

---

# The National Sea Grant College Program 1983

---

For further information, contact:

**B. J. Copeland, President, Sea Grant Association  
North Carolina State University, 919/737-2454**

or

**Robert W. Corell, Chairman, National Sea Grant Task Force  
University of New Hampshire, 603/862-2994**

152 pp.

## CONTENTS AND SUMMARY

---

This book has been compiled as a resource for the directors and personnel of the university Sea Grant programs, friends of the National Sea Grant College Program, and other interested parties. It is the most thorough presentation yet attempted of what Sea Grant does, who does it, who it serves and how it operates. It should be useful as a background document for national policy discussions and as a means of information exchange.

This notebook is divided into 10 sections, as follows:

### **1. The National Sea Grant College Program: Rationale, Status and Guiding Principles for the Future**

The National Sea Grant College Program, through the education, research and advisory service activities of the university Sea Grant programs, is a successful investment in the nation's marine resources. It is a model partnership involving the universities, the private sector and government at all levels. It is based on a national network involving strong local program input.

The program has carried out the intent of Congress and has proved to be effective and cost-efficient. It continues to have a needed role in future national ocean policy. It should be reauthorized for five years without major changes and at a funding level sufficient to carry out the Congressional mandate.

Legislative action concerning the program should preserve the fundamental principles that have made it successful.

### **2. Participating Institutions**

The primary responsibility for the research, education and advisory services activities of Sea Grant is undertaken by 29 institutions and consortia. Over the past five years the work managed by these institutions has involved the participation of over 250 institutions of post-secondary education in 39 states, the District of Columbia, Puerto Rico and Guam. Other nonprofit organizations are also participants. All of the recent participants are listed by state.

### **3. Descriptions of Major Programs**

In this section and the two that follow, the work and some of the accomplishments of the Sea Grant programs are summarized. This section is composed of a series of descriptions of the core Sea Grant Colleges, institutions and consortia, plus the Pacific Sea Grant College Program, the original regional network. The 29 core programs are represented in 30 write-ups, since both members of the New Hampshire/Maine consortia are represented. The order is alphabetical by coastal state, except that Alabama is included in the Mississippi/Alabama consortium description. Woods Hole is included with Massachusetts. The Pacific network write-up is at the end.

These presentations clearly delineate the scope and accomplishments of the Sea Grant programs, including both the different emphases and the common concerns.

#### **4. Some Recent Sea Grant Accomplishments**

In order to give some idea of the range and variety of Sea Grant work and achievement, one accomplishment write-up per program is included in this section. Only a small sample of Sea Grant work is covered, but these examples should make it evident how marine science has benefited the nation's citizens.

For ease of access, the order of presentation is the same as in the previous section, alphabetically by coastal state, rather than by subject matter. Since the Illinois/Indiana program is less than a year old it is not represented here. Where the Pacific regional network was represented in the previous section, it is replaced in this section by a write-up of accomplishments for the Southeast Marine Advisory Service, the newest of the Sea Grant regional networks.

A brief descriptive listing of the subjects covered is enclosed at the beginning of the section.

#### **5. Economic Benefits of the Sea Grant Program**

Not every activity of the broad-based Sea Grant Program can or should lead to measurable economic benefits. However, Sea Grant has had a number of gratifying successes in this regard. Two recent reports examine some of these successes.

- a. A recent study by the Center for Policy Alternatives at the Massachusetts Institute of Technology shows that the results of a small sample of projects begun in 1975 have led to annual sales of \$44-62 million. A summary of this report is included, along with information on how to obtain the full report (2 pages).
- b. The 1981 report of the Sea Grant Task Force, ECONOMIC EFFECTS OF SEA GRANT, is included in its entirety. This report, prepared at the request of Secretary of Commerce Baldrige, Senator Pell and Senator Weicker, suggested that a modest sample of Sea Grant work led to over \$200 million in annual economic benefits, nearly equal to the total federal investment in Sea Grant for the period 1968-81. This often cited report also provides useful information on the ocean sector of the national economy (38 pages).

#### **6. The Sea Grant Legislation**

Based on the experience of the program since the original Sea Grant Act of 1966, Congress undertook an extensive review of the program and passed the Sea Grant Improvement Act of 1976. This legislation has worked well and has needed only minor changes in the amendments of 1978 and 1980. A copy of the legislation is included, with the amendments printed side-by-side with the 1976 act.

A history by John Miloy of the original 1966 legislation and the process that led up to it is being printed by Texas A&M University and should be available in late February of 1983.

It is expected that the Congressional oversight committees will produce a legislative history of the program during 1983.

## **7. Evaluations of the National Sea Grant College Program**

Quite apart from continuing extensive congressional oversight, the Sea Grant Program is one of the most studied programs in which the federal government is involved, despite the relatively small size of the program. This section summarizes the nine studies since 1974 which are known to the Sea Grant community.

The evaluations have been generally highly favorable. All have been helpful to the Sea Grant Programs in their planning and organization.

## **8. Program Components, Planning, and Some Areas of Interest**

Several different kinds of documents are included in this section and in the back inside cover pocket inserts.

- a. "Summaries of Recent Sea Grant Activities," developed for the Sea Grant Association in 1982, provides a networkwide review of activities in a few theme areas. This information supplements sections 3-5 above and also provides background for ongoing network planning efforts (6 pages).
- b. The recent Council of Sea Grant Directors study of the Sea Grant Advisory Services activities is summarized. The full report will be available shortly on request (1 page).
- c. A brief summary and a chart describe the program planning and proposal review process at one Sea Grant college. The process, with minor variations, is typical for all mature programs in the network (2 pages).

### **Inserts (Back Pocket):**

- A. The Executive Summary of the "Sea Grant Aquaculture Plan, 1983-87" is enclosed. The full report is available. The entire Sea Grant community participated in this national planning effort.
- B. "The Graduates: Products of Sea Grant," summarizes a study of the most important product of the Sea Grant universities: students.
- C. The May/June 1982 issue of Sea Grant Today has articles on all of the various elements (research, education and advisory services) of the Sea Grant Program. The lead group of articles reports how satellites are helping increase our understanding of the oceans and have helped Sea Grant advisory services personnel provide to fishermen and shippers timely, cost-saving information on the temperature and shifting flow of the Gulf Stream.

## **9. Sea Grant and the Inland States**

Sea Grant is a national program, serving far more than just the coastal states and the marine community. The inland states are a part of the national audience for Sea Grant, and the citizens of these states are major users of Sea Grant products.

## **10. Sea Grant International Program**

Sea Grant is a national, regional and local program. It is also an international program. The fledgling Sea Grant International Program has made great strides, is a good investment both internationally and domestically and needs increased support as part of our national ocean policy.

This book has been prepared in a looseleaf binder form and provided with two pockets to allow for additions and updating as the year progresses.

## REAUTHORIZATION OF THE NATIONAL SEA GRANT COLLEGE PROGRAM

⊕ The Sea Grant College Program community requests a FIVE-YEAR EXTENSION of the EXISTING authorization legislation to provide funding authorization for the core program and the international program. ⊕

### THE EXISTING LEGISLATION WORKS:

- ⊕ The National Sea Grant College Program has been a successful INVESTMENT in the marine sector of the national economy.
- ⊕ The National Sea Grant College Program has carried out the INTENT OF CONGRESS. It was recently cited by a Congressional committee as one of the most effective, cost-efficient programs of the federal government.
- ⊕ The National Sea Grant College Program has become a MODEL for university/private sector/government PARTNERSHIP on critical resource development opportunities and problems. This model should be fostered and extended to other areas where there are national development needs.
- ⊕ Beyond its special role as the primary national university-based marine resource program, the National Sea Grant College Program has developed UNIQUE capabilities in such areas as marine aquaculture, interdisciplinary programs, advisory services, manpower development and marine technology transfer.

### SEA GRANT HAS A ROLE IN FUTURE NATIONAL OCEAN POLICY:

- ⊕ New opportunities and demands for sustained Sea Grant effort are growing out of PRIORITY NATIONAL POLICY areas such as extended jurisdiction, outer continental shelf resource development and Great Lakes transboundary questions, as well as from rapid SCIENTIFIC ADVANCES in such areas as genetic engineering and undersea technology.
- ⊕ The country needs a stable and adequate base of support for the fundamental, long-term, high-risk research that is the basis for scientific advance, industrial development and economic benefits. Continuity of support is also vital to sustain Sea Grant's educational and public service missions.
- ⊕ Marine resource development has been a neglected field in U.S. INTERNATIONAL assistance policy. There is increasing need for Sea Grant activity and for cooperative programming with AID.

The requested AUTHORIZATION levels reflect requirements for carrying out the Congressional mandate for the National Sea Grant College Program. Emphasis will be placed on support for sustaining the core Sea Grant Colleges and institutions, strengthening developing programs and enhancing priority efforts in areas of critical need.

NATIONAL SEA GRANT TASK FORCE  
JANUARY 1983

**NATIONAL SEA GRANT COLLEGE PROGRAM:  
PROPOSED REAUTHORIZATION**

**AN ACT**

To authorize appropriations to carry out the national sea grant college program for fiscal years 1984, 1985, 1986, 1987, and 1988, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, that the National Sea Grant College Program Act (33 U.S.C. 1121 et seq.), as amended, is further amended --

- (1) in section 212 by inserting the following new paragraph immediately after paragraph (3):
  - (4) not to exceed \$50,000,000 for fiscal year 1984, not to exceed \$55,000,000 for fiscal year 1985, not to exceed \$60,000,000 for fiscal year 1986, not to exceed \$65,000,000 for fiscal year 1987, and not to exceed \$70,000,000 for fiscal year 1988.
- (2) in section 3(c) by inserting the following new paragraph immediately after paragraph (3):
  - (4) not to exceed \$3,000,000 for fiscal year 1984, not to exceed \$3,000,000 for fiscal year 1985, not to exceed \$5,000,000 for fiscal year 1986, not to exceed \$5,000,000 for fiscal year 1987, and not to exceed \$7,000,000 for fiscal year 1988.

National Sea Grant Task Force  
November 1982

Contact: Louie Echols  
University of Wisconsin-Madison  
608/263-3262

## Basic Principles for Continued Authorization and Funding of the National Sea Grant College Program

---

1. The national interest requires a national ocean policy and a marine resource strategy in order to promote economic development, enhance wise use of resources and provide for conflict resolution.
2. Investment in people, ideas and technology transfer is basic to any ocean policy. A strong, on-going, university-based research, education, technology transfer and public service program is a fundamental part of this investment.
3. The National Sea Grant College Program has successfully carried out its role as the basic national university marine resource program. It has been cited in Congress as one of the most effective and cost-efficient programs of the federal government. It should be continued without fundamental change.
4. The essential characteristics of the National Sea Grant College Program should be maintained:
  - a) its national orientation and network, building on strong local programming;
  - b) its university base for education, research, and public service;
  - c) its multiple partnership approach, working with industry, business, the general public and all levels of government;
  - d) its matching fund nature;
  - e) its broad marine resource orientation;
  - f) its grant relationship based on competitive funding; and
  - g) its accountability.
5. Continued development and sufficient support of Sea Grant Colleges and institutions in all eligible states should be sustained as a priority goal.
6. Opportunities should be maintained for the broadest possible participation in the program by qualified institutions and investigators.
7. The capacity for an international element in the program should be preserved.
8. The authorization level should be adequate to meet the goals of the program as established by Congress.
9. In view of the need for a national marine resource strategy, the rapid expansion of marine program authorizations during the last decade, the continued fragmentation of administrative responsibility for the programs and the fiscal climate, a major review of national ocean policy, along the lines of the Stratton Commission, could serve an important function in examining alternative strategies for future national ocean policy.

NATIONAL SEA GRANT TASK FORCE  
Approved by the Sea Grant Community  
July 20, 1982



**NATIONAL SEA GRANT COLLEGE PROGRAM:**  
**PARTICIPATING EDUCATIONAL INSTITUTIONS**

NATIONAL SEA GRANT COLLEGE PROGRAM:  
PARTICIPATING EDUCATIONAL INSTITUTIONS

The 29 Sea Grant colleges and institutions, listed on the next page, are the core of the National Sea Grant College Program. A unique Sea Grant creation, these programs function as the primary planning, goal-setting, management and accountability units of the national program, and they are the main source of continuity and long-term commitment to the purposes of the National Sea Grant College Program Act.

The Sea Grant Program is a national model for multidisciplinary university work, one of the few national scientific programs that operates in this manner, rather than along strictly disciplinary lines. It is also a national model of interinstitutional cooperation, for each of the core colleges and institutions involves a number of other institutions in its work; and the regional and national network of Sea Grant programs keep active lines of communication and cooperation open.

Until now, no list of all of the educational institutions involved in the National Sea Grant College Program has been available. To remedy this situation, the National Sea Grant Task Force surveyed the core Sea Grant institutions, asking for a list of participating educational institutions. A "participant" was defined as an institution that is a required signatory of a Sea Grant institutional proposal and/or is a recipient of Sea Grant funds. (To be included, an institution must be an administratively separate campus or system level entity.) In addition the annual NOAA/Office of Sea Grant (OSG) list of current projects was checked, though this list does not show subcontracts or multi-institutional participants in projects. Further, over the years OSG has made a number of individual project grants, separate from the core institutional grants, and a list of these grants was used for additional participants. It should be noted that the number of these separate project grants has dropped sharply during the past two years, in part because of funding cuts and in part because there has been a move nationally to tie these projects to the core programs in order to insure better coordination and cooperation. However, both now and previously, most of the institutions involved in the program, including those from inland states, have been involved primarily through an affiliation with one of the 29 core programs.

The survey results, which are reflected in the geographical listing in this report, show that 253 institutions of postsecondary education, over 27 elementary and secondary schools or school systems and 26 other nonprofit institutions with marine-related educational and research missions have had some involvement with the National Sea Grant College Program since the enactment of the Sea Grant Improvement Act of 1976, the last major rewrite of Sea Grant legislation. These institutions come from 39 states, (all 30 coastal states plus nine inland states), the District of Columbia, Puerto Rico and Guam. Indirectly at least 35 other postsecondary institutions (which include two additional inland states) have had some involvement with Sea Grant programs. An asterisk (\*) denotes those institutions that have had some involvement since the last authorization act in 1980. The number appears to have dropped somewhat in the last year or so. The list does not include federal laboratories or agencies, state agencies other than those with special quasi-research-and-education marine-related functions, cooperative private sector enterprises, other cooperating groups that do not receive funds, or foreign universities.

Finally, though every effort has been made to keep this compilation accurate, it is inevitable that mistakes and omissions will occur. It should also be apparent that degrees of participation vary markedly, from heavy institutional involvement to modest project support for one researcher or student, and that not every institution listed is a participant every year. It should be abundantly clear, however, that the National Sea Grant College Program has mobilized a significant array of the nation's marine research and educational talent to foster better use of America's marine resources.

# **NATIONAL SEA GRANT COLLEGE PROGRAMS**

---

## **SEA GRANT COLLEGES AND INSTITUTIONS**

**Alaska Sea Grant College Program**  
**California Sea Grant College Program**  
**University of Southern California Sea Grant Program**  
**Connecticut Sea Grant**  
**University of Delaware Sea Grant College Program**  
**Florida Sea Grant College**  
**Georgia Sea Grant Program**  
**University of Hawaii Sea Grant College Program**  
**Illinois-Indiana Sea Grant Marine Extension Project**  
**Louisiana Sea Grant College Program**  
**University of Maryland Sea Grant College**  
**Massachusetts Institute of Technology Sea Grant Program**  
**Michigan Sea Grant College Program**  
**Minnesota Sea Grant Institute**  
**Mississippi-Alabama Sea Grant Consortium**  
**University of New Hampshire/University of Maine Sea Grant College Program**  
**New Jersey Institutional Sea Grant Program by New Jersey Marine Sciences Consortium**  
**New York Sea Grant Institute of State University of New York and Cornell University**  
**University of North Carolina Sea Grant College Program**  
**Ohio Sea Grant Program**  
**Oregon State University Sea Grant College Program**  
**University of Puerto Rico Sea Grant College Program**  
**University of Rhode Island Sea Grant College Program**  
**South Carolina Sea Grant Consortium**  
**Texas A&M University Sea Grant College Program**  
**Virginia Sea Grant Program**  
**Washington Sea Grant Program**  
**University of Wisconsin Sea Grant College Program**  
**Woods Hole Oceanographic Institution Sea Grant Program**

# GEOGRAPHICAL LISTING OF SEA GRANT PARTICIPATING INSTITUTIONS

---

## ALABAMA

- \*Auburn University
- \*Marine Environmental Sciences Consortium  
Talladega College  
Tuskegee Institute
- \*University of Alabama
- \*University of Alabama in Birmingham
- \*University of South Alabama

See also Appendix I

## ALASKA

- Kodiak Community College
- Sheldon Jackson College
- \*University of Alaska—Anchorage
- \*University of Alaska—Cooperative Extension Service
- \*University of Alaska—Fairbanks
- \*University of Alaska—Juneau

## ARIZONA

- \*University of Arizona

## ARKANSAS

- \*University of Arkansas

## CALIFORNIA

- \*California Institute of Technology
  - \*California State Polytechnic University, Pomona
  - \*California State University, Long Beach
  - California State University, Northridge
  - \*Humboldt State University
  - \*Moss Landing Marine Laboratories<sup>1</sup>
  - \*San Diego State University
  - \*San Francisco State University
  - \*San Jose State University
  - \*Scripps Institution of Oceanography
  - Southern California Ocean Studies Consortium<sup>2</sup>
  - \*Stanford University
  - \*University of California, Berkeley
  - \*University of California, Davis
  - \*University of California, Irvine
  - University of California, Los Angeles
  - \*University of California, Riverside
  - \*University of California, San Diego
  - \*University of California, Santa Barbara
  - \*University of California, Santa Cruz
  - University of San Diego
  - \*University of Southern California
  - \*University of the Pacific
- California Academy of Sciences
- \*Southern California Coastal Water Research Projects

<sup>1</sup>A consortium of six northern California state universities

<sup>2</sup>Composed of six southern California state universities

## COLORADO

- \*Colorado State University
- American Cancer Research Center and Hospital

## CONNECTICUT

- \*University of Connecticut
- \*Western Connecticut State College
- \*Yale University

## DELAWARE

- \*University of Delaware

## DISTRICT OF COLUMBIA

- \*American Geophysical Union
- National Association for Equal Opportunity in Higher Education
- \*National Fisheries Institute

## FLORIDA

- \*Florida Atlantic University
  - \*Florida Institute of Technology
  - \*Florida International University
  - Florida Junior College
  - Florida Keys Community College
  - \*Florida State University
  - Nova University
  - \*St. Petersburg Junior College
  - \*University of Central Florida
  - \*University of Florida
  - \*University of Miami
  - University of North Florida
  - \*University of South Florida
  - \*University of West Florida
- \*Harbor Branch Foundation
  - \*Mote Marine Laboratory

See also Appendix I

## GEORGIA

- Georgia Institute of Technology
- Georgia Southern College
- \*Morehouse Medical College
- \*Skidaway Institute of Oceanography
- \*University of Georgia

See also Appendix I

## GUAM

- \*University of Guam

---

\* Has received funds since 1980

## HAWAII

- \*University of Hawaii at Hilo
- \*University of Hawaii—Honolulu Community College
- \*University of Hawaii—Kauai Community College
- \*University of Hawaii—Leeward Community College
- \*University of Hawaii—Manoa
- \*University of Hawaii—Maul Community College
- \*University of Hawaii—Windward Community College

## IDAHO

- \*University of Idaho

## ILLINOIS

- \*University of Illinois at Urbana-Champaign

## INDIANA

- \*Indiana University
- \*Purdue University

See also Appendix I

## IOWA

- \*Iowa State University

## KANSAS

See Appendix I

## LOUISIANA

- \*Hebert Law Center
- \*Louisiana State University Agricultural Center
- \*Louisiana State University—Baton Rouge
- \*Nicholls State University
- Northeastern State University
- \*Southern University—Baton Rouge
- University of New Orleans
- University of Southwestern Louisiana

Terrebonne Parish School Board

## MAINE

- \*College of the Atlantic
  - \*Maine Maritime Academy
  - \*Southern Maine Vocational Technical Institute
  - University of Maine at Machias
  - \*University of Maine at Orono
  - \*University of Southern Maine
  - \*Washington County Vocational Technical Institute
- \*Bigelow Laboratory for Ocean Sciences

## MARYLAND

- Anne Arundel Community College
- \*John Hopkins University
- St. Mary's College in Maryland

- \*University of Maryland—Baltimore City
- \*University of Maryland—Baltimore County
- \*University of Maryland—Center for Environmental and Estuarine Studies
- \*University of Maryland—College Park
- \*University of Maryland—Eastern Shore

- Baltimore City Public Schools
- \*St. Mary's County Public Schools

- \*Citizens Program for Chesapeake Bay
- Council for National Cooperation in Aquatics
- \*National Aquarium in Baltimore
- Undersea Medical Society, Inc.

## MASSACHUSETTS

- \*Boston University
- \*Harvard University
- \*Massachusetts Institute of Technology
- \*Massachusetts Maritime Academy
- \*University of Massachusetts—Amherst
- \*Woods Hole Oceanographic Institute

- \*New Bedford Public School System

- \*Children's Memorial Hospital
- Marine Biological Laboratory
- New England Aquarium

See also Appendix II

## MICHIGAN

- \*Eastern Michigan University
- \*Michigan State University
- \*Michigan Technology University
- \*Northern Michigan University
- Northwestern Michigan College
- \*The University of Michigan
- Wayne State University

Michigan Primary and Secondary Schools (18)

## MINNESOTA

- \*University of Minnesota—Duluth
- \*University of Minnesota, Twin Cities

## MISSISSIPPI

- \*Jackson State University
- \*Mississippi State University
- \*University of Mississippi
- \*University of Southern Mississippi

- \*Biloxi High School
- \*Ocean Springs High School

- \*Gulf Coast Research Laboratory

## MONTANA

- \*University of Montana

## **NEW HAMPSHIRE**

- \*Colby-Sawyer College
  - \*Dartmouth College
  - \*Franklin Pierce Law Center
  - \*Plymouth State College
  - \*University of New Hampshire
- \*New Hampshire Council of Universities and Colleges

## **NEW JERSEY**

- Atlantic Community College
- Brookdale Community College
- \*Fairleigh Dickinson University
- Kean College of New Jersey
- Montclair State College
- New Jersey Institute of Technology
- \*New Jersey Marine Sciences Consortium
- \*New Jersey Medical and Dental School
- \*Princeton University
- Rider College
- \*Rutgers—The State University
- \*Stevens Institute of Technology
- Stockton State College

## **NEW YORK**

- \*Adelphi University
  - \*City University of New York—Graduate School at University Center
  - \*City University of New York—Hunter College
  - Clarkson College
  - \*Columbia University
  - \*Cornell University
  - Jefferson County Community College
  - \*New York University
  - Pratt Institute
  - \*Rensselaer Polytechnic Institute
  - \*Rochester Institute of Technology
  - \*Southampton College of Long Island University
  - \*St. John's University
  - \*State University of New York Agricultural and Technical College at Farmingdale
  - \*State University of New York at Buffalo
  - \*State University of New York at Stony Brook
  - \*State University of New York at Albany
  - \*State University of New York Binghamton
  - \*State University of New York College at Buffalo
  - \*State University of New York College at Oswego
  - \*State University of New York College at Fredonia
  - \*State University of New York College at Potsdam
  - \*State University of New York College at Brockport
  - \*State University of New York—College of Environmental Science and Forestry
  - \*The Medical Center for New York University
  - \*Webb Institute of Naval Architecture
- \*Great Neck Public School District
- \*Staten Island Continuum of Education
- Syracuse School District

Society of Naval Architects and Marine Engineers

## **NORTH CAROLINA**

- Beaufort County Technical Institute
- Campbell University

- Cape Fear Technical Institute
- College of the Albemarle
- \*Duke University
- \*East Carolina University
- \*North Carolina A&T University
- \*North Carolina Central University
- \*North Carolina State University
- \*University of North Carolina at Chapel Hill
- \*University of North Carolina at Wilmington

- \*Laque Center for Corrosion Technology, Inc.

## **OHIO**

- \*Bowling Green State University—Bowling Green
- Bowling Green State University—Firelands
- \*Case Western Reserve University
- Findlay College
- \*Hiram College
- Lakeland Community College
- Lorain County Community College
- \*The Ohio State University—Columbus
- The Ohio State University—Mansfield
- University of Cincinnati
- \*University of Miami
- \*Center of Science and Industry
- Cleveland Museum of Natural History
- \*Ohio Arts Council

See also Appendix I

## **OKLAHOMA**

- \*University of Oklahoma

## **OREGON**

- \*Clatsop Community College
- \*Lewis and Clark College
- \*Oregon Health Sciences University
- \*Oregon State University
- \*University of Oregon

## **PENNSYLVANIA**

- \*Lake Erie Marine Sciences Institute
- \*Lehigh University

## **PUERTO RICO**

- \*Catholic University
- \*Inter American University—Arecibo
- \*Inter American University—San German
- \*University of Puerto Rico—Humacao
- \*University of Puerto Rico—Mayaguez
- \*University of Puerto Rico—Rio Piedras

## **RHODE ISLAND**

- \*University of Rhode Island

## **SOUTH CAROLINA**

- \*Clemson University
- \*College of Charleston
- \*Medical University of South Carolina
- \*South Carolina State College
- \*The Citadel
- \*University of South Carolina—Columbia
- University of South Carolina—Beaufort
- \*University of South Carolina—Coastal Carolina
  
- \*Marine Resources Research Institute

## **TENNESSEE**

See Appendix I

## **TEXAS**

- \*Baylor College of Medicine
- Brazosport College
- Lamar University
- Pan American University
- Sam Houston State University
- \*Texas A&M University
- \*Texas A&M University at Galveston
- \*Texas Southern University
- \*Texas Southmost College
- Texas State Technical Institute—Harlingen
- \*University of Houston
- \*University of Houston at Clear Lake City
- \*University of Texas at Austin
- \*University of Texas at Port Aransas
  
- Texas Education Service Center—Waco

## **UTAH**

- \*University of Utah

## **VIRGINIA**

- \*College of William and Mary
- \*George Mason University
- \*Hampton Institute
- \*Norfolk State University
- \*Old Dominion University
- Rappahannock Community College
- Thomas Nelson Community College
- University of Virginia
- \*Virginia Institute of Marine Science
- \*Virginia Polytechnic Institute and State University
- \*Virginia State University

## **WASHINGTON**

- \*Bellingham Vocational-Technical Institute
- Clover Park Vocational-Technical Institute
- \*Grays Harbor College
- Highline Community College
- \*Seattle Central Community College
- Shoreline Community College
- \*University of Washington
- \*Washington State University
- Western Washington University
  
- \*Pacific Science Center

## **WEST VIRGINIA**

- \*West Virginia University

## **WISCONSIN**

- \*Lawrence University
- \*Medical College of Wisconsin
- \*University of Wisconsin—Extension
- \*University of Wisconsin—Green Bay
- \*University of Wisconsin—Madison
- \*University of Wisconsin—Marinette
- \*University of Wisconsin—Milwaukee
- \*University of Wisconsin—Parkside
- \*University of Wisconsin—Stevens Point
- \*University of Wisconsin—Superior



## APPENDIX I

Though the following institutions have not been direct recipients of Sea Grant funds, faculty and students at these institutions have been involved with the Georgia Sea Grant Program in a real way. The involvement has been in terms of (a) faculty members collaborating as co-investigators on research projects, (b) co-institutional sponsorship of training and education programs, (c) students who participated in the educational or trainee programs offered by the Georgia Sea Grant Program.

### ALABAMA

Selma University

### FLORIDA

Florida State University

### GEORGIA

Agnes Scott College  
Armstrong State College  
Atlanta University  
Berry College  
Clark College  
Columbus College  
DeKalb College  
Fort Valley State College  
Georgia State University  
Gordon Junior College  
Kennesaw College  
Morris Brown College  
Oglethorpe University  
Spelman College  
Wesleyan College  
West Georgia College

### INDIANA

Indiana University

### KANSAS

University of Kansas

### OHIO

Bowling Green State University  
Wright State University

### TENNESSEE

Tennessee State University

This is yet another example of the broad array of institutions and the national networking of the National Sea Grant College Program.

## APPENDIX II

A number of educational institutions have been involved in Sea Grant "spin-off" activities, even if they have not been regular Sea Grant participants. For example, in July 1978, with initial support from the Massachusetts Institute of Technology Sea Grant Program, faculty from a number of colleges and universities in the Boston, Massachusetts area formed the Marine Education consortium in order to pool resources. Among other activities, the group designed an interdisciplinary undergraduate course in marine affairs. This course, "Into the Ocean World," was offered to students at participating institutions in 1981 and 1982. The consortium has become self-supporting, and in 1983 two new courses will be introduced into the curriculum. The following colleges and universities are participants:

### MASSACHUSETTS

Assumption College  
Bentley College  
Boston University  
Bradford College  
Brandeis University  
Curry College  
Eastern Nazarene College  
Emmanuel College  
Framingham State College  
Merrimack College  
New England Aquarium  
Northeastern University  
Ocean Research and Education Society  
Pine Manor College  
Quincy Junior College  
Salem State College  
Stonehill College  
Suffolk University  
Tufts University  
University of Massachusetts-Boston  
Wellesley College

\*\*\*\*

Survey for the National Sea Grant Task Force by:

University of Wisconsin Sea Grant Institute  
1800 University Avenue  
Madison, Wisconsin 53705



**The Alaska Sea Grant College Program** is a center within the University of Alaska which encourages faculty and staff to apply their knowledge and skill to the practical needs of understanding, developing, and conserving Alaska's marine and coastal resources. Alaska Sea Grant is a statewide university program within the Office of the President.

Participating university campuses or units are:

- University of Alaska, Juneau • University of Alaska, Anchorage •
- University of Alaska, Fairbanks • Cooperative Extension Service •
- Fishery Industrial Technology Center •

Alaska Sea Grant has been instrumental in promoting cooperative activities between governmental and industry organizations concerned with Alaska fisheries.

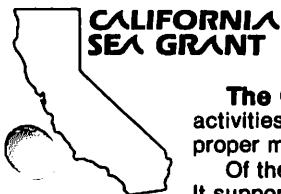
Currently participating entities include:

- National Fisheries Institute • National Marine Fisheries Service •
- Alaska Department of Commerce and Economic Development •
- Northern Southeast Regional Aquaculture Association •
- Alaska Troller's Association • Alaska Department of Fish and Game •
- North Pacific Fishery Management Council •

Some representative samples of the program's accomplishments are:

- **The aquaculture technician training program** at Sitka's Sheldon Jackson College was supported by Alaska Sea Grant during its early development. Salmon returns to their hatchery now wholly support the program.
- **ALASKA Tidelines, a marine periodical** for Alaska schools grew to reach one-third of Alaska's K-12 students during its Sea Grant sponsorship. In November 1982, publication of *Tidelines* was taken over by The Alaska Geographic Society, a non-profit corporation.
- **Data on the foreign fleet's productive fishing locations** off Alaska was jointly compiled by Alaska Sea Grant and the National Marine Fisheries Service's Northwest and Alaska Fisheries Center. That information is being used by industry and resource managers to initiate a domestic fishery off Alaska.
- **Reclaimed crab waste from Alaska processing plants** is now successfully used as a protein supplement to beef cattle and swine feed. Five years of Sea Grant research made this cheaper protein supplement possible. Demand for feedstuff using this meal now exceeds local supply.
- **Local commercial gillnetters now take 15 percent** of the western Alaska herring harvest as a result of Sea Grant workshops in 29 villages. Previously dominated by large "outside" seiners, the fishery is now open to gillnetters, with some "gillnet-only" areas. In the 1982 Togiak herring fishery, western Alaska's largest, local gillnetters took 31 percent of the \$6.3 million harvest.

Continuing efforts of the Alaska Sea Grant Program for the foreseeable future will be directed toward development and wise use of Alaska's fishery resources through an integrated program of research, education and public service. For further information on the Alaska Sea Grant College Program contact: Alaska Sea Grant College Program, 3 Bunnell, 303 Tanana Drive, University of Alaska, Fairbanks, Alaska 99701, (907)474-7086.



**The California Sea Grant College Program is...**a three-part program of research, education, and advisory activities designed to accelerate the wise development of our nation's marine resources, including the conservation, proper management, and economic utilization of those resources.

Of the 29 Sea Grant programs located in more than half of the nation's states, the California program is the largest. It supports development of marine information and marine assistance at California's public and private universities and colleges, directly benefiting more than 100 private sector organizations and government agencies in 1982.

Since its inception in 1968, California Sea Grant has funded marine activities at more than 30 academic and marine institutions in California, including:

California Institute of Technology  
California State Universities at Humboldt, Long Beach, San Diego, San Francisco, and San Jose  
Claremont College  
Loyola Marymount University  
Moss Landing Marine Laboratories (a consortium of 6 state universities in northern California)  
Occidental College  
Southern California Ocean Studies Consortium (composed of 6 state universities in southern California)  
Stanford University  
University of California campuses at Berkeley, Davis, Irvine, Los Angeles, Riverside, San Diego, Santa Barbara, and Santa Cruz  
University of San Diego  
University of Southern California

Many of the research activities supported by the California Sea Grant College Program have national, regional, and local benefits. For example, California Sea Grant has:

- identified 14 potential anti-cancer drugs currently under development by several major pharmaceutical corporations, and identified chemicals from the sea that are potential pain killers and topical anti-inflammatory agents.
- increased the potential for U.S. export of herring eggs-on-seaweed valued to \$20,000 per wet ton by integrating the economically valuable seaweed *Gracilaria* and the herring fishery; increased food yield from the sea by developing new hatchery techniques for salmon, abalone, and lobster.
- trained salmon and albacore fishermen to use remote sensing data to locate fish schools, saving fuel and reducing costs by \$500,000 per year.
- kept consumer costs down by saving shellfish fishermen 50% in bait costs through improved baiting techniques and by improving harvest methods and conservation practices of seaweed, salmon, and abalone resources.
- developed storage techniques which keep fish fresh seven to nine days longer than conventional methods; developed techniques that reduce water use by 43% in shrimp processing; and designed a free-moving fish filleting knife that runs on an air motor instead of an electric motor.
- developed a squid cleaning machine that cleans a pound of squid in seconds, a job that can take 20 minutes to do by hand. Commercial development of the machine is underway, and estimates indicate that the machine could increase the value of the squid fishery 50 fold, boosting the economic value of the fishery to \$60 million annually.

Some of the research supported by California Sea Grant is not directly quantifiable in economic terms but has resulted in increased awareness and understanding of marine resources and has improved the nation's capability for technological development of those resources. For example, California Sea Grant has:

- improved the safety of marine transportation and operations through modeling of safety techniques and through the development of more efficient equipment for assessing underwater construction sites and for exploration of the sea floor.
- trained nearly 400 graduate students since 1972 in technical aspects of biology, chemistry, economics, engineering, geology, oceanography, and political science. Most of these students are now putting their newly acquired skills and knowledge to work in government, industry, and university positions throughout the United States.
- educated more than 500,000 people annually through public displays, outreach programs, and consumer workshops on fisheries management and economics, salmon and abalone enhancement, trawling and gear development, alternative fisheries development, and the use of remote sensing data.
- assisted the abalone restocking efforts of government agencies by providing research support for seeding experiments on artificial reefs adjacent to power plants, by providing Sea Grant-developed seeding techniques, and by providing Sea Grant research results on the natural history of abalone.
- provided coastal wetlands information and advice based on California Sea Grant investigations to port districts, residential development organizations, planning agencies, and the federal government to restore marshlands for their environmental and economic benefits.
- published a coastal erosion manual and conducted erosion research investigations which have allowed coastal planners and property owners to better plan and control coastal development to reduce property losses.

**Regionally**...the California Sea Grant College Program, in cooperation with the Pacific Sea Grant college programs in Alaska, Hawaii, Oregon, and Washington, is working to develop, use, and conserve the vast resources of the Pacific Ocean—a largely undeveloped wilderness that occupies nearly one-half of the globe.

For more than a decade the five Pacific Sea Grant college programs have provided advisory education and services regionally through the Pacific Area Sea Grant Advisory Program (PASGAP). The coordinated Sea Grant research base along the Pacific Rim has enhanced local marine advisory programs and allowed the development of regional educational workshops and research symposia directed toward wise economic growth and better employment opportunities of our important marine industry and commerce.

In addition to supporting application-oriented marine research at the nation's leading universities, Sea Grant sponsors educational activities to communicate research results to government agencies, related industries, scientists, fishermen, aquaculturists, and consumers—people who can translate research information into social and economic benefits for the nation, for coastal regions, and for cities that have Sea Grant programs.

For more information regarding the California Sea Grant College Program contact: **Dr. James J. Sullivan**  
California Sea Grant College Program  
University of California A-032  
La Jolla, CA 92093  
(619) 452-4440

# SEA GRANT'S HELPING MAKE THE U.S. # 1 IN THE OCEANS . . .



***And the USC Sea Grant Program  
is a part of that effort!!***

Since the early 1900s, the University of Southern California has been involved in the areas of marine science, ocean engineering and marine policy. The USC Sea Grant Program, a part of the university's Institute for Marine and Coastal Studies (IMCS), is helping to carry on that tradition by linking university research with industry and user groups, which put research results into practice.

Virtually the entire population of Southern California is affected by the use and management of the ocean — for jobs, for goods and services, and for recreation. Therefore, the intelligent use and management of the ocean's scarce resources are of vital concern to all Southern Californians.

USC Sea Grant was established in 1969 and, since that time, has maintained its commitment to applying the expertise of specialists to solve special marine and coastal problems of the region through:

**Research** that spans coastal and marine resources, environmental problems, coastal management and ocean engineering.

**Marine Education** for elementary, secondary and adult classes.

**Advisory Services** for recreational activities, government agencies and private industry.

Recent accomplishments in these areas have included:

- Development of a new and inexpensive assay for the toxins that cause paralytic shellfish poisoning.
- Marine weather series on AM radio for recreational boaters and commercial fisheries.
- Pollution studies in the Los Angeles and Long Beach harbors.
- Series of graduate courses on seaport management.
- Teacher guides on incorporating marine subjects into school curricula.
- Studies of nearshore fisheries.
- Models of wave behavior in harbors and around structures.
- Inventory of offshore sand and gravel resources.

Further information on USC Sea Grant's services and programs is available by contacting:

**USC Sea Grant Program  
Institute for Marine and Coastal Studies  
University of Southern California  
University Park  
Los Angeles, CA 90089-0341  
Phone: (213) 743-6068**



**THE CONNECTICUT SEA GRANT PROGRAM** is a statewide multi-institutional program of marine research, education and advisory services, administered by The University of Connecticut Sea Grant Office, located on the Avery Point Campus in Groton, Connecticut.

Sea Grant research contributes to the growing body of knowledge about our coastal and oceanic resources and to the solution of contemporary problems in the marine sphere. Through its Marine Advisory Program, Sea Grant transfers information and technology developed in the national research network to a wide community of users in Connecticut, the region and the nation. Sea Grant also supports a broad range of educational programs for university students, public school teachers and students, and the general public, so our coastal and oceanic resources may be understood and judiciously used by this and future generations.

Institutions which have participated in the Sea Grant program in the past, or are currently involved, are:

*The University of Connecticut  
Western Connecticut State College  
Yale University*

Other institutions which have shown an interest in the program include:

*Central Connecticut State College • Connecticut College  
Eastern Connecticut State College • Fairfield University  
Southern Connecticut State College • Wesleyan University*

In addition to the normal Sea Grant activities, the Sea Grant Office at Avery Point is expected to maintain a coordinating center for maritime activities and information in education and research for the State of Connecticut.

The Connecticut Marine Advisory Service, which is a part of the Cooperative Extension Service, has been in place since 1974. During this period, five major projects can be identified in which the Advisory Service played a key role:

- Demonstration programs in aquacultural field methods for local coastal towns have produced net annual incomes of \$19,000 at an investment rate of \$5,000 a year. These local programs have resulted in major statewide efforts of seeding and mapping of shellfish, enforcement activities, and stock enhancement.
- Technical assistance provided by marine advisory agents contributed materially to revitalization of the Port of Stonington through reconstruction of the fishing piers and the off-loading facilities. In addition, such services were also extended to New London, New Haven and Norwalk for expanded facilities. Investment of about \$7,000 each year is yielding a net annual return of close to \$300,000.
- Taxation and financing programs developed by one Advisory Service Agent have resulted in a Connecticut Sales Tax exemption on fishing boats and equipment which is helping to increase fishing income. In addition, this has sparked a program for the procurement of new boats which are more economical to operate. Annual costs of this program are estimated at \$2,500, while benefits appear to approach nearly \$300,000 each year.
- Dredge disposal management is an essential economic factor in the region. One of our Advisory Agents has been a key participant in disposal monitoring and the establishment of effective dredge spoil management techniques. Estimating the value of his contribution at less than 2% a year for five years of the total savings of \$263 million claimed by the State of Connecticut, this effort shows a net annual benefit of \$4,000,000 a year with an annual cost of \$5,000.
- Improved fishing gear technology involving net design, handling, and repair has been a major source of improved income for fishermen as a consequence of fuel savings and increased fishing efficiency. By working closely with the fishing fleet, the Advisory Service believes that annual economic benefits of \$53,000 are being realized at an annual cost of \$5,000.

Although the establishment of a Sea Grant Program in Connecticut has been a recent development, the State has benefited from major academic programs in marine sciences and engineering over an extended period of time at the U.S. Coast Guard Academy, The University of Connecticut and Yale University. In more recent times, other private institutions and the four Connecticut State Colleges have added courses and programs in marine-related subjects. As noted in a recent publication on the scope of marine-related education in Connecticut, the State offers an extremely wide range of marine programs for the benefit of school children, the college student, and the general public. Many of these programs are specialized and national in character.

We believe that the total program in Connecticut in marine education, research and advisory services closely matches the stated goals of the National Sea Grant Program. The ability to show a sizeable profit in many areas of research and advisory services is also typical of the national experience.

For further information on the Connecticut Sea Grant Program, please contact:

*Dr. Victor E. Scottron, Acting Director  
Connecticut Sea Grant  
The University of Connecticut at Avery Point  
Groton, CT 06340  
(203) 446-1020, Ext. 258*



The University of Delaware (UD) Sea Grant College Program is a university-industry-government partnership, coalescing the necessary intellectual and financial resources for an effective, coordinated, and objective approach to both contemporary and future coastal and marine issues. The primary objective of the UD Sea Grant College Program is

*to stimulate practical marine resource development and use through application-oriented research, manpower education and training, and advisory services.*

Sea Grant does not operate in isolation. Rather, it is a mechanism to identify and bring together all aspects of marine and coastal resources. Therefore, as it provides answers to problems of the local, regional, and national coastal and marine environments, the program is relevant and of use to state agencies, legislative committees, industries, and individuals.

