students would provide quality support to ongoing Sea Grant research projects. The policy has been effective, with the goal surpassed in seven of the last eight years. Since 1993, 37 students have completed theses or dissertations with Sea Grant support, and an additional 19 are in progress.

As a result, beginning in 1998, a companion policy was initiated by the Florida Sea Grant to augment its research project funding guidelines. New project proposals that include graduate students now have a competitive edge for funding, assuming all other review criteria are satisfactory.

Florida Sea Grant manages a portfolio of scholarships and fellowships that help to intellectually engage students in the biological and social sciences, engineering, and other professions related to marine and coastal stewardship. Scholarships and fellowships, made possible through public support provide unique opportunities for qualified students.

The prestigious and competitive Dean John A. Knauss Marine Policy Fellowships accelerate the careers of promising graduate students interested in marine policy issues, by providing the opportunity to work and study for a year in the legislative or executive branch of government, based in the nation's capitol. During 1995-1999, eight Florida Sea Grant students received these prestigious awards, and 24 fellows have been from Florida Sea Grant since 1982.

National Oceanic and Atmospheric Administration Coastal Services Center Coastal Management Fellowships provide professional, on-the-job training and educational opportunities for postgraduate students, through technical assistance for state coastal resource management programs. State Coastal Management Programs submit project proposals in a competition for placement of a coastal management fellow. For example, a master's level student from Florida Tech was placed in the Massachusetts Coastal Zone Management Program, working with the Gulf Shore Council on the Marine Environment, on salt marsh monitoring and restoration project database management.

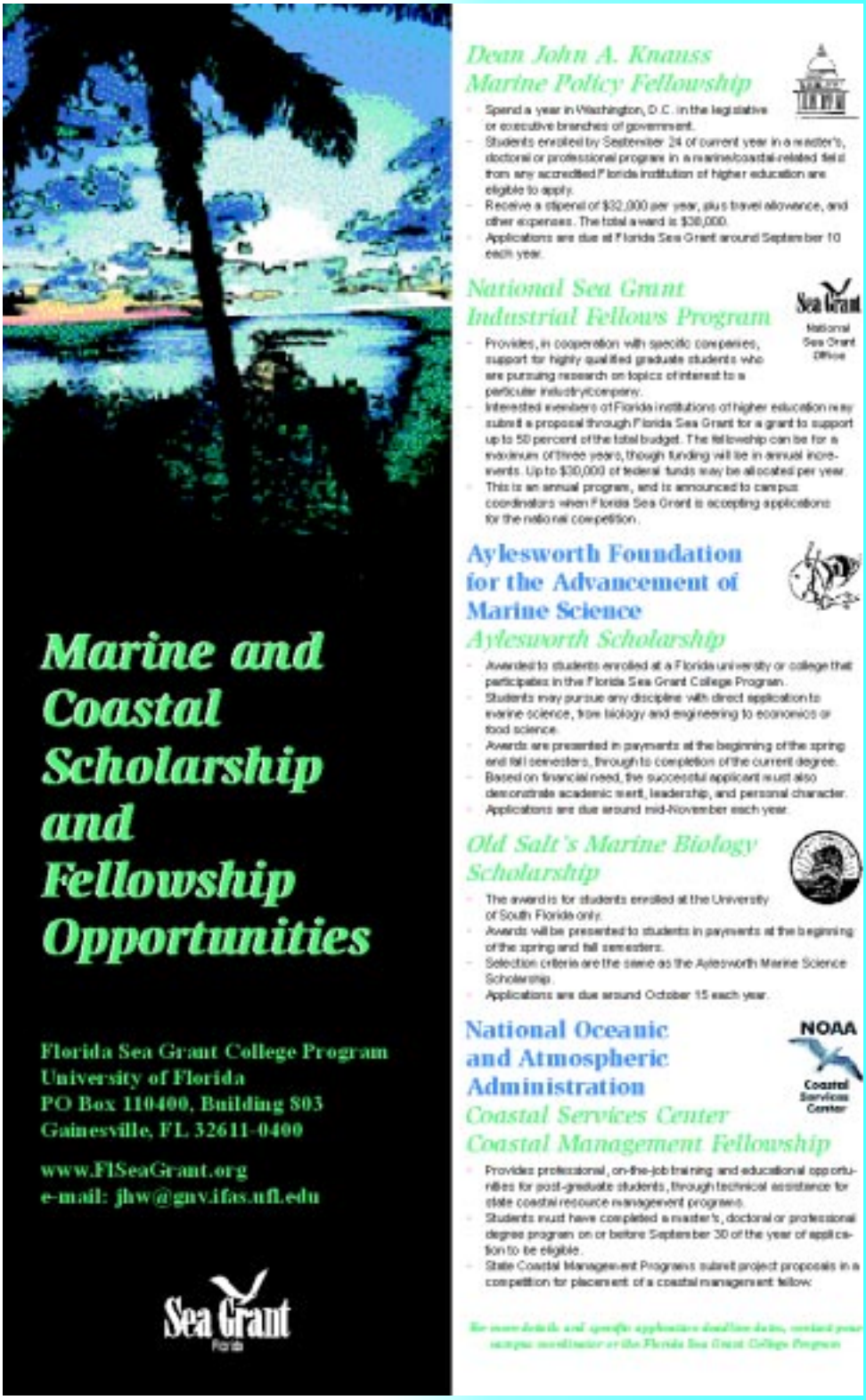
The National Sea Grant Industrial Fellows Program provides support for highly qualified graduate students that are pursuing research on topics of interest to a particular industry or company. The fellowship is a collaborative effort with private industry. A recent three-year industrial fellowship (completed in 1999) placed

