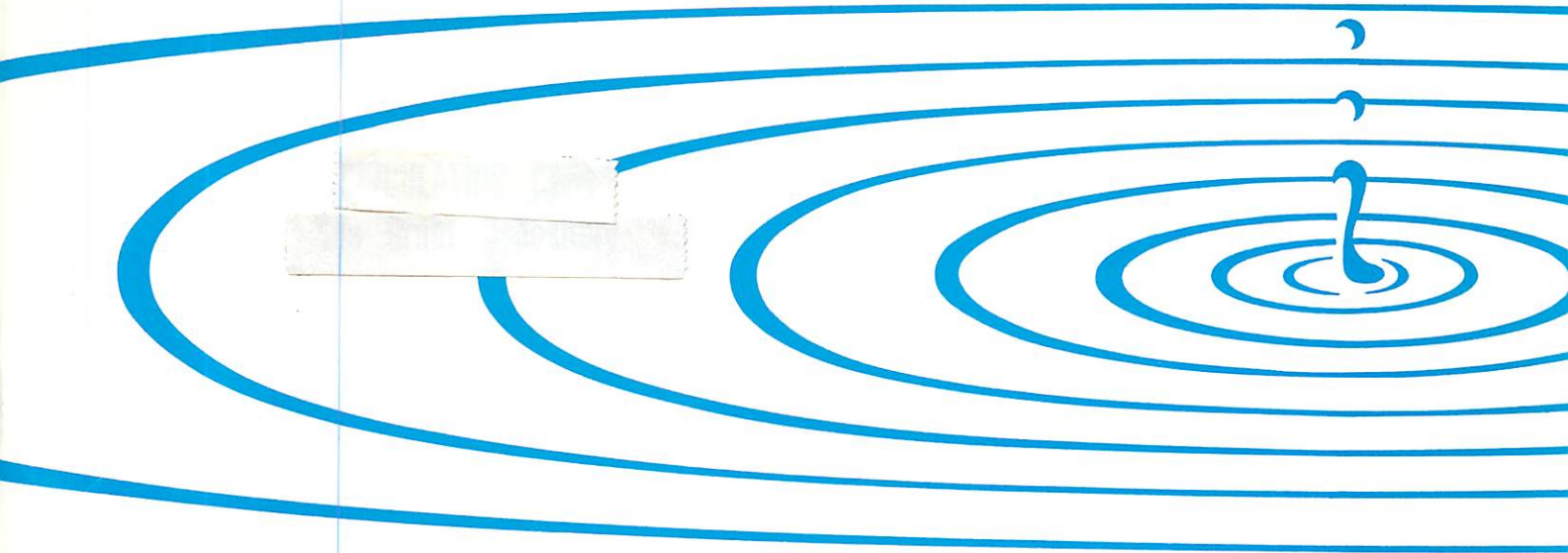


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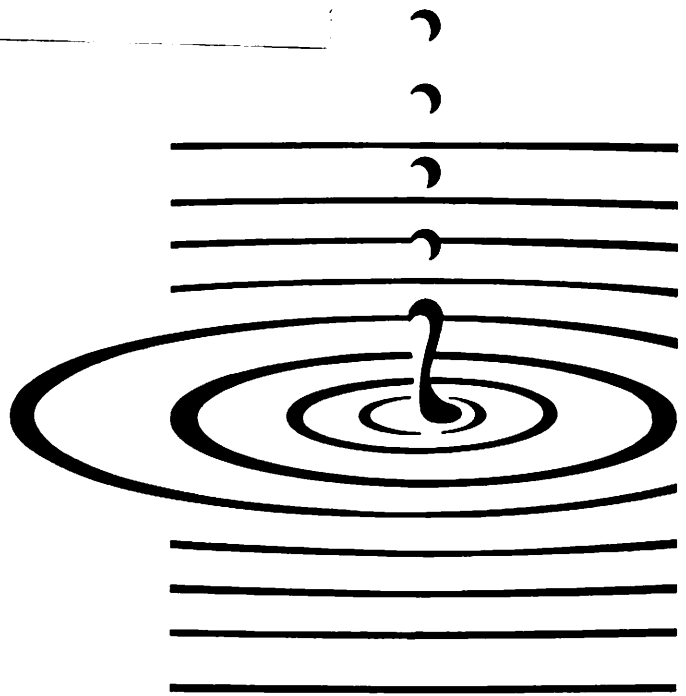
# Making Waves