**Research.** At University of Delaware Sea Grant, faculty members from seven of the ten colleges are carrying on research that contributes information that is relevant to solving identified coastal and marine problems and needs—that is, information that can be used. These examples are representative of Sea Grant's accomplishments through research:

- Chitin, a material obtained from the shell of crabs, shrimp, and other marine animals, was regarded as a waste product. Recent research has shown that due to special properties, chitin can be spun into adsorbable surgical sutures and can be used as an aid to digestion in animal feeds. The potential market for the surgical suture is forecasted at \$10 million annually. Projected savings in the cost of feed through the use of a chitin diet additive could be substantial.
- Sea-wave-powered desalination research has developed a low-cost buoy that uses wave energy to produce fresh-water. This breakthrough has a potentially large economic value, through both domestic use and export.
- Marine corrosion is estimated to cause an annual loss of \$10 billion. Research involving several institutions and industry is designed to minimize this loss through maximizing the benefit of calcareous deposits to protect offshore structures and increase the performance predictability of aluminum and stainless steels in seawater.
- Delaware and New Jersey, with support from Sea Grant and the Delaware River and Bay Authority, are carrying out a comprehensive study of the entire Delaware estuary. Defining how this system works, describing its health, and providing managers with predictive models to assess future trends potentially could save millions of dollars in lost or misused resources.

**Advisory Service.** Marine Advisory Service (MAS) outreach activities serve the public, the users of our marine resources, by extending the knowledge gained by research. The MAS works with researchers and marine users to find solutions through cooperation and to educate and assist users of marine resources and information:

- Given the importance of recreation and tourism to Delaware's economy, the MAS cooperated with the Milford Chamber of Commerce to determine the economic impact of the 1981 Milford World Championship Weakfish Tournament. Results showed that the economic impact to the state was nearly \$173,000.
- A high-school level fisheries education short course provided gifted and talented students with a working knowledge of biology, fishing techniques, and business management skills.
- The seafood specialist, with assistance from the Mid-Atlantic Fisheries Development Foundation, is investigating proper handling and storage techniques for dogfish shark, a local underused species with high protein and low cholesterol.
- To increase the public's awareness of the need to manage marine resources, MAS convened a public workshop to identify the major resource issues facing Delaware's inland bays. Based on the priorities determined there, MAS is preparing a report for the public and decision-makers to summarize that information critical to understanding the inland bays.
- For ten years, the Fishermen's Hotline has given daily fishing information, weather, and safety tips from May to October. As of last season, people had called the hotline over one million times. Also, a monthly public service radio program, SeaTalk, is sent to 40 commercial and public radio stations in a six-state area.

**Education.** As important as research and advice is the training of young professionals who, through their Sea Grant education, become aware of the importance of our marine resources and become prepared to deal with present and future marine issues. During the past year, Sea Grant supported 34 graduate students through fellowships, traineeships, internships, or miscellaneous wages. Many were involved with ongoing marine research.

Through research, training young professionals, and helping users to apply new knowledge, the University of Delaware Sea Grant College Program continues to carry out its role toward fulfilling the mandate of the National Sea Grant Program—to promote the wise use and development of marine and coastal resources. While not all achievements can be measured in dollars, Delaware has made a significant contribution to the economic benefits for the National Sea Grant network.

We would be pleased to provide you with further information on our program. Contact:

Dr. Carolyn A. Thoroughgood, Executive Director  
University of Delaware Sea Grant College Program  
College of Marine Studies, University of Delaware, Newark, Delaware 19711  
(302) 738-8062



**Florida Sea Grant College**....is a university program aimed at solving real problems. Faculty skills in research, education and advisory services focus on the wise use, development and management of Florida's coastal and marine resources. Sea Grant relies on the knowledge and talent in the nine state and two private universities. These institutions are:

- Florida A & M University • Florida Atlantic University • Florida Institute of Technology
- Florida International University • Florida State University • University of Central Florida
- University of Florida • University of Miami • University of North Florida
- University of South Florida • University of West Florida

Marine advisory agents provide statewide coverage through eleven coastal county Extension offices and the Florida Cooperative Extension Service. Research projects are funded in the universities as needs are identified. Some Florida Sea Grant College research and advisory benefits can be measured in hard economic terms. Others are just as important, but are more difficult to define monetarily. A few of the more significant accomplishments during the past ten years are:

- \* Provided technical assistance to over 20 Florida coastal communities in artificial reef site selection, permitting, construction and evaluation.
- \* Analyzed a proposed import duty on shrimp of 30% that would have raised import price by 37%, vessel price by 9% and decreased quantity imported by 8%. Florida processes major quantities of imported shrimp each year. The impact would have been substantial and the legislation was not successful.
- \* Held over 60 tax and business management workshops for fishing vessel and fleet owners in over 30 Florida fishing towns from Key West to Pensacola. Two banking workshops have educated 146 bankers from Florida, Georgia and the Carolinas on financing alternatives for the seafood industry.
- \* Developed residential canal construction designs which provide more efficient flushing and higher water quality. Two elaborate canal systems in Palm Beach County have been completed using these procedures and designs with a reported increase in property values from \$25,000 to \$100,000 per lot. Other projects are underway.
- \* Transferred technology from the Cheapeake soft shell blue crab fishery to Florida and now over 20 firms are attempting soft crab production. This industry could result in an annual dockside value in excess of \$1 million.
- \* Devised a method for transfer of Gulf Stream location information from NOAA Satellite Information Service to users through use of NOAA Weather Radio. One ocean-going transport company reports saving \$120,000 using the information by cruising within the walls of the Gulf Stream. Savings of \$2,000 per steaming day on seven line haul tugs are also reported.
- \* Coordinated a national Seafood Waste Management Conference to concentrate the best expertise from industry, government, and universities on methods and cost benefits resulting from compliance with numerous regulations. Agencies have recently proposed altering previous regulations that would have cost the Southeastern U. S. shrimp industry 1,590 jobs and \$38 million annually.
- \* Developed an effective design for a Beach Dune Walkover structure. Of the 200 permits requested each year, between 1/3 and 1/2 are based on these plans. The time and money savings for the citizens building the structures and the regulatory personnel granting the permits are great. Dune destruction is prevented.
- \* Long term research efforts in the Apalachicola Bay, a major estuarine and fisheries production area, have resulted in changes in pesticide use in Georgia, in timber clear-cutting practices, and in seafood processing techniques. The research also aided in the establishment of the Apalachicola National Estuarine Sanctuary, the largest in the United States. These actions are vital to the long term health of the Bay as the area's industry support system.

In addition to marine research and advisory service activities, education efforts by Florida Sea Grant College have been effective in a number of areas. These include:

- \* Development of a 4-H marine program which has involved over time 35,000 youth and 6,000 adults in marine education projects and activities in over two-thirds of Florida counties. Approximately 7,000 young people are presently enrolled in 4-H marine activities.
- \* Provided "seed" money for start-up of courses to train professional divers and marine propulsion systems mechanics. Industry contributors have been Outboard Marine Corporation, Evinrude Motors, Johnson Motors and Mercury Marine. Since 1976, over 20 divers per year have graduated with over 90 percent finding jobs in servicing offshore oil operations. Others work in research and development. Outboard mechanic graduates all find ready employment as factory certified mechanics. The course is now self supporting.
- \* Assisted in funding a ship and yacht design course utilizing computer graphics aids in the design of both power and sail yachts. Students include those needing to upgrade their currently employed skills. It was the first comprehensive yacht design course to be offered at a U. S. university and has been taught three times.

The combined effort of Sea Grant research faculty and advisory agents has built an effective framework that has created inter-institutional cooperation in solving Florida's critical coastal problems. In addition, bridges have been built to Sea Grant institutions who help form the National Sea Grant College Program, to industry, and to federal, state, and local agencies, and the coastal public--one large web of institutions and people cooperating with each other in the common task of responsible development and management of our marine resources.

For further information on the Florida Sea Grant College Program contact:

Dr. James C. Cato, Director  
Florida Sea Grant College  
Building 803, University of Florida  
Gainesville, Florida 32611  
(904) 392-5870



# GEORGIA SEA GRANT COLLEGE PROGRAM

The charter granted by the Georgia Legislature in 1785 for the fledgling Nation's first state university marked both the beginning of the land grant college movement and the first public recognition that a state has a duty to provide for the higher education of its citizens.

In commenting on the development of THE UNIVERSITY OF GEORGIA as the institution approaches its 200th anniversary, President Fred C. Davison has said, "No program more clearly demonstrates this university's commitment to research, education, and service for the benefit of the state, region, and the nation through a strong state-federal partnership than the GEORGIA SEA GRANT COLLEGE PROGRAM."

The National Sea Grant Program, established by Congress to promote the development of marine resources, was already five years old when Georgia's participation began in 1971 at the Coherent Area level. Georgia was granted Institutional status within the National Program in 1974, and the top level of recognition, Sea Grant College status, was awarded in 1980.

During the decade of work which earned these citations for the Georgia Sea Grant College Program, the State of Georgia has consistently provided a match of approximately two dollars per federal dollar (more than required by Congress), and the considerable, multi-disciplinary resources of the University System have been marshalled and carefully coordinated to address problems of coastal industries ranging from fisheries and seafood processing to pulp and paper, recreation and tourism, agriculture and trade.

A few examples of specific projects with significance and application extending beyond state boundaries include the following:

- The state's first successful fishermen's cooperative was established with the help of University specialists in hydrography, biology, marine economics, law, and business management. Services rendered from its inception included assistance to incorporate as a legal entity, develop a charter, purchase land, carry out environmental impact studies, obtain funds for capital construction, and set up management procedures.
- The R/V GEORGIA BULLDOG, a 73-foot trawler abandoned by smugglers and acquired at virtually no cost, has been refitted for multipurpose fishing and is used to conduct exploratory fishing and gear research to determine the feasibility of diversifying the troubled shrimp fishing industry.
- Food scientists work to find ways to use underutilized finfishes in products already a part of traditional foreign markets in an effort to expand the seafood industry and help to ease the U. S. trade deficit.
- Natural compounds from marine organisms are isolated by biologists to serve as prototypes for pesticides that are generally more selective and more easily biodegraded than man-made pesticides now used by agriculture.
- Microbiologists work with major pulp-producers to determine the effects of pulp mill waste on the marine environment.

In addition to research and advisory services, training is provided to shrimp fishermen in:

- Techniques of offshore fishing by means of trawls and bottom longlines
- Use of loran and sonar
- Net building and repair
- Rigging nets on board ship
- Wire splicing
- Construction of trawl doors and setting chains

Other educational programs serve students at all levels, continuing education for teachers, state agencies, members of the scientific community, and industrial developers.

For more information on THE GEORGIA SEA GRANT COLLEGE PROGRAM, contact:

Director  
Georgia Sea Grant College Program  
Ecology Building  
Athens, Georgia 30602  
404/542-7671

## The University of Hawaii Sea Grant College Program: A Dynamic Partnership

The University of Hawaii Sea Grant College Program is a catalyst which precipitates action in research, education, and extension services in the marine environment as a partner with state, federal, and private agencies. The intrinsic value is the high scientific quality of the work.

### Some notable scientific achievements:

- The development of the flotation methodology for separating metals contained in manganese nodules
- The discovery of the "Darwin point" of the Hawaiian archipelago — the point at which coral growth and subsidence achieves equilibrium so that the reef neither expands nor subsides
- The development of an alternate diving table for scuba divers
- The first successful development of a hybrid broodstock of *Macrobrachium* spp.
- Eleven new species of gorgonians have been identified in Hawaiian waters
- The successful spawning of moi in captivity enabled researchers to close its biological cycle

### In partnership with the State of Hawaii, the University of Hawaii Sea Grant College Program has:

- Supported the evolving aquaculture industry by providing the Division of Aquatic Resources with field agents to help establish aquaculture operations and answer crisis-oriented problems
- Studied effects of large-scale offshore dumping of manganese tailings from a land-based processing site to support the state's interest in seeking a manganese processing industry
- Supported the assessment of living resources of the Northwestern Hawaiian Islands in cooperation with state and federal agencies involved in marine resource management

### In partnership with the counties, the University of Hawaii Sea Grant College Program has helped:

- The City and County of Honolulu save \$120 million in capital costs for building secondary sewage treatment plants on the island of Oahu and \$13 million in annual operating costs because Sea Grant researchers established the die-off rate of pathogens at the proposed discharge sites
- Maui county develop a facility for culturing topminnows as baitfish

### In partnership with the private sector, the University of Hawaii Sea Grant College Program has:

- Taught fishermen in all counties how to use the "ika shibi" (deep handlining) method originally practiced only in one sector of the county of Hawaii. This has grown into a significant new fishery.
- Promoted harvesting of bottomfishing and deepwater shrimp by Kauai county fishermen through UH Sea Grant Extension Service workshops on gear development and fishery techniques
- Provided support for the establishment of a fuel cooperative for fishermen in Maui county
- Assisted the Guam Fishermen's Cooperative in upgrading fish handling
- Developed the first tide charts for Guam which are published in the local TV guide

### In partnership with federal agencies, the University of Hawaii Sea Grant College Program has:

- Enabled the multi-million dollar Deep Underwater Muon and Neutrino Detection (DUMAND) program to develop data which demonstrated the feasibility of Keahole Point as the study site
- Supported research on spiny lobsters and bottomfish to provide the data needed by the Western Pacific Regional Fishery Management Council for the development of a fishery management plan for the fishery

In partnership with academic departments, the University of Hawaii Sea Grant College Program has supported both graduate and undergraduate student research projects. About 295 undergraduate students and 39 graduate students are annually supported. In addition, 104 professional staff carry out work supported by Sea Grant.

The Sea Grant Extension Service (SGES) is the outreach arm of the University of Hawaii Sea Grant College Program. Among other contacts, extension agents annually establish 900 and more contact times with fishermen and others involved in commercial fishing; 500 contact times with commercial seafood processors; and 1,000 contact times with aquaculturists and others involved in support industries and government.

The University of Hawaii Sea Grant College Program disseminates an average of 15 publications, including technical reports, conference proceedings, journal articles, etc., and monthly and quarterly newsletters.

The University of Hawaii Sea Grant College Program, as a partner to existing institutions, has made significant contributions to the understanding of the ocean environment and development and use of the marine resources of the state, region, and nation.

For further information, contact: University of Hawaii Sea Grant College Program  
Marine Science Building, Room 220  
1000 Pope Road  
Honolulu, HI 96822  
Phone (808) 948-7031

# Illinois - Indiana Sea Grant Marine Extension Project



Office of Sea Grant, NOAA, U.S. Department of Commerce

Illinois Cooperative Extension Service, University of Illinois at Urbana-Champaign

Indiana Cooperative Extension Service, Purdue University

Coordinator - Robert D. Espeseth, University of Illinois at Urbana-Champaign  
1206 South Fourth Street, Room 104 Huff Gym, Champaign, IL 61820, (217) 333-1824

Co-Coordinator - James A. Peterson, Specialist in Recreation and Parks, Purdue and  
Indiana Universities, 133 HPER Building, Bloomington, IN 47401, (812) 335-8037

**The Illinois-Indiana Sea Grant Marine Extension Project** is the most recent program to be approved by the Office of Sea Grant, initiated in April, 1982. The focus of this new program will be the environs of Lake Michigan and will provide the two states with an opportunity to address some of the marine resource problems which they face. Through the Sea Grant mechanism information and technical assistance can be provided to identified constituent groups.

Purdue University, W. Lafayette, Indiana and the University of Illinois at Urbana-Champaign are the initiating institutions and as the program grows will provide, in concert with other research institutions in the two states, the knowledge, talent and skills of the faculty and staff to address research needs.

The length of the Lake Michigan shoreline encompassed in the two states is relatively small (approximately 110 miles), in comparison to that of most other coastal or Great Lakes states. However, between 8 and 9 million people in these two states live within an hour's drive of the lakeshore. The tremendous impact of this midwest megalopolis associated with most of this lake frontage is staggering and is one of the major areas to be addressed.

Although no significant benefits or impacts can be attributed to the new program at this early date, it may be of interest to note some of the efforts currently being pursued:

- Development of a workshop series for marine enterprises to improve operational efficiency and profit centers.
- Initiation of a 4-H Marine Sciences/Education program projected to reach 2500 members during a pilot period and an estimated 8000 members within 2 years.
- Assistance in establishing an Association of Illinois Port Districts and technical assistance as an educational and research advisor.
- Contacts have been made with 155 licensed charterboat operators. Technical assistance and educational programs are being initiated to assist this multi-million dollar recreation industry. A charterboat directory will be published.
- Plans are underway for an Urban Waterfront Improvement Workshop in 1983 in cooperation with other agencies and organizations in the metropolitan area.

As this new bi-state program expands beyond the initial phases it will take its place with other more comprehensive programs working to achieve the goals of the National Sea Grant Program.



# Louisiana Sea Grant College Program

## Benefits and Accomplishments

Since 1968, Louisiana's Sea Grant College Program has been at the forefront of the state's efforts to develop sound scientific principles and information for the management of marine resources. The great size, biological productivity, and mineral wealth of Louisiana's coastal zone make the region singularly important to both the state and national economies; its management has been Louisiana Sea Grant's dominant concern, for without effective management, vital long-term economic and social benefits will undoubtedly be lost.

Based at Louisiana State University's Center for Wetland Resources, the Sea Grant Program is committed to research, education, and advisory projects that lead to practical solutions for the problems of marine resources management and utilization. Its projects combine the skills and knowledge of the faculty and staff of a number of universities and institutions, including Louisiana State University, Nicholls State University, the University of New Orleans, the University of Southwestern Louisiana, and Southern University. Louisiana Sea Grant contributes effectively to the economy of the state, with a minimal commitment of state funds.

The following are representative of recently completed or ongoing Sea Grant projects in research and advisory services that not only benefit the state but are in keeping with the goals of the National Sea Grant Program.

- Sea Grant has concluded ten years of research on crawfish aquaculture, which virtually established and developed a thriving industry in Louisiana from what had once been just a traditional wild harvest. By 1982, this industry had an economic impact on Louisiana of \$70 million. Sea Grant investment over ten years: \$300,000.
- The study of antifoulant coatings and the development of laboratory testing methods for evaluating their performance in the marine environment have been of great benefit to the marine coating industry, the U.S. Navy, and maritime transportation companies, which can use such evaluation methods to select paints having the longest service life and least adverse environmental effects.
- The dynamic forces fostering the growth of the evolving Atchafalaya delta and their extensive impacts on surrounding wetlands have affected many important activities in the region—commercial fishing, trapping, hunting, shell dredging, flood control, oil and gas production, and navigation. Louisiana Sea Grant's extensive research program here has provided important information for governmental agencies and private industry in coastal management planning and resource-development projects.
- Simple, efficient techniques developed by Louisiana Sea Grant researchers for isolating and identifying cholera-causing organisms in south Louisiana waters have brought about great cost reductions in processing these samples and have led to a clean bill of health for the Louisiana seafood industry.
- Louisiana Sea Grant marine advisory agents collected valuable information that helped to establish state and federal programs for compensating shrimpers who lose gear on underwater obstructions. Shrimpers in the northern Gulf of Mexico often lose expensive trawls, which snag on underwater obstructions, but previously they had little recourse for compensation. Sea Grant marine advisory agents assisted shrimpers in filing claims and worked with state officials to designate for removal some of Louisiana's most damaging underwater obstructions.
- Since alligator hunting became legal in Louisiana, Sea Grant marine advisory agents have been responsible for a statewide education program to inform alligator trappers about the proper methods of processing the meat of these animals to obtain full market value. In addition, Sea Grant has produced a number of widely distributed publications to aid alligator processors.
- Sea Grant-supported meteorologists have collected extensive coastal weather and oceanographic data to develop forecasting formulas. Marine activities like fisheries, oil and gas production, and coastal aviation are weather-sensitive, and enhanced forecast abilities allow safer and more economical planning in these offshore activities.
- The seafood processing industry discards an enormous amount of wastes that represent both added handling expenses and loss of nutrients. The Louisiana Sea Grant Program has sponsored research on many aspects of this problem, ranging from low-cost techniques for disposal of plant effluents to improvements in product recovery technology.

Sea Grant food scientists and microbiologists have developed methods to recover the pigment astaxanthin from the waste products of shrimp and crawfish processing plants. The use of this pigment as a safe dietary additive to tint the flesh of pond-raised trout and salmon considerably increases the market value of these species.

- Louisiana's coastal marshes, which sustain the nation's most valuable commercial and recreational fisheries, are yielding to saltwater intrusion and erosion. Sea Grant-sponsored research has been in the vanguard of state efforts to measure the rate of wetland loss, study the fundamental processes that control wetland growth and decline, and propose measures to reverse the declining trend. The results of Sea Grant research are also used by federal agencies, including the U.S. Fish and Wildlife Service, the U.S. Corps of Engineers, and the National Marine Fisheries Commission.
- Louisiana Sea Grant scientists and the Mississippi-Alabama Sea Grant College Consortium are cooperatively building and testing a pilot-scale crab shedding facility that uses a closed, recirculating water treatment system. The information to be provided from this facility will aid soft-shelled blue crab producers to design and operate commercial facilities without the financial risk inherent in systems that use untreated water from natural systems.
- Besides coastal research and marine advisory services, which provide economic benefits to the state, Louisiana Sea Grant sponsors a number of activities that increase public awareness and appreciation of coastal resources. Its Legal Advisory Service, unique among Sea Grant programs, provides legal advice and drafting services to a wide variety of ocean and coastal users, including government agencies, business and industry, fishermen, recreational interests, and the general public. Marine education projects include *Seascope*, a marine study series for elementary schools, and the institution of academic internships for public school teachers to increase their awareness of Louisiana's coastal resources.

**LOUISIANA SEA GRANT COLLEGE PROGRAM**  
Center for Wetland Resources  
Louisiana State University  
Baton Rouge, Louisiana 70803

# Sea Grant College Program

## University of Maine

The Sea Grant College Program at the University of Maine is a cooperative program with the University of New Hampshire.

As part of the National Sea Grant College Program created by Congress in 1966, the University of Maine Sea Grant College Program is a statewide cooperative effort in marine research, education, and advisory service activities working to help meet the marine and coastal needs of the people of Maine.

Since its inception, the Sea Grant program in Maine has focused on these program areas: 1) Fisheries Development, 2) Fisheries Management, 3) Conflicting Demands for Marine Resources, and 4) Education for the Development and Use of Marine Resources.

University of Maine Sea Grant projects currently underway in these four program areas include:

### FISHERIES DEVELOPMENT

- Development of **artificial baits for lobstermen** and feed for pound operators will allow a bait and feed supply all year regardless of availability of fresh fish.
- A Sea Grant researcher in economics, working with representatives from the Maine Fishermen's Cooperative and **Portland's pier operations** committee, is helping to establish sound operating rules for the auction on Portland's \$25 million fish pier.

### FISHERIES MANAGEMENT

- Studies on the effects of clam-digging on the tidal flats, clam seed-planting efforts, and the economic impact of **clam flat management** will help towns such as Jonesboro, Brunswick, and Freeport manage their clam harvesting for optimal production.
- **Gear development** for Maine's shrimp and whiting fisheries by the Fisheries Technology Service of the state Department of Marine Resources illustrates Sea Grant-supported activities in conjunction with government and other agencies.

### CONFLICTING DEMANDS FOR MARINE RESOURCES

- **Territorial Sea**, published by the university's Marine Law Institute with Sea Grant support, reports the Institute's findings in issues concerning management of interjurisdictional marine resources.
- A study of the **economic impact of tourism** on the Maine coast by a Sea Grant researcher will provide public and private decisionmakers with information on tourist expenditures.

### EDUCATION FOR THE DEVELOPMENT AND USE OF MARINE RESOURCES

- An annual **Maine Fishermen's Forum** offers topical workshops, seminars, and panel discussions for the state's fishermen.
- A Sea Grant-assisted brochure on the **port of Eastport** is being used to interest potential shippers in the Downeast port.
- Sea Grant Marine Advisory Program activities at the Washington County Marine Trades Center include a series of technical **workshops for commercial fishermen**.

Joining with the many individuals and organizations in the state for guidance and knowledge, the University of Maine Sea Grant College Program is providing significant benefits in the development and management of Maine's marine and coastal resources.

R.K. Dearborn, Executive Director  
UME Sea Grant College Program  
14 Coburn Hall  
University of Maine at Orono  
Orono, Maine 04469  
(207) 581-1436

David Dow, Program Leader  
Marine Advisory Program  
30 Coburn Hall  
University of Maine at Orono  
Orono, Maine 04469  
(207) 581-1440

Kathleen Lignell  
Communications Coordinator  
Marine Advisory Program  
30 Coburn Hall  
University of Maine at Orono  
Orono, Maine 04469  
(207) 581-1440



## UNIVERSITY OF MARYLAND Sea Grant College Program

### THE MARYLAND SEA GRANT COLLEGE PROGRAM . . .

**Our mission:** To improve and accelerate the development, use and management of the coastal, estuarine and marine resources of Maryland and the nation.

**Our approach:** To draw on the knowledge, talent and expertise in the universities, colleges and schools of Maryland for addressing marine resource problems and opportunities through a coordinated program of research, education and advisory services.

The Maryland Sea Grant College Program is a unique and valuable asset to the region. As a member of the national network of Sea Grant programs, we bring to Maryland information and new technology developed at universities throughout the country and add the knowledge and expertise of Maryland's universities to solve national marine problems. As a statewide program, we seek the best talent available from the universities, colleges and schools of Maryland. To help set our goals and objectives, we work with those who use, manage and enjoy Maryland's estuarine and marine resources, including watermen, seafood processors, charter captains, marine businesses and government agencies.

We have focused our attention on the diverse problems and opportunities associated with the use and management of the nation's estuaries, with particular emphasis on the Chesapeake Bay--the nation's largest and most productive estuary.

Here are some examples of our recent activities and accomplishments:

- Sea Grant Researchers have identified a marine bacterium that acts to trigger oyster larval metamorphosis, an important finding that could lead to a chemical inducer for stimulating spat set in seed hatcheries or in the natural environment.
- Studies of oyster populations showed that poor spat set is not due to imbalances in the ratio of male to female oysters. This finding helps resource managers plan and conduct the state oyster seeding program.
- Sea Grant research resulted in the development of an off-bottom man-made oyster seed collector that has generated many orders and stimulated interest in the potential of oyster farming.
- Together with researchers from Delaware and Virginia Sea Grant, Maryland Sea Grant developed a model of blue-crab recruitment in the Mid-Atlantic Bight. This model helps explain the source of blue crabs in the Chesapeake Bay and the processes influencing blue crab recruitment.
- The results of a Sea Grant project on the composting of blue crab waste offers seafood processors a profit-making alternative to current disposal methods.

Helping to develop an informed public and the necessary cadre of marine specialists is one of the most important ways we serve the present and future marine needs of the state. Our education efforts include:

- The support of outstanding graduate students with Sea Grant traineeships which provide advanced training and direct experience in working on current marine resource issues.
- The conducting of workshops, conferences and seminars to provide researchers, managers, industry and the public with up-to-date information and technologies.

For further information about our program contact Rita R. Colwell, Director, Maryland Sea Grant College, University of Maryland, College Park, MD 20742 (301)454-5690.



## MASSACHUSETTS INSTITUTE OF TECHNOLOGY Sea Grant Program

MIT's Sea Grant Program uses the expertise of the Massachusetts Institute of Technology to further ocean resource development and management. A strong bond between researchers and those working in the marine field ensures that the most relevant problems and issues are addressed, with timely communication of solutions. Support for education helps students prepare for marine-related careers through participation in research and keeps working professionals abreast of engineering and scientific advances through short courses and university-government-industry conferences. Sea Grant's research at MIT is organized into thematic areas to target dollar and human resources to priority problems in areas of MIT's expertise. This summary describes some recent activities and accomplishments.

**1. Unmanned, Underwater Work Systems.** Research into undersea teleoperation promises long-term benefits for scientists, marine industries, and the military. For the past six years, MIT Sea Grant has been on the frontier of research in underwater work systems with supplemental funding of over a \$1 million from the Office of Naval Research, the Harbor Branch Foundation, the US Naval Explosive Ordnance Disposal Facility, the Naval Ocean Systems Center, Gould Inc. and the Doherty Foundation. Some of the achievements include:

- hardware and software to allow surface-based human operators to supervise and control undersea work vehicles.
- the design and patent of automatic tools that achieve high quality welds in the marine environment.
- touch sensors fashioned from optical fibers that will improve the dexterity of manipulators in handling tools and identifying their work environment.
- underwater communications systems for command and control that have advanced the state of the art in sending messages from seabed to surface.

**2. Offshore Facilities:** Today as interest in offshore oil increases, structures are being built in more hostile environments, such as the North Atlantic and the Arctic. Icy and stormy conditions require new reliable data and analytical techniques to develop design criteria for constructing safe platforms economically. Through Sea Grant, MIT engineers have contributed their extensive modeling expertise to develop:

- a method which uses natural frequency measurements to detect structural failure on platforms.
- instrumentation and on-site testing techniques which offshore operations have proved to be more reliable and economical than existing methods for determining seabed soil characteristics and strength.
- a set of criteria to strengthen a platform's ability to withstand damage from a collision.
- a design of mooring and riser systems for the new generation of deepwater platforms.

**3. Coastal Processes:** Offshore development, onshore waste disposal, and residential and industrial construction all demand increased understanding of the physical, chemical and biological processes of the coastal environment. MIT's experience in systems engineering and water quality analysis have been applied to:

- create two innovative computer models for siting power plants, sewer outfalls and for designing nuclear plant cooling water channels. Boston Edison in one application has estimated savings between \$29 and \$54 million.
- specify outfall design to mitigate the adverse effects of disposing of brine excavated to make room for oil reserves in salt domes located near the rich, shrimp fishing grounds in the Gulf of Mexico.
- construct a three-tiered model, now in final testing in Charleston, South Carolina, to decide whether and how to clean up nearshore oil spills. The model analyzes the efficiency and costs of available technology, the dollar and environmental cost of no response, the effect of existing laws and regulations.

**4. Living Resource Utilization.** Foreign industries supply the U.S. with 3/4 of the nation's fish products. Hopefully, a new breed of entrepreneur and manager entering America's fishing industry can boost domestic output with the aid of university research resources. A few projects illustrate how MIT Sea Grant is helping.

- Through MIT's advisory services, U.S. fisheries engineers now have easy access to a naval testing facility, the David W. Taylor Model Basin, that is competitive with fishery installations in major European fish-exporting countries.
- Sea Grant and the Massachusetts Maritime Academy have designed an education program for new and experienced fishermen. A survey of 20% of the 1,000 course participants has shown annual economic benefits of \$531,600.
- MIT biotechnology researchers are finding ways to use fish byproducts in profitable ways.
  - ... Shark cartilage shows great potential as an inhibitor of vascular-fed tumors.
  - ... Fish and shellfish may be an alternative and abundant source of a highly effective anticoagulant that does not have the serious side effects as existing animal sources.
  - ... Chitin, a substance derived from crabmeat processing wastes, will provide a controlled-release food capsule for the aquaculture industry.

For more information, contact the Marine Information Center at MIT Sea Grant.



**THE WOODS HOLE OCEANOGRAPHIC INSTITUTION SEA GRANT PROGRAM** is a coherent project focusing the majority of its time and funding on research. Over the last several years the focus has been on marine resources and related marine policy aspects. Representative of these studies are:

- \* The study of paralytic shellfishing poisoning (commonly known as red tide) in the New England region. Studies are currently being conducted on the monitoring of the initiation, development and decline of red tide events; the fundamental causes of red tide blooms; factors affecting distribution of the alga; and mapping of geographic distribution in New England waters.
- \* Stabilization of the bay scallop population in Massachusetts. The objective here has been to determine ways to optimize the use of seed scallops from other areas or from hatcheries to compensate for natural losses of juveniles.
- \* Development of a simple lipid-stain method to identify weak or diseased shellfish larvae and thus improve hatchery operations.
- \* Development of a Loran-C buoy to aid in acquiring detailed information on water circulation in an attempt to improve monitoring of movement of oil spills or hazardous waste.
- \* Improved technology for a sea-run, hatchery-based brook trout fishery on the Atlantic Coast.
- \* Support of a Cooperative International Marine Affairs Program to assist selected developing countries in the use of their marine resources and capabilities.

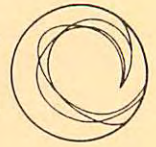
Local and regional research and information projects form an important part of our Program. Our Marine Assistance Service has worked to increase interactions with state, county and local shellfish agencies and associates as well as with selectmen and natural resource personnel in the local towns of Cape Cod.

A joint postdoctoral program exists between the Woods Hole Oceanographic Institution and the Massachusetts Institute of Technology; several of these students have been supported by Sea Grant. Our program at Woods Hole has also been involved with local teachers in several endeavors, one being a marine studies lecture series for science/math teachers in the Town of Falmouth school system.

The NATIONAL SEA GRANT COLLEGE PROGRAM plays a major role in the development of a responsive marine research effort for the United States by its encouragement of the understanding, assessment, development, utilization and conservation of our Nation's ocean and coastal resources. The W.H.O.I. SEA GRANT PROGRAM has strived during the past decade to meet these ideals.



# Michigan Sea Grant College Program



## What is Sea Grant?

The Michigan Sea Grant College Program sponsors a range of activities which promote the wise use of Great Lakes resources. Through research, education, and advisory services, Michigan Sea Grant helps state and local agencies, marine businesses, coastal communities, and individuals wisely develop and use the Great Lakes and their coastal resources.

As a cooperative effort of The University of Michigan and Michigan State University, Michigan Sea Grant is part of a national network of Sea Grant programs which use academic and professional expertise to address marine resource issues. Michigan colleges, universities, and government, industry, and public interest groups have contributed to the excellence of Michigan Sea Grant achievements over the past 14 years.

## How Sea Grant Works

Michigan Sea Grant's coordinated approach to marine resource development includes research, education, advisory services, and public information. In research, Michigan Sea Grant sponsors interdisciplinary projects on water quality, toxic substances, fisheries, coastal resources, transportation, tourism, and recreational uses of the Lakes to stimulate Michigan's economy. Sea Grant's educational programs provide professional and in-service training for students, fishers, marina operators, and other members of the marine business community. The Marine Advisory Service links Sea Grant's research and education programs to people who can directly apply program information; advisory agents in coastal counties provide information and technical assistance and identify new areas for research and education. Sea Grant Communications produces and disseminates information about Michigan Sea Grant activities, the Great Lakes, and marine resources.

## Achievements

Michigan Sea Grant's far-reaching contributions in marine research, education, and advisory services include:

- The well-known discovery that apparent cold water drowning victims may be revived with little or no after-effects after as much as an hour underwater. This discovery has saved hundreds of lives worldwide.
- Substantial restoration and protection of Great Lakes waters and wetlands through research on water quality, toxic substances, and wetlands. Many potential chemical hazards can now be identified, which helps chemical industries and government agencies determine research and testing expenditures, and protects public health.
- Fisheries research which has helped to ensure adequate populations of Great Lakes fish to support multimillion dollar commercial and sport fisheries, and created new fish processing markets by developing marketable foods from underutilized fish.
- Better erosion control for shoreline property owners through the testing of economical shore protection devices.
- Michigan's only comprehensive Great Lakes middle school curriculum, and a short course for U.S. shipbuilders on new technology and production methods, which helps them compete in international markets.
- Greater recreational opportunities through the development of underwater parks, sport fishing and tourism information networks, and improvements in marina and charter boat operators' business skills.
- Advances in Great Lakes ship design for winter navigation and utilization of channels and locks.

---

For further information contact:

Lillian Jarman, Communications - Michigan Sea Grant College Program  
2200 Bonisteel Boulevard, Ann Arbor, Michigan 48109, (313) 764-1138



# Minnesota Sea Grant Institute

116 Classroom-Office Building - University of Minnesota - 1994 Buford Avenue - St. Paul, Minnesota 55108

Phone: (612) 373-1708

THE MINNESOTA SEA GRANT INSTITUTE IS...a mature technical and educational Institute dedicated to serving the needs of Minnesota residents, industries, and businesses.

The Minnesota Sea Grant Program has developed over the past eight years from its beginning as a Marine Advisory Council to a contributor of vital information to the State and Nation. The Minnesota Sea Grant Institute is a working combination of the Institute in St. Paul, and the Extension Program in Duluth.

Sea Grant of Minnesota investigates:

Coastal and Environmental Processes of Lake Superior \* Water Safety \* North Shore Recreation and Tourism \* Marine Science Education \* Fisheries and Aquaculture

Sea Grant of Minnesota has contributed major economic benefits to the Minnesota economy. Current efforts in RESEARCH and ADVISORY SERVICES are:

\* HYPOTHERMIA - A singularly comprehensive project has contributed to the medical understanding of this malady. Hypothermia is estimated to contribute to over 50% of Minnesota's water fatalities; industrial and rec-reational. The 1982 book, Hypothermia, Causes, Effects, Prevention, by Pozos and Born resulted from this study.

\* Technical assistance provided by a Sea Grant physician led to the design and production of a class 3 personal floatation device. Stearns Mfg. Co. of St. Cloud has realized a profit ratio of 5.6/1 on this product.

\* Industrial needs plus University of Minnesota expertise led to the development of a Hypothermia Laboratory at UMD. Entire Sea Grant investment, \$85,857 over 3 years.

\* ENVIRONMENTAL IMPACT SAVINGS - \$1,400,000 savings realized by coal transportation industry from Sea Grant research of environmental impact to fish spawning areas. Sea Grant contribution, \$56,781.

\* CRYOPRESERVATION - Development of cryopreservation of spermatozoa and fertilized eggs of freshwater fish by a Sea Grant reproductive physiologist may develop faster growing hybrids and extend breeding time. Sea Grant investment, Federal and State; \$49,078 over 3 years.

\* PCB MONITORING OF LK.SUPERIOR - Sea Grant civil and mineral engineers continue to monitor Lake Superior for toxic PCB's and other compounds. Sea Grant investment, \$56,502 over 3 years.

\* FISHERIES AND WILDLIFE - Sea Grant specialists have discovered freshwater mullet, a salable resource that must be closely managed. Through study of the resource base, it has been possible to predict the potential for commercial fishing; apportioning tools and manpower accordingly. Sea Grant investment, \$23,259 over 2 years.

\* PINK SALMON - As a potential source of commercial harvest; this Lake Superior fresh water species is currently being studied. Total Sea Grant contribution, \$16,470.

\* TOURISM - Sea Grant economists are increasing options for North Shore managers in the recreational market. Contribution, \$37,646 over 2 years. The estimated yearly tourist revenue along the North Shore is \$13,550,000.

\* MARINE EDUCATION - The training and support of 11 graduate students from Duluth and Twin Cities campuses prepares individuals for future employment in natural resources areas. Investment, \$54,000.

\* Native American Undergraduate Marine Science Training - Minnesota has the unique position of having the only training program for Native Americans. 5 students yearly work toward their B.S. degrees in Marine Science. Sea Grant investment, \$46,083 over 2 years.

As we continue to look to our water resources to meet out needs, the Sea Grant College Program will provide the training necessary for tomorrow's leaders.

SEA GRANT EXTENSION - Offers Marine Resource Management and practical information through thousands of contacts yearly.

\* PORT MANAGEMENT - The impact of port user fees on Duluth Twin Ports was recently investigated at a Maritime User Fee Conference. The objective was to familiarize Upper Great Lakes port users with the potential economic impact of pending legislation that might considerably increase the cost of cargo leaving the port.

\* SEA GRANT WORKSHOPS AND CONFERENCES - Training sessions offer Lake Superior industries, resort owners, and commercial fisherman information on resort management, fish breeding, and commercial management of natural resource facilities as well as safety workshops.

\* INFORMATION DISSEMINATION - Educators continue to make available notes, books, bulletins, and practical guides to living; cookbooks, maps and new ideas. "Lawrence the Lake Trout" has spoken with millions of people over the past 4 1/2 years, including many Great Lakes Congressmen. For further information on the Minnesota Sea Grant Institute contact: Dr. Donald C. McNaught, Director. (612) 373-1708



## *The Mississippi-Alabama Sea Grant Consortium is ...*

A Sea Grant College comprised of nine institutions of higher learning joined together to promote the orderly development of marine and coastal resources and technology with the ultimate aim of enhancing the quality of life in the two states, the region, and the nation. Member institutions of the Consortium are:

Auburn University, Gulf Coast Research Laboratory, Jackson State University, Mississippi State University, University of Alabama, University of Alabama in Birmingham, University of Mississippi, University of South Alabama, University of Southern Mississippi.

As a Sea Grant College, the Consortium utilizes a broad range of talents within its research, education, and advisory service components to provide problem solving and scientific and technical advice to its public.

Some recent contributions of the Mississippi-Alabama Sea Grant Consortium which provided economic benefits to the public include:

- Technical assistance provided by the Sea Grant Advisory Service in cooperation with State agencies to develop a mechanized oyster depuration facility. This system currently provides a substantial portion of the production of three oyster processors in Mississippi. The annual ex-vessel value of oysters produced by the system is approximately \$108,000. Cost to Sea Grant - \$1,500.
- Many of the oyster stocks in Mississippi are located in waters closed to harvesting because of pollution. Sea Grant attorneys, in cooperation with State agencies, were instrumental in establishing a bottom leasing program. Other Sea Grant researchers then developed a low mortality relaying system with which oysters may be moved to clean leased-sites for natural depuration. This is currently producing an annual yield of approximately \$80,000. Cost to Sea Grant - less than \$2,000.
- An economic recovery plan developed for a two-generation old Mississippi seafood processor by the Sea Grant Advisory Service saved the company from certain foreclosure and bankruptcy. Five to ten full time jobs, 100-125 part-time jobs and a gross annual income of \$1.2 million were retained in the community. Cost to Sea Grant - \$2,000.
- In cooperation with the National Marine Fisheries Service and the Gulf and South Atlantic Fishery Development Foundation, Sea Grant initiated a project to categorize shrimp boat fuel consumption patterns and demonstrated that fuel savings of 8 to 10% are possible with improved fuel management practices. Applied across the Gulf shrimp fleet this could save an estimated \$25 million annually. Cost to Sea Grant - \$32,000 over a two year period.
- With the U.S. Army Corps of Engineers, Sea Grant researchers provided information for the construction of a breakwater which will reduce storm and wind damage to homes, wharves, moored vessels, and business facilities in a Northern Gulf town. Average annual benefits are estimated to be \$499,000. Cost to Sea Grant - just one component of a \$40,000 project.