a Florida Tech post-doctoral student with Atlantic Aquaculture Technologies, Inc., conducting a project on the use of giant clams to remove particulates and dissolved nutrients in aquaculture effluents.

Private scholarships and fellowships, that support both graduate students and undergraduates, are also managed by Florida Sea Grant on an annual basis. Two such opportunities are provided by the Aylesworth Foundation for the Advancement of Marine Science. Aylesworth Scholarship awards are made to qualified students enrolled at a Florida university or college that participates in the Florida Sea Grant Program. To qualify, candidates must demonstrate financial need, along with academic merit, leadership and personal character. The Foundation also provides the Old Salt's Marine Biology Scholarship, designated for University of South Florida students, following the same criteria. This program began in 1993 and is funded from the proceeds of a fishing tournament. Together, these two programs have funded 70 graduate students at nine different universities for their graduate work. The average award has been $5,326 per student.

The most recent scholarship program available by Florida Sea Grant is made possible through the generosity of the Skoch family, and the Charles Skoch Florida Sea Grant Scholarship. This $1,000 scholarship has been awarded annually since 1998. Selection is made through marine-science related project competition in the Florida Annual State Science and Engineering Fair. The award is made to an incoming college freshman who plans to attend a Florida university.

Florida Sea Grant also provides support to education through its Elise B. Newell Seminar Series, a statewide program to enhance university scholarship in coastal and ocean subjects. Annually, these seminars provide an opportunity for students, faculty, and the general public to learn more about timely issues concerning Florida's marine and coastal environment, from internationally renowned scholars and scientists.



Informed Citizens

A primary goal of the Florida Sea Grant College Program is to create a scientifically and environmentally informed citizenry. This goal is accomplished by utilizing the most appropriate communications technologies to reach a wide variety of target audiences ranging from scientific to lay audiences.

The backbone of communications efforts continues to be printed publications developed in support of the research and extension components of the Florida Sea Grant Program. Since 1996, more than 200 reports, conference proceedings, journal articles, book chapters and technical papers have been produced highlighting various research projects supported by Florida Sea Grant funding. The information is developed for specific target audiences. For example, the methodology for propagating sea oats has implications for not only biotechnology, but resource managers, homeowners and the nursery industry. The results of this project were reported in journal articles, at national meetings, through workshop materials and via press releases.