5-Year Report: 1977-82  
**California's Sea Grant Program**

## **CALIFORNIA SEA GRANT PARTICIPATING INSTITUTIONS**

California Academy of Sciences  
California Institute of Technology  
California State University, Long Beach  
California State University, Northridge  
Cerritos Community College  
Claremont College  
Humboldt State University  
Immaculate Heart College  
Loyola Marymount University  
Moss Landing Marine Laboratories, a consortium of  
California State University, Fresno  
California State University, Hayward  
California State University, Sacramento  
San Francisco State University  
San Jose State University  
California State University, Stanislaus  
Occidental College  
San Diego State University  
San Francisco State University  
San Jose State University  
Santa Barbara Community College  
Southern California Ocean Studies Consortium, composed of  
California State University, Dominguez Hills  
California State University, Fullerton  
California State University, Long Beach  
California State University, Los Angeles  
California State University, Northridge  
California State Polytechnic University, Pomona  
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



# making waves

February 1983

5-Year Report: 1977-82

**A Report to the Resources Agency Sea Grant Advisory Panel**

California Sea Grant College Program Publication

No. R-CSGCP-010

**Editor: Kelly E. Anderson**

Published by the California Sea Grant College Program, Institute of Marine Resources, University of California, La Jolla, 1983. Free copies are available by writing the California Sea Grant College Program, University of California A-032, La Jolla, California 92093.

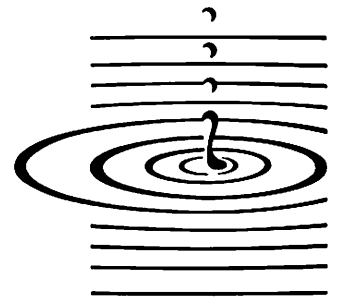
This work is the result of research sponsored in part by the National Sea Grant College Program, NOAA, Department of Commerce, under Grant #NA80AA-D-00120, Project #A/P-1 and all projects through the California Sea Grant College Program, and under Grant #NA81AA-D-00094 through the USC Sea Grant Institutional Program, and in part by the California State Resources Agency. The U.S. Government is authorized to produce and distribute reprints for governmental purposes.

This report was produced by the California Sea Grant College Program, a statewide, multiuniversity program of marine research, advisory services, and education activities administered by the University of California Institute of Marine Resources. Through the research it sponsors, Sea Grant contributes to the growing body of knowledge about our coastal and oceanic resources and helps solve contemporary problems in the marine sphere. Through its Marine Advisory Program, Sea Grant transfers information and technology developed in its research efforts to a wide community of users in California, the Pacific region, and the nation. Sea Grant also supports a range of educational programs for students, teachers, and the general public to promote the wise use of our coastal and oceanic resources by this and future generations.

**Sea Grant Administrative Offices**

California Sea Grant College Program  
University of California A-032  
La Jolla, CA 92093

USC Sea Grant Institutional Program  
University of Southern California  
Los Angeles, CA 90089-0341



# Contents

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## Introduction

- Purpose of Report 1
- Sea Grant Benefits California's Economy and Citizenry 1
- Local Programs in a National Network 3
- Research Applied to Real-Life Problems 4
- Sea Grant's Whole Strengthened by its Parts 4

---

## Economic Benefits of California Sea Grant

### Area Benefits

- Statewide, Regional, National 9
- Northern California Region 11
- San Francisco Bay Region 12
- Monterey Bay Region 15
- San Luis Obispo/Santa Barbara Region 18
- Los Angeles Region 20
- San Diego Region 24

### Additional Benefits

- Beneficiaries 29
- Cooperating Organizations 34
- Trainee Report 40
- Marine Advisory Program Workshops 43
- Publication Requests 43
- Regional 5-Year List of Projects 45

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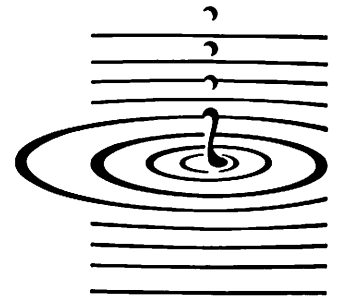
## Fiscal Data