In a non-economic vein, but as important, the Mississippi-Alabama Sea Grant Consortium through its Advisory Services had been involved in a wide range of efforts to increase general public awareness and appreciation of marine and coastal resources. Additionally, Sea Grant educators have been emphasizing enhanced formal marine and coastal education of both teachers and students.

In providing the types of benefits noted, many Consortium undertakings were done cooperatively with other groups, such as the Alabama Coastal Area Board, the Mississippi Bureau of Marine Resources, the National Weather Service, the Gulf States Marine Fisheries Commission, the Naval Ocean Research and Development Activity and the U.S. Fish and Wildlife Service.

More detailed information on the Mississippi-Alabama Sea Grant Consortium is available by contacting: Dr. James I. Jones, Director, Mississippi-Alabama Sea Grant Consortium, Caylor Building, Gulf Coast Research Laboratory, Ocean Springs, MS 39564.

# Sea Grant College Program

## University of New Hampshire

The Sea Grant College Program at the University of New Hampshire is a cooperative program with the University of Maine.

As part of the UNH Marine Program, Sea Grant works with state agencies, organizations, and area businesses to meet the unique needs of the state and northern New England. At the same time, Sea Grant educates various segments of the New Hampshire public, thereby enhancing their ability to make decisions about marine issues.

Examples of Sea Grant's ongoing work in New Hampshire—much of which also has national significance—include:

### INDUSTRIAL AND COMMERCIAL DEVELOPMENT

- Discovery of a technique for predicting the stability of coastal and seafloor sands. This technique can help builders avoid **earthquake and storm-wave damage** to oil rigs and pier foundations.
- Development of a fermentation process to produce **valuable chemicals from agricultural wastes**. In mobile shipboard units, or at fixed coastal facilities, the new process is designed to generate industrial alcohols, chemical feedstocks, and antibiotics in a seawater medium.
- Study of carrageenan, a seaweed extract used extensively in the food and pharmaceutical industries. UNH Sea Grant researchers have also worked with New England industry to **develop the commercial cultivation of Irish moss**, the primary source of carrageenan, now mostly imported from Canada.

### PROTECTION AND ENHANCEMENT OF MARINE RESOURCES

- Investigation of heavy metal pollution in northern estuaries such as the Seabrook River. Insights developed should help the EPA and state governments judiciously **regulate potentially toxic substances** that can enter the food chain and affect human health.
- Study of currents and eddies in the Piscataqua River, funded in cooperation with the New Hampshire Water Supply and Pollution Control Commission. Sea Grant investigators have provided advice during past oil spills and are now working to develop diversion booms that would **minimize oil contamination and cut clean-up costs** from future spills.
- Continuing **technical support to the Office of State Planning** regarding the possible designation of Great Bay as an estuarine sanctuary.

### FISHERIES MANAGEMENT AND DEVELOPMENT

- Study and a part-time agent to explore the financial, legal, and business aspects of **establishing a fishing cooperative**.
- **Advancement of New England fisheries** through the establishment of special courses, the development of the Fish Pier in Portsmouth, an investigation of potentially valuable new fish species, and a study of how clam flats can best be managed for optimum harvests.
- Development of **an accurate and inexpensive method for detecting the toxins of the red tide organism** which renders New England shellfish poisonous to humans.

### EDUCATION

- **Training of volunteer marine docents** who increase public awareness of marine topics through free Sea Trek lectures, tours, and slide presentations.
- Sponsorship of **a conference on Coastal Zone Management** for 125 New Hampshire officials and special interest group representatives.
- Design and implementation of **marine education programs for students and teachers** in elementary and high schools.

The State of New Hampshire and northern New England have benefited significantly from Sea Grant's contribution to marine research and education. For further information, contact:

Robert W. Corell, Director  
UNH Marine Program and  
Sea Grant College Program  
Marine Program Building  
University of New Hampshire  
Durham, New Hampshire 03824  
(603) 862-2994



**The New Jersey Sea Grant Institutional Program** is managed by the New Jersey Marine Sciences Consortium, an alliance of 24 institutions of higher learning, a number of business and private entrepreneurial organizations, and individuals interested in marine affairs. New Jersey Sea Grant has recently completed its sixth year of activity in coastal and marine concerns.

The Consortium was established in 1969 to pool scientific expertise and facilities for the purpose of addressing the challenges and opportunities represented by New Jersey's extensive marine resources. Early realization by Consortium participants of the major issues related to the State's coastal and estuarine areas narrowed its focus to highlight fisheries, shore processes, and pollution. The formative years of the New Jersey Sea Grant program have been characterized by steady growth and increasing value to both the State and the nation.

To place in perspective the importance of New Jersey's marine resources - and thus, the deserved attention given by the Consortium - recreation and tourism are the State's second largest industry. The fishing industry alone, recreational and commercial generates almost one billion dollars annually! Despite its small size, New Jersey is bounded by over 1700 miles of coastline, accounting for 17% of its land mass.

Listed here are a few of the most recent educational and research projects, illustrating the major thrust of the Consortium in the provision of new knowledge for use in the understanding and maintenance of the viability and quality of the fragile coastal resources:

- Sea surface temperature charts provided by a Sea Grant Cooperative Extension agent are used by commercial and sports fishermen from Maine to Maryland to improve catches, reduce transit time, and conserve fuel. In one year alone these charts saved the East Coast swordfishermen at least \$2.25 million in fuel costs and greatly improved catches. Consortium investment: \$4,000.
- More than 6,000 commercial and sports fishermen from Montauk, NY, to Ocean City, Md., have requested information during 1982 for weather and ocean wave conditions in the canyon regions at the edge of the continental shelf. These forecasts, provided by a Cooperative Extension agent and the Bendix Corporation, saved during one year about \$1.20 million in trip costs by the sports fishermen alone. Consortium investment: \$5,000.
- Stock separation and population studies of tilefish by Consortium investigators in the Gulf of Mexico and off the east coast of the US have increased markedly the number of vessels and people employed in this new fishery. Management plans for sustained yield of tilefish - the most valuable finfish in the New Jersey/New York area - are being prepared by the Mid-Atlantic Council based on the results of these studies. Consortium investment: \$65,000 over four years.
- A summer course offered at the graduate level was conducted for teachers, entitled, "The New York Bight: The MESA Monographs as an Educational Resource."
- A marine education seminar was conducted, and resulted in a publication entitled, "Marine Education in New Jersey: A Preliminary Assessment of Needs."

The goals of the National Sea Grant Program, created by Congress in 1966, sponsored by the National Oceanic and Atmospheric Administration, US Department of Commerce, become more readily attainable as the synergistic effects of New Jersey's efforts make themselves manifest. (Sea Grant employs the same basic philosophical approach as that of the time-honored Land Grant in agriculture; namely, the integration of research, education, and extension.)

From Sandy Hook to Cape May, and into the shallows of the Delaware Bay, New Jerseyans are rapidly becoming aware of their custodial responsibilities in the preservation of their incalculable and irreplaceable marine resources through the Consortium's resolute leadership, in concert with the national program.

For additional information on the New Jersey Sea Grant Institutional Program contact:

Dr. Robert B. Abel, Director  
New Jersey Sea Grant  
New Jersey Marine Sciences Consortium  
Building 22  
Fort Hancock, NJ 07732  
(201) 872-1300



# NEW YORK SEA GRANT INSTITUTE IS . . .

## Addressing Diverse Needs of a Diverse State

New York is a coastal state of great diversity, with 600 miles of marine coastline and 1,800 miles on the Great Lakes — Ontario and Erie. Eighty-five percent of New York's residents live in the 28 coastal counties. New York Sea Grant Institute was formed by the trustees of State University of New York and Cornell University as a cooperative activity to address these resources and people.

## One of the Sea Grant Network

Since Congress set up the National Sea Grant Program in 1966, Sea Grant programs in 30 states and 2 territories have been helping the states and the nation to wisely use and manage their coastal resources. The New York Sea Grant Institute was the eighth Sea Grant College named.

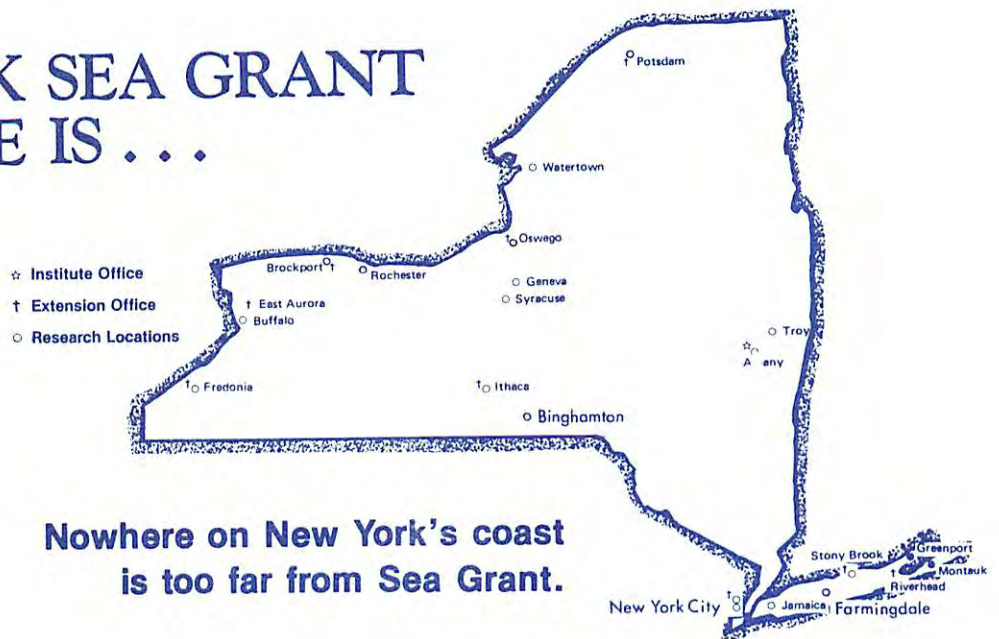
The Institute coordinates and manages its research program — by supporting faculty and students throughout the state in their investigations of coastal problems. From offices throughout the state's marine and Great Lakes districts, extension specialists help those who use coastal resources. The extension program is administered through New York State Cooperative Extension in Ithaca.

## Sharing Costs & Benefits

Many of New York Sea Grant's projects are funded, planned, and directed cooperatively with other agencies and industries. From Sea Grant activities, these agencies, industries, the state, and the region reap benefits that far exceed expenditures.

## Cooperating With Other Agencies and Institutions

A decade of experience has shown Sea Grant to be an objective organization, willing to work with various groups; an experienced program that can assemble and manage groups to address common problems; a unique non-profit group with the capability to tap university resources to get things done; and a program with the drive to take that extra step to implement research results — to convert ideas into action.



**Nowhere on New York's coast is too far from Sea Grant.**

## Getting Results:

- ♦ Half the hard clams eaten in the US during the 1970s came from Long Island's Great South Bay. But clam populations are dwindling. Scientists from SUNY at Stony Brook studied all aspects of New York's hard clam resources, then helped define management and policy options. One result: three Long Island towns have planned spawner sanctuaries — places where clams can live free from clambers and repopulate the waters with larvae.

- ♦ Waste is a perennial problem of the seafood industry. Sea Grant has beefed up efforts of Cornell's Poultry Science Department to include seafood, interesting major companies in turning under-used fish species and processing byproducts into seafood products. Annual sales have reached about \$1 million.

- ♦ When disease strikes a shellfish hatchery, it spreads rapidly and infects most of the clams or oysters. Sea Grant supported a team of shellfish pathologists who made housecalls to Long Island's hatcheries, trying to control disease by monitoring the animals, waters, and foodstuffs. As a result, hatchery revenues are up \$400,000.

- ♦ Tourism is a major economic factor on New York's Great Lakes. Sport fishing remains the region's biggest attraction. Fishery specialists from upstate campuses have studied various sport fish, their habits and habitats, to help anglers catch more fish and help communities attract more anglers. And since terrain, facilities, and land rights often limit the tourists' access to the Great Lakes, Sea Grant has worked with state agencies on alternatives.

- ♦ Sea Grant extension had a major role in setting up the Empire State Lake Ontario Trout and Salmon Derby — the largest sportfishing tournament in the country. Anglers brought in \$2.8 million in 1982 — a major economic boom to the seven counties along New York's Lake Ontario coast. Extension staff also helped NYS's Department of Environmental Conservation to tell consumers what we know about health effects of eating Great Lakes fish.

- ♦ Anywhere water meets land, shoreline erosion and wave damage can strike. Floating tire breakwaters (FTBs) are low-cost devices that use moored, scrap tires to protect property from these risks. New York Sea Grant has led the way in developing FTB technology and in helping shoreline property owners and managers to adopt the technologies. Private investment in FTBs has reached about \$3 million nationally; benefits from decreased damage to waterfront property and structures already total \$4.5 million.

- ♦ Sea Grant has built up the capabilities of the state's universities: by providing funds to bring new faculty to New York campuses, to focus on marine resource economics, population dynamics of Lake Ontario fisheries, and shellfish biology; by developing a center for coastal law at the SUNY at Buffalo Law School to identify and analyze legal aspects of coastal resource development issues; and by providing the impetus for new continuing course offerings at several New York State universities: from tourism hospitality training, to shellfish management, to Great Lakes ice dynamics.

**For more information, call:**

**NEW YORK SEA GRANT INSTITUTE • 411 STATE STREET • ALBANY, NY 12246 • (518) 473-8002  
THE SEA GRANT COLLEGE OF STATE UNIVERSITY OF NEW YORK AND CORNELL UNIVERSITY**



**The UNC Sea Grant College Program is . . .** a federal-and-state partnership that applies the expertise of our universities to marine and coastal problems. Sea Grant draws on talent from the sixteen member institutions of the University of North Carolina and integrates research, extension and education into programs that put good information to work where it is needed most. Today, in its second decade, UNC Sea Grant is paying off for North Carolina in several important ways:

### **Keeping seafood on the menu**

The value of the state's seafood catch has doubled in the past five years, to a single-year record \$60 million, largely because fishermen, seafood processors and resource managers have all done their jobs with increasing skill. Sea Grant supplied much of the information that made this growth possible. Sea Grant research into the complex personalities of our great estuaries, which support practically all of our key fish and shellfish, has yielded not just numbers, but guidelines that have begun to show how we can both increase the harvest and preserve the stocks of our wild resources. Meanwhile, Sea Grant seafood scientists are transforming once-wasted species of fish into nutritious new products the public will buy.

### **Striking a balance**

Many of our coastal problems come down to one tough question: How do we protect our coastal resources—especially our waters—and use them too? Sea Grant has applied research to the problem. Advanced microbiological studies into the viral contamination of shellfish are helping health officials protect both shellfish and consumers. Sea Grant research and advisory programs have produced improved septic systems designed to keep effluent out of shellfish waters. These systems have already made possible millions of dollars worth of new construction in coastal communities. Now, new Sea Grant studies are testing the designs on the stubborn sands of our barrier islands, where they offer some hope to communities hamstrung by the combination of poor soils and high water tables.

### **Letting science pay off for people**

In many other ways, Sea Grant pays off for people. A Sea Grant study into the impact of some proposed scalloping regulations helped save hundreds of incomes when it influenced East Coast fisheries managers to protect North Carolina scallop-shuckers. Several hundred boaters saved an estimated total of \$44,500 on new marine sanitation devices after a Sea Grant engineer showed them how to build their own. A hang-log book, compiled by a Sea Grant advisory agent, saves thousands of dollars worth of fishing gear each season by pinpointing for fishermen the locations of submerged "hangs." And other coastal businesses, such as the four new crab-shedding operations opened in North Carolina during 1982, credit Sea Grant with supplying the help they needed to get started. These are only a few examples among many, but they represent the Sea Grant concept: science at work solving real-life problems.

### **Providing the facts**

Many thousands of North Carolinians request and receive information from UNC Sea Grant each year. They get this information from Sea Grant publications, workshops and demonstrations, or one-to-one from Sea Grant agents. They get it also during visits to the NCSU Seafood Laboratory in Morehead City, to the Aquaculture Demonstration Project in Aurora, or to Sea Grant Marine Advisory offices in the three N.C. Marine Resources Centers. And, there is evidence that people are putting this information to use, boosting their incomes, improving the quality of their lives and making informed decisions about the use of their coastal resources. Students involved in Sea Grant research and education projects represent a pool of future scientists, managers and leaders skilled enough to face the challenges of our coasts and oceans. And, in classrooms across the state, teachers are getting the Sea Grant support they need to show their students that there's more to marine science than words on a chalkboard.

Solving our marine and coastal problems will continue to demand the combined efforts of government, business and the university. It will also demand good information, teamwork and a measure of humanity. And that is the Sea Grant formula.

For more information, contact:

Dr. B.J. Copeland, Director  
UNC Sea Grant College Program  
105 1911 Building  
North Carolina State University  
Raleigh, North Carolina 27650  
(919) 737-2454



The OHIO SEA GRANT PROGRAM is...a unique partnership of Ohio institutions, state agencies, private industry, the general public and the federal government, working to promote and implement research, education and advisory service in the sphere of Great Lakes resources. Sea Grant Program research combines the knowledge, talent and skills of the faculty and staff of over a dozen universities, colleges and institutions across the state with the needs of the private sector in order to increase the utilization and development of Lake Erie resources.

The first five years of the Ohio Sea Grant Program have benefited the economy and the people of the state with a minimal commitment of state or federal funds. Recent representative accomplishments of Sea Grant Program efforts in research, education and advisory service are:

- Publication of Dr. Milton B. Trautman's classic reference book, The Fishes of Ohio, the most complete regional treatise of North American ichthyology.
- An economic assessment of private-boat sportfishing in western Lake Erie determined that the value of the annual walleye sport fishery is in excess of \$325 million.
- Working with the Ohio DNR, Sea Grant was instrumental in obtaining NOAA designation for the first National Estuarine Sanctuary in the Great Lakes — Old Woman Creek on Lake Erie.
- A market was developed for a common unused fish, gizzard shad, as a crawfish bait in Louisiana; during the first month 250,000 pounds, valued at \$35,000, were shipped.
- More than 100 radio scripts and TV spots have been aired across the state on a variety of topics designed to increase the utilization of Lake Erie.
- Work with federal fish hatcheries in Hebron, Ohio, has resulted in the formulation of techniques for increasing hatchery productivity.
- Storm-surge model development to improve predictions of flooding in low-lying shore areas of western Lake Erie.
- 23 Oceanic Education Activities for Great Lakes Schools (OEAGLS), were developed for teachers and students, were disseminated nationally and locally, reaching over 200,000 students in Ohio schools alone.
- Research is underway to determine the feasibility of using Ohio's more than 60,000 farm ponds as rearing sites for bait minnows.
- The world's largest floating tire breakwater was placed in the port of Lorain as a result of Sea Grant efforts.
- Since Sea Grant began working with sportfishermen, fishing on Lake Erie has nearly doubled and the number of charter fishing businesses has increased from 34 to nearly 400.
- Advisory committees, groups of concerned citizens from all walks of life, have been organized to advise and set priorities for Sea Grant and our extension agents. These committees conduct "Congressional Day on Lake Erie," an event to allow senators, congressmen and aides to see Lake Erie values, potentials and problems first hand. These committees have also developed a plan to place artificial reefs to improve fishing in central Lake Erie.

A combined effort in research, marine advisory service and education makes Ohio Sea Grant Program's goals compatible with the goals of the National Sea Grant Program. The economic benefits for the National Program taken as a whole are impressive and consistent with the Ohio experience. Over a ten-year period, National Sea Grant network projects have produced a direct economic dollar gain to the national economy of approximately \$217 million per year.

For further information on the Ohio Sea Grant Program contact:

Dr. Charles E. Herdendorf, Director  
Ohio Sea Grant Program, The Ohio State University  
484 West 12th Avenue  
Columbus, Ohio 43210  
(614) 422-8949

January 1, 1983



Sea Grant  
College Program



Oregon State University  
Corvallis, Oregon 97331  
(503) 754-2714

The Oregon State University Sea Grant College is helping to put America's oceans to work through an integrated program of research, education, and advisory services. In developing our marine resources, OSU Sea Grant stimulates the economy by increasing our knowledge about the ocean and encouraging product development, which improves marine employment opportunities. Sea Grant-sponsored projects cover many marine areas and issues. A few examples follow:

**OSU Sea Grant researchers found a way to save millions of dollars annually for containerized shipping ports by developing a computerized loading plan.** Port management seminars are being held based on this research; as a result, West Coast ports should be better able to handle multi-million dollar projects that mean more Northwest jobs.

**OSU Sea Grant marine advisers developed and administer a towboat routing plan which has reduced equipment damages for West Coast crabbers and towboat operators.** Annual damages were decreased 10-to 16-fold, from as high as \$800,000 to just \$50,000 per year.

**Advisers develop workshops,** like the annual Northwest Trawl Conference and Gear Show, where this year, an electronic fish-finding session increased fishermen's use of Loran-C plotters. Now, fishermen are catching more fish, more efficiently.

Marine advisers studied pinnipeds (sea mammals with flippers), developing techniques to track seal movements with radio transmitters. They discovered much about what seals eat and where they roam. A sound-producing device was subsequently developed to ward off seals and sea lions. It promises to save millions of dollars in damaged fishing gear and lost fish catches, while saving marine mammals' lives. Radio-tagging is being adopted for satellite use to study and track migrating whales traversing off-shore oil drilling areas.

**OSU seafood technologists added millions of dollars annually to the West Coast seafood processing industry by developing ways to increase the yield of Pacific shrimp, while improving flavor.** Marine advisers report most West Coast processors have adopted the methods. These techniques are being applied to other seafoods, such as rockfish fillets.

**A unique international seafood trade conference recently attracted more than 150 economists from 21 countries.** The OSU-initiated conference — co-sponsored by Alaska Sea Grant — focused on understanding complex issues of the U.S. seafood trade balance problem. This problem is vast: We import 60 percent of the fish we eat.

**OSU Sea Grant salmon ranching research has stimulated development of private companies;** these companies not only provide salmon for consumers, but add fish to the resource that West Coast fishermen depend on. We developed low-cost technology needed to make such ventures feasible.

**OSU forest products specialists and oceanographers found ways to reduce decay and marine borer damage to docks and pilings — \$1 billion problem for the U.S. each year.** The construction and fungus control practices developed can save waterfront facility owners millions of dollars.

**More than 300 OSU Sea Grant-supported students have received advanced degrees.** These highly trained specialists are making positive impacts in private and public businesses, helping to design plans for the oceans.

Because the OSU program is part of the national Sea Grant network, the techniques developed to solve regional problems are often adopted nationally. The program is one of the nation's original programs, started 15 years ago. Oregon State was designated a Sea Grant college in 1971 and is dedicated to the development and wise use of the ocean and coastal zone. Five other schools of higher education are also involved with the OSU program: The University of Oregon, Lewis and Clark College, The University of Idaho, Clatsop Community College, and Washington State University.



# Sea Grant Program

## UNIVERSITY OF PUERTO RICO

THE NATIONAL SEA GRANT PROGRAM IS ...

- A MISSION :** To accelerate national development of marine resources, including their conservation, proper management, economic utilization and enjoyment...
- A CONCEPT :** To promote a working partnership between universities, industry, government and the community in its endeavor to accomplish the mission ...
- A METHOD :** To engage the knowledge, talents and skills available at the universities in the pursuance of practical solutions to the problems in the realm of the coastal resources through research, education and extension services ...

The University of Puerto Rico Sea Grant Program's goals and objectives are consonant to the mission, the concept and the method of the National Program. Some examples of how this commitment is being accomplished by UPR-SGP in its few years of operation are:

**\*Problem:** Puerto Ricans complete lack of awareness and knowledge of the potentialities of their marine resources. **Needs:** A source of information and technological transfer. To make Puerto Ricans aware of the potential economic benefits inherent in the development of marine resources. **Action:** UPR-SGP Marine affairs and resources information reaches 1,300 subscribers of the Marine Bulletin every month; a Marine Education publication is supplied to thousands of students from the public and private educational system of the island. Approximately 300,000 viewers are reached through a weekly television program; brochures, pamphlets and guidebooks have been distributed to 18,000 people at special demonstrations and activities; and additional 30,000 people have been oriented through practical demonstrations on marketing, preservation, handling and filleting of underutilized species of fish and molluscs presented in supermarkets, malls, schools and civic organizations,

**\*Problems:** Reports of ciguatera outbreaks affect the fishermen, seafood distributors, and seafood restaurants. **Needs:** A concerted effort in ciguatera research and dissemination of information to the public. **Action:** The U.P.R. Sea Grant Program co-sponsored with CFMC and CODREMAR a ciguatera conference of all experts in the nation on November, 1981, in San Juan, Puerto Rico. Research is now being funded by UPR-SGP. Sea Grant has offered information and advice during ciguatera outbreaks to alleviate the economic hardship on the fishing industry.

**\*Problem:** Hyperbaric facility, one of very few throughout the Caribbean, underused for lack of qualified chamber operators. **Needs:** Training of medical, paramedical and chamber operators. **Action:** UPR-SGP sponsored a course offered by the NOAA Diving/Hyperbaric Center in Florida. The course, aimed at medical, paramedical, and marine sciences personnel, resulted in the creation of an emergency hyperbaric unit. The chamber is one of the very few in the Caribbean and serves the whole Caribbean Basin. It will now again be available for the treatment of diving sickness, as well as for clinical cases such as gangrene and circulatory impairments, among others.

Other accomplishments of UPR-SGP: \*Translation into Spanish of much needed literature from government agencies such as the U.S. Coast Guard. \*Marine Advisors were mediators in an agreement by which the Neptune Tuna Cannery, Inc. buys approximately 6,000 lbs. of tuna a week from several fishing villages, thus providing the fishermen a source of income from fish that was usually discarded. \*Introduction of underutilized species (shark, small fish, mollusc species, etc.) into supermarkets and on the menus of prominent restaurants, thus increasing sales directly from the fishermen. \*Training and support of graduate students to provide qualified individuals for future employment in the national marine resources arena for the Nation. \*Research emphasis on: Feasibility studies in aquaculture-mariculture, marine pharmacology natural products, and coastal engineering. \*Improvement of artisanal fisheries and development of a deep water fisheries industry.

UPR-SGP is unique and necessary in Puerto Rico: \*Because of high population density, lack of marine industries, high unemployment rates, illiterate fishermen and other social economic problems in marine communities, the development, utilization and conservation of marine resources are more poignant and urgent.

For further information on the University of Puerto Rico Sea Grant Program write to:

Dr. Manuel L. Hernández-Avila  
Director  
Sea Grant Program  
University of Puerto Rico  
Department of Marine Sciences, R.U.M.  
Mayaguez, P.R. 00708

## **FISHERIES and COASTAL RESOURCE MANAGEMENT**

continue to be major thrusts for the pioneering  
**UNIVERSITY OF RHODE ISLAND SEA GRANT COLLEGE PROGRAM.**

As one of the first four Sea Grant Colleges, URI has developed a successful research, education, and advisory service combination which responds to local and national needs in marine resource use and management.



URI research in seafood science, marine resource economics, ocean engineering, oceanography, and other areas provides understanding of the marine environment so that resources such as fisheries and coastal lands can be used and managed more profitably with minimal negative impacts. As the need for trained personnel arises in industry and government, short courses and academic curriculums are developed; examples include financial planning for marinas and marine management. Many URI advisory projects including demonstrations on floating breakwater technology and the fishing vessel weather-reporting system have been adapted for use by out-of-state programs and by foreign countries. Cooperation with other programs and agencies in solving regional or national problems is fostered through the national Sea Grant network.

**FISHERIES.** Through joint projects with Rhode Island and Massachusetts fishermen, URI's program in fishing technology transfer has helped the Northeast industry to adopt more efficient fishing gear and methods.

- **URI High Rise 340 Trawl.** By using this trawl design, vessel owners have increased their fish catches; at least 25 fishermen have reported annual net benefits of \$125,000. High-rise trawls are now commonly produced by U.S. netmakers.
- **Pair Midwater Trawling.** One of the earliest methods introduced by URI, pair midwater trawling is now prevalent on both coasts. A recent survey of skippers using this gear shows that 18 Northeast vessels have increased their net earnings by well over a million dollars.
- **Pair Demersal Trawling.** Initial trials begun in 1982 with two Point Judith vessels indicate that this gear has potential for reducing by 25 percent or more the cost per ton of fish caught.

**COASTAL RESOURCE MANAGEMENT.** Interpreting environmental and economic research for coastal planners and assisting in the development of strategies for managing coastal areas have been substantial contributions of the URI program. The close working relationship that has evolved between URI and state agencies and citizen organizations is a factor in the success of Rhode Island's coastal management.

- **Coastal Zone Management Program.** With technical support from URI, Rhode Island developed its nationally recognized coastal management program. Modifications are made in response to changing economic and environmental situations.
- **Coastal Ecosystem Productivity.** An understanding has been gained of the importance of bottom-dwelling organisms to enhancement of coastal productivity. Highly susceptible to pollution, coastal bottom communities are now known to be major regulators of nutrients.
- **Coastal Lagoon Studies.** An interdisciplinary study resulted from urgent community questions on the impact of increased development on the state's highly productive coastal ponds. The study provided answers to questions such as how much development the ponds can support before large public expenditures for sewage and water treatment facilities are required.

**OTHER PROGRAM AREAS.** URI Sea Grant research and advisory activities also include fish preservation, salmon closed-system aquaculture, and marina design. Among the 425 students who participated in these projects are many whose studies directly benefited industry; one student developed a product using a seafood processing company's wastes and was later hired to handle quality control and new product design.

- **Corrosion Workshops.** Estimates indicate that each person who attends a URI corrosion workshop is able to transfer the learning into methods and practices which result in savings of about \$5,000 per year. In two years, about 125 persons have been trained, for a total saving to consumers of \$625,000.
- **Aquaculture Research.** Identifications were made of pollution-free strains of brine shrimp, a major diet item for larval forms of cultured fish. This will lead to lower fish losses by researchers, tropical fish hobbyists, and aquaculturists.



**The South Carolina Sea Grant Consortium is . . .** a unique partnership among statewide institutions working to promote and implement research, advisory services and education in the sphere of marine and coastal resources. As a state agency, the Sea Grant Consortium provides information and technical assistance in the development and management of South Carolina's vast natural resources. Sea Grant Consortium research combines the knowledge, talent and skills of the faculty and staff of its seven member institutions:

The Citadel • The College of Charleston • South Carolina State College  
The Medical University of South Carolina • The University of South Carolina  
Clemson University • South Carolina Wildlife and Marine Resources Department

The first years of the Sea Grant Consortium's operations have contributed major economic effects to the South Carolina economy with minimal commitment of state funds. The Consortium arrangement promotes sharing of facilities and personnel found at member institutions, avoiding duplication of research efforts and reducing the need to expend state funds for increased facilities and personnel.

Representative of Sea Grant Consortium efforts in research and advisory services conducted recently are:

\*Technical assistance provided by a Sea Grant Consortium marine advisory agent enabled several shrimping vessels to convert to finfishing in the winter months. Through 1983, total revenue gains should reach over \$3 million. Consortium investment: \$15,000 over 5 years.

\*Fiberglass bateaux building demonstrations by Sea Grant Consortium advisory agents have shown small boat fishermen how to build their own craft inexpensively. To date, 15 boats have been built, saving these fishermen about \$22,500. Consortium investment: \$5,000.

\*Five shrimping vessels are presently equipped with the Trawling Efficiency Device (TED) as a result of Sea Grant Consortium Marine Advisory Service efforts. Use of TED led to an increase in revenues by these shrimpers of over \$37,000. It is projected that eight more vessels will be equipped this year, resulting in a total increase in net revenues of about \$97,000. Consortium investment: \$1,000.

\*A shellfish closure study conducted in Horry County by Sea Grant Consortium researchers is incorporated as a significant section of the Grand Strand Water and Sewer Authority's application to the Environmental Protection Agency for over \$2 million for planning, design and construction of an innovative sewage treatment and sewer complex. Consortium investment: \$3,000.

\*Development of an automatic shrimp deheader by Sea Grant Consortium researchers will significantly reduce costs incurred by processors and large vessel operators and improve overall shrimp quality. An anticipated \$1 million will be added to the economy from the manufacture, sale and use of the device. Consortium investment: \$45,000 over 4 years.

In addition to coastal research and marine advisory service activities that illustrate economic benefits to the state, education efforts by the Sea Grant Consortium, while not having direct economic benefits, provide increased understanding, appreciation and awareness of coastal resources:

\*The training and support of graduate and undergraduate students from Sea Grant Consortium member institutions provides qualified individuals for future employment in the national resources arena in the state and nation.

\*A summer course accredited by the State Department of Education will be conducted in 1982 for use by teachers developing marine education course materials for grades 7 - 12 education level.

\*A marine seminar series offers up-to-date information on coastal issues and encourages public participation.

\*Sea Grant Consortium workshops and conferences offer researchers, students, business, industry and the public the opportunity to increase their knowledge of coastal matters.

\*The Coastal Heritage Program was begun to provide information on the interaction of the environment, the economy and the culture of South Carolina's coastal history.

A combined effort in research, marine advisory services and education makes the South Carolina Sea Grant Consortium goals compatible with the goals of the National Sea Grant Program. The economic benefits for the National Program taken as a whole are impressive and consistent with the South Carolina experience. Over a 10 year period, National Sea Grant network projects have produced a direct economic dollars gain to the national economy of approximately \$217 million per year.

For further information on the South Carolina Sea Grant Consortium contact:

South Carolina Sea Grant Consortium  
221 Fort Johnson Road  
Charleston, South Carolina 29412  
(803) 795-9650



**Texas A&M University is the Sea Grant College for Texas**, providing leadership for research, education and extension activities to promote wise use of our marine resources. For more than a decade this effort has involved the knowledge, talent and skills of specialists from:

Texas A&M University • Texas Agricultural Extension Service • Texas Agricultural Experiment Station • The University of Texas • University of Houston • Baylor College of Medicine • Texas A&M University at Galveston • Texas Southern University • Lamar University • Brazosport College • Texas Southmost College • Pan American University

Recent Texas A&M Sea Grant research and advisory efforts have made direct contributions to the state's economy and to the safe use of the marine environment. For example:

- Gulf shrimp fishermen saved an estimated \$30 million over a seven-year period as result of a Sea Grant effort to identify, catalog and disseminate information on bottom obstructions or "hangs." This also resulted in a \$1 million direct savings to the taxpayer because it was not necessary to carry out the sea floor surveying activities mandated under Title IV of the fishermen's contingency fund. The data already were available in the Sea Grant publication.
- Technical assistance and training provided by a Sea Grant marine advisory fisheries specialist enabled Texas shrimp fishermen to convert their trawlers for swordfish longlining during winter months. Nearly \$2.5 million worth of product was landed the first year. Another latent fishery, blackfin tuna, was developed so that now tuna can be harvested simultaneously with shrimp. This has resulted in more effective use of the shrimp vessels as well as the fishing gear.
- New deep, long-bottom time air decompression tables developed with Sea Grant funds are now used by commercial firms. One user places a value of \$210,000 on these tables. Nine U.S. hospitals, treating approximately 150 patients per day, also have the tables for use in emergencies.
- Continuing Sea Grant-funded mariculture research has resulted in the first spawning of the native Gulf shrimp *Penaeus setiferus* in captivity and the harvest of two crops of Central American shrimp *P. stylirostris* in one growing season. These developments end dependence on wild stocks as a source of shrimp larvae, provide a potential for doubling production and make realization of this promising new Texas industry even more imminent.
- A Marine Advisory Service recreation specialist works with local officials to explain techniques of obtaining parkland through donations and federal loans. Assisting more than 50 groups in a two-year period, he helped generate more than \$9 million for marine-related parkland.
- Research into water-related fatalities in Texas led to development of beach safety standards as guidelines for the country. The Sea Grant researcher then worked with county officials and private foundations to revamp the beach patrol at Galveston, Tex. Sophisticated new equipment, expansion of the lifeguard force, training sessions led by U.S. Lifesaving Association experts and a bilingual Sea Grant educational brochure have made Galveston beach one of the best protected in the country.

In addition to research and advisory service activities, education efforts by the Texas A&M Sea Grant Program provide increased understanding, appreciation and awareness of the coastal environment and resources.

- Marine educators have developed textbooks and curricular materials that are used in elementary and secondary schools throughout the country.
- A competitive marine fellowship program supports those graduate students most likely to pursue productive careers in marine research and ocean management.
- Public school teachers from throughout the country are given special inservice training in all aspects of marine education. More than 6,000 teachers in 20 states attended at least one workshop within a two-year period.
- An average of 700 industry representatives each year attend seminars conducted by the Marine Advisory Service business management specialist. The seven seminars cover financial management, marine/offshore business development, offshore security, marine safety, coastal boating facilities development, regulation and licensing, and manning of marine vessels.

As the needs of Texas and Texans change, so do the objectives of the Texas A&M Sea Grant Program. New goals bring new accomplishments, which are reported to the public through an active publications effort.

For further information on the Texas A&M Sea Grant College Program, or for copies of recent publications, contact:

Feenan D. Jennings, Director  
Sea Grant College Program  
Texas A&M University  
College Station, Texas 77843  
(713) 845-3854

# Virginia Graduate Marine Science Consortium

*The Virginia Graduate Marine Science Consortium, formed in 1981, is an effective organization drawing the talent, skills and energy of four major institutions of higher learning together to deal with marine-related issues and problems. Members include Virginia Institute of Marine Science of the College of William and Mary, Virginia Polytechnic Institute and State University, University of Virginia and Old Dominion University.*

*Under the auspices of the National Office of Sea Grant, and with funding provided cooperatively through Sea Grant and the Commonwealth, the Virginia Sea Grant effort has demonstrated its worth in dollars to taxpayers. Through research, education and advisory efforts on behalf of marine user groups, Sea Grant in Virginia is fulfilling its promise. The following are representative of the research and advisory efforts conducted by the Virginia Sea Grant Program.*

- Sea Grant sponsored research in hard clam culture in Virginia has resulted in refinement of hatchery techniques and production of a step-by-step instruction manual. Subsequent annual short courses for participants from 16 states, one territory and two foreign countries has seen the establishment of 15 commercial hard clam seed hatcheries, with 9 more under construction or in the planning stage.
- As a result of Sea Grant research into the potential for a shark fishery in Virginia, followed by a published report on the findings, a major seafood producer pioneered the effort to harvest spiny dogfish during the winter months. As a result, Virginia fishermen landed more than 1 million pounds of shark in 1981. The products were shipped to overseas export markets and an experimental domestic market.
- Development of the perched beach erosion control device by Sea Grant sponsored researchers in Virginia, and successful demonstration of the concept as an alternative to more expensive measures, has shown an annual benefit rate of \$500,000 to 1000 shorefront landowners. One \$5000 perched beach structure averted the need to move an air navigation site at a cost of more than \$1 million.
- Specialists from the seafood processing laboratory of the Virginia Sea Grant Program were credited with saving \$70,000 worth of pasteurized crabmeat which had been quarantined by the Food and Drug Administration (FDA) because of canning defects. The agents designed and implemented a plan in 5 days which essentially saved the season for a major seafood producer. A workshop to alert the rest of the industry to the problem was conducted, and future workshops and a guidelines manual are planned cooperatively among the FDA, Virginia Sea Grant and the State Health Department.
- A major softshell crab producer in Virginia, upon the advice of a Sea Grant specialist, changed his flow-through blue crab shedding system to a closed recirculating system. The shedder's survival rate on crabs, from peeler through softshell stage, jumped from 35% to 65% in one season. Sea Grant outlay was 15 working days; the shedder's outlay was \$500 in material cost.
- The marine advisory gear specialist assisted the owner of a 7-vessel fishing fleet in Virginia in the conversion of scallop boats to bottom trawlers for demersal species such as flounder and scup. The vessel crews and captains were shown how to repair nets and change deck plans for machinery to improve efficiency. Sea Grant outlay was approximately \$1000. The fleet owner is realizing a per vessel savings of nearly \$7000 on start-up time and initial trips. Substantial savings on subsequent trips are anticipated due to improved harvesting capability and efficiency.
- Disposal of blue crab processing wastes has been a problem which has periodically plagued processors in Virginia and other crab harvesting states. Sea Grant has funded research into the economic feasibility and practical applications of turning crab scrap into marketable livestock and poultry feed supplement. The recovery of crab scrap has the potential benefit of \$2.5 million annually in the Middle Atlantic region.

**For further information concerning Sea Grant in Virginia, please contact:**

**Dr. William Rickards, Director  
Virginia Graduate Marine Science Consortium  
102 Monroe Hill Range  
University of Virginia  
Charlottesville, VA 22903**



## Washington Sea Grant Program—a university-based partnership with industry, government, and citizens that is providing innovative leadership for addressing problems and opportunities of marine resource conservation and management—

To address the problems and opportunities of resource conservation and development, the Washington Sea Grant Program undertook in 1968 a coordinated program of research, education, and advisory services. Through its advisory services and because of a one-third matching requirement, Sea Grant's customers have become active partners in the development of effective research and education activities. This user-university partnership has not only produced new ideas that are the product of academic theory and marketplace practicality, but it also has facilitated the evaluation of these ideas in the field.

The effectiveness of this partnership is amply demonstrated by the following projects in which Washington Sea Grant has provided regional and national leadership.

\* **Growing salmon to maturity in enclosed pens.** Sea Grant research on fish diseases, nutritional needs, and genetics undertaken in cooperation with state and federal agencies and with support from the Weyerhaeuser Company and DomSea Farms, Inc. (a subsidiary of Campbell Soup) has led to the development of robust fish stocks, effective vaccines, and improved diets for pen-reared salmon. As a result, a young but vigorous multi-million dollar industry is producing 2,000 pounds of pan-size salmon each day in Washington waters.

\* **A new biological technique for early detection of certain human diseases.** Researchers at the University of Washington have extracted a substance called aequorin from a common Puget Sound jelly fish and purified that substance so that it can be used to measure minuscule changes in calcium concentrations in body fluids such as blood, saliva, urine, and cerebral spinal fluid. Such changes frequently are early signals of cellular destruction and point to the onset of diseases such as metastatic carcinoma, bone dysplasia, cardiac dysrhythmias, and parathyroid disorders. As a result of this Sea Grant research, clinical chemists and physiologists can now measure calcium concentrations as low as approxi-

mately 40 parts per trillion and can also measure calcium within a single cell. Today, aequorin is commercially available from Sigma Chemical Company of St. Louis.