Many communications techniques, including television, are used to educate Florida citizens.

Extension results are usually presented in a shorter format with larger press runs for use in the marine agents' programs and for general dissemination. This information generally focuses on how an individual's actions can translate into a positive result for the coastal environment. The 75 newsletters and brochures produced since 1996 have focused on a wide range of issues including: preventing the introduction of non-indigenous species via recreational boating directed at both residents and tourists; venting the swim bladder of undersized reef fish to increase their rate of survival for deep sea fishermen; and developing a soft-shell crab operation targeted at fishermen displaced by Florida's net ban.

It is difficult to evaluate the effectiveness of an outreach effort when it results in a non-event such as no zebra mussels being reported in Florida to date. On the other hand, videos and brochures developed for the bladder venting education project have been distributed to over 600 members of fishing clubs and 16 different charter boat captains this year alone. A planned follow-up survey by Rich Novak, Charlotte County Marine Agent, should provide information on adoption rates after 'the season'.

Fifteen manuals, brochures and identification sheets were developed for attendees of soft-shell crab workshops which targeted Florida's fishermen displaced by the net ban amendment. After the series of workshops, sixty new soft-shell crab operations became established in 1998. Sales from the 21,180 dozen crabs shed by the new producers in 1998 were valued at $561,270 gross income.

The World Wide Web provides an inexpensive avenue through which to reach Florida Sea Grant clientele. Under the leadership of Susan

Grantham, Florida Sea Grant was one of the first Sea Grant programs to develop a web site. Currently undergoing its third redesign/reorganization, this site continues to provide quality and timely information for a variety of target audiences. The site, comprised of over 500 individual web pages is accessed, on average: 200 times a month for anchorage information for southwest Florida, 60 times a month for information on marine degree programs in Florida and/or scholarship and funding opportunities, 80 times a month for meeting announcements, 60 times a month for bladder venting information, 34 times a month for the publications list, and 8 times a month for information about personnel and faculty associated with the program throughout the state. Topical sites such as the Florida Bay web site go through cyclical highs (250 hits per month) and lows (36 hits per month). Under a redesign, aided by input from students in the University of Florida College of Journalism, the site should become more appealing to industry and the general public by emphasizing information such as advances in biotechnology, seafood safety, and recreational boating information.

Since 1996, Florida Sea Grant has developed and produced an educational outreach program using low-power radio. This station broadcasts information about on-going research projects taking place in Florida Bay to an average of 22,000 motorists each day. Located at mile marker 111, the low-power radio can be heard at a range of two miles on either side of the transmitter and frequently much further away. Signage alerts drivers to tune in for a Florida Bay update. Three low-power radios have also been installed at the Florida/ Georgia border to help highlight the invasive species issue. Targeted at motorists trailering recreational boats into the state, the radio messages provide some basic information and how to get more information at Florida Welcome Centers.

One of Florida Sea Grant's four radio stations is located on the only highway, leading into the Florida Keys.

Traditional methods of highlighting results such as news releases (print and video) and magazine articles continue to be employed. However, Florida Sea Grant marine agents and faculty also provide this information in concentrated doses via newsletters.

Perhaps unique to Florida Sea Grant is the role of the advisory committee. Representing various areas of expertise pertaining to the overall goals of the program, these committee members provide guidance and feedback to the program's administration and faculty in the strategic planning process. The committee members provide a flow of information back into the program which is then used to adjust and update planning and outreach initiatives, and in turn, create even more informed citizens through future and improved programs.

LIVING MARINE RESOURCES

Economics

Biological and Economic Modeling and Assessment of Limited Entry Strategies in Multi-Species Fisheries in South Florida
J. W. Milon (University of Florida), N. Ehrhardt (University of Miami), D. Lee (University of Florida) and C. M. Adams (University of Florida).