- Federal, State, Other Matching Funds 57
- 5-Year Funding 58
- Matching Funds Sources 58
- Fact Sheet 59
- Individuals and FTEs 60

---

## Appendices

- A The National Sea Grant College Program 63
- B California Public Resources Code 66
- C Resources Agency Sea Grant Advisory Panel 67
- D Organizational Structure 69
- E Program Committees 72



# Introduction

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## *Purpose of the 5-Year Report*

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In 1978 the State of California reauthorized legislation enacted in 1973 to provide \$500,000 annually, in 1979-83, to the Resources Agency "for distribution for public and private higher education for use as up to two-thirds of the local matching share for projects under the National Sea Grant College and Program Act of 1966..."<sup>1</sup> The Act requires the legislature during the 1983-84 fiscal year to

consider recommendations from the Secretary of the Resources Agency and other interested parties on the benefits to the people of the State of California derived from this program and shall determine whether or not to continue similar appropriations for subsequent fiscal years.

The legislation established the Resources Agency Sea Grant Advisory Panel, which is composed of agency, industry, and university representatives. Each year the panel reviews

the project proposals submitted by the California Sea Grant College Program and the University of Southern California Sea Grant Institutional Program. The panel, whose members are listed in Appendix C, assures that the state money is spent in the most appropriate marine areas.

This publication reports the accomplishments and benefits of state-supported California Sea Grant activities in 1977-82. It is meant to assist the Resources Secretary in recommending to the legislature *future directions of California's Sea Grant program*.

The report also serves as a framework for conducting future programmatic reviews and evaluations of California Sea Grant. It is not intended to present technical results of projects. Readers interested in the detailed scientific and technical accomplishments of Sea Grant activities should contact the Sea Grant administrative offices for additional information on specific Sea Grant projects.

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## *Sea Grant Benefits California's Economy and Citizenry*

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California's coastal and marine resource management and planning needs are many, complex, and ongoing. The state has more than 3400 miles of coastline<sup>2</sup> encompassing two distinctly different biological environments and six natural resource regions. California's 24 million residents make it the most heavily populated state in the nation. More importantly, the concentration of population in coastal cities and counties also makes California one of the most coastal-oriented states in the nation. More

than 80% of the state's population live within 30 miles of the coast.

The wealth of California's marine resources and the enormous and often conflicting demands for these resources require a strong managerial effort in mobilizing the state's research capabilities. Much of this research is conducted through California Sea Grant.

California Sea Grant supports research, education, and advisory services at as many as 30 universities and colleges in the state. Unlike

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<sup>1</sup>Source: Cal. Stats, 1978, Chapter 1255: Section 6217 of the Public Resources Code, as amended. For the entire citation, refer to Appendix B.

<sup>2</sup>Source: National Oceanic and Atmospheric Administration data, reprinted in *USA Today*, 1983. Includes offshore islands, bays, rivers, and creeks.

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any other existing agency, Sea Grant links university research with industry and ocean user groups to stimulate innovative and imaginative solutions to conflicting marine development needs.

Sea Grant is in a strong position to help California's economy. As the largest Sea Grant program in the U.S., California Sea Grant has developed innovative scientific and engineering techniques that increase the contribution of marine resources to the state and the nation. It analyzes the socio-economic allocation and distribution of marine resources and marine products to aid public policy-making, and it provides the scientific and technical training necessary for productive use and management of the state's valuable marine resources. Most importantly, it communicates the results of the research activities it supports to government, industry, academia — all sectors of the marine community that have a vested interest in California's marine and coastal resource development.

To Californians, Sea Grant's activities mean increased supplies of marketable protein from marine sources. It means more efficient capital expenditures on ports, harbors, and beaches. It means a better understanding of and improved defense against the destructive forces of the marine environment, thus reducing property losses. It means improved technology to increase the contribution of marine resources to the production, transportation, and distribution of energy supplies at minimal social cost.

In the last 5 years, California Sea Grant continued to serve the people of the state in a variety of ways. In particular, it has supported the development of marine research information and technology at academic and marine institutions throughout California, which in turn directly benefits more than 100 public and private organizations and agencies each year. The California institutions receiving Sea Grant support include:

- California Institute of Technology
- California State Universities at Fullerton, Humboldt, Long Beach, San Diego, San Francisco, and San Jose
- Cerritos Community College
- Claremont College
- Immaculate Heart College
- Loyola Marymount University
- Moss Landing Marine Laboratories (a consortium of 6 state universities in northern California)
- Occidental College
- Santa Barbara Community 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
- University of the Pacific

The communication Sea Grant fosters between the state government and academia continues to be valuable. Because of Sea Grant, academia is aware of the problems that need to be addressed by the state as well as the role state agency personnel must play under legal and institutional constraints.