\* **Economic analyses for Pacific Northwest seafood processors.** Over several years, Washington Sea Grant's marine economist has provided requested assistance to the Pacific Seafood Processors' Association and in one instance helped prevent the closure of numerous processing plants. His analysis of wastewater guidelines proposed by the Environmental Protection Agency (EPA) in 1976 demonstrated that those guidelines were not economically achievable and would result in plant closures—particularly in Alaska. This work contributed to EPA's withdrawal of the guidelines and has influenced consideration of wastewater guidelines for application elsewhere.

\* **Fishing Vessel Safety Center.** Annually, the U.S. commercial fishing fleet suffers 80-100 fatal accidents. To determine the causes of these accidents and to find ways of preventing them, the University of Washington, with Sea Grant support, has established a fishing vessel safety center in the College of Engineering. The center's computerized accident information data bank is so impressive that Lloyd's of London—insurance brokers for many Bering Sea crab boats—flew the center director to London in 1981 for consultation and advice. Data collected by the center are also being used to design commercial fishing vessels that remain stable in extreme wind and wave conditions and to develop improved safety practices for the fishing industry.

\* **Technical training programs for young men and women seeking careers as hard-hat divers, engine-room maintenance crew members, and as technicians in fish hatcheries and oceanographic laboratories.** These programs pioneered by Washington Sea Grant and conducted by Highline Community College, Seattle Central Community College, Grays Harbor College, Peninsula College, and Shoreline Community College attracted nationwide attention in the early 1970s and served as models for similar pro-

grams subsequently established throughout the country. Because of their stature and near 100 percent success rate in placing graduates, the programs have been able to secure contracts from state and federal agencies and from industry to investigate marine problems. This contract work has provided on-the-job training for students and helped finance program costs. As a result, the programs are now self-sustaining and no longer require Sea Grant support.

To achieve results such as these has required many years, the dedicated efforts of hundreds of individuals, and the cooperation of a multitude of businesses, agencies, public institutions, and civic groups. This indeed is a partnership that has paid off for the users of Sea Grant efforts.

### More information?

For a catalog of Washington Sea Grant publications, a directory of current projects, or the latest biennial report, write:

Washington Sea Grant Communications  
College of Ocean & Fishery Sciences  
University of Washington  
Seattle, WA 98195



## THE UNIVERSITY OF WISCONSIN SEA GRANT PROGRAM

The University of Wisconsin Sea Grant Program was established in 1968—one of the first programs in what is now a nationwide network of 32 Sea Grant universities. In 1966, Congress established the National Sea Grant College and Program Act to promote *research, education* and *public service* activities related to marine and Great Lakes resources. Congress challenged universities to do for the marine community what they had done for American farmers. Sixteen years later, the experiment is succeeding.

### THE SCOPE

Wisconsin's "oceans" are the Great Lakes, and the Sea Grant Program focuses most of its attention on these inland seas. Headquartered in Madison, Sea Grant is a statewide program, with offices in Washburn, Sister Bay, Green Bay and Milwaukee.

Over 300 faculty, staff and students are now involved in Sea Grant projects at campuses throughout the state: UW-Green Bay, UW-Madison, UW-Milwaukee, UW-Stevens Point, UW-Superior, UW-Extension, Lawrence University, and the Medical College of Wisconsin. The program's \$3 million annual budget goes to support both research and public service activities. Its primary research areas are *fisheries, water quality and lake contaminants, aquaculture, diving physiology, ocean engineering, policy studies*, and a comprehensive research effort on *Green Bay*. The program is jointly supported by the National Oceanic and Atmospheric Administration and by state, university and private sources.

### THE RECORD

The UW Sea Grant Program has had many notable successes and has become a nationwide leader in research on toxic substances, water quality, fisheries modelling, ecosystem dynamics and diving medicine. Among Sea Grant's achievements:

- A broad range of research findings and educational activities related to the PCB contamination of Great Lakes waters and fish. This work has made it possible to predict the longevity of the PCB problem in the region, address means of solving the problem and allay public fears and uncertainties over the possible health hazards posed by these chemicals.
- The development of a process to produce plant fertilizer from fish wastes which is now being used by Wisconsin fish processors as well as those in Alabama, Mexico and Canada.
- Work to restore native lake fish populations in Lakes Michigan and Superior, and related studies on the dynamics of Great Lakes fish populations. Research results have been used by Wisconsin's Department of Natural Resources in their management of the trout and salmon sport fishery, and in balancing commercial and sport use of fishery resources.
- Sea Grant Advisory Services specialists helped save the city of Racine \$900,000 by providing advice on a harbor improvement project under consideration by city engineers.

- Research on more flexible and cost-efficient water pollution control methods contributed to revisions in Wisconsin DNR standards that could save towns and paper mills along the Fox River over \$12 million, and at the same time enhance the water quality of the river and Green Bay.
- Over 200 students have received Master's and Ph.D. degrees as a result of UW Sea Grant support. Representing a broad range of disciplines, these students have gone on to work in academia, government, business and for major industries including Bechtel Corporation, Exxon, General Motors and Bell Labs.

### THE WISCONSIN IDEA

Since the origin of the "Wisconsin Idea" in the early 1900s, it has been traditional to apply the UW's resources to solving state problems. In fact, it's often said that the boundaries of the University are the boundaries of the state. The UW Sea Grant Program embodies this philosophy by devoting more than 25% of its resources to education and service programs that go beyond the classroom.

*Public service is a high priority* for Sea Grant researchers, students, field agents and staff members. Sponsoring a fisheries workshop for commercial and sport fishermen; helping marina owners minimize ice damage; advising the Port of Milwaukee on dredge spoil disposal; or producing the popular Earthwatch radio program—Sea Grant puts the university to work for the people of the state. The program represents a unique working *partnership* among the federal, state, university and private sectors.

### THE GOAL

The people of Wisconsin place a high value on the Great Lakes. Most of the coastal cities draw their drinking water from the lakes. Shipbuilders, dockworkers, tourist businesses and commercial and charter fishermen depend on the lakes for their livelihoods. The Great Lakes' beautiful coasts, pure waters and bounty of fish are irreplaceable resources that state residents are determined to preserve. The University of Wisconsin Sea Grant Program is dedicated to protecting and enhancing these resources, which have such an important impact on the economy and quality of life in Wisconsin.

For more information: UW Sea Grant Institute  
1800 University Ave.  
Madison, WI 53705  
(608) 262-0905

January, 1983



## PACIFIC SEA GRANT COLLEGE PROGRAM

**The Pacific Sea Grant College Program**--In 1969, the universities of the Pacific states joined together in an organization which would allow the region's Sea Grant programs to make the best use of both personnel and financial resources. This organization has matured, evolving into one which represents the Pacific's five Sea Grant Colleges. The Pacific Sea Grant College Program's goal is to improve the quality and extent of Sea Grant in the region through cooperative research projects, information exchange among Sea Grant educational programs, and information and personnel exchange in support of each university's Marine Advisory Program.

Member institutions are:

**Oregon State University • University of Alaska  
University of California • University of Hawaii  
University of Washington**

Representative accomplishments of the Pacific Sea Grant College Program are:

**The International Seafood Trade Conference**, held in September 1982, brought together economists working on seafood trade problems. Thirty-one of the 155 participants came from 21 foreign countries. An ongoing institute was structured during the conference to foster cooperative research and projects.

**The International Symposium on Recent Innovations in Cultivation of Pacific Molluscs**, held in December 1982, brought together leading aquaculturists and researchers to discuss the regional successes and research needs in aquaculture of abalone, clams, scallops, oysters, mussels, and other commercially important molluscs. Academia, government, and industry were represented by invited participants and observers from eight Pacific and Atlantic states and Canada, Chile, China (including Taiwan), Japan, Mexico, Palau, and Tahiti. The symposium was a unique opportunity for mollusc experts to meet and share knowledge in an informal workshop atmosphere.

**The high mortality of captive salmonid broodstock and low egg viability** were the subjects of a workshop in May 1980. Salmon farmers and researchers from Alaska, British Columbia, Washington, Oregon, and California participated. A follow-up workshop was held in March 1981. Discussion revealed that application of pooled knowledge from the first session had substantially reduced broodstock mortality and increased egg fertility.

By joining in this regional effort, the Sea Grant College Programs of the Pacific states are able to more effectively apply the resources and facilities of the member institutions to problems associated with the development, conservation, and wise use of the marine resources of the Pacific region. For more information:

**Pacific Sea Grant College Program  
Alaska Sea Grant College Program  
University of Alaska  
3 Bunnell, 303 Tanana Drive  
Fairbanks, Alaska 99701**

## SOME RECENT SEA GRANT ACCOMPLISHMENTS

---

ALASKA -- The Lowell Wakefield Fisheries Symposia bring the latest scientific information to fisheries managers, leading both to sounder management practice and feedback on research needs.

CALIFORNIA (U of C) -- New squid processing technology increases available protein from the sea.

CALIFORNIA (USC) -- A major publication and education effort helped citizens and government officials better understand and work with the complex coastal permit process.

CONNECTICUT -- Fisheries port development is part of a strategy for creating a more economically viable commercial fishery.

DELAWARE -- Wave-powered technology for desalinization should supply a new source of fresh water.

FLORIDA -- Marine technology training is addressing the critical technical manpower shortage.

GEORGIA -- Harvesting of underutilized fish turns previously seasonal shrimp fishery into productive year-round fishery.

HAWAII -- Researchers advise South Pacific Island nations on impact of Law of the Sea Treaty, while both examining overlooked aspects and creating closer ties.

LOUISIANA -- A long-term university research and advisory effort works with state and federal officials to find ways to preserve nation's most valuable wetlands.

MAINE -- Cooperative university/industry/government analysis of shrimp harvest methodology prevents uneconomic and unnecessary new regulations.

MARYLAND -- Networkwide project led by Maryland achieved better understanding of cholera causing agents in water column and also helped relieve public fears about connection of this disease with seafood.

MASSACHUSETTS (MIT) -- Comprehensive oil spill cleanup approach brings diverse groups together and has many applications.

MASSACHUSETTS (WOODS HOLE) -- Work on red tides is yielding new insights on causes, prediction and timing of outbreaks, and possible inhibiting factors for this costly phenomenon.

MICHIGAN -- Research and education on coldwater drowning has led to 25 percent drop in drowning fatalities.

MINNESOTA -- Cryopreservation of fish sperm and eggs aids fish hatchery and aquaculture operations and improves potential for genetically strong stocks.

MISSISSIPPI/ALABAMA -- Improved fuel management practices yield energy cost savings for Gulf Shrimp Fleet.

NEW HAMPSHIRE -- A more accurate and efficient technique is developed for determining shellfish poisoning caused by red tide in saltwater and for analyzing toxic freshwater algae.

NEW JERSEY -- Improved weather and sea surface temperature information aids fishermen and reduces costs.

NEW YORK -- Floating tire breakwaters, developed by cooperative efforts of New York and several other Sea Grant programs, plus Canadian and industry colleagues, provide low-cost means to protect many harbors from wind and waves.

NORTH CAROLINA -- New coastal septic systems in southeast and Gulf areas improve waste disposal while protecting shellfish waters from contamination.

OHIO -- Cooperative work with Louisiana and Texas provides market for under-utilized Great Lakes fish while providing badly needed bait for use in commercially important crawfish industry.

OREGON -- Sea Grant works with oyster growers, farmers and government to develop pollution abatement and regulatory program to preserve Oregon's oyster industry.

PUERTO RICO -- Cooperative national network effort underway to identify causes, mechanisms and responses to ciguatera fish poisoning, which is both a health and economic hazard.

RHODE ISLAND -- Improved fishing technology effort has yielded impressive economic benefits, while enhancing the quality of the catch and increasing vessel safety.

SOUTH CAROLINA -- Cooperative Sea Grant/government/industry effort has developed commercial-scale hard clam mariculture facility and new information and technology.

TEXAS -- Research on water safety has led to improved beach safety measures and to legislative changes and nationally-recognized recommendations.

VIRGINIA -- Improved crab canning procedures eliminate health risks and save food from destruction.

WASHINGTON -- Marine acoustic research has developed new business and products, improved fishery management and aided fishermen.

WISCONSIN -- Transferable discharge permit system leads to more effective, cost-efficient system of water pollution control.

SOUTHEAST MARINE ADVISORY SERVICE -- Eight states plus Puerto Rico are covered by the newest Sea Grant regional network, where the universities are developing cooperative activities to enhance wise marine resource utilization.

## ALASKA SEA GRANT COLLEGE PROGRAM

### Lowell Wakefield Fisheries Symposia

Our nation's fisheries resource managers and scientists need the latest techniques and data for management of Alaska's important fisheries resources.

To help integrate the ever expanding scientific knowledge into fisheries management, the University of Alaska Sea Grant College Program has been hosting a fisheries symposium series. The series is named after Lowell Wakefield, founder of the Alaska king crab industry and a great supporter of sound fisheries management programs. One or two symposia are scheduled each year, each on a particular species.

The first meeting in the series was held May 4-6, 1982, and dealt with the essential tanner crab resource. Although it was sponsored primarily by the Alaska Sea Grant College Program, support was also provided by the North Pacific Fishery Management Council, the National Marine Fisheries Service, and the Alaska Department of Fish and Game.

The meeting was international, with nine participants from Canadian agencies and universities, and three from Japanese organizations among the 72 participants. Virtually all the primary scientists conducting tanner crab research in these countries and the United States gathered to present 43 scientific papers and hold a workshop session. The workshop resulted in a list ranking the future research information needed by management agencies in order to effectively manage and preserve the resource and the industry. Proceedings of this meeting were published by and are available from the Alaska Sea Grant College Program.

The second symposium is well along in the planning process. It is scheduled for March 1983 and will cover the biology and management of Alaska's significant sablefish resources.

The majority of Alaska's fisheries resources are important not only to the state, but nationally and internationally. The Lowell Wakefield Symposia offers the first opportunity for researchers from all participating countries to informally discuss major fisheries issues with fishery managers.



# California Sea Grant College Program

## California Sea Grant College Program Major Achievements

### SQUID CLEANING MACHINE MEANS MORE PROTEIN FROM THE SEA

Problem: Researchers estimate that squid is potentially the largest single source of animal protein in the marine environment, yet the squid fishery remains underutilized because there is insufficient technology available to process squid efficiently for commercial marketing.

Research/Outreach Activity: Because squid is low in fat, high in protein, and plentiful along the west coast, the California seafood industry expressed interest in developing the squid fishery and testing squid's potential marketability with restaurants, fast-food chains, and general consumers. Industry representatives asked members of the California Sea Grant Marine Advisory Program (MAP) if a machine could be designed to clean squid quickly and easily, thus replacing the labor-intensive, time-consuming method of cleaning squid by hand. MAP staff outlined the problem to a group of agricultural engineers at UC Davis, who in turn acquired California Sea Grant support for two years to develop a prototype squid cleaning machine.

Results/Implications: The Sea Grant engineers succeeded in developing a prototype machine that beheads squid, then skins and eviscerates it using powerful water jets. The machine's design vastly improves the speed and efficiency of the squid cleaning process: it allows a pound of squid to be cleaned in seconds -- a job that can take 20 minutes to do by hand. The machine has been patented, and it is currently being developed by Young Development in Santa Cruz, CA. It should be available in about a year. With the new machine, it is estimated that California's current 10,000 ton annual squid catch, which is worth about \$1.2 million, could be increased 50 times its present amount, thus providing the west coast and the nation with a new source of protein for human consumption.



# USC SEA GRANT EXPLAINS COASTAL PERMIT PROCESS

## STATEMENT OF THE PROBLEM:

With the emergence of California's coastal management laws -- among the first such legislation in the nation -- citizens and organizations concerned with development and conservation of the coastal zone needed help in understanding the complexities of the coastal permit process.

## SEA GRANT RESPONSE:

The coastal planning specialist at the University of Southern California's Sea Grant Program, in conjunction with an advisory agent from the University of California Sea Grant Program, developed a comprehensive 24-page booklet, including a flowchart summary, on the California Coastal Commission's permitting process.

The flowchart showed 52 steps in the permitting process, from proposal preparation through court appeal options. Each step or group of steps was accompanied by explanatory text. Listings, including phone numbers, covered the California coastal communities' planning departments, the regional coastal commissions, state and federal agency contacts and area-wide clearinghouses (COGS).

When published jointly by the two Sea Grant programs, the booklet was the only concise and comprehensive publication available on the permitting process for state agencies and the general public.

## RESULTS:

\* More than 900 requests for the document were received from industry and businesses, agencies, environmental groups and citizens; hundreds more were distributed by city and state agencies throughout California.

\* The California Coastal Commission office used the text and flowchart to train new staff members.

\* Members of the regional coastal commissions utilized the booklet -- and recommended it to interested parties seeking further information on the permitting process.

\* KCET-TV, the public television station in the Los Angeles area, devoted half an hour of air time for the coastal planning specialist from USC and the coastal commission's counsel to explain the permitting process, as described in the booklet and illustrated by the flowchart. The show was aired twice to an audience of almost two million people.

## FURTHER INFORMATION:

USC Sea Grant Program  
Institute for Marine and Coastal Studies  
University of Southern California  
University Park  
Los Angeles, CA 90089-0341  
Phone: (213) 743-6068

## ECONOMIC IMPACT REPORT

### Fisheries Port Development

Work was commenced in 1980 to assist Connecticut's last commercial fishing fleet and harbor (Stonington) to revitalize deteriorating facilities. Combined efforts of the Southern New England Fishermen's Association, Stonington Town Officials, Stonington Waterfront Commission, the New England Innovation Group, and the Connecticut Sea Grant Marine Advisory Service provided testimony and grant proposal preparation. H.U.D. provided \$100,000 for dock improvement; Connecticut Economic Development contributed a low-cost bond at \$50,000; an F.H.A. grant of \$37,500 went toward icing facilities; and F.H.A. also provided a \$12,500 construction loan.

These funds were utilized to refurbish docks and channels, and to enlarge the capacity to handle many larger fishing vessels. Offloading and servicing facilities have been modernized. In addition to the direct financial aid afforded by the grants, the Stonington fleet increased by 5 new vessels of 70-foot length and port landings have doubled. The multiplier effect associated with fisheries landings (3 times) would significantly increase the actual derived value.

On a state-wide planning basis, the Marine Advisory Service has contributed similar efforts to advisory committees for the cities of New London, New Haven, and Norwalk. An increase in net annual return of about \$300,000 seems reasonable.

### Commercial Fishing Tax Exemptions

The Marine Advisory Service economist, Norman Bender, has worked with the fishing industry and legislative officials in evaluating the impact of changes in state tax regulations to both the industry and the state's revenue situation. M.A.S. brought together industry and agency representatives to review existing laws and regulations and recommend changes.

A new Connecticut sales tax exemption, which was passed in 1982 on fishing boats, engines, electronics and related equipment, is increasing fishing net income. A Stonington fishing captain reduced the cost of a new 80-foot dragger by over \$15,200 through use of the new exemption. A lobsterman saved \$1,000 on the purchase price of an inshore lobster boat operating out of Old Saybrook. A party boat operator is going ahead with plans for a new party fishing vessel as a result of the new law. It will result in more jobs for a Connecticut boatyard and related firms. Connecticut firms are benefiting from in-state purchases of electronic equipment, power plants and other fishing machinery.

It is estimated that the first-year increase in net fishing income due to the new sales tax exemption will reach \$100,000. An average annual increase in fishing disposable income of \$30-50,000 has been estimated by the Connecticut Office of Legislative Analysis.

For further information on the Connecticut Sea Grant Program, contact:

Dr. Victor E. Scottron, Acting Director  
Connecticut Sea Grant  
The University of Connecticut at Avery Point  
Groton, CT 06340  
(203) 446-1020, Ext. 258



**UNIVERSITY OF DELAWARE  
SEA GRANT COLLEGE PROGRAM**

**STATEMENT OF THE PROBLEM:**

Fresh water for drinking, for irrigation to supplement rainfall for agriculture, and for use in food preservation and preparation is a primary commodity need through much of the world.

**DESCRIPTION OF THE RESEARCH AND/OR OUTREACH ACTIVITY:**

This Sea Grant-sponsored DELBUOY project is the first attempt to desalt ocean water using the energy stored in the medium: that of sea waves. Techniques for desalting seawater have been studied for many years; one of the most energy efficient is reverse-osmosis. This research is based on the thesis that the required energy (wave energy) and the raw material (ocean water) for the desalting process exist together in the same medium (the ocean). Since the energy resource is essentially inexhaustible and free, it should be possible to create a simple, economically viable ocean-water desalting system for use in areas where the cost of energy prohibits use of electric or diesel drive.

Research has addressed all of the problems associated with the design, construction, and testing of a wave-powered buoy that drives a high-pressure seawater pump which forces filtered seawater through a standard reverse-osmosis module. The evaluation of model systems as well as a quarter-scale sea trial has led to a system configuration which has avoided the corrosive problem of seawater by using synthetic materials. The objectives of this research were accomplished in cooperation with several governmental, private sector, and university groups. Researchers had the cooperation of the U.S. Army Corps of Engineers Research Center at Duck, North Carolina, in conducting scale-model sea trials. Industrial assistance included collaboration with Steinmetz and Sons in the development of urethane castings, the Lord Corporation on structural adhesives, the DuPont Company in material selection and testing of reverse osmosis models, as well as work with Film Tech on reverse osmosis, and Garlock on the development of seals for high-pressure pumps.

In collaboration with the University of Puerto Rico Sea Grant Program, a 250-gallon/day DELBUOY prototype system has been deployed and operated at Magueyes Island, Puerto Rico. This field test has validated laboratory testing and modeling studies, while serving to create a working system on which accurate estimates of water costs can be based. Cost estimates indicate that the 250-gallon/day DELBUOY prototype will provide fresh water at a cost between \$5.00 and \$10.00 per 1,000 gallons. There is reason to be optimistic that careful research and development carried out on location may bring the cost of water to less than \$5.00/1,000 gallons, and future scaled-up installations could produce excellent water at less than \$1.00/1,000 gallons. This unit cost compares favorably with a new state-of-the-art electric-powered desalting plant at Key West Florida, which is currently producing fresh water for between \$3.00 and \$4.00 per 1,000 gallons.

Process development activity was recently augmented through an award from USAID for further testing and deployment of DELBUOY systems at 10 different sites in the Caribbean Basin. This effort will allow for further sea trials, the solution of real-time problems that develop, and the transfer of assembly and installation know-how to local artisans.

**SUMMARY OF RESULTS:**

Two patents have already been granted and a third application is pending. The economic potential inherent in this novel process has already resulted in the formation of a limited partnership, DELBUOY Systems LP, by a group of private investors. The intent is to commercially manufacture and market DELBUOYs and/or to market water to local utilities. The market potential has been assessed as being substantial.

## FLORIDA SEA GRANT COLLEGE

Building 803, University of Florida, Gainesville 32611  
(904) 392-5870 Suncom 622-5870



### MARINE TECHNOLOGY TRAINING

In the mid-70s, a shortage of 500 professional divers was estimated for the Gulf of Mexico and a need for two to three thousand divers was projected over the next five years for the North Sea oil fields. It was also estimated that 40 percent more mechanics would be needed in 1980 for outboard engines in Florida.

In response, Florida Sea Grant College provided seed money for curriculum development for three courses at Florida Institute of Technology (FIT). An Underwater Technology course was developed in 1975 to provide industry with highly skilled divers holding a two-year Associate of Science Degree in Underwater Technology and who also possessed technical and managerial skills needed in topside support and shore based operations. By the end of the second year the course was self-supporting with members of the Association of Diving Contractors contributing to the program in the form of equipment supplies, educational materials and guest speakers. In some cases they provide short term employment for instructors to update their field experience.

In 1979 the second course was initiated--an outboard mechanics program designed to provide instruction in basic skills required for entry level positions as marine mechanics or for upgrading existing work skills. Major engine manufacturers such as Outboard Marine Corporation, Evinrude Motors, Johnson Motors, and Mercury Marine have supported the program through contributions of equipment and supplies.

A third course--a diesel mechanics program--was started in 1982 using the same "hands on" approach to technical training. Industrial advisory committees helped develop the diesel curriculum with about 30 percent classroom instruction and 70 percent diesel lab work covering all common types of engines and auxiliary components. This eliminates approximately two years of on-the-job training and allows graduates to progress as mechanics into more advanced diesel diagnosis.

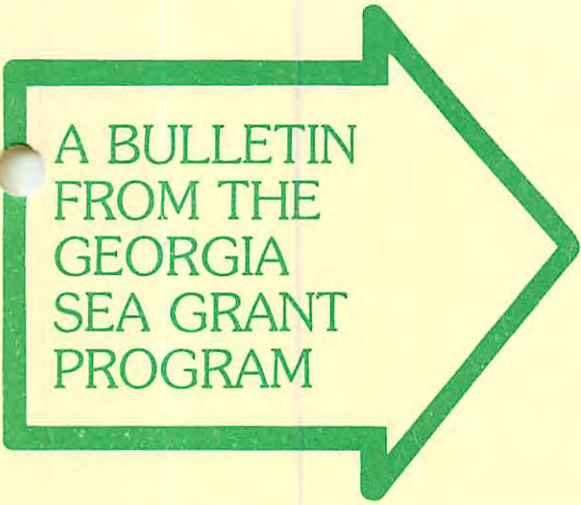
Since 1976, about 90 percent of the divers graduating have taken positions in the diving industry each year. Most of them join major firms servicing offshore oil operations such as Santa Fe Engineering, Subsea International, and Taylor Diving, while others join research and development groups such as Harbor Branch Foundation, Perry Oceanographics or hyperbaric treatment centers.

The outboard mechanics program now graduates factory certified mechanics with all graduates at the end of the initial two-year course finding jobs in their field of training. Enrollment continues strong with contributions from manufacturers and endorsement from the Marine Industries Association of Florida. Through discussions with industry it has been estimated that an FIT graduate will save an employer \$5 per hour for at least two years. With the number of FIT graduates now in the job market, the marine industry can expect to save approximately \$20,800 per student for a total of \$332,800 over a two-year period.

Although still in its initial phase, the same support and placement success is anticipated for the diesel mechanics program. These three courses are now a part of FIT's Marine Technology Offshore Operations program which has been approved by the U.S. Coast Guard with equivalent academic time given in lieu of sea time in applying for licenses.

In addition to U.S. students, 62 students from 24 foreign countries were enrolled in these courses during the Fall 1982 semester.

James C. Cato, Director -- January 1983



A BULLETIN  
FROM THE  
GEORGIA  
SEA GRANT  
PROGRAM

Harvesting of underutilized offshore  
fishes in the southeast

Offshore finfishes in the southeast have been virtually unexploited because the commercial fishery is based mainly on penaeid shrimp and is active for six months a year. There is a need to identify offshore finfish resources, to determine the feasibility of diversifying the operations of shrimp fishermen to harvest these hitherto underutilized resources and to provide a profitable activity for shrimp fishermen during the six months of the non-shrimping season.

The Georgia Sea Grant College Program has been carrying out a program of exploratory fishing in the southeast to identify offshore finfish resources and a program to train shrimp fishermen in techniques of offshore finfishing and use of modern navigational tools.

In the seven years from 1969 to 1975, prior to the beginning of this project, Georgia landings of four offshore fishes (grouper, porgy, red snapper, and other snappers) averaged less than 73,000 pounds per year with an average dockside value of less than \$38,000.

In the four years following the initiation of this project (1976-79), the catch of these same four species, landed by fewer than 10 boats, averaged over 245,000 pounds per year for an increase of 172,000 pounds per year over the average annual catch during the previous seven years. These fish had an average dockside value of more than \$231,000, or almost \$194,000 more than the average annual value for these same species during the previous seven years. With a multiplier effect of 2.5 the value of the increase in catch can be estimated to be almost \$1.94 million.

The minimal long range effect over 30 years should be an increase of over \$5.8 million (dockside value). With a multiplier effect of 2.5, this minimal increase represents more than \$14.5 million. It is important to note that these fish would not have been harvested and marketed without the effort of this project.

University of Hawaii Sea Grant Researchers Advise South  
Pacific Island Nations on Impact of the LOS Treaty

The Problem: The Law of the Sea Treaty negotiations have significantly impacted the boundaries of the insular political jurisdictions in the Pacific in subtle ways which are inherent in their geographic configuration, and hence have not been examined in detail by international arbitral bodies as yet.

The Research: A series of studies by individual researchers and the Law of the Sea Institute have examined the issue of boundaries as they apply to islands and island groups within the context of the current text of the Law of the Sea Treaty. Sea Grant researchers have examined the archipelagic regime in relation to the boundaries of Fiji, Tonga, and the Philippines and the definition of "islands" particularly as it applies to Tonga and Fiji.

Benefits of the Findings:

1. The South Pacific political jurisdictions require reinterpretation of the existing international maritime regimes because they are based on common laws that evolved to meet needs of continental land-based governments. The studies which are being done provide the first serious look at the implications of the Law of Sea Treaty in terms of the cultural traditions of insular societies.
2. In addition to disseminating the "Pacific Way" of interpreting the Law of the Sea provisions, to his colleagues in the U.S. and Europe, researchers are sharing their findings with the legal and academic communities in the South Pacific. Many of the independent nations are too small to support large legal staffs to research the full implications of the finer points of international law and the Law of the Sea even though these laws will vitally affect their fragile economies.
3. This work has done much to foster the goodwill of South Pacific nations toward the United States in a part of the world where the American presence is nearly absent.

Louisiana Sea Grant Researchers Work  
To Save Coastal Wetlands

Louisiana's coastal wetlands, created through centuries of Mississippi River delta-building, are being claimed by the Gulf of Mexico at an alarming rate; as much as 50 square miles are lost yearly. This loss will devastate the nation's most valuable and productive fisheries, eliminate an outdoor recreation paradise, and expose coastal cities like New Orleans to the ravaging forces of waves and hurricanes.

The Louisiana Sea Grant College Program has been in the vanguard of state efforts to understand the reasons for this accelerating coastal decline and to explore management measures that will stem the loss and maintain the high productivity of renewable resources. "Understanding the reasons" calls for deciphering the processes of nutrient cycling, hydrology, and sedimentation in natural wetland systems. It also calls for determining how these processes are affected by levee building, canal dredging, drainage, and pollution.

Researchers have shown that human activities related to flood control and canalization do indeed affect the health of wetlands. Coastal marshes require nourishment to counteract subsidence; when the seasonal recharge of sediment and dissolved nutrients provided by natural rivers is denied, the biomass production of wetlands quickly drops below the levels needed to maintain a land surface against the inexorable forces of subsidence. Permanently flooded soils are not nearly as productive as those having even a thin layer that is exposed to the atmosphere. When dredge spoil banks and levees block the overland flow of flooding rivers and storm tides across the marsh surface, the inevitable result is the breakup of the marsh. Just as detrimental are canals that shunt flow from the land surface too quickly into coastal lakes, bays, and estuaries. Canals allow nutrients to bypass wetland vegetation that needs them for sustained growth, and they create eutrophic conditions in coastal waterbodies that would otherwise be productive habitats for shrimp, fish, and shellfish.

Research that can conclusively demonstrate these kinds of impacts takes a long time to perform. Fortunately Sea Grant researchers in Louisiana began their search for answers nearly fifteen years ago. Now, the region has come alive with projects to halt the erosion of barrier islands; to create freshwater diversions from the Mississippi; to build new levees; and to dredge deeper navigation channels. Agencies like the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, the Louisiana Department of Natural Resources, and the National Marine Fisheries Service look to Sea Grant-sponsored researchers at LSU's Center for Wetland Resources as a foremost source of scientific guidance, data, and assistance in the challenging tasks of restoring and maintaining what's left of America's greatest wetland treasure.

## MAINE/NEW HAMPSHIRE SEA GRANT COLLEGE PROGRAM

The Northern Shrimp Management Committee governs the harvesting of shrimp in the Gulf of Maine. At its January 1981 meeting, the Committee voted to remove tolerances previously allowed by law for shrimp mesh size regulations.

Through its Marine Advisory Agent connections both at universities and state agencies, the Sea Grant College Program soon became aware that under the new regulations few, if any, existing shrimp nets could meet the new measurement requirements. The shrimp harvesting industry became concerned about the cost of replacing nets. Net makers were concerned about what sized twine would meet the specifications once the twine had been stretched through use, and whether they could supply the numbers of needed nets before the beginning of the 1982 shrimp season.

Fishermen and net manufacturers sought the assistance of the Sea Grant-supported Fisheries Technology Service of the Maine Department of Marine Resources. Through careful analysis, the Fisheries Technology Service showed that the new net twine requirement would not enable economic fishing and that the previous allowed tolerances released adequate numbers of juvenile shrimp.

As a result of this new information generated by the Fisheries Technology Service, the Northern Shrimp Management Committee voted at its November 1981 meeting to reinstate shrimp mesh size tolerances for the 1982 season. This action is believed to have saved the industry at least \$1,000,000 - \$750,000 in net replacement costs and \$250,000 in lost harvests.



## UNIVERSITY OF MARYLAND Sea Grant College Program

### CHOLERA AND THE SEAFOOD INDUSTRY

**Problem:** Cholera outbreaks have threatened the public health and jeopardized the seafood industry, especially along the U.S. Gulf Coast.

**Response:** Maryland researchers like Dr. Rita R. Colwell and Dr. James Kaper were among the first to propose that cholera-causing vibrios (*Vibrio cholerae*) lived in the water column as part of the ecology of estuaries like the Chesapeake Bay. By isolating vibrios from the Bay, these scientists demonstrated that traditional notions about cholera--that it existed only in the feces of infected individuals--were wrong.

Maryland Sea Grant headed up a cooperative effort which included the Oregon, Florida and Louisiana Sea Grant Programs that captured, analyzed, labeled and experimented with vibrios from our national waters. Outbreaks of cholera in the southern states added a sense of urgency to the project and threatened the well-being of a seafood industry which suffered from adverse public reaction.

By describing the nature of the cholera-causing bacteria, Sea Grant researchers have helped to dispel some of the mystery and fear surrounding the disease. Investigations have shown that no cholera cases have resulted from eating commercially prepared seafood. To ensure the continued protection of the public health, researchers at Maryland Sea Grant are now establishing a vibrio index that will help set measurements for safe bacterial levels.

**Benefits:** Improved understanding of the cholera-causing vibrio has not only helped describe potential health hazards, but also helped educate the public about a disease that can trigger negative and unnecessary consumer reactions and damage the seafood industry. An outreach program which includes articles, radio spots, publications (including a comprehensive volume published with John Wiley & Sons, Inc.) and lectures continues to dispel the darkness surrounding the public's perception of cholera and its causes.



## MASSACHUSETTS INSTITUTE OF TECHNOLOGY Sea Grant Program

### CLEANING UP OIL SPILLS

#### Problem:

Every time an oil spill occurs someone must estimate the costs of cleanup and determine whether those costs, compared with projected environmental damages, warrant mobilizing a cleanup effort. Those decisions are based on complex analysis of the size of the spill, availability and capability of equipment, and government regulations and estimated values of coastal resources.

#### Solution:

To develop a comprehensive, systems approach to clean up, the Sea Grant Program has been drawing upon MIT's expertise in computer modeling and multidisciplinary research. The project was brought to MIT by Ralph Bianchi, an industrial member of Sea Grant's marine advisory program. At a 1979 MIT meeting on oil spill technologies, he suggested that Sea Grant, with its university base, was the ideal organization to develop an approach that would be credible to the many, and sometimes conflicting, groups affected by spills and responses to them. Bianchi organized an advisory board to outline the range of concerns, supply relevant data, and critique the model as it evolved. The Board, which has met four to five times a year from 1980 through 1982, includes in its membership representatives from the U.S. Coast Guard, U.S. Environmental Protection Agency, national and Massachusetts Offices of Coastal Zone Management, the American Petroleum Institute, the Spill Control Association, equipment manufacturers, major oil companies and environmental groups.

Sea Grant organized the research team, headed by J.D. Nyhart and H. Psaraffis, professors in MIT's Department of Ocean Engineering. The team completed the model in June, 1982. An advisory service plan to make it effective in many geographic areas will be completed in June, 1983. The researchers have gotten the support and cooperation of the U.S. Naval Facilities Engineering Command. Sea Grant and the Navy group are applying all aspects of the model to reduce operational pollution in the Navy's Charleston, South Carolina port. One of the tasks is to use the model's oil spill simulation capability to train personnel for cleanup work.

#### Accomplishments and Benefits To Date

...Environmentalists, spill cleanup companies, the oil industry, and government regulators have been brought together to solve a common problem.

...Petro-Canada is using a simplified version of one part of the model to stockpile and mobilize equipment from three locations to respond to spills from rigs located in the North Atlantic.

...The Central Institute for Industrial Research in Norway has used information from the Sea Grant model to help assess various blowout technologies in the North Sea.



Woods Hole Oceanographic Institution  
Sea Grant Program

Red Tides  
(R/B-20; R/B-41; R/B-39)

Shellfish industries worth well in excess of \$36 million annually are threatened annually by the invasion of red tide into the New England area in recent years. Red tide research at WHOI has revealed aspects of the cause of red tides, timing of the outbreaks and possible factors inhibiting growth of red tide organisms.

The U.S. commercial inshore shellfish catch of hard clams (Mercenaria) in 1981 was worth \$51 million (up 51% from 1979), of which nearly 60% was landed in the New England area. The commercial soft clam catch (Mya) that year was worth \$14 million, of which two-thirds came from New England. In 1980 commercially cultured clams and oysters were worth \$17.9 million and aquaculture of mussels has shown increasing promise. Unfortunately, this optimistic picture is clouded by the appearance in Southern New England waters of a red tide alga responsible for producing paralytic shellfish poisoning (PSP) in humans who eat certain shellfish. The red tide has resulted in many annual closings of shellfish areas in New England since 1972, when it first spread south to Cape Cod. Although the disease is potentially fatal, early cases were effectively treated and monitoring of coastal waters now has considerably reduced the public health threat. The direct economic disruptions to commercial and recreational shellfishermen, aquaculturists and the seafood industry, however, has not been ameliorated and, in fact, can only get worse as use of shellfish increases. Also, there is increasing evidence that the southward spread of red tide toxicity is continuing, posing a potential threat to the rich shellfish areas of the Chesapeake.

Dr. Donald Anderson's comprehensive red tide research, as part of the Woods Hole Sea Grant Program has focused on the following:

- monitoring the initiation, development and decline of red tide events
- determining the fundamental cause of recurrent red tide blooms and factors affecting the distribution of the causative alga
- mapping the distribution of red tide dinoflagellate cysts in New England area waters

Results of this research include the major discovery that the resting stage (or "cyst") is responsible for important aspects of the population cycle. Knowledge of the distribution of the cysts and its response to temperature has allowed Anderson to begin to predict where and when some blooms will occur, including an accurate prediction of a bloom where none was known to have happened before. Research is also being conducted on the role of copper in natural waters as an inhibitory factor in growth of red tide organisms, and the possible role of marine protozoans in controlling red tide outbreaks.

Researchers and representatives of regulatory agencies in Massachusetts, New York and New Jersey have received instruction on identification and culturing of the red tide cysts in Anderson's laboratory at Woods Hole. As a result, separate monitoring and research programs have been started in these areas as well.



## SEA GRANT SAVES LIVES: Cold Water Drowning Research

**Hundreds of lives are saved worldwide per year as a result of Sea Grant sponsored research and education on cold water drowning and revival techniques.**

**Research** - Until 1976, drowning victims submerged underwater for longer than four minutes were generally presumed dead and efforts were not made to resuscitate them. However, based on medical knowledge and first-hand experience, Sea Grant researcher and physician Martin Nemiroff had developed a theory that people submerged for even longer periods of time underwater, especially cold water, could survive with little or no after effects. In 1976, Michigan Sea Grant funded Dr. Nemiroff to further document his theory. His research activities revealed that cold water drowning victims could survive after submersion for as long as an hour if properly resuscitated.

**Outreach** - Through the efforts of Dr. Nemiroff, the U.S. Coast Guard, and Michigan State Police, Michigan Sea Grant began a widespread public information and education program to promote awareness of the nature of cold water near-drowning and resuscitation techniques. Sea Grant communicators assisted in developing and disseminating informational materials through national and international media and other outlets. Advisory service agents began an extensive training and education program to train first responders (such as firemen, sheriffs, water rescue personnel) and those in charge of hospital emergency room treatment of cold water accident victims. Agents also developed support materials to help those already trained to train others.

**Results** - As a result of Sea Grant's research and outreach efforts:

- The Coast Guard estimates a 25% drop in drowning fatalities. The Coast Guard has been training its personnel and has carried out a wide-reaching campaign to teach boaters about cold water near-drowning and revival measures.
- Hospitals across the nation have set up emergency teams to handle near-drownings and have obtained special equipment to handle these cases. National and international medical personnel have been trained in cold water near-drowning revival techniques.
- Water safety manuals used by the Coast Guard, hospitals, and Red Cross have been rewritten to incorporate information on cold water near-drowning rescue techniques.
- Michigan Marine Advisory Service Agents have informed, educated, and/or trained over 5000 persons (first responders, emergency medical personnel), and others about near-drowning and rescue procedures.
- The Michigan Marine Advisory Service and the Communications program have prepared publications on emergency treatment of near-drowning victims which are now distributed by the Coast Guard, Departments of Natural Resources, and other organizations.

For further information contact:

Lillian Jarman, Communications - Michigan Sea Grant College Program  
2200 Bonisteel Boulevard, Ann Arbor, Michigan 48109, (313) 764-1138



# Minnesota Sea Grant Institute

116 Classroom-Office Building - University of Minnesota - 1994 Buford Avenue - St. Paul, Minnesota 55108  
Phone: (612) 373-1708

## MAJOR PROGRAM ACHIEVEMENT

### TOPIC: CRYOPRESERVATION OF FISH SPERM AND EGGS

PROBLEM: To develop capability to store and ship spermatozoa and fertilized eggs of fishes for use in breeding and raising fishes.

RESEARCH ACTIVITY: Examine in the laboratory the factors which affect the freezing, storage, and thawing of spermatozoa and both unfertilized and fertilized eggs; develop refined extenders (antifreeze) and a computerized freezer for handling sperm and eggs.

ANTICIPATED BENEFITS: Cryopreservation of gametes facilitates transportation of gametes to needed locations throughout the world, reduces the number of males that must be maintained as brood stock, and eliminates detrimental effects of disparate ripening between sexes. It allows the genetic manipulation of fish populations, and establishes hatchery production on a year round basis. In addition, there is reduction or removal of the time element from artificial propagation.