A Bioeconomic Analysis of Florida's Spiny Lobster Trap Certificate Program
J. W. Milon (University of Florida), N. Ehrhardt (University of Miami), D. Lee (University of Florida) and C. M. Adams (University of Florida).

The Impacts of the 1995 Florida Entanglement Ban on Commercial Fishing Families
S. Smith (University of Florida), G. Evans(University of Florida), G. Israel (University of Florida) and N. Torres (University of Florida).

Seafood Quality

Defining Concentrations of Virulent *Vibrio vulnificus* in Oysters
M. L. Tamplin (University of Florida).

Management Biology

Development of Age-Structured Population Models and Risk Analysis for Small Coastal Sharks: An Avenue to Informed Management and Sustainable Fisheries
C. A. Simpfendorfer (Mote Marine Laboratory) and G. H. Burgess (University of Florida).

Habitat-Mediated Predator-Prey Interactions: Implications for Sustainable Production of Gag Grouper in the Eastern Gulf of Mexico
W. J. Lindberg (University of Florida), D. M. Mason (Purdue University) and D. J. Murie (University of Florida).

Management of Spiny Lobsters in South Florida Based on Postlarval Supply and Juvenile Dynamics
W. Herrnkind (Florida State University) and M. Butler (Old Dominion University).

Establishing the Importance of Postlarval Supply to Recruitment and Management of Spiny Lobsters in the Florida Keys
W. Herrnkind (Florida State University) and M. Butler (Old Dominion University).

Regional Patterns of Habitat Use by Juvenile Blue Crabs: Assessing the Relative Importance of Alternate Habitat Types in Florida and North Carolina
T. K. Frazer (University of Florida), M. H. Posey (University of North Carolina at Wilmington), T. D. Alphin (University of North Carolina at Wilmington) and S. B. Blitch (Florida Department of Environmental Protection).

Critical Evaluation of Fish Abdomen Deflation as a Means of Enhancing Survival of Undersized Catch in the Reef Fish Fishery
K. Burns (Mote Marine Laboratory) and V. Restrepo (University of Miami).

Rock Shrimp Attraction to Odors and Traps: Collaboration With a Fishery to Develop Less Destructive Harvesting Method
W. Carr (University of Florida) and W. Clark (University of Florida).

Impacts of Turtle Excluder Designs (TED) and Bycatch Reduction Designs (BRD) on Overall Finfish Bycatch Reduction and Their Relative Effects on Management Strategies Adopted in Directed Finfish Fisheries
N. Ehrhardt (University of Miami).

Hydrodynamic Processes at Artificial Reefs and Effects on Plankton and Baitfish Abundance
P. Sheng (University of Florida).

Measuring and Modeling the Contribution of Seagrass Habitat to Juvenile Spiny Lobster Recruitment in Florida Bay
W. Herrnkind (Florida State University) and M. J. Butler (Old Dominion University).

The Future of Florida Spiny Lobster: Developing a Predictive Model and Putting Artificial Shelters to the Acid Test
W. Herrnkind (Florida State University) and M. J. Butler (Old Dominion University).

Further Development of a Heritable Genetic "Tag" for Hatchery-Released Fish: Dynamics of "Tag Recovery"
R. R. Wilson, Jr. (University of South Florida).

Field Assessment of the Effects of Artificial Reefs and Their Role in Fisheries Management
Craig W. Osenberg (University of Florida), Colette M. St. Mary (University of Florida) and Benjamin M. Bolker (University of Florida).

Evaluating Gag Spawning Aggregations & Benthic Habitat in the West Florida Shelf
Christopher Koenig (Florida State University), Felicia Coleman (Florida State University) and Don Levitan (Florida State University).

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Aquaculture

The Feasibility of Sturgeon Culture: An Integrated Market-Driven Evaluation
A. Lazur (University of Florida), S. F. O'Keefe (University of Florida), F. F. Wirth (University of Florida), P. Zajicek (Florida Department of Aquaculture and Consumer Services), D. J. Zimet (University of Florida) and C. Adams (University of Florida).