Sea Grant also provides state personnel with opportunities to consult a variety of university researchers to keep abreast of current scientific and technical developments important in their employment. Direct interaction between agency and academic personnel can and does result in widening perspectives. Sea Grant communication with state agencies defines relevant and important research areas for academic investigation. This information exchange also helps to broaden state understanding of coastal and ocean resource systems, particularly the implications of various resource management techniques that may be employed.

Because marine and coastal resource research can be controversial, it is important that the work is conducted in an objective, third-party manner. State agencies concerned with ocean and coastal resource issues frequently rely on Sea Grant's impartial research investigations to avoid conflict-of-interest problems.

The practical results of Sea Grant research can be divided into two kinds of economic benefits: direct and indirect. For example, Sea Grant research has disclosed new agricultural and pharmacological compounds derived from marine organisms, and improvements have been made in the utilization and marketability of seafoods by improving storage and developing machines for processing. These results have contributed direct economic benefits to Californians through improved existing operations and the development of new products. Assistance with coastal erosion management, investigations into underutilized fisheries, and studies of harbor pollution control are some of California Sea Grant's

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accomplishments in environmental management that indirectly benefit the state's economy.

Since 1972, California Sea Grant has provided scientific and technical training to more than 400 California graduate students, most of whom are now putting their skills and knowledge to work in government, industry, and university positions in California and throughout the nation.

The marine advisory service provides public education as well as enhancement of public opportunities to use and enjoy marine resources. More than one million southern Californians are reached by Sea Grant marine weather broadcasts. News reports contributed by Sea Grant personnel appear in various local and regional papers, which are read by more than 1.25 million people per week. Each year, nearly 400,000 people visit five Sea Grant-supported aquariums and museums throughout the state, and more than 35,000 school children participate in Sea Grant-supported educational programs.

The state's Sea Grant matching fund program is not unique. In fact, most other states have a state matching fund arrangement to participate in and benefit from Sea Grant research, education, and advisory activities. Of the states

that have enacted hard money matching fund programs, over half match every four federal dollars with one state dollar, or better. Currently, California matches one out of about every six federal dollars.

During 1977-82, California Sea Grant programs and projects received more than \$17 million from the federal government. However, the proportion of state to federal funds distributed to the California Sea Grant Program has been declining since 1974. That year the percentage of state to federal funds was 22%. In 1977-78, the percentage decreased to 17%, and in 1981-82 it decreased still further to 6.5%. The proportionate decline was due to increases in federal funding matched against level and then decreased state funding of California Sea Grant.

In the past 5 years, state funding has decreased overall by 10% — due to level funding in the first four years and a dramatic 50% decrease in the fifth year — while federal participation in the California Sea Grant Program has increased. Increased federal support coupled with inflation has considerably reduced the proportional and actual value of state support.

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## *Local Programs in a National Network*

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The National Sea Grant College Program is an applied, interdisciplinary ocean and coastal resource program which seeks, in an innovative and cooperative fashion, to link together the efforts of universities, government, and industries throughout the U.S. Typically, each Sea Grant program involves application-oriented projects that

- interest state and local governments, the public, and industry;
- involve highly qualified scientists, engineers, planners, economists, lawyers, and others;
- are accomplishable under college and university auspices.

The primary goal of these activities is to promote the wise utilization, conservation, restoration, and management of ocean and coastal resources through applied research activities, professional and vocational training, and the effective dissemination of research results.

The National Sea Grant Program was created by Congress in 1966 to authorize grants to

universities to conduct research, educational, and advisory activities related to the wise use of our ocean and coastal resources. The Sea Grant Act (P.L. 89-688) requires nonfederal funding participation. At least one-third of the cost must be supported by nonfederal sources, including state and local government, related industries, universities and colleges, and private sources. This wise provision is to ensure the program's responsiveness to a broad range of specific, practical problems.