IDENTIFIED BENEFITS TO DATE: Dr. Graham's research investigating the preservation of fish spermatozoa and ova has resulted in both the accumulation of basic data concerning fish gametes, as well as findings of practical importance to aquaculture programs. The collection, dilution, and storage of semen at low temperatures offers aquaculturists the mechanisms for maximum utilization or reproductive potential during a spawning season. Techniques such as the collection of semen from sacrificed fish and semen extension result in sperm numbers and semen volumes that ensure optimal fertilization of available eggs.

Although frozen semen may not be ready for widespread application at this time, present techniques may allow for workable populations of genetically important lines to be retained indefinitely. Furthermore, this research has resulted in interactions with individuals involved in fisheries management. These individuals have served to increase knowledge of the physiology of reproduction of fishes, and also provided an awareness of potential mechanisms for improved fish reproductive performance.



# Mississippi-Alabama Sea Grant Consortium

## ADMINISTRATIVE OFFICES

Caylor Building - Gulf Coast Research Laboratory - Ocean Springs, Mississippi 39564 - (601) 875-9341

## MISSISSIPPI-ALABAMA SEA GRANT CONSORTIUM MAJOR ACIEVEMENTS - ONE EXAMPLE

Declining catch per unit effort, and sharply increasing fuel costs have created severe economic problems for the Gulf Shrimp Fleet.

Presently 1.25 gallons of diesel fuel are required to land each pound of the 200 million pounds of shrimp landed annually in the gulf. Area shrimpers approached Sea Grant through the Advisory Service, for assistance in alleviating their problem.

In 1980, the Mississippi-Alabama Sea Grant Consortium in cooperation with the National Marine fisheries Service and the Gulf and South Atlantic Fisheries Development Foundation initiated a program to categorize fuel consumption patterns of shrimpers by size and power. Through the use of ship mounted fuel monitoring computers and a system of on board observers, the program has been able to identify usage patterns and suggest where savings might be made.

Through the use of improved fuel management practices, fuel savings of 8% to 10% have been observed on representative shrimp boats. If applied across the Gulf Shrimp Fleet, an estimated \$25 million annually could be realized.

*"DEDICATED TO MARINE RESEARCH, EDUCATION AND PUBLIC SERVICES"*

AUBURN UNIVERSITY  
Auburn University, Alabama 36849  
GULF COAST RESEARCH LABORATORY  
Ocean Springs, Mississippi 39564

JACKSON STATE UNIVERSITY  
Jackson, Mississippi 39217  
MARINE ENVIRONMENTAL SCIENCES CONSORTIUM  
Dauphin Island, Alabama 36528

MISSISSIPPI STATE UNIVERSITY  
Mississippi State, Mississippi 39762  
UNIVERSITY OF ALABAMA  
University, Alabama 35486

UNIVERSITY OF ALABAMA IN BIRMINGHAM  
Birmingham, Alabama 35294

UNIVERSITY OF MISSISSIPPI  
University, Mississippi 38677

UNIVERSITY OF SOUTH ALABAMA  
Mobile, Alabama 36688  
UNIVERSITY OF SOUTHERN MISSISSIPPI  
Hattiesburg, Mississippi 39401

University of New Hampshire/University of Maine  
Sea Grant College Program  
Major Program Achievement

The New Hampshire coastline experienced its first major red tide bloom in 1972 with subsequent occurrences in 1974, 1975, and 1982. Each time it was necessary to close shellfish beds because of the rise in paralytic shellfish poison (PSP) in clams, mussels, and oysters consumed by the public. This rise in poison level is due to the ingestion of toxic red tide organisms by filter-feeding bivalves and the subsequent accumulation of the poison in their tissues.

After the initial outbreak in 1972 it became clear that New Hampshire fish/game and public health officials were in need of sophisticated, analytic techniques for the rapid isolation, determination and detection of PSP. In cooperation with the N.H. Fish and Game Department and the N.H. Public Health Laboratory, Sea Grant researchers developed a new, simple fluorometric method for detecting toxins produced by Gonyaulax tamarensis on a thin-layer chromatogram. The method is extremely sensitive and can detect minute amounts of toxin. It is in the order of 100 x more sensitive than the standard mouse bioassay, and has a lower range of error than the bioassays  $\pm 20\%$ . Scientists in Alaska, Rhode Island, Wisconsin, and California, as well as those in New Hampshire, involved in red tide detection, are currently utilizing the fluorometric method developed by the UNH/UMe Sea Grant researchers.

The new detection method has proven equally valuable to researchers studying certain toxic fresh water blue-green algae (Cyanobacteria) which are implicated in kills of livestock, birds and fishes worldwide. (See W.W. Carmichael (ed.), The Water Environment: Algal Toxins and Health, Plenum Press, New York and London, 1981). In addition, the neurobiological results from the project have been instrumental in the recent rapid growth of the use of saxatoxin as a research tool.

A simple fluorometric method has also been developed for the determination of PSP's. The results have shown promise in the case of toxic New England shellfish and offer an alternative method to the mouse bioassay. State of New Hampshire officials and UNH researchers are continuing their cooperation in an ongoing comparison between the bioassay and fluorometric methods using shellfish samples from the field. The long term goal is to establish the fluorometric method as a complement, or eventual replacement, for the bioassay in this and other states with red tide problems. In addition to the public health benefits and savings to the shellfish industry, the savings to the states in testing expense would be substantial.

IMPROVED WEATHER AND SEA SURFACE TEMPERATURE INFORMATION  
AIDS FISHERMEN AND REDUCES COSTS

1. New Jersey has a significant offshore big game sportfishery and long-line swordfish industry, which are dependent on sea surface water temperatures. Increasing energy costs have burdened the fishery since it requires about a 60-mile run to reach the Baltimore and Hudson Canyons. In the past, boat captains searched for a particular water temperature pattern consuming costly fuel in the process. Our Sea Grant Cooperative Extension Agent has worked with the Swordfish Association, many charter boat captains, and other boat captains to demonstrate the utility of isotherm charts produced by other components of the National Oceanic and Atmospheric Administration and the U.S. Navy.

This partnership program involving the commercial and sport fisheries, government, and academia has proved highly successful. The subscription program which sends charts to 135 commercial and sport fisheries from Maine to Maryland has conserved fuel, enhanced catches, and coupled with the canyon weather forecast has provided more successful, safer fishing for the offshore boats, which range from 24 feet to over 90 feet in length. The President of the American Swordfish Association estimated that in one year only these charts saved the east coast swordfishermen \$2.25 million in fuel costs and resulted in greater catches.

One Sea Grant Extension Agent will also serve as the key coordinator in the Mid-Atlantic Region for the initiation of the National Weather Service's Marine Reporting (MAREP) System, which will serve to update weather forecasts and provide additional sea surface temperatures, thus improving forecasts and other oceanographic products throughout the region.

2. The New Jersey Sea Grant Extension Service has entered into a highly successful offshore canyon weather forecasting program through the auspices of the Bendix Field Engineering Corporation's Marine Science Services Branch, a New Jersey Sea Grant Program advisor. The forecast which has been used by sport and commercial fishermen from Montauk, New York, to Ocean City, Maryland, has proved to be a highly trusted and well used service. Over 6,000 calls were logged during 1982, and it was estimated that \$1.25 million in trip costs was saved by the sportfishermen alone in the 1981 season. This service has also led to a Sea Grant project being carried out by Bendix and the Extension agents to analyze the weather constraints of the New Jersey fishing industry.

**PROBLEM:** Low-cost ways to protect harbors from wind and waves were being sought, but existing engineering design principles were not adequate.

**RESPONSE:** Floating-tire breakwaters (FTBs) were developed in Sea Grant's early days as a cooperative project with Goodyear Tire Company. Early FTB designs were widely used, often with great success. But the early developmental work on the concept was insufficient to inspire broad commercialization: mooring designs and specifications were not offered, and some of the FTB designs worked poorly or were short-lived.

Sea Grant extension specialists requested better engineering specifications for wave-protection devices. Communities and businesses were asking them about this technology--now aging and incomplete. But they were reluctant to make recommendations, given the state-of-the-art. Engineering experiments undertaken collaboratively in New York, Rhode Island, California, and Canada resulted in detailed specifications for mooring systems and in the development of new concepts, particularly the Pipe-Tire floating system. While considerably more expensive than the older FTBs, this new design could withstand stronger and larger waves and had a longer lifetime.

A Sea Grant Extension manual that provided full information on how to build an FTB now needed to be updated. The original version has been widely used in the United States and Canada and translated into French and German. A new manual, which includes current state-of-the-art technology, describes a wide variety of design options and their performance criteria, as well as how these have actually performed. Publication costs for this new manual are being met in part by grants from industry.

**RESULTS:** One of the first innovations of the National Sea Grant College Program--FTBs--has now matured into a more highly developed state. Engineering research has produced new specifications, now transmitted through marine advisory service into a form usable by communities and businesses. FTBs are being installed in increasing numbers not only throughout the United States but in other nations as well.

New York Sea Grant Institute  
of  
State University of New York and Cornell University



105 1911 Building  
North Carolina State University  
Raleigh, North Carolina 27650  
919 737-2454

---

North Carolina Sea Grant at Work

The desire to live and build on the coast is compelling, but the environment there is fragile. In North Carolina, for example, where an estimated 70 to 80 percent of coastal soils are unsuitable for conventional, on-site sewage disposal, coastal communities have often been faced with septic systems that are too expensive or with an outright ban on new construction. There are no easy solutions to the problem, but Sea Grant research has made possible construction on sites previously thought unsuitable while at the same time protecting shellfish waters from contamination.

In 1977 Sea Grant began funding research on coastal septic systems. That research led to the development of two "alternative" septic systems that work where conventional systems fail, in the stubborn, wet clays along estuarine shorelines. Coupled with Sea Grant studies of viral contamination, the research showed that effluent could be controlled and treated without endangering shellfish in nearby waters. Unlike many traditional systems, the alternative designs don't allow effluent into the run-off. As a result of Sea Grant research, communities throughout the Southeast and as far away as Texas, have used the designs to help solve their own waste-treatment problems. (Two manuals on the design of these systems are available from UNC Sea Grant.)

Now Sea Grant is extending the study to the coarse and sandy soils of the barrier islands, where only 15 percent of the land is suitable for conventional on-site sewage disposal. Researchers are testing the designs, which employ low-pressure pumps to "dose" effluent evenly into shallow soils, to see how much vertical separation is required between the pipes and water tables. At the same time, researchers will monitor the sites, tracing the movement of harmful viruses through the soils. With the completion of this research, some island homeowners may eventually have safer, more effective waste-treatment systems.

Already, the economic benefits of Sea Grant's research into septic systems --- in new construction and direct savings --- are estimated well into the millions of dollars.

\* \* \*





## THE VALUE OF NETWORK COOPERATION

Development of markets for underutilized species has long been a goal of Ohio Sea Grant and a request from Ohio commercial fishermen. In fact, this past year Dave Kelch conducted taste tests and evaluations using freshwater drum with well over 7,000 people. These have been very successful; sales of drum increased 80 percent between 1980 and 1981. But, of much greater benefit and an effort which truly shows the value of the National Sea Grant Program, is the development of a rough fish market for crawfish bait in Louisiana.

The Louisiana crawfish industry is very large with thousands of acres in production and a value of \$80 million per year. These crawfish are for human consumption and must be trapped. Oily freshwater fish are the preferred bait. This bait is in short supply during the spring of each year, which coincides with the greatest catches of rough fish from Lake Erie.

Louisiana Sea Grant Agent Gerald Horst, while reading an article by Fred Snyder in our newsletter, "Twine Line," saw that we were looking for new markets for gizzard shad, carp, goldfish and other underutilized species. Gerald contacted Fred to discuss the possibilities of shipping these fish to Louisiana for bait. Fred brought agent Dave Kelch into the effort because Dave's program area is market development.

Working with Texas Sea Grant agents, Dave was able to get lists of all the bait dealers in the south to which he subsequently sent questionnaires to characterize their bait needs. Dave then presented these results to the Ohio Fish Producer's Association.

Prior to the spring fishing season, the Ohio Fish Producers sent two representatives with Fred and Dave to Louisiana to meet directly with bait dealers. Louisiana Sea Grant agents made reservations in hotels for the group and organized tours of the crawfish farms and meetings with bait dealers.

While in Louisiana, agreements were reached concerning price, product form and species. During the first month after ice-out on Lake Erie, 250,000 pounds of shad were shipped by truck to Louisiana. It is expected that this market will grow as the Louisiana need is great and Lake Erie could supply about 10 million pounds of rough fish per year. It means a badly needed supply of bait for Louisiana and new markets and jobs in the Ohio fishing industry.

Ohio Sea Grant Program  
The Ohio State University  
484 W. 12th Avenue  
Columbus, Ohio 43210



PRESERVING OREGON'S OYSTER INDUSTRY  
A multi-agency effort spearheaded by OSU Sea Grant

The goal of the Oregon State University Sea Grant College Program is to put our oceans to work through a partnership of industry, government and the university. One good example of how well this partnership works: a pollution abatement and regulatory program was developed that helped save Oregon's oyster industry from closure. The closure would have had far reaching impacts—affecting tourism, fishing and recreational clamming, upon which the coastal economy depends.

**ABSTRACT:** In 1977, the Federal Food and Drug Administration (FDA) threatened to close down the Oregon oyster industry because of water pollution coming from several sources. Oyster growers asked OSU Sea Grant for technical help. A Sea Grant seafood specialist in microbiology, a Sea Grant marine advisor and an OSU agriculture extension agent brought regulatory agencies, oystermen and dairy farmers together to clean up the bay and save the industry. The four-year project is a success story of industry, government and university representatives working together to solve a problem.

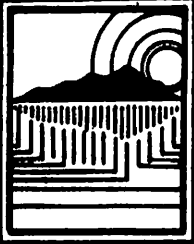
**BACKGROUND:** In Oregon, the Department of Environmental Quality (DEQ) is charged with developing water quality management plans that meet requirements of the 1972 Federal Water Pollution Control Act. DEQ handles sampling of shellfish-growing water, while the Oregon Health Division and the FDA cooperatively administer the National Shellfish Sanitation Program. The primary-oyster growing area, Tillamook Bay, is 6 miles long by 2 miles wide, with a 363,520-acre drainage basin. It is a multiple-use estuary with two major industries: oysters and dairies. The two industries are not very compatible and further complications come from five sewage treatment plants depositing treated sewage in the bay.

**THE PROBLEM:** Because of problems with these plants and dairy-waste runoff during heavy rains, Tillamook Bay failed state and federal shellfish-growing water bacterial standards. The FDA often criticized Oregon's shellfish sanitation program, threatening to remove its federal endorsement in 1977. Without this endorsement, oyster growers could not ship across state lines. The problems were broader: the coastal economy depends on tourism. Tourists, who fish mainly for salmon and dig for clams, might mistakenly think all the estuaries were polluted and avoid Oregon.

**THE APPROACH:** Oyster growers asked OSU Sea Grant for help and advice. Sea Grant began researching the source and severity of Tillamook Bay pollution, helping to form a task force to make recommendations. The task force was made up of (1) the oyster industry, (2) the Oregon Health Division, (3) the DEQ, (4) the Oregon Department of Agriculture, (5) the Oregon Department of Fish and Wildlife, and (6) Sea Grant.

**RESULTS:** The task force developed a comprehensive shellfish sanitation program and bay management model to protect public health, while maintaining the shellfish industry. The recommendations made and followed include strategies which allowed the five sewage treatment plants to meet EPA standards set for shellfish-growing waters and plans designed to reduce dairy farm pollution. Specific recommendations included (1) the hiring of a full-time shellfish sanitation specialist to coordinate the sanitation program and respond to emergencies; (2) the setting of pollution standards for closing Oregon bays to shellfish harvesting; (3) the sampling of shellfish meat for fecal coliform and *Salmonella*, not simply testing for bacteria in water; (4) more frequent water quality monitoring by DEQ; and (5) closure criteria for the bay. Currently, some 88 dairymen (out of 115) have signed up for some \$3 million in construction funds available through the U.S. Department of Agriculture, under the Rural Clean Water Act. The funds—disbursed by the Agricultural Stabilization and Conservation Service and applied with the help of the Soil Conservation Service and OSU Extension—are being used to build protective shelters and storage units for dairy wastes. Dairy farmers, in turn, are using additional private funds for further dairy improvements, which is helping the local economy.





# Sea Grant Program

## UNIVERSITY OF PUERTO RICO

### Problem:

Lack of toxic fish samples and little communication between research groups hampers ciguatera break-through.

News of a ciguatera outbreak depress fishing and the seafood industry.

### Description:

Ciguatera fish poisoning is a human health problem that has increasingly affected not only the people of Puerto Rico, but all persons living near tropical seas for whom the marine fish represent a significant source of food. The agent (s) responsible for human intoxication is ciguatoxin (CTX).

At present, the precise chemical nature of the active material is not well understood. The toxin, while it is found in the flesh of the pisonous animal, appears to be concentrated in the liver. The mechanism of this hepatic accumulation is not well understood either, and the precise nature of the pharmacological action of ciguatoxin has not been defined. The lack of information concerning ciguatoxin is in large measure due to difficulties in obtaining and isolating the partially purified toxic agent.

The University of Puerto Rico Sea Grant Program has invited other Sea Grant programs involved in ciguatera research to collaborate and exchange information. Among those responding and contributing are SUNY/Cornell, Hawaii, South Carolina, and Puerto Rico.

Also, the U.P.R. Sea Grant Program co-sponsored a ciguatera conference in November, 1981. Other co-sponsors were the Caribbean Fishery Management Council and Puerto Rico's Corporation for the Development of Marine Resources (CODREMAR). Attending the conference were the leaders of the major research efforts on ciguatera in the nation, such as Dr. Thomas Higerd (Medical University of South Carolina); Dr. Paul Scheuer (University of Hawaii); Dr. David Jollow (MUSC); Dr. Edward Rogelis (Food and Drug Administration); Dr. Robert Galbraith (MUSC); Dr. Donald Tindall (Southern Illinois University); Dr. Nancy Withers (U.H.); Dr. Joseph McMillan (College of the Virgin Islands); Dr. Donald Miller (S.I.U.); Dr. Carol Tachett (Center for Disease Control of Atlanta); Mr. Fred Lewis, Attorney from Miami; and Dr. David Olsen (St. Thomas Division of Fish & Wildlife).

A major problem in isolation the ciguatoxin has been the dearth of samples known to be toxic. Fish are known to be toxic only after they have affected the persons that have consumed them. Sea Grant has issued calls for fish samples and fish left-overs from cases known to have caused disease. Samples and left-overs of known toxicity have thus been obtained and have been extracted. Sea Grant is sponsoring a research program on the origin, detection and the chemical nature of ciguatoxin.

Reports of ciguatera outbreaks affect the fisherman, seafood distributors, and seafood restaurants. The public simply refuses to purchase or consume fish products during a reported ciguatera outbreak. Sea Grant has endeavored to publicize which fish and seafoods are safe to eat, and how to avoid ciguatera poisoning by selecting small whole fish versus large fish or large fish fillets.

### Results:

A major joint effort for dealing with ciguatera and for exchanging information among ciguatera research groups has been generated by the University of Puerto Rico Sea Grant Program.

Calls for contaminated fish samples have produced specimens which have been extracted in the laboratory.

Sea Grant has offered information and advice during ciguatera outbreaks to alleviate the economic hardship on the industry caused by the reluctance of the public to consume fish and seafood during reports of a ciguatera episode.

# SEA GRANT BENEFITS



## UNIVERSITY OF RHODE ISLAND

FIELD DEMONSTRATIONS OF ALTERNATIVE FISHING METHODS, DISSEMINATION OF INFORMATION ABOUT FISHING GEAR, AND RESEARCH INTO FISH PRESERVATION AND FUEL-EFFICIENT FISHING TRAWLS ARE PART OF THE UNIVERSITY OF RHODE ISLAND SEA GRANT PROGRAM'S FISHING TECHNOLOGY EFFORT. COST OF THE TEN YEAR DEVELOPMENT PROGRAM TO THE FEDERAL GOVERNMENT, THE UNIVERSITY AND THE FISHING INDUSTRY HAS BEEN \$450,000. BENEFITS TO JUST ONE GROUP OF NORTH-EAST SKIPPERS USING ONLY ONE OF THE ALTERNATIVE FISHING METHODS INTRODUCED BY URI, PAIR TRAWLING, HAS BEEN NEARLY \$2,000,000.

Advisory. URI commercial fishing specialists have introduced to the New England fleet such fishing methods as midwater pair trawling, Scottish seining, single vessel midwater trawling and pair demersal trawling. Adoption of these methods has spread to other coasts. Recently the relocation of the National Marine Fisheries Service fisheries engineering group and its demonstration fishing vessel at URI has fostered closer cooperation between URI and NMFS. An initial project has been the demonstration of squid jigging gear; currently this gear, which allows landing of superior quality squid, is being tested by industry.

To date, URI's major contribution to gear design has been the high rise URI 340. High rise nets are now commonly produced by U.S. netmakers. In 1980 a net testing and design program using URI's ocean engineering tow tank was begun. One product will be data sheets providing performance information on commonly used nets such as the Yankee trawl. Fishermen are encouraged to try out gear modifications in the tank before undertaking at sea trials. Loss of gear from faulty changes can be as much as \$10,000 for a medium sized fishing vessel.

Demonstrations and short courses are also conducted on fishing aids, such as warp tension meters which can help avoid gear loss, and more sophisticated electronic equipment which can increase catches. For example, published results from ground surveys made with color sounder fish finding equipment will enable skippers to calibrate their color sounders.

Other advisory projects have included the establishment of a vessel stability analysis service and an at-sea fishing vessel weather reporting system in cooperation with the National Weather Service. Both have contributed to safer and more efficient operations.

Research. A new net design which incorporates low drag features for more efficient use of fuel has been designed using the tow tank. A full scale net will be tested on three size classes of draggers in the commercial fleet. Methods for extension of shelf life for fish both aboard vessels and ashore have been developed and are being tested by industry.

Education. On a daily basis the URI commercial fishing program answers requests for information from all sectors of the fishing industry. The annual Fishermen's Forum, a format pioneered by URI in 1960 and now used by many states, provides an opportunity for presentation of up-to-date information. Training courses in fishing technology are offered during the slack fishing season. An in-depth commercial fisheries training curriculum offers more formalized training. Outlets for information distribution include the bimonthly Commercial Fisheries Newsletter, the monthly column "Gear Talk" in the National Fisherman, publications, articles for the print media and the weekly New England radio show SPLIT AND HOIST.

For further information: Dr. Niels Rorholm, (401)792-2553

# THE SOUTH CAROLINA SEA GRANT CONSORTIUM

221 FORT JOHNSON ROAD  
JAMES ISLAND  
CHARLESTON, SC  
29412  
TEL: (803)795-9650

## BOARD OF TRUSTEES

Dr. Bill L. Atchley  
President  
Clemson University

Dr. Edward M. Collins, Jr.  
President  
College of Charleston

Dr. James Holderman  
President  
University of South Carolina

Dr. James B. Edwards  
President  
Medical University of  
South Carolina

Dr. Maceo Nance  
President  
South Carolina State College

Major General James A. Grimsley, Jr.  
Chairman  
President  
The Citadel

James A. Timmerman  
Executive Director  
South Carolina Wildlife and  
Marine Resources Department

## MAJOR PROGRAM ACHIEVEMENT

PROBLEM STATEMENT - To assist industry in the development of commercial-scale hard clam mariculture in South Carolina.

RESEARCH/OUTREACH ACTIVITIES - The South Carolina Sea Grant Consortium, the S. C. Wildlife and Marine Resources Department, and Trident Seafarms, Inc. structured a cooperative program to determine the operational and economic potentials of commercial hard clam mariculture in South Carolina. The project is a cooperative facility where Trident Seafarms, Inc. provides all production facilities, personnel, and equipment; the Department provides technical direction and support facilities; and the Sea Grant Consortium provides funds for experimentation on specified mariculture protocols, systems, equipment, and for information dissemination and technology transfer.

The research project involved the evaluation of operational protocols (nursery and field grow-out methods) particularly in relation to constraints associated with optimum production parameters. Ancillary to this primary objective, extant legislation, management policies, and license/permit regulations were examined and reviewed for their applicability to aquaculture in South Carolina.

SUMMARY OF RESULTS - A commercial-scale hard clam mariculture demonstration facility in South Carolina is the major accomplishment of this project. This system has been, and continues to act as, a realistic model for economic evaluations, research, and education as well as a source of non-proprietary information. Some 500 individuals have visited the facility, including legislators on fact finding visits, educators, visiting foreign dignitaries, researchers, students, entrepreneurs, regulatory agency personnel and others. In addition, commercial users have included Bluepoints Company and Bristol Shellfish Farms, both of whom employed project-generated technology in their renovation projects. Fiberglass Specialist, Inc., a local manufacturing company, used project specifications to produce a line of aquaculture-oriented products.

DATE OF RESEARCH ACTIVITY - September, 1979 to August, 1982.

## Water Safety in Texas

In 1979, Sea Grant researchers, concerned about the more than 600 drownings in Texas each year, reviewed state and county records to discover patterns associated with these fatalities. This modest study led to a number of activities designed to improve water safety at the local, state, and national levels.

First, to improve the usefulness of information about aquatic accidents and deaths, the investigators, with the cooperation of the Texas Parks and Wildlife Department developed a standard reporting form for use in Texas. In addition, they worked with the United States Lifesaving Association (USLA) on a coast-to-coast reporting system that will enable easy comparison of drowning incidents at beaches in different areas.

Second, it quickly became apparent that the absence of water safety standards on Texas beaches was a significant factor in accidents and fatalities. In April 1980 they hosted a Conference to Develop Guidelines for Open-Water Recreational Beach Standards. Experts in water safety from around the country discussed standards and drafted guidelines for lifeguard qualifications, training, management and equipment.

Later that year, the Galveston, Texas, beaches were used to test the guidelines recommended at the Conference. With funding support from the City of Galveston and the philanthropic Moody Foundation, the beach patrol became part of the Sheriff's Department, the staff was increased and up-to-date lifesaving equipment was purchased. This revamping of the beach patrol raised Galveston's beaches to among the best protected in the country.

Third, in 1981 the Texas Legislature used findings from the study as the basis for increasing the state's hotel-motel tax structure to expand support for beach cleaning, beach patrol, and lifeguard services.

Finally, the researchers recommendations for water safety were widely disseminated through the information, advisory, and educational parts of the Sea Grant program. The Marine Information Service, working with the Galveston County Marine Advisory Service agent and the Galveston County Medical Society Auxilliary, produced and distributed a safety brochure in English and Spanish. In addition, it developed and distributed an instructional unit on beach and water safety to the 4000 teachers receiving the Sea Grant program's quarterly education newsletter.

### TEXAS A&M SEA GRANT PROGRAM

Contact: Dr. James McCloy, Director  
Coastal Zone Laboratory  
Texas A&M University at Galveston  
Galveston, TX 77553  
(713) 766-3265

Prepared by: L.R. King  
(713) 845-3854

## SEA GRANT AT VIRGINIA TECH MARKETS SEAFOOD PRODUCTS TO INLAND STATES

Last year, the seafood canning industry was faced with two major problems. One occurred on the West Coast involving salmon. The other problem, on the East Coast, involved Blue Crab meat. Both of these problems were due to a lack of quality assurance programs administered by the Seafood Processing Industry. The salmon recall was one of the greatest product recall programs in history and was international in scope. The East Coast problem was minimized through rapid action by Sea Grant, the Seafood Industry, the can producers, and the Food and Drug Administration.

Three Blue Crab meat processing companies, one in Florida and two in Virginia, were found to have produced can products which did not have can seams meeting acceptable standards. Because of the potential danger of food poisoning through improperly sealed cans, the Food and Drug Administration requested that each processor recall their product so that a determination could be made as to how to proceed under the circumstances. One of the Virginia processors had to recall \$65,000 worth of products and the other \$15,000. Sea Grant at Virginia Tech developed an integrated program to minimize the impact of these recalls not only for the Virginia industry, but also for the total industry within the country. The benefits of the program were as follows:

1. Cooperation was initiated with can companies, the Food and Drug Administration, the Shellfish Institute of North America, and Virginia Tech to produce a training manual. If this manual is followed by processors, it will enable them to produce high quality products.
2. A training course was held for all Virginia processors. Participants were given instructions on how to pasteurize crab meat, store crab meat, and how to evaluate successful can seam closures.
3. Local marine extension agents scheduled follow up visits for each processor in the State to check their pasteurization processes for efficiency.
4. A color coded can seaming form was developed in cooperation with the can industry and the Food and Drug Administration. For the first time, specific standards for can closures were detailed in a simple to follow format. The color coded form indicates at a glance whether any particular reading is questionable, acceptable, or not acceptable.
5. Sea Grant at Virginia Tech also gave assistance to the two Virginia Blue Crab meat processors who had recalled products. As a result, both companies were able to reprocess their products under Food and Drug Administration guidelines and place the products back into the marketplace. As a result, \$70,000 worth of products was saved from destruction or rejection.
6. The Seafood Industry has also requested that the State Virginia Health Department require that each dealer who wishes to produce pasteurized crab meat be required to attend a Sea Grant training program related to the production of high quality crab meat.



## Washington Sea Grant Program—a university-based partnership with industry, government, and citizens that is providing innovative leadership for addressing problems and opportunities of marine resource conservation and management—

Although fishermen have been using echo sounders to locate fish for almost half a century, it is only since the early 1970s that fishery managers have had access to acoustic equipment with the precision and sophistication needed for accurate and practical assessment of fish populations. Hydroacoustic surveys are cheaper, quicker, and more accurate than traditional net sampling, and cost, speed, and accuracy are important factors when determining the number of fish that can be harvested without endangering future yields.

Much of the technology associated with this equipment and its use has stemmed from research at the University of Washington which combined the talents of biologists, engineers, and physicists to apply the science of hydroacoustics to the problem of fisheries assessment and to transfer the resulting technology to management agencies.

Benefits of this Washington Sea Grant research include the following:

- \* **Improved precision in acoustic surveys** which has made it possible to increase substantially the yields of several fisheries while permitting adequate escapement for spawning.

- \* **The birth of a new domestic industry**—the manufacture of high precision acoustic instrumentation needed for research and fishery management agencies. Biosonics, Inc., formed in 1978 by former Sea Grant researchers, today employs more than 60 people and annually manufactures and sells several million dollars worth of equipment to customers throughout the United States and eight foreign countries.

- \* **A new technology for studying fish behavior** around water intakes of such diverse structures as near-shore thermal power plants, hydroelectric turbines, and pumps that force sea water into offshore oil fields to increase oil recovery. These studies are guiding design engineers and plant operators in the modification of structures and operating procedures to minimize the ingestion of fish.

- \* **Improved design and use of fish nets** for both sampling and harvesting. In order to compare the efficiency of alternative net designs or procedures, it is necessary to know the population density and behavior of fish in a test area. These factors can vary widely over brief time intervals for many reasons, but an acoustic survey conducted simultaneously with each test cycle permits accurate assessment of fish density and behavior.

- \* **Development of hydroacoustic tools and methods** used by the National Marine Fisheries Service and the fisheries management agencies of Washington, Alaska, and British Columbia to

- routinely assess herring and pollock stocks

- monitor juvenile salmon in regional lakes

- measure potential yield of new fisheries such as hake

- \* **Trained personnel** for fishery management agencies. Many personnel in the above agencies have received their training in academic programs and short courses supported by Washington Sea Grant.

Acoustics is neither the final nor the complete answer to stock assessment. Nets still are required so that specimens can be captured for species identification, and acoustic performance is marginal for fish very close to the sea bottom or the water surface. Much remains to be done, but benefits to date more than exceed dollars invested in this research.

### More information?

For a catalog of Washington Sea Grant publications, a directory of current projects, or the latest biennial report, write:

Washington Sea Grant Communications  
College of Ocean & Fishery Sciences  
University of Washington  
Seattle, WA 98195

## Benefits of Marine Acoustics Research





## THE UNIVERSITY OF WISCONSIN SEA GRANT PROGRAM

### A NEW APPROACH TO MEETING WATER QUALITY STANDARDS

#### PROBLEM

Because of very heavy waste discharges to the Lower Fox and Upper Wisconsin rivers, federal guidelines required the State of Wisconsin to establish pollution control regulations for stretches of these two rivers that were stricter than those normally required to meet federal water quality standards. Lower Fox River discharges affect water quality in Green Bay and Lake Michigan, while Upper Wisconsin River discharges affect water quality in the Lower Wisconsin and ultimately the Mississippi River.

The problem: How could such strict standards be met in an economically viable and cost-effective manner?

#### APPROACH

Two University of Wisconsin Sea Grant investigators, working with the state government, local communities and the paper industry, developed an innovative approach to pollution control that involves government-regulated discharge permit markets. In the fall of 1981, the Wisconsin Department of Natural Resources (WDNR) adopted such a pollution control strategy in its new regulations for the Lower Fox and Upper Wisconsin rivers.

The new regulations include two significant innovations. First, instead of the usual practice of fixing a single, absolute total on the amount of waste that industries and municipalities can discharge at any time, the new permit system allows discharge levels to vary according to the river's varying ability to absorb wastes as determined by its flow and temperature. The second innovation involves the use of "transferable discharge permits" ("TDPs").

The UW Sea Grant investigators helped create the flexible new discharge standards and were the driving force—in cooperation with the WDNR and industry experts—in setting up the TDP system for Wisconsin. Under the TDP concept, though *all dischargers* would continue to have to meet the *basic* federal water quality standards, *each discharger* has the alternative of going to the permit market, rather than making major capital investments in pollution control devices, to meet the *stricter* standards for the Lower Fox and Upper Wisconsin rivers. In other words, a discharger who cannot presently meet the stricter standards could pay one or more other dischargers on the same stretch of river who have already met those standards to reduce their discharges even more. In sum, the water quality standard for the river would be met and at less cost to all dischargers involved. Such a concept could lead to more efficient, cost-effective implementation of pollution regulations and improved water quality in less time.

#### SOLUTION

Under the new rules, Wisconsin has already allowed one Fox River paper mill to join a municipality in a TDP trade involving sewage treatment. The industry reduced its discharges and the municipality increased its discharges at a cost savings to both. Two other paper companies are currently looking into a transfer of discharge requirements. The TDP approach, though still in the early stages of implementation, offers an interesting model for environmental regulation in other parts of the country, particularly for highly industrialized and urbanized areas.

In June 1982, the UW Sea Grant Program sponsored a national conference at which 42 industry, government and academic experts discussed the implications of TDPs and other innovative pollution control strategies for a broad range of subjects, including water and air pollution and acid rain. A 290-page book, *Buying A Better Environment: Cost-Effective Regulation Through Permit Trading* (in press), resulted from this conference. It is being published by the UW Sea Grant Program in cooperation with the prestigious *Land Economics* journal and the University of Wisconsin Press.

#### BENEFITS AND IMPLICATIONS

The two University of Wisconsin Sea Grant researchers have calculated that, when fine-tuned, TDPs and other new WDNR regulations could save the seven towns and 14 paper mills along the Lower Fox River an estimated \$13 million a year in meeting the stricter water quality standards.

This is the first time the concept of exchangeable discharge permits has been applied to water quality management, though it has been used for air pollution control in other parts of the country. Though not universally applicable, the Wisconsin approach may be the most efficient, cost-effective means to achieve environmental quality goals in many situations.

For more information:

Peyton Smith or Stephen Wittman  
Communications Office  
UW Sea Grant Institute  
1800 University Avenue  
Madison, WI 53705  
(608) 263-3259

Southeast Marine Advisory Service (SEMAS)--  
Using Resources Across the Region

The Southeast Marine Advisory Service Network (SEMAS) is composed of marine advisory programs in the coastal states from North Carolina to Texas and Puerto Rico. This is the newest regional network in the Sea Grant system, having been formally chartered in 1982. Even so, the program leaders who comprise the governing body of SEMAS have met regularly for three years, in semiannual sessions hosted by the Gulf States Marine Fisheries Commission, so the SEMAS record of cooperation predates the network's formal existence. A number of activities have resulted from this cooperation:

- Regional cooperation in the southeast dates from 1976, when Gary Graham, fisheries specialist at Texas A & M University, undertook his "hang book" project for the northern Gulf of Mexico. Through contacts with shrimpers and additional data from marine agents of other states, Graham developed a list of Loran coordinates for underwater obstructions off Texas and western Louisiana. The books were widely distributed throughout the northern Gulf. When the Coast Guard converted from Loran A to Loran C, Graham recomputed the book coordinates and shipped a microcomputer to marine agents in Texas and other Gulf states so that fishermen throughout the region could convert their private lists of coordinates.
- A workshop was held in Atlanta, Georgia, on November 10, 1981, to acquaint insurance industry representatives with the health and accident insurance needs of the fishing industry in the southeastern region. This was in response to the closure of public health service hospitals and the suspension of government medical aid to mariners.
- The University of Georgia's experimental fishing vessels have been valuable educational resources for fishermen throughout the entire southeastern region. Captain Dave Harrington and his crew introduced twin trawling to the region's shrimping industry in 1972. They have since demonstrated a host of other innovations in commercial fishing technology. Recently, the Georgia team has led the way for fishermen interested in the off-season conversion of vessels from shrimp trawling to long-lining. The Georgia program has extended invitations to fishermen throughout the region who desire to participate in an electronics training course scheduled in February 1983.
- Louisiana's claim to being the "crawfish capital of the world" is unchallenged, but the state's success in developing a \$30 million crawfish farming industry in one decade has generated much interest elsewhere. Marine advisory programs in Texas, Mississippi, and South Carolina have borrowed Louisiana's Sea Grant extension crawfish specialists to transfer technology and train their own field personnel in the successful Louisiana aquaculture systems.

- The OPEC-engineered fuel shortage brought hard times to the southeastern region's shrimping industry, which burns about one gallon of diesel fuel for each pound of shrimp it lands. The National Shrimp Congress, National Marine Fisheries Service, and southeastern Sea Grant programs organized a cooperative research program to investigate fuel conservation options for fishing vessels. The results were presented to marine advisory personnel in two training workshops held in Houston, Texas, and Orlando, Florida. Marine advisory personnel from Texas and Mississippi shared instructional responsibilities. Marine agents in the southeast are still engaged in extending results to users.
  
- When scientists of the National Marine Fisheries service wanted to publicize a trawl modification designed to protect sea turtles from capture during shrimping, they called in marine advisory agents from the SEMAS network. Agent training on TED--the trawl efficiency device--was provided at two NMFS-sponsored workshops, and the agents mounted a major educational campaign through newsletters and local demonstrations for fishermen. Shrimp fishermen were skeptical--and many remain so--but their interest picked up when tests sponsored by the South Carolina marine advisory service showed significant fuel savings through reduced drag. All states in the SEMAS network participated, and, in North Carolina alone, more than 20,000 individuals were exposed to TEDs. The University of Georgia's R/V Bulldog performed much of the device's testing.
  
- Following the example of the Northeast Marine Advisory Service (NEMAS), SEMAS members are organizing a regional mariners' reporting system (MAREP). In such a system, mariners radio observations on weather and sea conditions to a land-based operator, and the information is relayed to the regional National Weather Service forecast office. These marine weather forecasts are updated frequently for broadcast over the marine weather radio network.
  
- A MAREP system is also useful for oceanographic information of value to fishermen and the towing industry. Marine agents in the South Atlantic states have developed systems for relaying information extracted from satellite observations of the Gulf Stream and the great gyres that it creates as it flows northward along the continental margin. Fishermen use such information to locate their quarry, and towing operators can take advantage of information about location of the Gulf Stream to cut fuel costs. Marine agents in the Gulf Coast states hope to find similar uses for satellite information about the Gulf of Mexico's Loop Current, which is not as well organized or easy to interpret as the Gulf Stream.

# A Reevaluation in 1981 of the Commercial Use of Sea Grant Projects Funded in 1975

---

## SUMMARY

The National Sea Grant College Program has many goals and activities that are important to the nation and to the individual states. Given the nature of marine problems and opportunities and of universities, not all activities can or should lead to readily quantifiable results. However, the work of the Sea Grant institutions has led to a number of demonstrable economic benefits, some of which were reported in the 1981 Sea Grant Task Force Document, "ECONOMIC EFFECTS OF SEA GRANT."

ONE class of economic benefits can be measured by commercial PRODUCT developments that result in SALES. In 1976 the Massachusetts Institute of Technology's Center for Policy Alternatives (CPA) looked at a sample (77) of Sea Grant projects funded in 1975 that might lead to new commercial products and tried to predict future sales. In 1981-82, a team at the Center headed by Professor James Utterback and Margaret Linskey reviewed developments in 59 of the 77 projects over the intervening six years and published the results in a CPA report under the title heading at the top of this page.

Highlights of the CPA report include:

- In 1981, ANNUAL SALES in the range of \$44-62 MILLION resulted from the 19 projects surveyed that have led to commercial developments. Thus even with the most conservative figure, annual sales from this small sample exceed the highest annual federal appropriation (\$41.8 million in FY81) to the National Sea Grant College Program.
- ELEVEN NEW PRODUCTS have resulted as a direct consequence of the Sea Grant projects studied.
- TEN NEW COMPANIES have been formed primarily as a direct result of Sea Grant efforts to introduce the projects' results commercially.
- There have been approximately 25 SECONDARY COMPANIES that have started producing products similar to those of the 10 primary companies.
- HIGH RISK, BROADLY BASED research projects have actually produced more of the values reported than have those that were seemingly less risky and more specific at the outset.
- The more SUCCESSFUL projects often go in different directions than their originally stated objectives, exhibiting Sea Grant FLEXIBILITY to accommodate emerging industrial and market NEEDS.
- At least 15 additional projects from the sample which have not yet produced commercial results are thought still to have potential. This underlines the LONG-TERM nature of research and development.
- Sea Grant has built a STABLE and RELIABLE marine research base.

- The report notes that GRADUATE STUDENTS from Sea Grant Programs are particularly effective in transferring Sea Grant research results to industry and government agencies.
- The CPA report further notes that there have been many INDIRECT or social RETURNS from Sea Grant work, such as increased personal safety at sea, increased quality and availability of seafood products, and the introduction of new production methods and new uses for products originating in the oceans.

It should be reemphasized that the report, like the 1981 "ECONOMIC EFFECTS OF SEA GRANT," studied only a small sample of Sea Grant work and only a specifically prescribed set of benefits. Even in the circumscribed area of economic benefits it did not look at all projects or at the many other kinds of economic benefits, such as cost SAVINGS or jobs preserved. In that light, the results are even more impressive.