Enhancing Seed Availability for the Hard Clam, *Mercenaria mercenaria*, Aquaculture Industry Through Application of Remote Setting Techniques
C. M. Adams (University of Florida), L. N. Sturmer (University of Florida) and J. E. Supan (Louisiana State University).

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E. A. Irlandi (Florida Institute of Technology), G. L. Hitchcock (University of Miami) and W. S. Arnold (Florida MarineResearch Institute).

Market Preferences, Wholesale Demand, and Break-even Prices for Ornamental Fish Cultured and Collected in Florida
J. W. Milon (University of Florida), R. L. Degner (University of Florida) and S. L. Larkin (University of Florida).

Captive Nutritional Management of Herbivorous Reef Fish Using Atlantic Surgeonfish (*Acanthurus* spp.) As a Model
R. Francis-Floyd (University of Florida), E. Phlips (University of Florida), I. Berzins (Florida Aquarium) and P. Cardeilhac (University of Florida).

Assessment of Sea Urchins as Aquaculture Candidates in the Gulf of Mexico
J. M. Lawrence (University of South Florida), S. A. Watts (University of Alabama at Birmingham) and J. B. McClintock (University of Alabama at Birmingham).

Culture Techniques for Marine Ornamental and Consumable Fish: A Better Larval Diet?
N. Marcus (Florida State University) and J. Holt (University of Texas).

Structure and Competitiveness of Florida's Tropical Ornamental Marine Species Industry
D. J. Lee(University of Florida), J. W. Milon (University of Florida), C. M. Adams (University of Florida) and R. L. Degner (University of Florida).

Atlantic Surgeonfish as a Model for Description of Normal Anatomy, Histology and Natural Diet of Herbivorous Ornamental Reef Fish
R. Francis-Floyd (University of Florida), P. T. Cardeilhac (University of Florida), A. Riggs (University of Florida) and I. Birzens (Florida Aquarium).

Ecophysiological Assessments of Critical Juvenile Fish Habitat: Applications for Stock Enhancement and Habitat Conservation
K. M. Leber (Mote Marine Laboratory), J. M. Miller (North Carolina State University) and W. H. Neil (University of Texas).

Development of Seagrass Nursery Techniques
M. D. Hanisak (Harbor Branch Oceanographic Institution).

Aquaculture and Marketing of the Florida Bay Scallop in Crystal River, Florida
N. Blake (University of South Florida), R. Degner (University of Florida) and C. Adams (University of Florida).

Development of Seagrass Nursery Techniques
M. D. Hanisak (Harbor Branch Oceanographic Institution).

Cultivation of Ornamental Marine Shrimp for the Saltwater Aquarium Industry
L. Creswell (Harbor Branch Oceanographic Institution) and J. Lin (Florida Institute of Technology).

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Biosynthesis and Enzymology of the Pseudopterosins: Anti-inflammatory Agents from the Soft Coral *Pseudopterogorgia elisabethae*
R. G. Kerr (Florida Atlantic University).

Bipyridyl Marine Natural Products as Anti-Fouling Compounds
W. R. Kem (University of Florida) and F. Soti (University of Florida).

Bioactive Agents Produced by Invertebrate-Associated Marine Microbes
J. E. Grimwade (Florida Institute of Technology), B. J. Baker (Florida Institute of Technology) and A. C. Leonard (Florida Institute of Technology).

Development of a Marine Prophage Induction Assay for Detection of Mutagens in Seawater Samples
J. Paul (University of South Florida).

Marine Invertebrate-Associated Microorganisms as a Source of Novel Agents for Biotechnology
B. Baker (Florida Institute of Technology), J. Grimwade (Florida Institute of Technology) and A. Leonard (Florida Institute of Technology).

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Marine Invertebrate Cell Culture for In Vitro Production of Compounds with Therapeutic Potential
S. Pomponi (Harbor Branch Oceanographic Institution) and J. Lopez (Harbor Branch Oceanographic Institution).

Development and Optimization of In Vitro Production Methods of Bioactive Marine Alkaloids
R. Kerr (Florida Atlantic University) and S. Pomponi (Harbor Branch Oceanographic Institution).

Cellular Localization and Production of Bioactive Discodermia Metabolites
S. Sennett (Harbor Branch Oceanographic Institution), P. McCarthy (Harbor Branch Oceanographic Institution), S. Pomponi (Harbor Branch Oceanographic Institution) and S. Gunasekera (Harbor Branch Oceanographic Institution).

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B. J. Baker (Florida Institute of Technology).

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S. A. Pomponi (Harbor Branch Oceanographic Institution) and A. E. Wright (Harbor Branch Oceanographic Institution).

COASTAL PROCESSES AND DEVELOPMENT

Shore Dynamics

Compatible Plant/Mycorrhizal Fungus Ecotype Combinations for Micropropagated Sea Oats Planted on Florida Beaches
D. M. Sylvia (University of Florida), M. E. Kane (University of Florida), A. K. Alagely (University of Florida) and N. L. Philman (University of Florida).

Long-term Sediment Budget for Florida's East Coast for Coastal Management
R. G. Dean (University of Florida).

A Field Study of Rip Currents and the Development of a Predictive Model
D. Hanes (University of Florida), R. Theike (University of Florida) and R. Dean (University of Florida).

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M. K. Ochi (University of Florida).

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Quantification of Short and Long-term Shoreline Changes Due to Cross-shore Sediment Transport
R. G. Dean (University of Florida).

Genetic Characterization of Atlantic and Gulf Coast *Uniola paniculata* (Sea Oats) Populations: Implications for Varietal Selection Using Micropropagation Technology
M. E. Kane (University of Florida), G. Davis (University of Florida), C. Guy (University of Florida) and D. Crewz (Florida Marine Research Institute).

Design and Structures

Post-Storm Model for the Reconstruction of Habitable Coastal Structures
N. Yazdani (Florida A&M University).

A Novel Methodology for Marine Cathodic Protection Design
W. H. Hartt (Florida Atlantic University).

Policy

Development and Implementation of a Gaming Simulation of Community Planning for Hurricane Mitigation and Disaster Recovery
R. A. Smith (Florida State University), R. E. Deyle (Florida State University) and A. G. Feldt (University of Michigan).

The Legal and Institutional Framework for Regional Coastal Waterway Management in Southwest Florida
R. Hamann (University of Florida) and T. Ankersen (University of Florida).

Development of a Risk Based Mechanism for Funding Local Government Coastal Storm Hazard Management Services
R. E. Deyle (Florida State University), R. A. Smith (Florida State University) and E. J. Baker (Florida State University).

Estuarine Productivity and Restoration

Tracer Techniques to Evaluate Rates of Non-Point Source Pollution from Barrier Islands to Surface Water
W. C. Burnett (Florida State University), J. P. Chanton (Florida State University) and D. R. Corbett (Florida State University).

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(continued)

The Role of Filter-Feeding Sponges in Controlling Phytoplankton Blooms in Florida Bay and the Concomitant Effect on the Health of Seagrasses
B. J. Peterson (Florida International University) and J. W. Fourqurean (Florida International University).

Blue-Green Algal Blooms in Florida Bay: Controlling Factors and Consequences for Food Webs
E. J. Phlips (University of Florida) and T. L. Crisman (University of Florida).

Significance of Submarine Groundwater Discharge on Seagrass Distribution, Biomass and Productivity
J. Chanton (Florida State University), W. Burnett (Florida State University) and R. Iverson (Florida State University).

Florida Bay Estuary: Using Corals to Detect and Reconstruct Environmental Change
R. E. Dodge (Nova Southeastern University) and P. K. Swart (University of Miami).

Viral Tracer Technology for Tracking Wastewater Contamination of Coastal Environments
J. H. Paul (University of South Florida) and J. B. Rose (University of South Florida).