Copies of the full report may be obtained from:

Marine Division  
NASULGC  
One Dupont Circle  
Washington, D.C. 20036

or

MIT Sea Grant Program  
Room E 38-366  
77 Massachusetts Avenue  
Cambridge, Massachusetts 02139

**ECONOMIC EFFECTS  
OF  
SEA GRANT**

**SEA GRANT TASK FORCE  
WASHINGTON, D.C.  
MARCH 26, 1981**

ECONOMIC EFFECTS OF SEA GRANT

Prepared by  
Sea Grant Task Force  
Washington, D.C.  
March 26, 1981

On Behalf of  
The Marine Affairs Committee  
of  
The National Association of State Universities and Land-Grant Colleges  
in conjunction with  
The Sea Grant Association

The National Association of State Universities and Land-Grant Colleges  
Suite 710, One Dupont Circle, N.W.  
Washington, D.C. 20036

\* \* \* \* \*  
Don Rosenberg, President  
Sea Grant Association  
University of Alaska  
Fairbanks, Alaska 99711

EXECUTIVE SUMMARY

- EXAMPLES FOR THIS ECONOMIC APPRAISAL CAME FROM SEA GRANT PROGRAMS NATIONWIDE.
- ECONOMIC EFFECTS ON INDUSTRY, BUSINESS AND COMMERCE, DERIVED FROM 57 PROJECTS STIMULATED BY FEDERAL INVESTMENT THROUGH SEA GRANT, SHOWED:

A. FISH HARVESTING	\$ 36,552,000
B. SEAFOOD PROCESSING AND MARKETING	16,500,000
C. AQUACULTURE	21,752,000
D. MARINE CONSTRUCTION	126,896,000
E. MARINE TRANSPORTATION	2,890,000
F. MARINE-RELATED RETAIL TRADE	19,400,000
G. MARINE-RELATED REAL ESTATE	2,196,000
H. MARINE SERVICE INDUSTRY	<u>813,000</u>
TOTAL	\$226,999,000

- THIS ANNUAL FIGURE (\$227 MILLION) APPROACHES THE TOTAL FEDERAL INVESTMENT IN THE SEA GRANT PROGRAM OVER ITS THIRTEEN-YEAR HISTORY.



SEA GRANT TASK FORCE

- R. Corell, University of New Hampshire \* (Chairman)
- D. Horn, Massachusetts Institute of Technology \*
- F. Jennings, Texas A&M University \*
- J. Judd, University of Michigan \*
- J. Kermond, Sea Grant Association/NASULGC
- N. Rorholm, University of Rhode Island \*
- D. Rosenberg, University of Alaska \*
- V. Scottron, University of Connecticut \*

\* For identification purpose only

PARTIAL LISTING OF ECONOMIC EFFECTS

OF

THE SEA GRANT COLLEGE PROGRAMSummary

Estimates and analyses of parts of the Sea Grant program indicate it has led to or stimulated over \$227 million in annual gross revenue or savings (cost avoidance) leading to fuller utilization and greater efficiency in marine or coastal resource based industries.\* Not accounted for are contributions to better management of these resources. Neither do we attempt to place a monetary value on the manpower development role of Sea Grant. The latter is a major contribution to the nation's ability to use its coasts and water productively whether for commerce, food or for recreation.

Twenty-six Sea Grant Programs participated in developing the data for an analysis of economic effects. A substantial volume of background data was prepared as source information on the economic stimulation to industry, business, and commerce. The data obtained (based on fifty-seven projects) represent a few percent of the total project activity within Sea Grant. Each program selected only a few examples of documented economic effect from its research and educational efforts. The intent of this report is to provide, from a nation-wide point of view, a partial assessment of economic effects of Sea Grant's work. A summary (Table I) of the findings for eight major categories of Sea Grant research and educational activity indicates the aggregated annual effects.

TABLE I

## SELECTED SET OF ECONOMIC EFFECTS FROM THE SEA GRANT COLLEGE PROGRAM

A. FISH HARVESTING	\$ 36,552,410
Increase the economic productivity of commercial shellfish, groundfish, and mid-water fisheries.	
B. FISH PROCESSING AND MARKETING	\$ 16,500,465
Expand the economic base of the seafood processing industry.	
C. AQUACULTURE	\$ 21,752,000
Provide new commercial opportunities by developing the science, technology, and economic potential of aquaculture of marine species.	

\* Footnote: Production costs have not been subtracted. Later analysis will attempt more detailed net benefit studies of selected parts. The partial nature of this analysis should also be stressed. It is based on examples from individual programs rather than on total coverage. Hence, it is conservative.

D. MARINE CONSTRUCTION	\$126,895,771
Facilitate improvements in environmentally sound, economical, and safe waste disposal and offshore construction activities.	
E. MARINE TRANSPORTATION	\$ 2,890,000
Increase the efficiency and safety of the U.S. shipping fleet and the competitiveness of U.S. boat manufacturers in the foreign market.	
F. MARINE-RELATED RETAIL TRADE	\$ 19,400,000
Promote the growth of precious coral and pet turtle industries and reduce the loss of lives from cold-water drownings.	
G. MARINE-RELATED REAL ESTATE	\$ 2,196,000
Develop new technologies for shoreline stabilization, flood control, and alternative methods of sewage treatment.	
H. MARINE SERVICE INDUSTRY	\$ 812,760
Reduce wave damage to marinas and find an economically feasible alternative to breakwater construction for small marinas.	
	\$226,999,406
TOTAL	\$226,999,406

The material that follows provides summary information on each of the fifty-seven projects in the eight major categories outlined above.

## Sea Grant and the Economy

The economic development potential of the marine and coastal resources of the United States has attracted much attention in recent decades. The magnitude of 1972 economic activity within the coastal and ocean sectors only recently has been assessed (Science, Vol. 208, 30 May 1980). This analysis of the ocean economic sector in the National Income Accounting System (NIAS) places the ocean sector value at \$30.6 billion in 1972 which is comparable to agriculture (\$35.4 billion), mining (\$18.9 billion), construction (\$58 billion), transportation (\$46.2 billion), and communications (\$29.4 billion). The NIAS is an analysis technique that indicates the contribution of various economic sectors to national income and, hence, provides a way of understanding the composition of the economy. The NIAS assessment is based upon nine major subsectors, with the percentage indicated:

1. Commercial Fishing (1%)  
(Harvesting, processing, and aquaculture)
2. Marine Mining (7%)  
(Oil and gas, sand and gravel, and limestone)
3. Marine Construction (1%)
4. Manufacturing (4%)  
(Ship and boat building)
5. Marine Transportation and Communications (8%)  
(Shipping, cargo handling, and warehousing, transportation, services, and marine-related communications)
6. Marine-related Retail Trade (24%)  
(Marine-related merchandising and retailing)
7. Marine Financing, Insurance, and Real Estate (15%)
8. Marine Services (3%)  
(Hotels, marine recreation, educational services, museums, and marine organizations)
9. Public Administration--State and Local (37%)  
(Federal Government, ocean-related activities)

These data provided the first major overview of the oceans' economic importance. A more recent assessment of the magnitude of the private marine sector has been conducted by the Sea Grant Association Budget Committee. Considering all aspects of fishing, marine-related manufacturing, marine transportation and marine-related tourism, it was found that total sales exceeded \$58 billion in 1978, with employment in these industries at nearly 1.4 million. Further, Department of Commerce figures indicate that sales within these industries increased 21.4% from 1977 to 1978 with an increase of 8% in employment, for a productivity increase of 14% in sales or shipment per person before adjustment for inflation.

Understanding the structure and characteristics of the industrial, business and commerce components of the ocean sector is important. A preliminary analysis suggests, that with some exceptions such as the oil and gas industry, most of the components within the private marine sector are disaggregated and evolving in nature. The fisheries component, for example, is comprised mainly of small independent businesses that have been shown to be the most viable economic force in the catching sector.

Most observers agree that the university/industry commitment to research and extension was the key Federal policy that contributed so significantly to the productivity of our agricultural industry. In 1966, the Federal Government established the policy and structure for similar activities aimed at marine resources through the National Sea Grant College Program Act. Fortunately, like the agricultural sector, the oceans sector has access to universities and industry. Primarily, the focus is on fisheries and aquaculture, seafood processing, marine construction and transportation, and marine-related trade, real estate, service industries, recreation, and tourism.

The Sea Grant College and Program Act of 1966 (P.L. 89-688) was passed "to accelerate national development of marine resources, including their conservation, proper management, and maximum social and economic utilization." More specifically, the program was directed to "achieve the gainful use of marine resources" (Sec 202(d)) through a partnership between the Federal and State Governments, universities, and the private sector. The term "Sea Grant" was chosen to emphasize the agricultural parallel in meeting present needs of the nation by developing the economic potential of our marine resources.

Since 1966, the United States has laid claim to a 200-mile economic zone, including all resources in the water column, on and under the ocean floor. By this single action, the United States almost doubled the territory under sovereign jurisdiction. When developed wisely, these vast new areas offer the nation economic opportunities equal to or greater than the agricultural sector of the nation's economy.

The factors that contribute to the productivity of the Sea Grant Program are:

1. The partnership of universities, industry, and government.
2. Sea Grant is the only Federally-stimulated program focused on developing the resources of the ocean on a broad economic front.
3. Economic analyses of the Sea Grant Program, such as the attached, clearly demonstrate an unusually good return on investment.
4. The Sea Grant Program is identifying and developing new resources for the nation in such areas as biomedicinals, aquaculture, ocean energy, conversion, diverse waste conversion, reduction of marine corrosion and biofouling.

Several independent assessments of the Sea Grant Program have been made in the past. The productivity of the program is generally recognized. The most recent assessment was made by the Heritage Foundation, which reviewed all Federal programs in 1980 and reported the following on Sea Grant:

"It has an impressive record of success....It operates in partnership with state and local governments, private industry, universities, organizations and individuals concerned with or affected by ocean and coastal resources....A key element of Sea Grant is its outreach mechanism whereby results of research are provided to users in industry, government agencies, and the general public."

This appraisal demonstrates the economic effects of the Sea Grant Program. The sections that follow were based on data supplied by 26 Sea Grant Programs. However, this report must be seen as a partial assessment, prepared on relatively short notice. The Sea Grant Program will continue to improve its means of assessing benefits and documentation of program accomplishments.

Economic ExamplesA. FISH HARVESTING

Sea Grant's assistance in increasing the productivity of the commercial shellfish, groundfish, and mid-water fisheries resulted in annual economic effects of \$36,552,410 on industry, from sixteen projects on which data are readily available.

## EXAMPLES OF ANNUAL ECONOMIC EFFECTS

1. Eel fishery	\$ 148,000
2. Herring fishery	1,250,000
3. Commercial fish	6,500,000
4. Shrimp trawl obstruction	3,500,000
5. Side trawler operations	494,000
6. Soft blue crab production	1,000,000
7. Oyster fishery	98,100
8. Black cod fishery	321,000
9. Net damage by underwater obstructions	600,000
10. Offshore fishery	11,210
11. Alaska commercial fishery	1,055,000
12. Swordfish and blackfish tuna fisheries	2,600,000
13. Finfishery	475,000
14. Herring fishery	1,500,000
15. Great Lakes commercial fishery	6,000,000
16. Crab fishery	<u>18,000,000</u>
TOTAL	\$36,552,410

- A1. CHALLENGE: Develop the eel fishery in North Carolina.
- SOLUTION: Provide research to improve fishing and handling techniques and development of export market for fresh frozen eels to Europe and Japan.
- BENEFIT: Growth of eel fishing industry from \$16,000 in 1972 to \$1,200,000 of foreign exports in 1980, an average annual growth of \$148,000.
- SOURCE: North Carolina
- 
- A2. CHALLENGE: Assist ground fishing fleet changeover to deep water species.
- SOLUTION: Development of midwater fishing gear for herring export catch.
- BENEFIT: Has led to annual gross increases of \$1,250,000, or net increases of \$431,000 of exportable fish from 18 vessels. Technology is still spreading.
- SOURCE: Rhode Island
- 
- A3. CHALLENGE: Improve the efficiency of harvesting by commercial fishermen.
- SOLUTION: Assisted the fishermen to develop new and improved technology for handling nets, crab pots, and other fishing gear. Cost-effective hydraulic gear is now being used on 60 medium-sized boats.
- BENEFIT: \$6,500,000 per year increased income for fishing industry.
- SOURCE: North Carolina



- A4. CHALLENGE: Reduce loss and damage to shrimp trawls (subject to federal compensation by law) from bottom obstructions.
- SOLUTION: Collected data on obstruction locations from personal contacts with boat captains and the historical record, assembled their data with LORAN navigation coordinates, and disseminated the information to the shrimping fleet.
- BENEFIT: \$3,500,000 per year.
- SOURCE: Texas
- 
- A5. CHALLENGE: Improve the safety of side trawler operations; the attachment of towing cables to the stern of a side trawler is extremely hazardous, sometimes causing serious injury or death to fishermen.
- SOLUTION: Developed and introduced a quick-acting, remote-releasing hook-up block to New England fishermen. Modification of this unique device has adapted it for use by U.S. Coast Guard for life boat handling. A commercial concern is studying use of the block as an anchor release.
- BENEFIT: Increased one fishing captain's earnings by at least \$3,000 per year. When fully implemented, a modified block for successfully handling its new RHI lifeboat will save the Coast Guard an estimated \$2,500,000 or \$491,000 annually over 15 years.
- SOURCE: Massachusetts
- 
- A6. CHALLENGE: Revitalize declining soft blue crab production.
- SOLUTION: Provided technical, economic feasibility analysis and marketing assistance to the industry.
- BENEFIT: \$1,000,000 per year.
- SOURCE: Florida

- A7. CHALLENGE: Reduce threat to Chesapeake Bay oyster industry of the widespread occurrence of pink coloration in oysters.
- SOLUTION: Showed the pink coloration had no effect on the oysters' wholesomeness or palatability, publicized these findings, and convinced a Federal purchasing agent to reverse an earlier shipment rejection.
- BENEFIT: This one incidence had a \$500,000 benefit but the aggregate value to the Chesapeake Bay oyster fishery is hard to calculate. Over 15 years this amounts to an annual amount of \$98,100.
- SOURCE: Virginia
- 
- A8. CHALLENGE: Re-establish black cod fishing catch.
- SOLUTION: Provided research and developed new design traps.
- BENEFIT: Landings increased by a factor of 8 (poundage) from 1973 to 1975 with an average annual value of \$321,000.
- SOURCE: California
- 
- A9. CHALLENGE: Prevent net damage by underwater obstructions (reimbursable by the Federal Government by law).
- SOLUTION: Collected information on such obstacles from individual fishermen and published the descriptions and locations in a log book.
- BENEFIT: Saved fishermen \$600,000 per year in net costs plus unaccounted reduction of losses in fishing time.
- SOURCE: North Carolina

- A10. CHALLENGE: Locate offshore fishing grounds and disseminate new sonar tracking techniques.
- SOLUTION: Provided offshore research and training in advance fish travel, radar and navigation.
- BENEFIT: \$80,000 in one harvest involving 5 boats (otherwise idle due to failure of in-shore fishery). This amounts to \$11,210 annually over 15 years.
- SOURCE: Georgia
- 
- A11. CHALLENGE: Enhance the income of the native Alaskan fishermen from commercial fishing.
- SOLUTION: Designed program to improve effectiveness of native Alaskan fishermen in commercial herring fishery.
- BENEFIT: Earnings increased by \$1,055,000 in first year after program started.
- SOURCE: Alaska
- 
- A12. CHALLENGE: Develop a winter catch supplement for the seasonal Gulf coast shrimp fishery to provide year-round employment and capital utilization.
- SOLUTION: Developed new swordfish and blackfish tuna fisheries.
- BENEFIT: \$2,600,000 per year.
- SOURCE: Texas

- A13. CHALLENGE: Find alternative fisheries for shrimpers in South Carolina.
- SOLUTION: Helped shrimp fishermen adapt their vessels to fish for previously unexploited finfish and instructed fishermen in new techniques.
- BENEFIT: \$475,000 annual gross income from finfish over past 5 years.
- SOURCE: South Carolina
- 
14. CHALLENGE: Accurately determine the herring fish stock, to increase harvesting efficiency while protecting against over fishing.
- SOLUTION: Successfully applied acoustic techniques for more accurately estimating fish populations for the Pacific herring fishing. Data are used in establishing the Regional Fisheries Management Plan for Pacific herring.
- BENEFIT: Increased the allowable harvest from approximately 30% resulting in an annual landed value increase of approximately \$1,500,000.
- SOURCE: Washington
- 
- A15. CHALLENGE: Rebuild the Wisconsin Great Lakes Fishing Industry.
- SOLUTION: Identified historical spawning reefs in Lake Michigan, developed new processing and new marketing techniques for under-utilized sucker fish, developed canned pack for improved marketing of under-utilized alewives, and provided research data and technical assistance to the industry.
- BENEFIT: Recovery of Wisconsin commercial fishing industry from brink of collapse to \$6,000,000 annual dockside sales.
- SOURCE: Wisconsin

A16. CHALLENGE: Increase number of crab species harvested by U.S. fishermen.

SOLUTION: Carried out a marketing study in conjunction with North Pacific Fishery Management Council which successfully showed that Japanese Tanner Crab fishing fleets should be removed from U.S. waters.

BENEFIT: Tanner Crabs now totally harvested by domestic fishing industries with a value of \$18,000,000 per year to date. The U.S. industry was \$6,000,000 prior to 1977.

SOURCE: Alaska

**B. SEAFOOD PROCESSING AND MARKETING**

Through Sea Grant's efforts to expand the economic base of the seafood processing industry, the annual aggregate economic effects from eleven projects on which data are readily available was \$16,500,456.

**EXAMPLES OF ANNUAL ECONOMIC EFFECTS**

1. Salmon canneries	\$ 4,615,456
2. Seafood quality	150,000
3. Storage of fresh fish	454,000
4. Clam-mincing by-products	500,000
5. Oyster industry	1,000,000
6. Crab-processing wastes	2,500,000
7. Oyster-cleansing system	1,000,000
8. New domestic seafood markets	100,000
9. Shrimp processing	5,600,000
10. Fish processors	1,231,000
11. Frozen seafood packaging	<u>350,000</u>
TOTAL	\$16,500,465

- B1. CHALLENGE:** Help prevent closing of Alaska salmon canneries that would result from proposed environmental regulations on disposal of salmon-processing waste requiring modification of equipment.
- SOLUTION:** Studied economic impact of proposed regulations and revealed serious errors in the contractor data and analysis report supporting the regulations. As a result of the Sea Grant study EPA regulations were modified.
- BENEFIT:** The requirement for modifications to waste processing equipment was rescinded with the resulting saving of \$22,500,000 to the Alaskan salmon processors in 1979. This amounts to \$4,615,465 annually over a 15 year period.
- SOURCE:** Washington
- 
- B2. CHALLENGE:** Improve seafood quality by insulating boat holds.
- SOLUTION:** Promoted engineering and research to develop insulation requirements and handling techniques for improved quality of catch and increase income to fishermen for higher quality products.
- BENEFIT:** \$150,000 per year increased revenue for fishermen.
- SOURCE:** North Carolina
- 
- B3. CHALLENGE:** Extend storage time in transportation of fresh fish.
- SOLUTION:** Developed CO<sub>2</sub>-modified atmosphere containers.
- BENEFIT:** Estimated savings of \$454,000 per year for transporting Alaskan salmon into California as well as saving one-third of energy costs.
- SOURCE:** California

- B4. CHALLENGE:** Recover and utilize protein and other nutrients from surf clam processing waste.
- SOLUTION:** Development of marketable clam broth and freeze-dried clam flavor ingredient.
- BENEFIT:** Clam broth - \$500,000 per year in sales and reduced waste treatment cost for one firm.  
Flavor ingredient - one firm estimates potential annual sales of \$750,000.
- SOURCE:** New York
- 
- B5. CHALLENGE:** Sustain Apalachicola Bay oyster industry threatened with shutdown due to water-quality problem.
- SOLUTION:** Through technical assistance in sanitation and processing procedures and cooperation with the state Oyster Task Force, sustained and enlarged continued production of safe oysters, even under newly strengthened sanitation requirement.
- BENEFIT:** Not only was disaster to the industry averted, but oyster production was increased from 5,784,930 pounds in 1979 to 6,395,778 pounds in 1980 equaling a landing value of \$5,800,000.
- SOURCE:** Florida
- 
- B6. CHALLENGE:** Reduce the cost of disposal of crab processing wastes (many processors faced shutdown due to increased cost of waste disposal).
- SOLUTION:** Demonstrated crab-meal production, using 20-30 million pounds of hard-crab processing scrap.
- BENEFIT:** A gross benefit of \$2,500,000 per year, through reduction of waste disposal costs and sale of crab meal, has been achieved in the Middle Atlantic region.
- SOURCE:** Virginia



- B7. CHALLENGE: Develop an off-bottom oyster cleansing system.
- SOLUTION: Developed mechanization system for depuration process and performed biological studies enabling lifting of some regulatory restrictions.
- BENEFIT: Productive and economically feasible depuration process resulting in \$1,000,000 of oysters.
- SOURCE: Mississippi
- 
- B8. CHALLENGE: Find new seafood markets (domestic).
- SOLUTION: Perform market research and provide technical assistance.
- BENEFIT: \$100,000 per year to one company in Tennessee.
- SOURCE: Georgia
- 
- B9. CHALLENGE: Prevent waste of edible portion of shrimp that is lost during processing.
- SOLUTION: Developed and introduced to industry improved handling and processing techniques to reduce waste by increasing yield and saving energy.
- BENEFIT: Annual yield region was increased by 4%; the equivalent of \$5,600,000 per year direct return to processors.
- SOURCE: Oregon

- B10. CHALLENGE: Assist fish processors to cope with environmental regulation problems.
- SOLUTION: Studied operations of fish meal plants and developed a procedure to increase productivity simultaneously with reduction of problems from effluent pollution.
- BENEFIT: Prevented closure of fish processor allowing continuance of industry amounting to \$1,231,000 gross annual income to processor and commercial fishermen.
- SOURCE: Wisconsin
- 
- B11. CHALLENGE: Develop new convenience seafood products from under-utilized species of fish.
- SOLUTION: Develop and market test a number of new frozen products, several eventually adopted by commercial processors.
- BENEFIT: Additional annual sales revenues to fish wholesalers and processors of at least \$350,000.
- SOURCE: New York

C. AQUACULTURE

Aquaculture of marine species provided new commercial opportunities by developing the science, technology, and economic potential. \$21,752,000 represents the annual aggregate economic effects on industry from projects on which data are readily available.

## EXAMPLES OF ANNUAL ECONOMIC EFFECTS

1. Crawfish aquaculture	\$ 8,450,000
2. Pen-reared salmon	192,000
3. Oyster beds	160,000
4. Net-pen fishery	3,000,000
5. Land clam and oyster spawn	400,000
6. Seafood production	6,000,000
7. Maine fishing industry	1,000,000
8. Ocean ranching	2,300,000
9. Salmonid mortality	<u>250,000</u>
TOTAL	\$21,752,000

- C1. CHALLENGE: Develop crawfish aquaculture as an industry in Louisiana.
- SOLUTION: Since 1969, introduced research on crawfish aquaculture to pond operators and to rice farmers where crawfish are now being stocked in rice paddies.
- BENEFIT: Increased pond acreage from 12,000 acres in 1969 to 62,000 acres in 1980 with associated increased income for crawfish farmers of \$8,450,000 per year.
- SOURCE: Louisiana
- 
- C2. CHALLENGE: Reduce mortality rate (50 to 80%) of pen-reared salmon when smolt are transferred from freshwater to saltwater.
- SOLUTION: Through generic research (similar to that applied to the poultry industry), developed a strain of coho salmon specifically adapted to pen-rearing with one-half the mortality rate of natural stock.
- BENEFIT: One commercial salmon grower realized a net saving of \$192,000 per year raising this new strain.
- SOURCE: Washington
- 
- C3. CHALLENGE: Help prevent continual reduction of the size of natural oyster beds due to development and pollution.
- SOLUTION: Develop pilot closed-system oyster culture facility.
- BENEFIT: Understanding in oyster spawning, spot setting, nutrition, and water-quality control are already contributing an estimated \$160,000 per year benefit to the natural bed fisheries. The ultimate goal of commercial sized closed-system aquaculture facilities will be a major industry of conservation breakthrough.
- SOURCE: Delaware

- C4. CHALLENGE: Develop a net-pen fishery.
- SOLUTION: Provided research and demonstrated projects that resulted in several companies in the Pacific Northwest going into commercial production of salmon using this technology.
- BENEFIT: Domsea Farms, now a subsidiary of Campbell Soup, is harvesting over \$3,000,000 of salmon per year.
- SOURCE: Washington
- 
- C5. CHALLENGE: Reduce disease-related mortalities in New York shellfish hatcheries.
- SOLUTION: Research/extension program to identify diseases of New York shellfish, develop disease-control procedures and train hatchery operators in these procedures.
- BENEFIT: Doubling of effective hatchery production on Long Island should produce annual market sales increases of \$400,000.
- SOURCE: New York
- 
- C6. CHALLENGE: Increase the production of seafood through aquaculture.
- SOLUTION: Conducted research to identify and select the most promising plant and animal species for aquaculture, developed the supporting technology and marine science for commercial expansion, and provided advisory assistance to the developing industry.
- BENEFIT: Aquaculture in Hawaii now produces a wholesale value of over \$6,000,000 (1980) and is projected to increase to over \$32,000,000 in 1985.
- SOURCE: Hawaii

- C7. CHALLENGE: Bring greater economic stability to the Maine fishing industry.
- SOLUTION: Stimulated the formation of a new shellfish aquaculture industry.
- BENEFIT: This still young industry's last year's sales exceeded \$1,000,000 with a projected five-fold increase over the next five years.
- SOURCE: Maine
- 
- C8. CHALLENGE: Develop ocean ranching in Alaska.
- SOLUTION: Assisted development of private non-profit aquaculture corporation and hatchery to stock salmon in geographic areas where salmon fisheries do not exist.
- BENEFIT: New salmon fishery where salmon stocks had not existed with a catch in 1980 valued at \$2,300,000.
- SOURCE: Alaska
- 
- C9. CHALLENGE: Excessive mortality in smoltification of salmonids.
- SOLUTION: By demonstrating the role of ammonia in oxygen transport in fish, investigators have helped the Dworshak National Fish Hatchery to reduce salmonid mortality during smoltification from 35,000 per day to 300 per day.
- BENEFIT: An annual savings of \$250,000
- SOURCE: Rhode Island

D. Marine Construction

Facilitating improvements in environmentally sound, economical and safe coastal and offshore construction activities has resulted in \$126,995,000 annualized cost avoidance or savings aggregated from projects on which data are available.

## EXAMPLES OF ANNUAL ECONOMIC EFFECTS

1. Mathematical modeling	\$80,645,000
2. Construction aggregates	45,000,000
3. Sand and dredging industry	250,000
4. Wave-tracking buoy	<u>1,000,000</u>
TOTAL	\$126,995,000

- D1. CHALLENGE:** Assess impacts on marine environment of offshore construction and disposal permitting.
- SOLUTION:** Developed finite element mathematical models to accurately assess impacts and successfully predict transport and disposal of materials in semi-enclosed water bodies.
- BENEFIT:** Saved \$29,000,000 to \$54,000,000 in estimated circulating-water channel modifications or new construction costs. An annual saving of \$5,417,779 over 15 years. Using the minimum estimate amortized over an assumed 10-year construction period, this represents a \$2,900,000 annualized cost avoidance. Demonstrated environmental acceptability of sewage outflow led to EPA approval of a waiver request and will result in construction cost avoidance of \$400,000,000 (\$300,000,000 is federal subsidy). Amortizing this saving over a 10 year construction period, this represents a \$74,727,992 annualized cost avoidance. Contractor reports savings of \$15,000 to \$80,000 for each application of the model over conventional techniques and estimates total savings of up to \$500,000 per year.
- SOURCE:** Massachusetts
- D2. CHALLENGE:** Assure availability of reasonably-priced supply of construction aggregate to New York Metropolitan Area.
- SOLUTION:** Econometric models capable of predicting net cost reductions from aggregate mining in New York Harbor.
- BENEFIT:** Development of most cost-effective mining scenario would produce annual cost savings of \$20 million to sand suppliers and \$45 million to building industry.
- SOURCE:** New York
- D3. CHALLENGE:** Revitalize sand and dredging industry in Toledo, closed because of environmental concerns.
- SOLUTION:** Showed that the sand and gravel used for construction aggregate could be dredged without harming the environment.
- BENEFIT:** \$250,000 worth of sand and gravel now dredged annually.
- SOURCE:** Ohio



D4. CHALLENGE: Obtain accurate wave-spectra data for design and construction of offshore facilities and structures.

SOLUTION: Developed wave-tracking buoy to directly measure and record wave directional spectra.

BENEFIT: New wave-tracking buoy has been added to a small business product line with projected annual sales of \$1,000,000.

SOURCE: Massachusetts

**E. MARINE TRANSPORTATION**

The result of increasing the efficiency and safety of the U.S. shipping fleet and the competitiveness of U.S. boat manufacturers in the Mexican market meant an annual aggregate economic benefit to industry of \$2,800,000, from four projects on which data are readily available.

**EXAMPLES OF ANNUAL ECONOMIC EFFECTS**

1. Satellite information	\$1,560,000
2. Shrimp boat manufacturing	700,000
3. Fishing vessel replacement	40,000
4. Offshore tanker mooring	<u>590,000</u>
<b>TOTAL</b>	<b>\$2,890,000</b>

- E1. CHALLENGE: Disseminate NOAA's satellite information on Gulf Stream dynamics to disaggregated user industries.
- SOLUTION: Worked with NOAA satellite and weather service personnel to locate and establish communication linkages to a broad-base user clientele.
- BENEFIT: One shipping company estimates \$1,560,000 annual savings in fuel costs.
- SOURCE: Florida
- 
- E2. CHALLENGE: Increase competitiveness of U.S. shrimp boat manufacturing (for international markets).
- SOLUTION: Trained international boat operators for maximum vessel usage (on site) (e.g. Mexican fishermen).
- BENEFIT: Continued gross sales of U.S.-built vessels amounted to \$700,000 in a year.
- SOURCE: Georgia
- 
- E3. CHALLENGE: Replace worn out fishing vessels for individual fishermen.
- SOLUTION: Instructed fishermen how to build their own fiberglass boats.
- BENEFIT: Sixteen boats built resulted in total net saving of \$40,000.
- SOURCE: South Carolina

**E4. CHALLENGE:** Improve the safety of offshore tanker mooring operations.

**SOLUTION:** Developed prototype talking current spar buoy that reports ocean currents to ship operators making offshore moorings.

**BENEFIT:** A new talking current spar buoy instrument has been added to a small business product line with projected annual gross sales of \$590,000.

**SOURCE:** Massachusetts

**F. MARINE-RELATED RETAIL TRADE**

Sea Grant helped promote the growth of precious coral and pet turtle industries and helped reduce the loss of lives from cold-water drownings. \$19,400,000 represents the annual aggregate economic effects on industry from only three projects on which data are readily available.

**EXAMPLES OF ANNUAL ECONOMIC EFFECTS**

1. Cold-water drowning	\$10,000,000
2. Pet turtle industry	2,100,000
3. Precious coral industry	<u>7,300,000</u>
TOTAL	\$19,400,000

- F1. CHALLENGE:** Reduce loss of lives resulting from cold-water drownings.
- SOLUTION:** Studied temperature regulation of humans in cold-water environments and, in partnership with industry, designed new kinds of personal flotation devices that minimize body temperature loss.
- BENEFIT:** Stimulated production in three new lines of personal flotation devices and thermal suits grossing \$10,000,000 in 1980.
- SOURCE:** Minnesota
- 
- F2. CHALLENGE:** Help prevent collapse of pet turtle industry threatened due to FDA ban on interstate shipment of carriers of salmonella.
- SOLUTION:** Developed antibiotic treatment of turtle eggs in vacuum chamber that eliminated the salmonella transmission problem.
- BENEFIT:** Industry expanded in business to \$2,100,000 yearly production.
- SOURCE:** Louisiana
- 
- F3. CHALLENGE:** Develop a precious coral industry while husbanding rare stocks of coral.
- SOLUTION:** Promoted research and application of undersea technologies.
- BENEFIT:** The industry grew from 50 employees and gross sales of \$500,000 to 214 employees and gross sales of \$7,800,000.
- SOURCE:** Hawaii

**G. MARINE-RELATED REAL ESTATE**

The economic importance of coastal real estate has motivated the development of new technologies for shoreline stabilization, flood control, and alternative methods of sewage treatment. This represents \$3,000,000 aggregated annual economic effects on industry from four projects on which data are available.

**EXAMPLES OF ANNUAL ECONOMIC EFFECTS**

1. Shoreline erosion	\$1,000,000
2. Flood control	750,000
3. Waste disposal	850,000
4. Irradiation of sewage sludge	<u>400,000</u>
TOTAL	\$3,000,000

- G1. CHALLENGE: Reduce economic losses to coastal property owners from shoreline erosion.
- SOLUTION: Performed research on vegetation to stabilize shorelines, studies of cement-asbestos bulkhead failure, and research on erosion in local communities, providing information to adjust building setbacks.
- BENEFIT: \$1,000,000 saved from property damages and remedial actions.
- SOURCE: North Carolina
- 
- G2. CHALLENGE: Improve flood control techniques.
- SOLUTION: Developed and demonstrated new design concepts.
- BENEFIT: Reduction in federal flood insurance payments (e.g. \$750,000 per flood) and reduced flooding.
- SOURCE: New York
- 
- G3. CHALLENGE: Reduce the impact of waste disposal on the economic development of coastal land and water.
- SOLUTION: Provide research on environmental distribution of sewage waste and developed alternative, cost-effective disposal system which has been approved and adopted by coastal communities.
- BENEFIT: \$850,000 per year increase in shellfish harvest and the lifting of building restrictions to allow \$4,000,000 of new building during 1980.
- SOURCE: North Carolina



- G4. CHALLENGE: Provide a new method of sewage sludge treatment that is less capital and energy intensive.
- SOLUTION: Developed and had approved by EPA an electron irradiation process for pasteurizing sewage sludge.
- BENEFIT: Miami-Dade Water and Sewage Authority is now constructing the first facility based on this process which is projected to perform at an annual savings of \$400,000.
- SOURCE: Massachusetts

#### H. MARINE SERVICE INDUSTRY

Reducing wave damage to marinas and finding an economically feasible alternative to breakwater construction for small marinas resulted in annual aggregate economic effects on industry of \$812,760 from just three projects. These savings have been replicated numerous times in many regions of the U.S.

#### EXAMPLES OF ANNUAL ECONOMIC EFFECTS

1. Small-marina operators	\$ 176,760
2. Wave damage reduction	500,000
3. Marine trade seminars	<u>136,000</u>
TOTAL	\$ 812,760

- H1. CHALLENGE: Find an economically feasible alternative to traditional breakwater constructions for small-marina operators.
- SOLUTION: Introduced marina operators to the concept of floating tire breakwaters and floating tire docks, gave the needed design and construction information, and advised on the construction and installation of an expanded marina facility.
- BENEFIT: Saved \$176,760 in annual facilities costs.
- SOURCE: Michigan
- 
- H2. CHALLENGE: Develop low-cost, effective shore protection technologies.
- SOLUTION: With Rhode Island, design, construct, and field test several floating tire breakwaters.
- BENEFIT: Annual savings to shorefront property owners of \$500,000 through reduced wave and storm related damage.
- SOURCE: New York
- 
- H3. CHALLENGE: Improve efficiency of Marine Recreational firms.
- SOLUTION: Formulated and conducted ten Marine Trade management seminars along the U.S. East Coast involving 680 firms.
- BENEFIT: \$136,000 in immediate savings.
- SOURCE: Rhode Island

SEA GRANT PROGRAM IMPROVEMENT ACT of 1976

AMENDMENTS \*

PUBLIC LAW 94-461—OCT. 8, 1976

90 STAT. 1961

Public Law 94-461  
94th Congress

An Act

To improve the national sea grant program and for other purposes.

Oct. 8, 1976  
[H.R. 13035]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Sea Grant Program Improvement Act of 1976".

SEC. 2. AMENDMENT TO THE NATIONAL SEA GRANT COLLEGE AND PROGRAM ACT OF 1966.

Title II of the Marine Resources and Engineering Development Act of 1966 (33 U.S.C. 1101 et seq.) is amended to read as follows:

"TITLE II—NATIONAL SEA GRANT PROGRAM

"SEC. 201. SHORT TITLE.

"This title may be cited as the 'National Sea Grant Program Act'.

"SEC. 202. DECLARATION OF POLICY.

"(a) FINDINGS.—The Congress finds and declares the following:

"(1) The vitality of the Nation and the quality of life of its citizens depend increasingly on the understanding, assessment, development, utilization, and conservation of ocean and coastal resources. These resources supply food, energy, and minerals and contribute to human health, the quality of the environment, national security, and the enhancement of commerce.

"(2) The understanding, assessment, development, utilization, and conservation of such resources require a broad commitment and an intense involvement on the part of the Federal Government in continuing partnership with State and local governments, private industry, universities, organizations, and individuals concerned with or affected by ocean and coastal resources.

"(3) The National Oceanic and Atmospheric Administration, through the national sea grant program, offers the most suitable locus and means for such commitment and involvement through the promotion of activities that will result in greater such understanding, assessment, development, utilization, and conservation. Continued and increased Federal support of the establishment, development, and operation of programs and projects by sea grant colleges, sea grant regional consortia, institutions of higher education, institutes, laboratories, and other appropriate public and private entities is the most cost-effective way to promote such activities.

"(b) OBJECTIVE.—The objective of this title is to increase the understanding, assessment, development, utilization, and conservation of the Nation's ocean and coastal resources by providing assistance to promote a strong educational base, responsive research and training activities, and broad and prompt dissemination of knowledge and techniques.

"(c) PURPOSE.—It is the purpose of the Congress to achieve the objective of this title by extending and strengthening the national sea

Sea Grant  
Program  
Improvement  
Act of 1976.  
33 USC 1121  
note.

National  
Sea Grant  
Program Act.  
33 USC 1121  
note.  
33 USC 1121.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the title heading of title II of the Marine Resources and Engineering Development Act of 1966 (33 U.S.C. 1101 et seq.) is amended to read as follows:

"TITLE II—NATIONAL SEA GRANT COLLEGE PROGRAM".

Section 201 of the National Sea Grant Program Act (33 U.S.C. 1121) is amended by inserting "College" immediately before "Program".

Sections 202(a)(3), 203(3), 204, and 211 are each amended by striking out "national sea grant program" each place it appears therein and inserting in lieu thereof "national sea grant college program".

1978  
National sea  
grant program,  
appropriation  
authorization.

1978  
33 USC 1121  
note.

1978  
33 USC 1121-  
1123, 1130.

\* 1978 = 1978 Amendments  
Public Law 95-428-Oct. 7, 1978(92 Stat. 999)

1980 = 1980 Amendments  
Public Law 96-289-June 28, 1980(94 Stat. 605)

grant program, initially established in 1986, to promote research, education, training, and advisory service activities in fields related to ocean and coastal resources.

33 USC 1122.

**"SEC. 203. DEFINITIONS.**

"As used in this title—

"(1) The term 'Administration' means the National Oceanic and Atmospheric Administration.

"(2) The term 'Administrator' means the Administrator of the National Oceanic and Atmospheric Administration.

"(3) The term 'Director' means the Director of the national sea grant program, appointed pursuant to section 204(b).

"(4) The term 'field related to ocean and coastal resources' means any discipline or field (including marine science (and the physical, natural, and biological sciences, and engineering, included therein), marine technology, education, economics, sociology, communications, planning, law, international affairs, and public administration) which is concerned with or likely to improve the understanding, assessment, development, utilization, or conservation of ocean and coastal resources.

"(5) The term 'includes' and variants thereof should be read as if the phrase 'but is not limited to' were also set forth.

"(6) The term 'marine environment' means the coastal zone, as defined in section 304(1) of the Coastal Zone Management Act of 1972 (16 U.S.C. 1453(1)); the seabed, subsoil, and waters of the territorial sea of the United States; the waters of any zone over which the United States asserts exclusive fishery management authority; the waters of the high seas; and the seabed and subsoil of and beyond the outer Continental Shelf.

"(7) The term 'ocean and coastal resource' means any resource (whether living, nonliving, manmade, tangible, intangible, actual, or potential) which is located in, derived from, or traceable to, the marine environment. Such term includes the habitat of any such living resource, the coastal space, the ecosystems, the nutrient-rich areas, and the other components of the marine environment which contribute to or provide (or which are capable of contributing to or providing) recreational, scenic, esthetic, biological, habitation, commercial, economic, or conservation values. Living resources include natural and cultured plant life, fish, shellfish, marine mammals, and wildlife. Nonliving resources include energy sources, minerals, and chemical substances.

"(8) The term 'panel' means the sea grant review panel established under section 209.

"(9) The term 'person' means any individual; any public or private corporation, partnership, or other association or entity (including any sea grant college, sea grant regional consortium, institution of higher education, institute, or laboratory); or any State, political subdivision of a State, or agency or officer thereof.

"(10) The term 'sea grant college' means any public or private institution of higher education which is designated as such by the Secretary under section 207.

"(11) The term 'sea grant program' means any program which—

"(A) is administered by any sea grant college, sea grant regional consortium, institution of higher education, institute, laboratory, or State or local agency; and

"(B) includes two or more projects involving one or more of the following activities in fields related to ocean and coastal resources:

Sec. 203(3): See amendment (1978) at Sec. 202(a)(3)

in section 203(6) by inserting "Great Lakes and the" 33 USC 1121  
immediately before "territorial sea"; note.

1980

- “(i) research,
- “(ii) education,
- “(iii) training, or
- “(iv) advisory services.

“(12) The term ‘sea grant regional consortium’ means any association or other alliance which is designated as such by the Secretary under section 207.

“(13) The term ‘Secretary’ means the Secretary of Commerce.

“(14) The term ‘State’ means any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Mariana Islands, or any other territory or possession of the United States.

“SEC. 204. NATIONAL SEA GRANT PROGRAM.

33 USC 1123.

“(a) IN GENERAL.—The Secretary shall maintain, within the Administration, a program to be known as the national sea grant program. The national sea grant program shall consist of the financial assistance and other activities provided for in this title. The Secretary shall establish long-range planning guidelines and priorities for, and adequately evaluate, this program.

Planning guidelines and priorities.

“(b) DIRECTOR.—(1) The Secretary shall appoint a Director of the national sea grant program who shall be a qualified individual who has—

“(A) knowledge or expertise in fields related to ocean and coastal resources; and

“(B) appropriate administrative experience.