Algal Blooms in Coastal Waters: Using Corals to Differentiate Nutrients From Pollution or Natural Sources
R. E. Dodge (Nova Southeastern University), L. Fisher (Broward County), P. Swart (University of Miami) and R. B. Halley (U. S. Geological Survey).

Algal Blooms in Coastal Waters: Eutrophication on Coral Reefs of Southeast Florida
B. E. Lapointe (Harbor Branch Oceanographic Institution) and M. D. Hanisak (Harbor Branch Oceanographic Institution).

An Evaluation of the Effects of Turbidity on Coral Photosynthesis, Respiration and Growth
W. M. Goldberg (Florida International University).

Solid Phase Solventless On-site Extraction of Pesticides From Marine Waters and Fishes
H. A. Moye (University of Florida) and M. R. Marshall (University of Florida).

EDUCATION

Seafood Hazard Analysis and Critical Control Point (HACCP) Education and Training Program
J. C. Cato (University of Florida) and W. S. Otwell (University of Florida).

EXTENSION PROGRAM

Florida Sea Grant Extension Program
M. L. Clarke (University of Florida) and C. T. Waddill (University of Florida).

Florida Sea Grant Communications Program
C. T. Waddill (University of Florida), M. L. Clarke (University of Florida) and S. Kearl (University of Florida).

National Sea Grant Marina Network Enhancing the Economic and Environmental Sustainability of the Marina Industry
M. L. Clarke (University of Florida).

Sea Grant Haznet
M. L. Clarke (University of Florida) and S. Grantham (University of Florida).

ADMINISTRATION

Florida Sea Grant College Program Management
J. C. Cato (University of Florida) and W. Seaman (University of Florida).

Coastal Science and Technology Innovation With Limited Funds: The Florida Sea Grant College Program Development Portfolio
J. C. Cato (University of Florida) and W. Seaman (University of Florida).

Institutions

Florida Sea Grant Program Participants Receiving Sea Grant Funds (Academic/ Research) or Providing Match (Government, Organizations, Industry, Counties), 1997 - 2000.

Academic/Research
(Received Funds/Provided Match)
Florida State University
University of Florida
University of Miami
University of South Florida
Florida Institute of Technology
Mote Marine Laboratory
Harbor Branch Oceanographic Institution
Florida Atlantic University
Florida International University
Nova Southeastern University

Government (Match)
State
Department of Community Affairs
Division of Housing and Community Development
Department of Environmental Protection
Marine Research Institute
Bureau of Beaches and Coastal Systems
St. Martins Marsh Aquatic Preserve
Big Bend Seagrass Preserve

Districts
West Coast Inland Navigation District
South Florida Water Management District

Organizations (Match)
Florida Marine Life Association
Florida Aquarium
Boaters Action and Information League
Gertrude E. Kelly Charitable Trust
Friends of the Nature Coast

Industry (Match)
Bayboro Microbiological Associates
Wyeth-Ayerst Research, Inc.
Wanger International
Sea Critters
Segrest Farms
Nereus
Dixie Crossroads
Neotronics
Riverdale Mills Corp.
Shrimp Landing of Crystal River

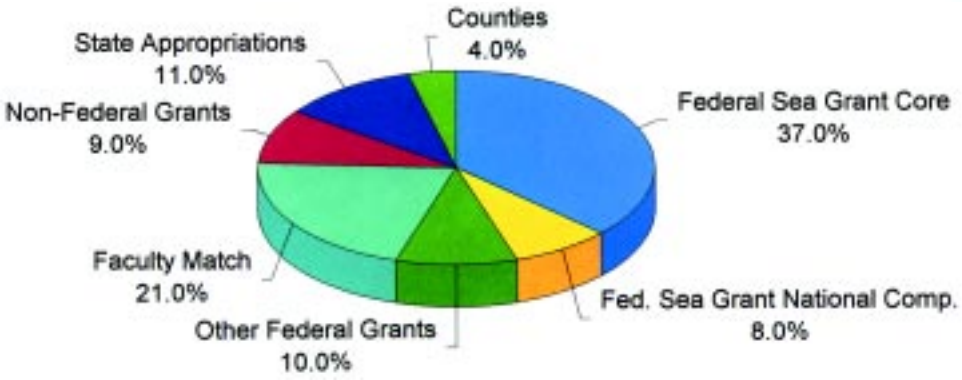
Counties (For Research) (Match)
Bay County Building Division