“(2) The Director shall be appointed and compensated, without regard to the provisions of title 5, United States Code, governing appointments in the competitive service, at a rate not in excess of the maximum rate for GS-18 of the General Schedule under section 5332 of such title.

5 USC 3301  
et seq.  
5 USC 5332  
note.

“(c) DUTIES.—The Director shall administer the national sea grant program subject to the supervision of the Secretary and the Administrator. In addition to any other duty prescribed by law or assigned by the Secretary, the Director shall—

“(1) apply the long-range planning guidelines and the priorities established by the Secretary under subsection (a);

“(2) advise the Administrator with respect to the expertise and capabilities which are available within or through the national sea grant program, and provide (as directed by the Administrator) those which are or could be of use to other offices and activities within the Administration;

“(3) evaluate activities conducted under grants and contracts awarded pursuant to sections 205 and 206 to assure that the objective set forth in section 202(b) is implemented;

“(4) encourage other Federal departments, agencies, and instrumentalities to use and take advantage of the expertise and capabilities which are available through the national sea grant program, on a cooperative or other basis;

“(5) advise the Secretary on the designation of sea grant colleges and sea grant regional consortia and, in appropriate cases, if any, on the termination or suspension of any such designation; and

“(6) encourage the formation and growth of sea grant programs.

“(d) POWERS.—To carry out the provisions of this title, the Secretary may—

The section heading of such section 204 is amended to read as follows:

1978

“SEC. 204. NATIONAL SEA GRANT COLLEGE PROGRAM.”

Sec. 204(all parts): See amendment (1978) at Sec. 202(a)(3)

in section 204(c) by redesignating paragraphs (5) and (6) as paragraphs (6) and (7), respectively, and by inserting immediately after paragraph (4) the following new paragraph:

33 USC 1122.  
33 USC 1123.

1980

“(5) encourage cooperation and coordination with other Federal programs concerned with ocean and coastal resource conservation and usage.”

“(1) appoint, assign the duties, transfer, and fix the compensation of such personnel as may be necessary, in accordance with the civil service laws; except that five positions may be established without regard to the provisions of title 5, United States Code, governing appointments in the competitive service, but the pay rates for such positions may not exceed the maximum rate for GS-18 of the General Schedule under section 5332 of such title;

“(2) make appointments with respect to temporary and intermittent services to the same extent as is authorized by section 3109 of title 5, United States Code;

“(3) publish or arrange for the publication of, and otherwise disseminate, in cooperation with other services, offices, and programs in the Administration, any information of research, educational, training, and other value in fields related to ocean and coastal resources and with respect to ocean and coastal resources, without regard to section 501 of title 44, United States Code;

“(4) enter into contracts, cooperative agreements, and other transactions without regard to section 3709 of the Revised Statutes of the United States (41 U.S.C. 5);

“(5) accept donations and voluntary and uncompensated services, notwithstanding section 3679 of the Revised Statutes of the United States (31 U.S.C. 665 (b)); and

“(6) issue such rules and regulations as may be necessary and appropriate.

“SEC. 205. CONTRACTS AND GRANTS.

“(a) IN GENERAL.—The Secretary may make grants and enter into contracts under this subsection to assist any sea grant program or project if the Secretary finds that such program or project will—

“(1) implement the objective set forth in section 202(b); and

“(2) be responsive to the needs or problems of individual States or regions.

The total amount paid pursuant to any such grant or contract may equal 66⅔ percent, or any lesser percent, of the total cost of the sea grant program or project involved.

“(b) SPECIAL GRANTS.—The Secretary may make special grants under this subsection to implement the objective set forth in section 202(b). The amount of any such grant may equal 100 percent, or any lesser percent, of the total cost of the project involved. No grant may be made under this subsection unless the Secretary finds that—

“(1) no reasonable means is available through which the applicant can meet the matching requirement for a grant under subsection (a);

“(2) the probable benefit of such project outweighs the public interest in such matching requirement; and

“(3) the same or equivalent benefit cannot be obtained through the award of a contract or grant under subsection (a) or section 206.

The total amount which may be provided for grants under this subsection during any fiscal year shall not exceed an amount equal to 1 percent of the total funds appropriated for such year pursuant to section 212.

“(c) ELIGIBILITY AND PROCEDURE.—Any person may apply to the Secretary for a grant or contract under this section. Application shall be made in such form and manner, and with such content and other submissions, as the Secretary shall by regulation prescribe. The Secretary shall act upon each such application within 6 months after the date on which all required information is received.

by amending section 204(d)—

(A) by striking out “and” at the end of paragraph (5),  
(B) by redesignating paragraph (6) as paragraph (7), and  
(C) by inserting immediately after paragraph (5) the following new paragraph:

“(6) accept funds from other Federal departments, agencies (including agencies within the Administration), and instrumentalities to pay for grants made, and contracts entered into, by the Secretary under section 205(a); and”;

33 USC 1123.

1978

33 USC 1124.

by striking out the period at the end of the last sentence of section 205(a) and inserting in lieu thereof the following: “; except that this limitation shall not apply in the case of grants or contracts paid for with funds accepted by the Secretary under section 204(d)(6).”;

33 USC 1123.

1978

5 USC 3301  
et seq.  
5 USC 5332  
note.

Publication.

Rules and  
regulations.

33 USC 1124.

Application.

“(d) TERMS AND CONDITIONS.—(1) Any grant made, or contract entered into, under this section shall be subject to the limitations and provisions set forth in paragraphs (2), (3), and (4) and to such other terms, conditions, and requirements as the Secretary deems necessary or appropriate.

“(2) No payment under any grant or contract under this section may be applied to—

“(A) the purchase or rental of any land; or

“(B) the purchase, rental, construction, preservation, or repair of any building, dock, or vessel;

except that payment under any such grant or contract may, if approved by the Secretary, be applied to the purchase, rental, construction, preservation, or repair of non-self-propelled habitats, buoys, platforms, and other similar devices or structures, or to the rental of any research vessel which is used in direct support of activities under any sea grant program or project.

“(3) The total amount which may be obligated for payment pursuant to grants made to, and contracts entered into with, persons under this section within any one State in any fiscal year shall not exceed an amount equal to 15 percent of the total funds appropriated for such year pursuant to section 212.

“(4) Any person who receives or utilizes any proceeds of any grant or contract under this section shall keep such records as the Secretary shall by regulation prescribe as being necessary and appropriate to facilitate effective audit and evaluation, including records which fully disclose the amount and disposition by such recipient of such proceeds, the total cost of the program or project in connection with which such proceeds were used, and the amount, if any, of such cost which was provided through other sources. Such records shall be maintained for 3 years after the completion of such a program or project. The Secretary and the Comptroller General of the United States, or any of their duly authorized representatives, shall have access, for the purpose of audit and evaluation, to any books, documents, papers, and records of receipts which, in the opinion of the Secretary or of the Comptroller General, may be related or pertinent to such grants and contracts.

Record retention. Regulation.

Audit.

33 USC 1125.

Grants and contracts.

Application.

“SEC. 206. NATIONAL PROJECTS.

“(a) IN GENERAL.—The Secretary shall identify specific national needs and problems with respect to ocean and coastal resources. The Secretary may make grants or enter into contracts under this section with respect to such needs or problems. The amount of any such grant or contract may equal 100 percent, or any lesser percent, of the total cost of the project involved.

“(b) ELIGIBILITY AND PROCEDURE.—Any person may apply to the Secretary for a grant or contract under this section. In addition, the Secretary may invite applications with respect to specific national needs or problems identified under subsection (a). Application shall be made in such form and manner, and with such content and other submissions, as the Secretary shall by regulation prescribe. The Secretary shall act upon each such application within 6 months after the date on which all required information is received. Any grant made, or contract entered into, under this section shall be subject to the limitations and provisions set forth in section 205(d) (2) and (4) and to such other terms, conditions, and requirements as the Secretary deems necessary or appropriate.

“(c) AUTHORIZATION FOR APPROPRIATIONS.—There is authorized to be appropriated for purposes of carrying out this section not to exceed \$5,000,000 for the fiscal year ending September 30, 1977. Such sums as may be appropriated pursuant to this subsection shall remain available

in section 205(d)(2) by inserting “may be applied to the short-term rental of buildings or facilities for meetings which are in direct support of any sea grant program or project and” immediately after “contract” the second time it appears therein; 88 USC 1124.

1980

by amending the first sentence of section 206(c) to read as follows: 33 USC 1125.

1978

“There are authorized to be appropriated for purposes of carrying out this section not to exceed the following amounts:

- “(1) \$5,000,000 for each of fiscal years 1977, 1978, and 1979.
“(2) \$7,000,000 for fiscal year 1980.”;

in section 206(c) by inserting “out” immediately after “carrying”, and by inserting the following new paragraph immediately after paragraph (2): 88 USC 1125.

1980

Not to exceed \$5,000,000 for fiscal year 1981, not to exceed \$6,000,000 for fiscal year 1982, and not to exceed \$7,000,000 for fiscal year 1983.”;



until expended. The amounts obligated to be expended for the purposes set forth in subsection (a) shall not, in any fiscal year, exceed an amount equal to 10 percent of the sums appropriated for such year pursuant to section 212.

33 USC 1126. "SEC. 207. SEA GRANT COLLEGES AND SEA GRANT REGIONAL CONSORTIA.

"(a) DESIGNATION.—(1) The Secretary may designate—

and "(A) any institution of higher education as a sea grant college;

"(B) any association or other alliance of two or more persons

(other than individuals) as a sea grant regional consortium.

"(2) No institution of higher education may be designated as a sea grant college unless the Secretary finds that such institution—

"(A) is maintaining a balanced program of research, education,

training, and advisory services in fields related to ocean and coastal resources and has received financial assistance under section 205 of this title or under section 204(c) of the National Sea Grant College and Program Act of 1966;

"(B) will act in accordance with such guidelines as are prescribed under subsection (b) (2); and

"(C) meets such other qualifications as the Secretary deems necessary or appropriate.

The designation of any institution as a sea grant college under the authority of such act of 1966 shall, if such designation is in effect on the day before the date of the enactment of the Sea Grant Program Improvement Act of 1976, be considered to be a designation made under paragraph (1) so long as such institution complies with subparagraphs (B) and (C).

"(3) No association or other alliance of two or more persons may be designated as a sea grant regional consortium unless the Secretary finds that such association or alliance—

"(A) is established for the purpose of sharing expertise, research, educational facilities, or training facilities, and other capabilities in order to facilitate research, education, training, and advisory services, in any field related to ocean and coastal resources;

"(B) will encourage and follow a regional approach to solving problems or meeting needs relating to ocean and coastal resources, in cooperation with appropriate sea grant colleges, sea grant programs, and other persons in the region;

"(C) will act in accordance with such guidelines as are prescribed under subsection (b) (2); and

"(D) meets such other qualifications as the Secretary deems necessary or appropriate.

"(b) REQUISITES.—The Secretary shall by regulation prescribe—

"(1) the qualifications required to be met under paragraphs (2) (C) and (3) (D) of subsection (a); and

"(2) guidelines relating to the activities and responsibilities of sea grant colleges and sea grant regional consortia.

"(c) SUSPENSION OR DESIGNATION OF DESIGNATION.—The Secretary may, for cause and after an opportunity for hearing, suspend or terminate any designation under subsection (a).

"SEC. 208. SEA GRANT FELLOWSHIPS.

"(a) IN GENERAL.—The Secretary shall support a sea grant fellowship program to provide educational and training assistance to qualified individuals at the undergraduate and graduate levels of education

33 USC 1126.

33 USC 1124.

33 USC 1121.

note. Aug. p. 1961.

Hearg.

33 USC 1127.

in fields related to ocean and coastal resources. Such fellowships shall be awarded pursuant to guidelines established by the Secretary. Sea grant fellowships may only be awarded by sea grant colleges, sea grant regional consortia, institutions of higher education, and professional associations and institutes.

Guidelines.

“(b) **LIMITATION ON TOTAL FELLOWSHIP GRANTS.**—The total amount which may be provided for grants under the sea grant fellowship program during any fiscal year shall not exceed an amount equal to 3 percent of the total funds appropriated for such year pursuant to section 212.

“**SEC. 209. SEA GRANT REVIEW PANEL.**

33 USC 1128.

“(a) **ESTABLISHMENT.**—There shall be established an independent committee to be known as the sea grant review panel. The panel shall, on the 80th day after the date of the enactment of the Sea Grant Program Improvement Act of 1976, supersede the sea grant advisory panel in existence before such date of enactment.

Act, p. 1961.

“(b) **DUTIES.**—The panel shall take such steps as may be necessary to review, and shall advise the Secretary, the Administrator, and the Director with respect to—

“(1) applications or proposals for, and performance under, grants and contracts awarded under sections 205 and 206;

“(2) the sea grant fellowship program;

“(3) the designation and operation of sea grant colleges and sea grant regional consortia, and the operation of sea grant programs;

“(4) the formulation and application of the planning guidelines and priorities under section 204 (a) and (c) (1); and

“(5) such other matters as the Secretary refers to the panel for review and advice.

The Secretary shall make available to the panel such information, personnel, and administrative services and assistance as it may reasonably require to carry out its duties.

“(c) **MEMBERSHIP, TERMS, AND POWERS.**—(1) The panel shall consist of 15 voting members who shall be appointed by the Secretary. The Director shall serve as a nonvoting member of the panel. Not less than five of the voting members of the panel shall be individuals who, by reason of knowledge, experience, or training, are especially qualified in one or more of the disciplines and fields included in marine science. The other voting members shall be individuals who, by reason of knowledge, experience, or training, are especially qualified in, or representative of, education, extension services, State government, industry, economics, planning, or any other activity which is appropriate to, and important for, any effort to enhance the understanding, assessment, development, utilization, or conservation of ocean and coastal resources. No individual is eligible to be a voting member of the panel if the individual is (A) the director of a sea grant college, sea grant regional consortium, or sea grant program; (B) an applicant for, or beneficiary (as determined by the Secretary) of, any grant or contract under section 205 or 206; or (C) a full-time officer or employee of the United States.

“(2) The term of office of a voting member of the panel shall be 3 years, except that of the original appointees, five shall be appointed for a term of 1 year, five shall be appointed for a term of 2 years, and five shall be appointed for a term of 3 years.

“(3) Any individual appointed to fill a vacancy occurring before the expiration of the term for which his or her predecessor was appointed shall be appointed only for the remainder of such term.

in section 209(c)(3) by striking the first two sentences and inserting in lieu thereof the following: “Any individual appointed to a partial or full term may be reappointed for one additional full term.” 33 USC 1128.

1980

No individual may be appointed as a voting member after serving one full term as such a member. A voting member may serve after the date of the expiration of the term of office for which appointed until his or her successor has taken office, or until 90 days after such date, whichever is earlier.

Chairman,  
Vice Chairman.

"(4) The panel shall select one voting member to serve as the Chairman and another voting member to serve as the Vice Chairman. The Vice Chairman shall act as Chairman in the absence or incapacity of the Chairman.

"(5) Voting members of the panel shall—

Compensation.  
5 USC 5332  
note.

"(A) receive compensation at the daily rate for GS-18 of the General Schedule under section 5332 of title 5, United States Code, when actually engaged in the performance of duties for such panel; and

"(B) be reimbursed for actual and reasonable expenses incurred in the performance of such duties.

"(6) The panel shall meet on a biannual basis and, at any other time, at the call of the Chairman or upon the request of a majority of the voting members or of the Director.

"(7) The panel may exercise such powers as are reasonably necessary in order to carry out its duties under subsection (b).

33 USC 1129.

"SEC. 210. INTERAGENCY COOPERATION.

"Each department, agency, or other instrumentality of the Federal Government which is engaged in or concerned with, or which has authority over, matters relating to ocean and coastal resources—

"(1) may, upon a written request from the Secretary, make available, on a reimbursable basis or otherwise any personnel (with their consent and without prejudice to their position and rating), service, or facility which the Secretary deems necessary to carry out any provision of this title;

"(2) shall, upon a written request from the Secretary, furnish any available data or other information which the Secretary deems necessary to carry out any provision of this title; and

"(3) shall cooperate with the Administration and duly authorized officials thereof.

33 USC 1130.  
Submittal to  
Congress and  
President.

"SEC. 211. ANNUAL REPORT AND EVALUATION.

"(a) ANNUAL REPORT.—The Secretary shall submit to the Congress and the President, not later than February 15 of each year, a report on the activities of, and the outlook for, the national sea grant program.

"(b) EVALUATION.—The Director of the Office of Management and Budget and the Director of the Office of Science and Technology Policy, in the Executive Office of the President, shall have the opportunity to review each report prepared pursuant to subsection (a). Such Directors may submit, for inclusion in such report, comments and recommendations and an independent evaluation of the national sea grant program. Such material shall be transmitted to the Secretary not later than February 1 of each year, and the Secretary shall cause it to be published as a separate section in the annual report submitted pursuant to subsection (a).

33 USC 1131.

"SEC. 212. AUTHORIZATION FOR APPROPRIATIONS.

"There is authorized to be appropriated for purposes of carrying out the provisions of this title (other than section 206) not to exceed

Sec. 211(all parts): See amendment (1978) at Sec. 202(a)(3)

by amending section 211—

(A) by striking out "ANNUAL" in the section heading and inserting in lieu thereof "BIENNIAL",

(B) by amending subsection (a) to read as follows:

"(a) BIENNIAL REPORT.—The Secretary shall submit to the Congress and the President, not later than February 15, 1980, and not later than

33 USC 1130. 1978

Report to  
Congress and the  
President.

February 15 of every even-numbered year thereafter, a report on the activities of, and the outlook for, the national sea grant program."; and

(C) by amending the last sentence of subsection (b) to read as follows: "Such material shall be submitted to the Secretary not later than February 1 of the year in which the report concerned is to be submitted under subsection (a), and the Secretary shall cause it to be published as a separate section in such report."

by amending the first sentence in section 212 to read as follows:

"There are authorized to be appropriated for purposes of carrying out the provisions of this title (other than section 206) not to exceed the following amounts:

- "(1) \$50,000,000 for each of fiscal years 1977 and 1978.
- "(2) \$55,000,000 for each of fiscal years 1979 and 1980."

33 USC 1131. 1978

33 USC 1125.

in section 212 by inserting the following new paragraph immediately after paragraph (2):

"(3) Not to exceed \$50,000,000 for fiscal year 1981, not to exceed \$58,000,000 for fiscal year 1982, and not to exceed \$65,000,000 for fiscal year 1983."

33 USC 1131.

1980

\$50,000,000 for the fiscal year ending September 30, 1977. Such sums as may be appropriated under this section shall remain available until expended."

SEC. 3. INTERNATIONAL COOPERATION ASSISTANCE.

33 USC 1124a.

(a) IN GENERAL.—The Secretary of Commerce (hereafter in this section referred to as the "Secretary") may enter into contracts and make grants under this section to—

(1) enhance the research and development capability of developing foreign nations with respect to ocean and coastal resources, as such term is defined in section 203 of the National Sea Grant Program Act; and

(2) promote the international exchange of information and data with respect to the assessment, development, utilization, and conservation of such resources.

(b) ELIGIBILITY AND PROCEDURE.—Any sea grant college and sea grant regional consortium (as defined in section 203 of the National Sea Grant Program Act) and any institution of higher education, laboratory, or institute (if such institution, laboratory, or institute is located within any State (as defined in such section 203)) may apply for and receive financial assistance under this section. Each grant or contract under this section shall be made pursuant to such requirements as the Secretary shall, after consultation with the Secretary of State, by regulation prescribe. Application shall be made in such form, and with such content and other submissions, as may be so required. Before approving any application for a grant or contract under this section, the Secretary shall consult with the Secretary of State. Any grant made, or contract entered into, under this section shall be subject to the limitations and provisions set forth in section 205(d) (2) and (4) of the National Sea Grant Program Act and to such other terms, conditions, and requirements as the Secretary deems necessary or appropriate.

Regulation.

Consultation.

(c) AUTHORIZATION FOR APPROPRIATIONS.—There is authorized to be appropriated for purposes of carrying out this section not to exceed \$3,000,000 for the fiscal year ending September 30, 1977. Such sums as may be appropriated under this section shall remain available until expended.

SEC. 4. CONFORMING AND MISCELLANEOUS PROVISIONS.

(a) Section 5314 of title 5, United States Code, is amended by adding at the end thereof the following new paragraph:

"(63) Administrator, National Oceanic and Atmospheric Administration."

(b) Section 5315 of title 5, United States Code, is amended by adding at the end thereof the following new paragraphs:

"(109) Deputy Administrator, National Oceanic and Atmospheric Administration.

"(110) Associate Administrator, National Oceanic and Atmospheric Administration."

(c) (1) Section 2(d) of Reorganization Plan Numbered 4 of 1970 (84 Stat. 2090) is amended by striking out "Level V" and "(5 U.S.C. 5316)" and inserting in lieu thereof "Level IV" and "(5 U.S.C. 5315)", respectively.

5 USC app. II;  
15 USC 1511  
note.

The section heading of section 3 of the Sea Grant Program Improvement Act of 1976 (33 U.S.C. 1124a) is amended to read as follows:

1980

"SEC. 3. SEA GRANT INTERNATIONAL PROGRAM."

Section 3 of the Sea Grant Program Improvement Act of 1976 (33 U.S.C. 1124a) is amended—

1978

(1) by striking out "National Sea Grant Program Act" each place it appears therein and inserting in lieu thereof "National Sea Grant College Program Act";

(2) by amending subsection (a) (2) to read as follows:

"(2) promote the exchange among the United States and foreign nations (including, but not limited to, developing foreign nations) of information and data with respect to the assessment, development, utilization, and conservation of such resources."; and

(3) by amending the first sentence of subsection (c) to read as follows:

"There are authorized to be appropriated for purposes of carrying out this section not to exceed the following amounts:

"(1) \$3,000,000 for each of fiscal years 1977, 1978, and 1979.

"(2) \$5,000,000 for fiscal year 1980."

Section 3(c) of the Sea Grant Program Improvement Act of 1976 (33 U.S.C. 1124a(c)) is amended by inserting the following new paragraph immediately after paragraph (2):

1980

"(3) Not to exceed \$5,000,000 for fiscal year 1981, not to exceed \$5,000,000 for fiscal year 1982, and not to exceed \$5,000,000 for fiscal year 1983."

5 USC app. II.

(2) The individual serving as the Associate Administrator of the National Oceanic and Atmospheric Administration (pursuant to section 2(d) of Reorganization Plan Numbered 4 of 1970) on the date of the enactment of this Act shall continue as the Associate Administrator, notwithstanding the provisions of paragraph (1).

Approved October 8, 1976.

---

**LEGISLATIVE HISTORY:**

HOUSE REPORTS No. 94-1048 (Comm. on Merchant Marine and Fisheries) and No. 94-1556 (Comm. of Conference).

SENATE REPORTS No. 94-848 accompanying S. 3165 (Committees on Labor and Public Welfare and Commerce).

CONGRESSIONAL RECORD, Vol. 122 (1976):

May 3, considered and passed House.

June 14, considered and passed Senate, amended, in lieu of S. 3165.

Sept. 17, Senate agreed to conference report.

Sept. 23, House agreed to conference report.

WEEKLY COMPILATION OF PRESIDENTIAL DOCUMENTS, Vol. 12, No. 42:

Oct. 10, Presidential statement.

---

**LEGISLATIVE HISTORY:**

1978 Amendments

HOUSE REPORT No. 95-1011 (Comm. on Merchant Marine and Fisheries).

SENATE REPORT No. 95-887 (Comm. on Commerce, Science, and Transportation) and (Comm. on Human Resources).

CONGRESSIONAL RECORD, Vol. 124 (1978):

Apr. 17, considered and passed House.

June 7, considered and passed Senate, amended.

June 29, House concurred in Senate amendment with amendments.

Sept. 25, Senate concurred in House amendments.

Approved October 7, 1978.

---

**LEGISLATIVE HISTORY:**

1980 Amendments

HOUSE REPORT No. 96-844 (Comm. on Merchant Marine and Fisheries).

SENATE REPORT No. 96-723 (Comm. on Commerce, Science, and Transportation and Comm. on Labor and Human Resources).

CONGRESSIONAL RECORD, Vol. 126 (1980):

Apr. 17, considered and passed House.

May 22, considered and passed Senate, amended.

June 5, House concurred in Senate amendment with amendments.

June 9, Senate concurred in House amendments with an amendment.

June 16, House concurred in Senate amendment.

Approved June 28, 1980.

## **EVALUATIONS OF THE NATIONAL SEA GRANT COLLEGE PROGRAM**

---

Although funding for Sea Grant represents a mere fraction of the billion dollar federal ocean program, it has been the subject of continuous scrutiny and evaluation for more than a decade. Studies have focused on the general effectiveness of the program, Sea Grant's relationship to the National Oceanic and Atmospheric Administration, the contributions of individual research projects, and on the attitudes and perceptions of academic marine scientists toward Sea Grant.

Several themes emerge in these assessments. First, Sea Grant plays a unique and important role in the nation's marine program. Second, its strengths reside in its ability to promote interdisciplinary marine research, education, and advisory activities responsive to both local and national needs. Its biggest limitation in fulfilling its promise has been insufficient funding. Third, perceptions about the quality of Sea Grant research and administrative effectiveness depend largely on whether researchers are interested primarily in basic or applied research. Fourth, a variety of administrative changes would improve the effectiveness of the program. Finally, the relationship between Sea Grant and its parent agency, the National Oceanic Atmospheric Administration, can and should be clarified in a manner that would enable each to draw on the strengths and resources of the other.

The following is a summary, with a minimum of commentary, of the major points made in these reports. Although many of the recommendations made in these reports have been addressed by the National Sea Grant Office and the Sea Grant directors, no effort is made here to trace these actions, nor to summarize the evaluations of the Sea Grant programs made as a regular part of the congressional oversight or budget process. All of these forms of oversight and review have been useful in helping lead to the program accomplishments summarized in Sections 3-5 of this book.

For Further Information Contact:

Lauriston King  
Texas A&M Sea Grant Program  
College Station, Texas 77801  
713/845-3854

Review of the Office of Sea Grant Operations and Functions. Board of Visitors. Unpublished. 1982.

In a June 29, 1981 letter, the NOAA Assistant Administrator for Research and Development formed a six-member Board of Visitors to conduct an external review of the Office of Sea Grant. The Board's task was to assess the role and performance of the Office of Sea Grant as the federal administrator of the National Sea Grant College Program. Members reviewed earlier evaluations of Sea Grant and interviewed Office of Sea Grant staff and others knowledgeable about the program.

Ten specific recommendations emerged. The Board encouraged full implementation of a reorganization of the office staff by subject area rather than by institution; development of a strategic approach to planning based on these revised program management responsibilities; development of a solid appreciation for the nature of the advisory function in all aspects of the Sea Grant program; and accelerated adoption of new procedures for reviewing Sea Grant College programs. The Board also called for improved communications between Sea Grant and other federal agencies and greater integration of the mission and capabilities of Sea Grant with other parts of NOAA.

The Federal Funding of Academic Marine Science - A Report. W. Wayne Shannon and David D. Palmer. Institute for Social Inquiry, The University of Connecticut. 1982.

This extensive study of the relationship between federal funding agencies and university marine scientists is the only report that examines Sea Grant in the context of the broader pattern of federal support for academic marine programs. Data were compiled between 1977 and 1979 from mail questionnaires received from 793 academic marine scientists, 918 questionnaires from recent graduates of marine programs, and 153 interviews with federal agency and university administrators.

The researchers noted that Sea Grant, along with the National Science Foundation's Oceanography Section and Office for the International Decade of Ocean Exploration (since 1980 merged in the Division of Ocean Sciences), and the Navy's Office of Naval Research, have the most extensive linkage to the university ocean research community of all the federal agencies.

Interviews and survey data revealed several areas of dissatisfaction on the part of university marine scientists. First, the scientists felt the national Sea Grant office had not followed a consistent program. Second, site visit review teams were often comprised of individuals who were thought not to be sufficiently familiar with programs at various institutions to evaluate them "in a professional and consistent manner over time." Third, many felt that Sea Grant was "too sensitive to political winds" and the wants of different users, "too prone to 'target' various desired areas of research, too much concerned with relevance and too anxious to cite accomplishments in the real world. Finally, many complained about the "excessively arduous review process" for Sea Grant proposals and too little money to support and sustain those who were interested in doing Sea Grant research. At the heart of many of these concerns was the tension between Sea Grant's emphasis on applied research, and university scientists' desire to pursue basic problems of their own choosing.

The authors observed, however, that often after such critical comments were made, persons expressing them would quickly reaffirm interest in and devotion to the 'Sea Grant idea.'" They concluded that "While it is surely not everyone's enthusiasm, a broad range of individuals in the academic marine science community see Sea Grant as a highly important part of the federal funding system. Recognition is widespread that Sea Grant is the most durable and institutionally committed program supporting academic marine science research beyond the disciplines of oceanography, proper. Its importance as a catalyst for interdisciplinary activity, marine-related engineering, and social science is widely recognized. Generally, however, there is a pervasive sentiment in the academic community, even among some of Sea Grant's strongest supporters, that the Sea Grant idea -- a creative partnership between the federal government, the university, and the governmental and private users of marine technology--needs continuing assessment and perfected implementation."



Mandate for Leadership, Charles L. Heatherly (ed.). Heritage Foundation, Washington, D.C. 1981.

Prior to President Ronald Reagan's inauguration, teams of knowledgeable individuals, under the auspices of the Heritage Foundation, surveyed the role and performance of programs throughout the federal government. The group that evaluated the Department of Commerce found that the Sea Grant Program "has an impressive record of success, primarily because it is based largely on local priorities and needs. It operates in partnership with State and local governments, private industry, universities, organizations and individuals concerned with or affected by ocean and coastal resources. The Congress makes regular requests of Sea Grant for information.

A key element of Sea Grant is its outreach mechanism whereby results of research are provided to users in industry, government agencies and the general public.

"Sea Grant funding should be increased by 10 percent per year in real terms for the next five years."

Sea Grant Issue Paper. Prepared by the National Oceanic and Atmospheric Administration Office of Policy and Plans. Unpublished. September 25, 1980.

This internal staff report reviewed the legislative origins of Sea Grant, its administrative practices, and funding history as a basis for improving Sea Grant's relationships with other parts of NOAA. The basic questions included: (1) the responsiveness of Sea Grant to NOAA's needs; and (2) ways in which cooperation between Sea Grant and other parts of NOAA might be improved.

Sea Grant, noted the report, filled a number of roles for NOAA. It was NOAA's largest "marine outreach arm, through its advisory services, educational activities and university research," and thus was able to maintain close contact with marine specialists in the universities. Sea Grant, with its constituency base and attention to local needs, was able to respond to local issues and concerns, as well as serve as an effective early warning system for emerging national problems. Sea Grant had not, however, "been used adequately to enhance NOAA's stature and image."

There was a need for greater communication between Sea Grant and other parts of NOAA, more participation in the Sea Grant review process by other NOAA specialists, and improved understanding of the roles, missions, and priorities by those in Sea Grant and NOAA in order to improve the performance of each.

## General Accounting Office

The General Accounting Office (GAO) has conducted two assessments of Sea Grant. The first and most extensive was conveyed by letter to the Office of Sea Grant on March 26, 1974, and the second, far more limited in scope, was summarized in a letter dated October 25, 1979. The 1974 observations were directed primarily at issues of program management and reporting. Recommendations included more explicit attention to relating efforts to accomplishments and benefits; increased suggestions for program development by local advisory groups; more attention by Sea Grant to matching costs; development of procedures that would, before final approval of a proposal, resolve and document actions taken as a result of peer reviews; and creation of a NOAA-wide advisory service. Additional suggestions concerned establishing guidelines and procedures for the management of Sea Grant programs in the universities.

The 1979 letter was based on an examination of the administration of Sea Grant to identify areas needing further review and analysis. Based on visits to Sea Grant programs in six states, personal contacts in four others, and discussions with NOAA personnel, the reviewers concluded that: (1) "Many Sea Grant projects appear to have only limited application and to be of little benefit to the identified user community," and (2) "A followup evaluation appears to be needed to determine if the federally supported Sea Grant projects are meeting expected goals and objectives."

The first observation was based on a strictly literal interpretation of the relationship between research, advisory services and user relationships, a point made with great clarity and force in the Office of Sea Grant's explanation of why it could not accept that statement as valid. The second statement involved evaluation of completed projects, procedures for which were well established in Sea Grant administrative practices.

Program Development Procedures and Transfer Mechanisms in the National Sea Grant Program. J. Herbert Hollomon, Byron F. Battle, Linsu Kim, Blair McGugan, and James M. Utterback. Center for Policy Alternatives, Massachusetts Institute of Technology. November 1977.

This study evolved from an earlier MIT evaluation of the commercial and foreign trade impact of the Sea Grant program, and sought to suggest ways Sea Grant could increase the speed and frequency of economic benefits without sacrificing other benefits of Sea Grant support, or "distorting the fundamental characteristics of participating institutions."

The analysis reviewed the conditions that influenced commercially successful Sea Grant projects, program orientation, and development procedures and transfer mechanisms, with particular emphasis on the strengths and deficiencies of each of these aspects of the program. Inadequate funding was a key problem. "Many imaginative initiatives" had been rejected and Sea Grant institutions had few incentives to promote new ideas in the face of limited funding. A more fundamental problem, however, was the failure of Sea Grant "to project itself forcefully and prove its usefulness."

They concluded that "the objective which it established for itself during its first ten years -- the construction of a forceful and balanced network of institutions to implement the Sea Grant concept -- has been achieved, and in the opinion of the authors, with highly superior marks." They urged that attention turn to defining those areas where Sea Grant wished to make an impact, to promote a network of diverse institutions, each with its own special strengths and capabilities, and continue to play a "forceful catalyst role, linking university and community together in research on relevant and highly present" marine resource issues. In addition, Sea Grant should make "a more unabashed effort to 'sell' itself", and to continually emphasize the close working relationship between advisory services and research projects which "remain Sea Grant's strongest asset." To pursue these goals, the analysts called for a more active role in program development by the National Sea Grant Office, the Review Panel, and the Directors, in particular in setting priorities and identifying clusters ("portfolios") of research projects, and the use of site visits to review past performance. They also recommended greater latitude for high-risk proposals (which the earlier MIT study found produced the greatest pay-offs), and active pursuit of more cooperation with the private sector, including joint university-industry programs.

The National Sea Grant Program: A Review. A Report for the Secretary of Commerce by the National Advisory Committee on Oceans and Atmosphere. Washington, D.C. November 3, 1976.

During the fall of 1975 the members and staff of the National Advisory Committee on Oceans and Atmosphere (NACOA), embarked on a year-long evaluation of the Sea Grant program. Based on extensive interviews, site visits, panel reviews, attendance at directors' meetings and a review of the extensive documentation about the program, the Committee concluded that:

"...Sea Grant plays an important role in the national effort to develop and conserve our marine resources. Its ability to draw on the pool of talent in our universities and other research institutions, and its close contacts with users and potential users of marine information and technology, enable it to complement the activities of the numerous other Federal agencies and programs also concerned with marine resource development. Its most significant contributions have stemmed from its sensitivity to regional and local perceptions of issues which, while collectively important to the Nation, may be individually too small or too new to have attracted attention at the Federal level."

In strongly recommending that the program be continued, NACOA noted that Sea Grant had been "responsive to its legislative charter", had "contributed significantly to the Nation's marine effort," and that there was "a continuing need for the kind of service it provides." To strengthen the program, the committee made recommendations on policy, management, and funding.

With respect to policy, NACOA urged the Administrator of NOAA to "clarify the goals and role of Sea Grant in relation to NOAA's overall mission", to make more extensive use of the Sea Grant Advisory Panel for advice on broad policy issues, and to develop and implement procedures for improved coordination between other agencies, other parts of NOAA, and Sea Grant.

The Office of Sea Grant was encouraged to clarify its guidelines to aid participating institutions in establishing priorities; expedite its proposal review process; ensure that engineering is incorporated into research projects where appropriate; and, for projects with commercial potential, consider economic as well as technical feasibility.

NACOA concluded that Federal funding was "inadequate for the task assigned to the program," hence should be increased to a minimum of \$40 million per year over the next several years.

Sea Grant Capacity-Building and Resource Management. Office of Program Evaluation, Department of Commerce. Unpublished. October 1976.

In this staff study Department of Commerce evaluation specialists addressed two questions raised initially by the Office of Management and Budget. These were whether Sea Grant was a "capacity-building program" or a conduit for grants, and whether or not these grants duplicated work supported by other agencies. The report noted that Sea Grant represented only a fraction of the total funding for federal marine programs but endorsed Sea Grant's role in developing institutional capabilities (e.g. "capacity-building").

They concluded that Sea Grant research was funded by a variety of public and private sources; provided a mechanism for passing funds from other agencies which reduced administrative costs and duplication; and employed an effective review process which assured project quality. They also noted that peer reviews of the Sea Grant approach and program administration had been favorable and that "the local initiative model" was preferred to a model which sought to impose national criteria for requesting and selecting research proposals.

With respect to "capacity-building", however, there was no common understanding of the goals, objectives, and procedures for developing the kinds of institutions and resources required to fulfill government missions. It did seem possible, however, that a model of "capacity-building could be developed and tested which would have pay-offs in Sea Grant's resource management and program structure." The evaluators recommended that the Office of Management and Budget develop a "capacity-building model" for application throughout the government.



# SEA GRANT ASSOCIATION

SEA GRANT COLLEGE PROGRAM  
Texas A&M University  
College Station, Texas 77843  
(713) 845-3854

*President 1981-82*  
Feenan D. Jennings  
Texas A&M University

*President Elect*  
B. J. Copeland  
University of North Carolina

*Past President*  
Donald H. Rosenberg  
University of Alaska

*Executive Committee*  
Al M. Becton (84)  
University of Michigan

Roy E. Martin (82)  
National Fisheries Institute

William McNeil (83)  
Weyerhaeuser Company

Neils Rorholm (84)  
University of Rhode Island

Frank R. Van Lopik (82)  
Louisiana State University

*Treasurer*  
John H. Judd  
University of Michigan

April 20, 1982

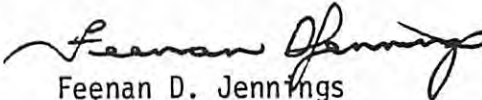
## MEMORANDUM

SUBJECT: Summaries of Recent Sea Grant Activities

Attached are five brief summaries of recent Sea Grant activities covering a wide variety of topics. These include ocean engineering for development of the outer continental shelf, fisheries, marine microbiology, seafood technology, pollution in the Great Lakes, and the resolution of conflict between competing ocean uses. Beneficiaries of these efforts include commercial and recreational fishermen, state, local, and federal governments, students at all levels of education, and the many small, specialized marine industries with few resources to invest in their own research and development projects.

The Sea Grant program was established by Congress in 1966 to promote marine resource use and development by a network of research, advisory, and education activities at universities and research centers in the states bordering the oceans and Great Lakes. Federal funds - \$35 million 1982 - are administered by the National Sea Grant Office in the Department of Commerce's National Oceanic and Atmospheric Administration. Matching support comes from state and local governments, private industry, and participating universities.

I encourage you to contact the Sea Grant directors listed at the end of these summaries for additional information on these projects or any other particular interest to you.

  
Feenan D. Jennings  
President  
Sea Grant Association

Sea Grant: keeping seafood on the menu

Seafood is today's staple and tomorrow's promise of protein for a hungry world. But there are problems facing our fisheries. Fish are a common-property resource, little understood and on the move from state to state, from offshore depths to nearshore shallows, spawning, feeding, migrating and dying in a dizzying array of interlocking cycles.

From the beginning, Sea Grant focused much of its energies on fisheries. Under increasing pressure from intensive harvesting and declining water quality, some key species and old favorites became scarce. Foreign fleets, heavily subsidized by their governments, took larger and larger shares of both the catch and the market. The question: How do you tend the crops when nobody owns the farm?

For the answer, Sea Grant mustered teams of experts in fields ranging from ecology to economics, aquaculture to computer modeling. In Oregon, the flow of the Columbia River surrendered the secrets of Salmon--their life cycles and their feeding habits. Sea Grant teams from Maryland, Virginia and North Carolina began tracing the almost-unknown habits of the scarce and valuable striped bass. Sea Grant teams from Delaware, Maryland and Virginia gathered on the Chesapeake Bay to learn what features in the blue crab's behavior might help resource managers recruit more of the prized crustaceans into the estuaries, and so into fishing boats.

Basic research data began to pile up from dozens of other such projects, and fisheries managers got facts they needed to help them map key habitats, assess populations and decide when and where catches could be made most profitably, for everyone. As the research findings accumulated, they began laying a "baseline" of fisheries science upon which future work could build. Key links between species and their habitats became clear. Applied aquaculture began to show how shellfish hatcheries could best replenish the stocks of valuable clams, oysters and scallops. And, Sea Grant-trained students and technicians gave the nation a new pool of badly needed expertise.

But in fisheries, the action is in the marketplace as well as in the waters. Sea Grant's blend of research, extension and education helped seafood handlers and processors, often hamstrung by outmoded gear and methods, be more efficient and so more competitive in world and national markets. More fish protein made it to the dinner table and less went down the drain. Some under-used but eminently edible seafood species went out to meet the public. And, fishermen got training and facts they needed to help them stay afloat.

For now, America's seafood dinner is still on the menu. But to keep it there, and to keep our fisheries competitive with foreign nations', will require teamwork. It will take more than the combined efforts of industry and government. It will take the diverse tools of our universities. And, just as our Land Grant colleges helped lead American agriculture to a place of world leadership, so can the national Sea Grant program help put American fisheries first.



Sea Grant: letting science pay off for people

-- Off the coast of Rhode Island, a fishing boat goes down in waters icy enough to kill its crew. But the crew, equipped and trained against such an emergency, survives. Later, they give credit to a Sea Grant marine advisory specialist, who had trained the fishermen to help them prevent hypothermia and cold-water drowning. The specialist had applied some ground-breaking research on hypothermia funded by Sea Grant in Michigan and Minnesota.

-- Off California, albacore fishermen use advanced satellite "pictures," showing warm and cool water masses, to home in on their catch, saving precious fuel. And in North Carolina, charter boat captains use the same technique to log a successful trip. Both groups tapped into the system through Sea Grant marine advisory agents, who put the fishermen in touch with sources of information, then let them do the rest.

-- And, in New England, Sea Grant agents rushed critical information to shellfishermen about a toxic algal bloom, helping avoid disastrous losses to the region's seafood industry.

In such cases, and in hundreds of others like them, the Sea Grant network supplied help when it was needed. The cost was low; the benefits very great. And, the timing was right.