Counties (For Extension) (Match)
Bay
Brevard
Broward
Charlotte
Citrus
Clay
Collier
Dade
Dixie
Duval
Escambia
Flagler
Franklin
Gulf
Hernando
Hillsborough
Indian River
Jefferson
Lee
Leon
Levy
Manatee
Martin
Monroe
Nassau
Okaloosa
Palm Beach
Pasco
Pinellas
Putnam
St. Johns
St. Lucie
Santa Rosa
Sarasota
Taylor
Volusia
Walton
Wakulla

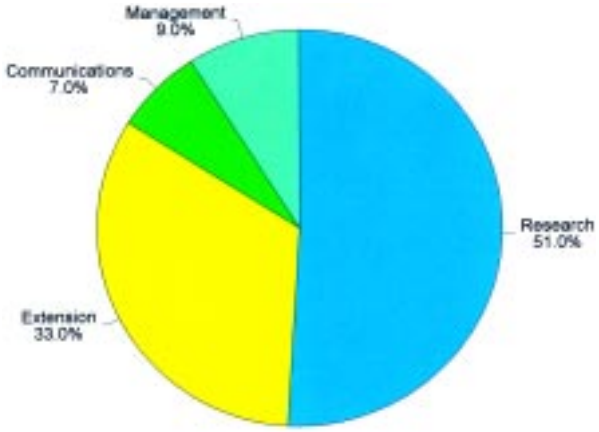
Funding

Florida Sea Grant total funding effort for the last five years has averaged $4.5 Million. Funds come from seven sources. Florida Sea Grant annually generates about $4 in grants for each $1 of state appropriations.

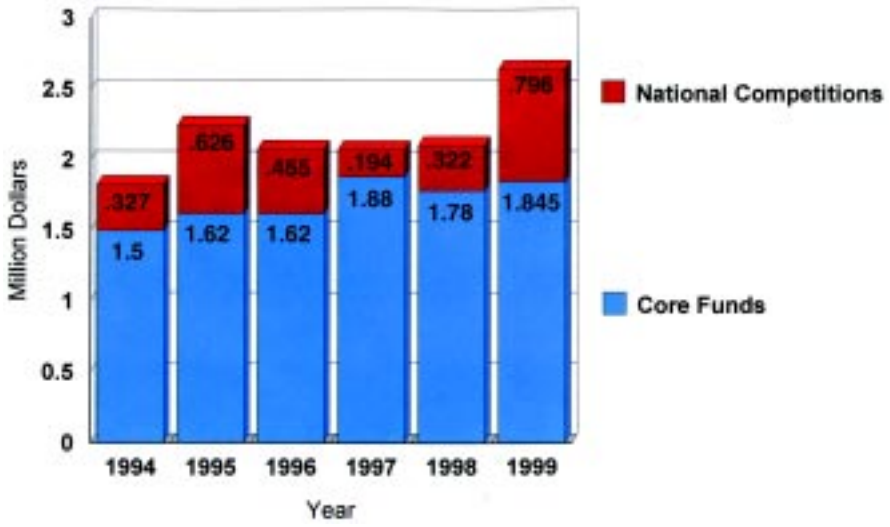
Average Florida Sea Grant Program Funding Effort, 1994-1999



The Allocation of Florida Sea Grant Core Program Funds By Program Function, 1994-1999



Florida Sea Grant Federal Sea Grant Funding, 1994-1999



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