One of the great frustrations of using research has always been that research can take a decade or more to find its way into use. Conditions change, information goes out of date. The national Sea Grant network cuts the lag time by building a bridge between research and the private sector. Trained specialists translate scientific findings into a shape that industry and government can put to use. Marine advisory agents go right to the workplace with information tailored to help their communities boost incomes and improve the quality of their citizens' lives. Information specialists keep the vital information pulsing through the media, through publications and through the Sea Grant network of people. A good bridge serves both sides of the stream, and the same network also enriches research, by keeping it in touch with what is happening down on the waterfront.

As research pushes farther the frontier of science, the gulf between the experience of science and the experience of everyday life grows deeper and broader. The wider that gulf, the higher the risk that good ideas will be lost there--ideas people need to keep their ingenuity, and the nation's, forging ahead. Sea Grant is bridging the gap, putting good ideas to work.

The National Sea Grant College Program: developing the outer continental shelf.

The National Sea Grant College Program is helping the United States realize the most balanced use of its outer continental shelf resources. Because of the unique problems connected with new techniques needed to recover these resources, Sea Grant has mobilized the best talent at our leading universities to help solve both pressing technical problems and problems associated with multiple uses of the nation's offshore assets.

Here are examples of national Sea Grant College Program activities in the area of continental shelf development and ocean resource recovery:

- Development of underwater manipulators for working the sea bed

- Analysis and modification of marine cable systems

- Investigation into ocean mining techniques

- Analysis and development of offshore structures and platform systems

- Development of welding systems for marine use

- Examination of techniques for manganese nodule exploitation

Such projects focus not only on the productive use of the offshore environment, but also on processes and techniques which can enhance the safety of those who work on or under the sea.

An example of Sea Grant's involvement in solving problems resulting from multiple use of continental shelf resources lies in the Georges Bank area, valuable both to the oil industry and the fisheries industry. Sea Grant developed comprehensive computer models to provide the technical information necessary to make judgments about placement and management of oil rigs, probable production and shipment schedules and potential impact of oil spills. This technical assistance facilitated management decisions which recognize the importance of both fisheries and energy development.

As the United States continues to look to the continental shelf to meet its energy, mineral and seafood needs, the national Sea Grant College Program is providing the cutting-edge research and information needed to ensure efficient and wise use of this national resource.

## Sea Grant: striking the balance of uses

When it comes to water quality, it is easy to show what poses a threat. It is much more difficult to take one step farther and show how our waters can and should be used, while preserving their capacity to sustain future generations.

The national Sea Grant program is taking that step. In the Great Lakes, levels of toxic chemicals called PCBs had all but extinguished the lake-trout fisheries, until Sea Grant teams from Wisconsin, Michigan and New York studied the lakes' ecosystems and helped show which areas could safely be put back into production. Using Sea Grant research, agencies were able to determine where and how urban wastes from New York and Los Angeles could be dumped offshore, while maintaining the water quality crucial to fisheries and recreation industries. And, many acres of nearshore waters, closed to shellfishing because of contamination, may soon be reopened thanks to Sea Grant research that developed more specific tests for harmful toxins and helped demonstrate how contaminated shellfish can purge themselves of contaminants, when given the right conditions.

Striking such a balance of uses requires good facts and good management. By learning the interactions of currents, nutrients, sediments, organisms and toxins, Sea Grant teams have been able to show how to time disruptions in the marine environment so that they least upset nature's natural balances. They have shown how differing ecological "compartments" can be managed for the best use of each.

With such information, Sea Grant teams are demonstrating that environmental research can actually save money, by showing what environmental safeguards are necessary and which are not. And, at the same time, Sea Grant is working to break down the barriers and dispel the conflicts that divide science from industry, the needs of the environment from the needs of man.

As we look more and more to our coastal waters and the seas for food, transportation, waste disposal, energy, minerals and recreation, the conflicts over resources will increase. New uses will create new complexities, and the balance of uses will become more delicate. Developing our waters' resources will challenge us to keep our research and our training up-to-date. It is a challenge suited to a national network of university programs, a network with all the tools of science and education at its disposal, yet with none of the burdens of regulatory responsibility. Sea Grant is just that network.

The National Sea Grant College Program: solving problems through marine microbiology.

The national Sea Grant College Program is using the resources of the nation's leading research institutions to further our basic knowledge about the genetics, serology and basic biochemistry of infections which threaten the seafood industry and the public health.

More than 60% of the nation's coastal areas are closed to the harvest of valuable shellfish such as oysters, clams and scallops because of feared contamination. This contamination often results from natural toxins or from viruses or bacteria such as Vibrio cholerae - the causative agent of cholera. Almost every coastal state faces some contamination problem, and closure of harvesting grounds represents a significant loss in jobs and revenues for the seafood industry.

Sea Grant's microbiological research has wide-range implications for the future of the fisheries industry and for our basic understanding of disease and its relation to seafood handling, processing and marketing. This research effort lies on the threshold of breakthroughs in bioengineering which could revolutionize current processing methodology, allowing for the development of new products and for the eradication of disease associated with seafood.

Sea Grant activities in this area include:

- Examining the microbial contamination of fish

- Analyzing effects of temperature and other environmental factors on the storage and handling of seafood

- Improving seafood quality through the control of pathogens

- Evaluating nutritional components of seafood

- Modifying seafood processing techniques

- Clarifying the role of Clostridium botulinum in seafood handling

- Developing methods for processing wastes for use as fertilizer and other products

Sea Grant's research effort in the area of marine microbiology and seafood technology cuts across state and regional boundaries and represents a world-class science effort. Sea Grant researchers, at the request of individual countries or the United Nations, have traveled to Europe and the third world to represent United States leadership in solving problems caused by waterborne diseases such as cholera. This research effort by many universities has a far-reaching impact both on economics of the seafood industry and on human health worldwide.

# SEA GRANT'S ADVISORY SERVICE PROGRAM: SERVING THE NATION'S MARINE COMMUNITY\*

## Executive Summary

In 1982, the Council of Sea Grant Directors appointed a task force to describe Sea Grant's advisory service and to illustrate the educational service it performs for the nation. This summarizes that report.

Sea Grant's advisory service is part of a public education effort designed to help improve the development of human resources and better utilize the nation's marine resources. This is done by using the knowledge and resources of the nation's academic institutions to solve marine-related problems common to citizens, businesses, communities, organizations and government agencies around the country. Beneficiaries range from the largest corporate and government agencies to the smallest of "mom and pop" business operations.

Sea Grant's advisory service is truly national in scope, in importance and in organizational structure. There is an advisory service program in every coastal and Great Lakes state. The national scope of many projects has developed in response to regional or local needs in such areas as port development, fishing gear technology, fuel conservation in maritime industries, marine business development and management, and seafood harvesting and processing technology.

In partnership with NOAA's Office of Sea Grant, the various advisory programs have worked at some time or other with virtually every NOAA agency and many other federal agencies as well. The programs focus on fisheries, coastal management, marine education, aquaculture, recreation and tourism, seafood processing, pollution, transportation and ports, among other topics.

About half of the advisory service units are administered through the state Land Grant University Cooperative Extension Service. Most others work in close cooperation with formal extension programs. Across the nation, the average program receives about 60 percent of its support from Sea Grant. An additional 30 percent comes from state funding, with the remainder coming from private sources, local government and other federal sources. A core of 350 agents and specialists comprise the 31 advisory programs.

The advisory service agent/specialist helps solve problems, initiate new ideas and bring together diverse groups of individuals with common interests in the marine environment. This requires the development of relationships between clientele groups, and it precludes the taking of parochial attitudes and/or advocacy positions. A typical cross-section sample of program activities would include advising industry of geotechnical research in Massachusetts, showing port managers better business practices in Oregon, teaching coastal residents about hurricane preparedness in Texas, informing state government about marine needs in Florida, and advising regional agencies on water quality around the Great Lakes.

This approach -- of using university-based talent to draw together university researchers and the resources of local, state and federal governments, and of applying these talents to create a greater appreciation for marine resources in our society -- has been a success.

\*For the full published report, contact your nearest Sea Grant College Program.

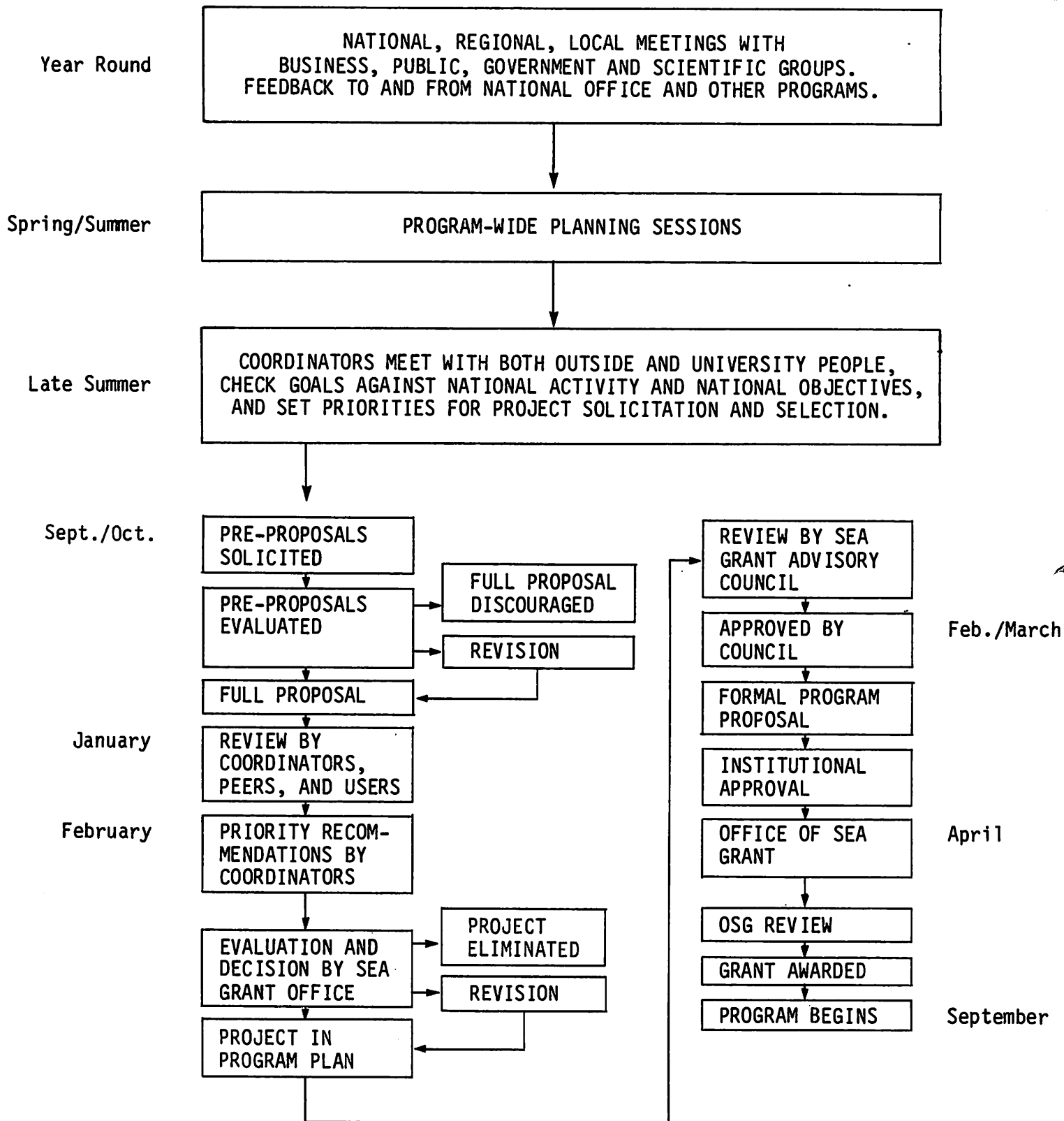
NATIONAL SEA GRANT COLLEGE PROGRAM:  
INSTITUTIONAL PLANNING, PROPOSAL AND REVIEW PROCESS

In 1976 the Office of Program Evaluation of the U.S. Department of Commerce studied the management of the Sea Grant Colleges and Institutions in some detail. Part of the purpose of the study was to examine the appropriateness of Sea Grant's local initiative (grassroots, bottom up) approach to marine problem identification. Further, the office looked at the question of quality control and elimination of unnecessary duplication.

On all counts, the evaluation supported the Sea Grant approach and record. In part, this support came because the report noted: "The laborious, six stage review process which proposals must undergo is adequate to assure that enough of the right people have raised objections and passed upon the relevance and significance of the projects." Thus the process led to wise identification of problems, and the evaluation further noted that it assured project quality and nonduplication.

The following chart outlines the planning, proposal and review process at one major Sea Grant institution. Though details will vary from institution to institution, the process is fairly typical for a Sea Grant College.

PLANNING, PROPOSAL AND REVIEW PROCESS



## SEA GRANT AND THE INLAND STATES

---

The activities of the National Sea Grant College Program address issues of national concern, not just those of the residents of the coastal states. While most of the work is done in those states and much has its most immediate ramifications there, the majority of the work affects people throughout the country. Consider:

- Work at Michigan on coldwater drowning and hypothermia had its initial impetus from tragedies on the Great Lakes, but the resulting lifesaving treatment has national and international applicability in the colder water regions. The U. S. Coast Guard estimates a 25 percent drop in drowning fatalities as a result of Sea Grant sponsored research and outreach efforts.
- The long-term potential of "drugs from the sea" in helping to provide better health care for the nation's citizens is great. For instance, aequorin, a "drug from the sea," extracted from a common jelly fish, is used in measuring calcium deficiencies in humans and detecting resulting diseases. Originally developed by the Washington Sea Grant Program, it has been produced commercially by the Sigma Chemical Company of St. Louis, Missouri.
- Work in Wisconsin on alternative pollution control regulations (transferable discharge permits) may have its greatest application not along the Great Lakes and the oceans but on heavily industrialized river stretches and for air pollution regulation in urban areas, regardless of geographic location.
- Much of the work in the Great Lakes on freshwater fish has equal application on inland lakes, rivers and streams. For example, work begun at Cornell and continued at Iowa State University has led to improved methods for handling catfish eggs in hatcheries. The resulting treatment is now being applied to most of the state-raised fish in Iowa and Kansas, as well as Illinois and Minnesota. Work on perch, walleye and trout has similar potential, as does work on currently "underutilized" freshwater species. Interestingly, the original Cornell/Iowa State work was concerned with walleye, even though the initial application came with catfish.
- The American appetite for shrimp is insatiable and knows no geographic limits, and the demand for seafood generally is rising. Work on better fishing methods, new species, better processing and packaging is as important to the inland consumer as it is to the coastal fisherman. For example, Georgia Sea Grant, in cooperation with Wisconsin, has been working with a Tennessee fish processor on better processing and packaging methods which will insure a safer, fresher, better product for the inland



buyer. Virginia Tech has been working with the midwestern Kroger food chain to develop new supplies of fresh fish. Efforts like this and aquaculture are also necessary to help hold down imports of foreign fish, which currently account for 60 percent of the U. S. market.

- Aquaculture is increasingly a necessary means for providing affordable stocks of high demand species and for assuring a future for species that are endangered by overfishing, pollution or other stresses on the natural system. Sea Grant is a major national contributor to this aquaculture effort. The benefits will affect the inland consumer, and many of the new aquaculture methods and activities will be capable of adoption in a number of places besides the seacoast. Sea Grant sponsored aquaculture products, such as crawfish and eels, have developed major foreign markets, thus helping the balance of payments problem; and the crawfish industry has become a major user of inland fish, as bait.
- Students working on Sea Grant projects come from every state in the nation. After graduation, they work throughout the country.
- Over the past six years, faculty members and students at universities in Arizona, Arkansas, Colorado, Idaho, Iowa, Montana, Oklahoma, Utah and West Virginia have participated directly in Sea Grant work, and there has been indirect participation by some of their counterparts in Kansas and Tennessee. Lack of a long-established marine curriculum and of immediate access to the sea can sometimes inhibit inland participation in Sea Grant activities. The recent squeeze on Sea Grant funds has been a greater inhibitor. The greatest obstacle is the very high matching fund requirement, which is particularly hard for inland institutions and legislatures to justify, though these institutions continue to be a source of talent that can contribute to the work of Sea Grant in many areas.
- People from every state regularly write for Sea Grant publications. People in most states also hear Sea Grant radio programs, see Sea Grant films and participate in Sea Grant-sponsored-or-inspired educational programming, including continuing and technical education.

In addition to these specific examples, there are several areas of need for a national ocean policy and a national resource strategy which affect the entire country and in which the National Sea Grant College Program has a vital role to play:

- The oceans and much of the coastal margin are the common property of the entire nation. The coastal states have a special stake in the resource issues of the marine environment, but the citizenry at large and our posterity must be well-served in the decision-making process. The impartial expertise of the Sea Grant programs is a vital part of this process.

- The citizens of the inland states are major users of the sea and the coasts as locations for leisure activities and aesthetic enjoyment. Just as they are a major source of financial support to the important coastal tourism business, so they also must be well-served by activities that protect water quality, enhance the fishery and contribute to coastal amenities. Sea Grant must continue to serve this segment of society as it has in the past.
- The ocean sector of the economy is a significant part of the total national economic picture. A 1980 analysis of this sector and its place within the National Income Accounting System rated its value at \$30.6 billion, roughly equivalent to the corresponding value of agriculture or communications, and significantly greater than the figure for mining. Sea Grant is widely recognized as having made significant contributions to this vital, but troubled and fragmented sector of the economy. The annual economic benefits accruing from Sea Grant work far exceed the investment made in the program.
- Both for economic and national security reasons, the nation is going to make heavier demands on offshore regions for oil and gas and for minerals. Sea Grant is a major source of manpower for this effort. It will supply much of the needed new technology for underwater efforts and for necessary action to preserve the marine environment in the process. It also provides a major forum for conflict resolution.
- Activities under the Fisheries Conservation and Management Act and the continuing discussion of a 200-mile exclusive management zone are likely to create a management area that will ultimately be much larger than the land mass of the United States. Decisions on this zone will have enormous consequences for the national security and economy, and also for the global environment. The requirements for wise use of this vast resource is already creating enormous strains on our technological and management resources. There will be increasing demands on Sea Grant as a primary source of the underpinning for a national strategy for this critically important area.
- The Great Lakes are the largest freshwater resource in the world, at a time when there are increasing stresses on groundwater and other supplies. These lakes are also a primary recreation area and fishery for the people of the midwest, the border states and the Great Plains, and they provide a vital transportation network to the grain, coal and ore-producing areas of the inland United States. The Sea Grant programs of the region are now the major source of research, information and informed public service programs concerning the Great Lakes.

The oceans have always been a source of fascination for mankind. They remain the last great frontier on this planet. An investment in the future of the oceans is an important reflection of the national interest.

## SEA GRANT INTERNATIONAL PROGRAM

---

The Sea Grant Program Improvement Act of 1976 (Public Law 94-461, 90 Stat. 1961), established the International Cooperation Assistance Program, later renamed the Sea Grant International Program (SGIP). The goals of the program are to (1) "enhance the research and development capability of developing foreign nations with respect to ocean and coastal resources," and (2) "promote the international exchange of information and data with respect to the assessment, development, utilization, and conservation of such resources." The Congress envisioned that the grants made under this legislation would promote cooperation between U.S. universities and their counterparts in developing countries. Grants were to be made only to U.S. institutions, and consultation with the Secretary of State was required before grants were made.

The guidelines for SGIP proposals, published in the Federal Register on April 11, 1978, explicitly requested (1) an indication of commitment by the developing country to the proposed project, (2) a statement of the anticipated impact of the project on the foreign participant as well as benefit to the United States, and (3) a direct institution-to-institution approach in project design and implementation.

Since its inception, the SGIP granting strategy has been to promote continuity of effort that will result in sustained beneficial impact on developing countries, while continuing to offer opportunities to fund new projects over an expanding geographical distribution.

SGIP became operational in FY78, at a modest budget level of \$900,000. Appropriations remained constant at that level until July of 1981, when funds were reduced to an essentially phaseout level of \$260,000. Twelve project grants, five of which have been completed, have involved the Florida Sea Grant Program, Lehigh University, Louisiana State University, the Maryland Sea Grant Program, the New York Sea Grant Institute, Oregon State University, the South Carolina Sea Grant Consortium, the Universities of California, Delaware, Hawaii, Miami and Rhode Island, and the Virginia Institute of Marine Science. Foreign countries involved include Chile, Columbia, Costa Rica, Egypt, India, Israel, Malaysia, Mexico and a group of South Pacific island countries.

Several key elements have contributed to the effectiveness of the Sea Grant International Program as a mechanism for institution building. First, education and training of developing country personnel are integral parts of each project. Second, projects are developed on an institution-to-institution basis rather than a government-to-government basis. Third, as a result of this form of project development, there is an absence of unnecessary administrative intervention and bureaucratic delay. This allows principal investigators administrative freedom in carrying out their projects while providing necessary program accountability. Endorsement of SGIP from developing nations and the U.S. marine science community indicates that the program has been a success.

There is a need for a commitment by the federal government to continue at an appropriate level of support what is recognized as the best mechanism yet developed for providing U.S. marine technical assistance to developing countries. AID has provided some support for good proposals that SGIP could not

afford, but marine activities remain a very minor part of AID programming. The developing cooperation between SGIP and AID should be fostered at the same time that SGIP is strengthened and given long-term credibility as a focus for international marine technical assistance. The last SGIP funding level of about \$260,000 for FY-1982 in effect closes out the program except for such projects as can successfully compete for funding within the various state institutional programs.

It should be emphasized that this program is not a handout. Participation by host countries is real. In many cases a foreign project allows the year-round continuation of ongoing research in this country that would otherwise be seasonally limited. It allows another means of field-testing and evaluating research results. Finally, the oceans and marine resources are international in scope. A fully viable and effective marine science and resource program must have a full range of activity, from local to regional to national to international. The Sea Grant International Program should be reauthorized, and funds should be provided for it in a manner that does not further jeopardize the existing core program support.

# Sea Grant Aquaculture Plan

1983-1987



Executive Summary

## Policy, Goals and Objective

The National Sea Grant College Program was established to form a university-based partnership between the federal government, state governments and industry to develop and conserve the nation's marine resources. The National Aquaculture Act of 1980 (Pub. L. 96-362) called for a coordinated national aquacultural program that would involve 13 federal agencies and departments. It assigned responsibility for expanded research, development and related programs to the Secretaries of Agriculture, Commerce and Interior. In a Memorandum of Understanding signed in April 1980 by representatives of the three Departments, responsibility for aquacultural research and development on marine, estuarine, anadromous and Great Lakes species was assigned to the Department of Commerce.

This plan is for aquacultural research, development, advisory and training

activities to be conducted during fiscal years 1983-1987 by the National Sea Grant Program within the Department of Commerce. It is an integral part of the national aquaculture plan called for by the Aquaculture Act.

The plan builds on the legislative mandate of the National Sea Grant Program and on nearly 14 years of research accomplishments by Sea Grant researchers and their partners in government and industry. The budget proposed for each of the five years is realistic and represents a logical continuation of the efforts underway in the nation's Sea Grant institutions. Finally, this plan represents the best assessment of problems and opportunities in aquaculture as seen in 1982. It defines policy, sets goals and establishes objectives to help guide decisions in the direction of research efforts and the allocation of resources.

**Policy.** It is the policy of the National Sea Grant Program to support the legislative mandate of the Aquaculture Act of 1980 by encouraging aquacultural activities and programs to increase aquacultural production, coordinate aquacultural efforts in the United States, conserve and enhance aquatic resources, and create new industries and jobs.

**Goal.** In accordance with this policy, it is the goal of the National Sea Grant Program to establish a sound scientific basis and disseminate knowledge to ensure the development of a strong national aquacultural industry.

**Objective.** To accomplish this goal, it is the objective of this plan to define where research, development, education and training should be applied to produce the most rapid progress in stimulating a broadly based and commercially viable aquacultural industry for the nation.

## The Economic Importance of Aquaculture

Americans consumed about 6 kg (13 lb) of fish and fishery products per capita in 1980. Consumption has slowly but steadily increased during the past several decades and is expected to continue to increase as population grows, as real per capita income increases and as consumer awareness of the nutritional values of fishery products increases.

Most traditional fisheries in United States waters are being harvested at or near maximum sustainable yields. At present, more than 60 percent of the fish products consumed in the United States are imported. In 1980, this represented a trade deficit of more than \$2.5 billion,

which was 28 percent of the U.S. trade deficit exclusive of petroleum products. As demand increases and fisheries stocks become limited worldwide, these imports will become more expensive and harder to obtain.

An economically viable aquacultural industry would augment the supply of fishery products and decrease reliance on imports. Benefits would include a favorable effect on the balance of trade, increase in domestic business activity and jobs, stabilization of seafood industries and markets, and better use of the nation's aquatic resources. Aquaculture can also augment natural stocks of fishes

and shellfishes, which are being diminished by exploitation, pollution and habitat destruction.

The potential of aquaculture has been a topic of intense public discussion for two decades. In spite of this interest, food production by aquaculture is only three percent of U.S. fishery landings or two percent of total consumption of fishery products. Annual aquacultural production in this country is about 100,000 metric tons (220 million pounds). In 1980, aquacultural production had an estimated value of \$500 million and a retail value of more than \$1 billion.

## Present Aquacultural Technology

Public investment in aquacultural research and development has remained small compared to that for land-based agriculture, and the establishment of commercial enterprises has proceeded slowly.

In spite of the relatively low levels of funding, more than a decade of Sea

Grant-sponsored aquacultural research has provided the basis for the establishment of evolving aquacultural industries, substantially improving the potential for aquacultural development. For marine or anadromous species, accomplishments include the development of net/pen culture and ocean ranching of

fishes in the Pacific Northwest; the establishment of abalone culture in California; the introduction of Malaysian prawn culture in Hawaii and South Carolina; the improvement of raft culture of blue mussels and oysters in New England; the proliferation of oyster hatcheries in the Pacific Northwest and the

Publication of the **Executive Summary** of the Sea Grant Aquaculture Plan, 1983-1987 was partially supported through Institutional Grant NA81AA-D00092 to Texas A&M University by the Office of Sea Grant, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

To order additional copies of the **Executive Summary**, write Marine Information Service, Sea Grant College Program, Texas A&M University, College Station, Texas 77843; ask for publication **TAMU-SG-82-115**. The entire Plan (TAMU-SG-82-114) is available from the same address and costs \$5. Make check payable to Texas A&M University.

Atlantic States; and an influential role in establishing shrimp and prawn farms in Central America by U.S. firms. Most of the enterprises that have developed or have reaped direct benefits from the new knowledge are infant industries that still need a wide range of research and extension support.

The following table lists present and potential aquacultural organisms according to their present degree of commercial aquacultural development. "Commercial" aquaculture represents enterprises with established production facilities, profitable markets and continuity of sales. Research needs are similar to those that support established agricultural enterprises. These include product improvement, increased production efficiency, and effective marketing. "Infant industries" may require research on several aspects of production, marketing and creation of an acceptable institutional framework. "Pilot scale" includes promising organisms for which proof of concept is established and basic breakthroughs in production technology have been achieved, but for which refinements are needed to solve scale-up problems and ensure reasonable prospects for economic viability. For species for which technology is "partially developed," one or several crucial problems in the aquacultural technology have not yet been

solved. The final group, "major lack of technology," represents those species of high market potential for which many major problems, such as reproduction,

larval survival, domestication, strain selection, nutrition and production systems, must still be solved.

Commercial Development Continuum	Organism
Commercial Industry Exists	trout baitfish penaeid shrimp prawns (Hawaii) salmon (net/pen rearing; ocean ranching) yellow perch
Infant Industry	oyster mussels abalone prawns (continental United States) scallops (bay and rock) seaweeds
Technology Developed to Pilot Scale	clams eels bait leech striped bass channel bass scallops (other than bay and rock)
Technology Partially Developed	lobster red drum sturgeon southern flounder speckled trout red snapper pompano milkfish H <sub>2</sub> S bacteria
Major Lack of Technology	

### Assignment of Resources

Federal funding for the Sea Grant aquacultural program, projected by area of effort for fiscal years 1983 through 1987, is shown in the following table. The areas of effort include the following research thrusts.

Aquacultural systems must be developed to control environmental quality, including monitoring and control of physical, chemical, biological and thermal conditions. They must handle the various species from early life stages through harvest and preparation for marketing.

Genetic studies must be recognized at the outset as long-term commitments to improvement of cultured animals and plants. For genetic studies, at least 10 years of continuous effort are usually required to begin to achieve useful results.

Nutrition and diets must be studied at all phases of the life cycle of aquacultural organisms. This is not only crucial to growth rates, but diet composition must be conducive to maturation and reproduction in captivity. Also important is the most cost-effective protein level and feed conversion ratios.

Studies of diseases will become more important as crowded conditions and continuous operation of commercial aquacultural systems inevitably present substantial disease problems similar to those that haunt poultry and swine growers.

Research in public policy is crucial to understand and recommend improvements in state and national policies and statutes so that aquacultural business

attracts entrepreneurs and venture capital. Many states now have laws written to encourage or manage the harvesting of fish in "the wild." Because aquaculture was not envisioned when these laws were written, many of them inadvertently cause hardships and barriers to the establishment of aquacultural enterprises.

Economic studies are needed to improve the efficiency and profitability

Projected federal funding<sup>1</sup> for Sea Grant aquacultural efforts.

Area of effort	1983	1984	1985	1986	1987
Systems	938	1,023	1,061	1,139	1,227
Genetics	687	695	764	777	857
Nutrition	649	816	683	937	1,017
Diseases	353	361	491	560	616
Policy	266	287	381	534	606
Economics	409	449	435	447	512
Exploratory	108	119	130	144	158
Advisory	527	580	638	701	771
Total	3,937	4,330	4,583	5,239	5,764

<sup>1</sup>Values, in thousands of dollars, were based on 1981 Sea Grant funding and include an annual inflation factor of 10 percent.

of commercial aquacultural systems. The potential of markets for species, grown in aquacultural systems in which product quality and regular supplies can be assured, has been assessed for only a few cases. The market potential is substantial for new and economical food products with desirable human nutritional characteristics.

Resources also must be set aside to encourage exploratory research into species not currently thought of as having aquacultural potential. In a fast-moving, exciting field such as aquaculture, new discoveries prompt new, unexpected ideas that need to be examined if optimal progress is to be achieved.

Finally, advisory services and training are needed to disseminate the results of research and to effect technology transfer to industry and a wide range of

other users to reach the goal set by Sea Grant.

To date, funding of research and advisory services in support of the nation's aquacultural industry has been low. However, through the Sea Grant-sponsored research program, substantial progress has been made. Even with continued modest federal funding, but with industry cooperation and assistance, three levels of emphasis in aquacultural research will be pursued.

- Primary emphasis will be placed on those species and systems that will directly benefit the developing aquacultural industry during the next 10 years.

- A secondary program of emphasis will be made in systems and species for which the technology and experience do not yet justify commercialization, because there is often a time lag between

innovative research and its application in industry.

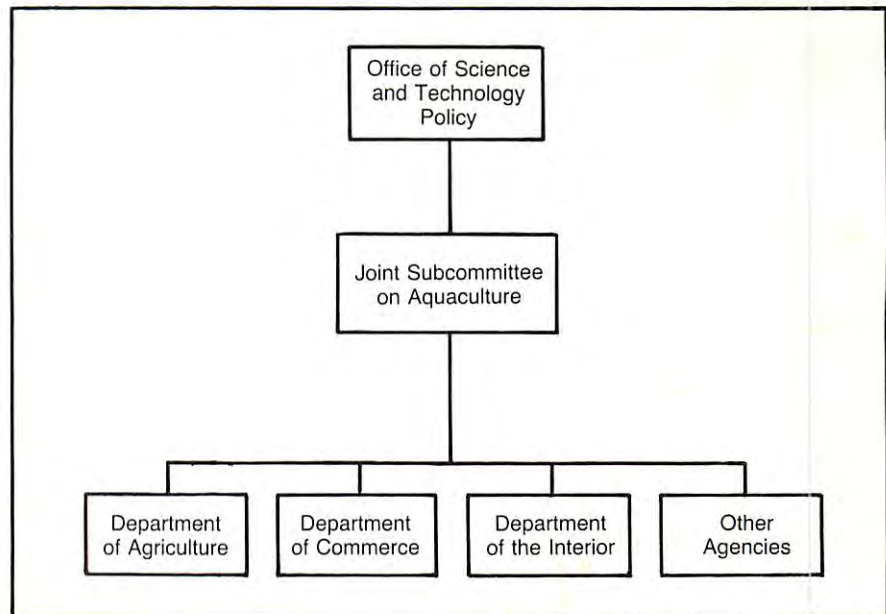
- Sea Grant will continue to place a third level of emphasis on approaches and species that are most adaptable to these long-term and/or high-risk solutions. Experiences in land-based agriculture have shown that the most important progress in diseases, genetics and nutrition requires an extended program of systematic research. Conversely, some of the most exciting developments from university-based research have resulted from innovative solutions to problems not adequately described by conventional wisdom.

Through this balanced program of resource investment, Sea Grant will move U.S. aquaculture forward in cooperation and in consultation with the evolving industries.

This Sea Grant Aquaculture Plan is an integral part of the national aquaculture effort called for by Aquaculture Act. It must be recognized as a major element of the national effort for two reasons. First, it builds on the solid foundation of 14 years of Sea Grant-sponsored research, which has produced new knowledge, technological advances in aquacultural systems, important patents, useful publications and overall advances in the nation's aquacultural capability.

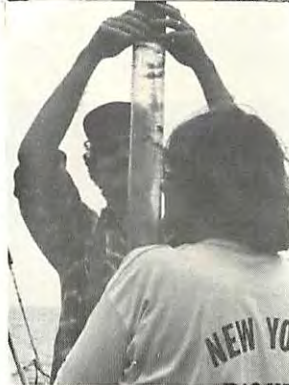
The second reason that this plan is a major component of the national aquacultural effort is that marine and Great Lakes organisms represent the largest share of the nation's species that are potentially eligible for aquaculture. As the populations of the United States and the world increase, and as freshwater supplies become even scarcer, food grown in salt water will assume an ever-increasing role of importance.

### The National Aquaculture Effort





Sea Grant Association  
UNC Sea Grant Program  
North Carolina State University  
Raleigh, NC 27650



## The Graduates: Products of Sea Grant Resources for the Nation

---

Sea Grant Association  
National Association of State Universities  
and Land-Grant Colleges  
Washington, DC 20036

## The National Sea Grant College Program invests in people, ideas, and technology.

Our nation's future strength depends on the quality of its education and training. The National Sea Grant College Program insures educational quality by investing in people, ideas, and technology. A growing corps of graduates marks the results of that investment.

In the act that set up the National Sea Grant College Program as a cooperative federal-state program, Congress encouraged the universities to develop a skilled labor force — of scientists, engineers, and technicians — that can benefit our environment and economy — and transfer knowledge from the university to industry.

## Sea Grant Graduates Make a Difference

These graduates and others, trained through activities and programs of the National Sea Grant College Program, become a national asset, a link between the universities and industry or government.



## A National Survey

A national survey, conducted for the Sea Grant Council of Directors, asked several questions about Sea Grant's graduates:

- To what extent has Sea Grant supported education?

Since the inception of the Sea Grant Program in 1968, according to the survey, the program has supported nearly 7,000 students in research or course work. This includes graduate and undergraduate degrees.

- In which fields have graduates been educated or trained?

As the program's founders suggested, Sea Grant students have been broadly trained.

## Who Are They?

Roger Townley directs the parent company for the Long John Silver's seafood chain. During his Sea Grant work at North Carolina State University, Townley worked on methods for measuring seafood quality. This experience, he says, has helped him to put his company's 1,200 restaurants in the forefront of seafood marketing.

"My Sea Grant experience gave me a well-rounded exposure — to the various species and to the industry itself. It's given me contacts that have helped with this job. This practical experience was extremely beneficial. You just don't read this kind of thing in books."

\* \* \*

Martha Bean developed a model land-use planning system for wetland watershed development with researchers at the University of California, Berkeley. In developing her model, Bean says she gained experience in quantitative impact assessment, aerial photography interpretation, applied hydrology and hydrologic assessment, computer applications of environmental data, and mapping measurement techniques.

"This experience," she says, "allowed me to step into an upper-level planning position in times of job scarcity." She now works as a county environmental planner and water management specialist in Washington.

\* \* \*

Marine sciences, biology, and engineering have been the leading fields, followed by economics and law; but many other disciplines have been represented as well.

• **Where do these students go after graduation?**

A majority of Sea Grant graduates find employment in the private sector; about a third work in the public sector; and about a quarter stay in academia. Of those at work in the public sector, nearly two-thirds are employed by state or local governments.

• **How useful was their training?**

More than half of the graduates in the public

sector said that their Sea Grant training related directly to their jobs or helped them to get the jobs. At private industries fewer reported a relation to their training — perhaps because the private marine sector is less developed than other areas.



Of students involved in projects with the greatest economic benefits, showed MIT's more detailed study, over half entered the private sector.

At State University of New York at Stony Brook, Anne Williams studied the impact of foreign fishing on the coastal fisheries of New York State as part of a Sea Grant-supported cooperative program with the New York State Legislature.

After earning her master's, Williams joined the newly formed staff of the Mid-Atlantic Fisheries Management Council as its fisheries statistician. In this role she has applied her knowledge of marine fishery management and, in particular, the operations and management of foreign fishing effort, to help the Council to formulate management plans for several important commercial and recreational fisheries.

\* \* \*

Heather Fortner is author of *The Limu Eaters*, a popular book on Hawaiian seaweed. The book started out as a project for the Sea Grant-funded Marine Option Program at the University of Hawaii. In addition to recipes for native seaweeds, it focuses on seaweed history, harvest, and identification.

Fortner plans to become captain of a research vessel, and has amassed nautical and research experience — from unloading Alaskan king crab boats to cooking for her passage to Seattle to serving as marine technician in the electronics lab aboard a University of Hawaii research vessel.

\* \* \*

Under Sea Grant support for master's work in resource economics at the University of Rhode Island, Richard Lentz studied the feasibility of building a fish processing plant in Mexico for Zapata Corporation, a Houston-based fishery company.

When he graduated, Zapata hired him to help build a \$15 million factory. This joint venture with Mexico processes 150,000 tons of fish a year. Lentz went on to manage several plants for Zapata, and then began a consulting firm in San Diego, Fisheries Development Services.

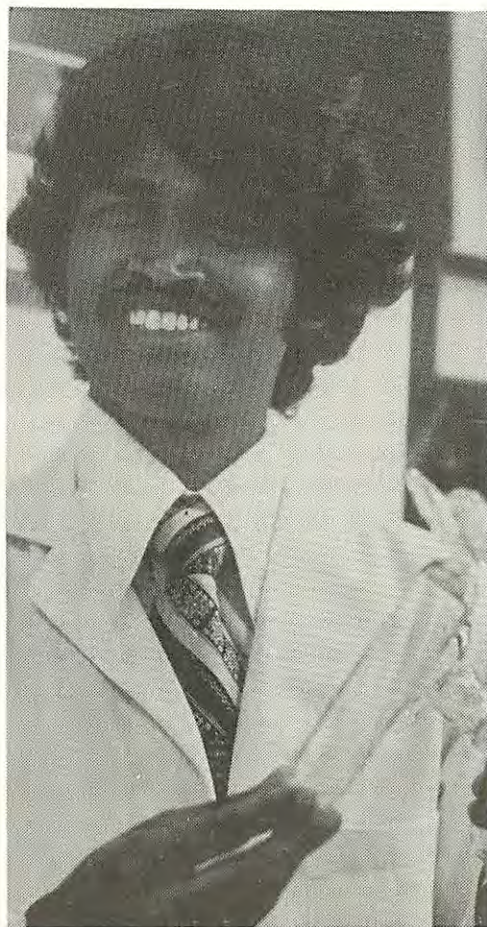
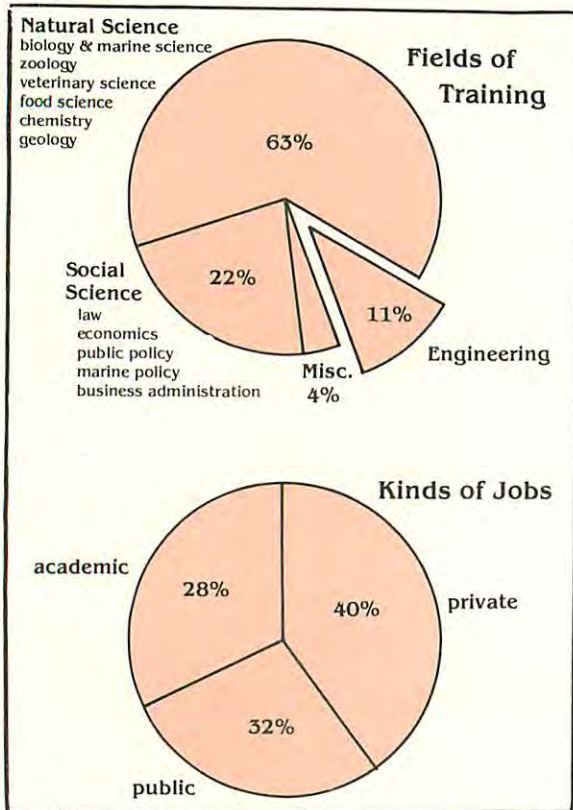
\* \* \*

Under North Carolina Sea Grant support, David Owens researched questions and problems of beach access. Owens has used this experience to draft an innovative beach-access statute recently enacted by the North Carolina General Assembly.

Owens is now deputy director of the Division of Coastal Management in the N.C. Department of Natural Resources and Community Development. He received his law degree from the University of North Carolina at Chapel Hill.

"My Sea Grant experience gave me a general education in natural processes, such as coastal geology, biology, and ecology and a better idea of the politics surrounding coastal issues."

\* \* \*



## From University to Industry or Government

Every June the Sea Grant program gives the nation its greatest gift — another class of graduates, steeped in natural, physical, and social sciences, and ready to bring their training, ideas, and enthusiasm to the marine trades. Every semester there are more capable hands to more wisely use our nation's marine and Great Lakes resources.

Responses to a national survey show that Sea Grant graduates are more than a skilled work force; they have become a major factor in the nation's marine sector and their skills benefit the environment and the economy.

And Sea Grant graduates are more than an investment in the wise use of our coastal resources; they are a channel for transferring research knowledge from the university laboratories to industry. Their experience speaks for itself.

**Every June the Sea Grant program gives the nation its greatest gift — another class of graduates . . . ready to bring their training, ideas, and enthusiasm to the marine trades.**