The continuing provision of state matching funds by the California legislature meets an important criterion for the state to have a Sea Grant program. According to the federal guidelines, one measure of the strength of an institutional program is its ability to obtain matching funds from nonfederal sources. Such sources include state legislatures, universities, state agencies, businesses, and industries.

As a corollary to the requirement of nonfederal participation, decisions concerning nomination and selection of projects are carried out on the local level. In effect, the participating



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institutions, in consultation with a wide spectrum of the marine community, have a high degree of autonomy in matching their research and

training capabilities to problems, subject to review at both local and national levels.

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## *Research Applied to Real-Life Problems*

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Sea Grant is involved with "applied research" — a description that is often not completely understood. "Applied" describes the practical end result, not necessarily the research itself. End results depend on the state of knowledge in a particular field and on what must be learned before an environmental, economic, or social benefit can be obtained. For example, before economically and environmentally viable marine aquaculture of many species is possible, it is necessary to solve fundamental problems of the physiology of reproduction, the etiology of parasites, the chemistry of culture media, behavioral patterns, nutritional requirements, and genetic characteristics. Scientifically and technically sound commercial aquaculture is the desired result, but a single research activity may be directed to only one piece of the total puzzle and may be basic in nature. Accordingly, "problem-oriented research" is a better

description of interdisciplinary investigations in such areas as energy, marine pharmaceuticals, and new food sources. However, to qualify for Sea Grant support, the results of a project must have a clear possibility of application.

Sea Grant is not limited to the natural sciences; it encompasses the disciplines of business, law, economics, political science, and management. The research projects and practical results reflect this interdisciplinary approach to local, state, and national problems. They extend and magnify the fruits of our basic research to practical applications for the benefit of all concerned with coastal and ocean resources. For a relatively small investment, the program builds on and extends other federal and state sponsored research to resolve specific coastal and ocean resource problems of our state and nation.

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## *Sea Grant's Whole Strengthened by its Parts*

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California Sea Grant is made up of two cooperating Sea Grant programs: the California Sea Grant College Program, administered by the University of California, and the University of Southern California Sea Grant Institutional Program. With the enactment of the state matching funds legislation in 1973, the California Sea Grant College Program became the largest Sea Grant program nationwide. Since then, it has remained in this preeminent position. USC's Sea Grant Institutional Program, which serves more than 10 million residents in the southern California coastal basin, works with the California Sea Grant College Program to meet the state's regional and statewide needs. By involving diverse groups of people and a variety of cooperating organizations, Sea Grant activities facilitate information exchange through established networks and through informal communication among scientists, advisors,

advisory committee members, agency staff, industry representatives, students, and the public.

Sea Grant, both at the state and national level, comprises a mutually supportive set of three interacting activities: research, education, and advisory services.<sup>3</sup> The three activities are primary functions not only of Sea Grant but also of the universities involved. The development and expansion of the Sea Grant Program with state funding has had three notable effects: it enhanced the ability to draw on the pool of talent in California universities, it established close contacts with users and potential users of marine information and technology, and it enabled coordination among the activities of the numerous other state and local agencies concerned with marine and coastal resources use. Much of the strength of the Sea Grant Program lies in its sensitivity to regional and

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<sup>3</sup>Table 10 on page 60 outlines California Sea Grant's budget, institutional participation, and faculty-student involvement in 1982.

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local issues. A list of specific benefits derived from state support begins on page 9.

### **Research Activities**

Sea Grant research covers a range of activities, including coastal resources, waste management, fisheries and aquaculture, natural marine products, ocean engineering, marine policy, and energy development. Research efforts focus on the wise utilization of marine resources and cover a wider range of interests. For example, social, legal, and scientific projects include coastal zone management, fisheries conservation and management, productivity analysis of coastal wetlands, coastal bluff erosion control, aquaculture of marine plants and animals, enhancement of underutilized fisheries, and salmon physiology and pathology.

### **Education Activities**

Supporting and encouraging marine education is a vital function of Sea Grant. Each year, graduate students with majors in diverse marine-related fields receive training and experience in practical research and carry this knowledge into government service and private industry. In the past five years nearly 300 students supported by California Sea Grant research activities graduated and were employed by more than 100 groups in government, industry, and academia.<sup>4</sup> California Sea Grant's displays, outreach programs, and consumer workshops reach more than 400,000 people annually.

### **Advisory Services**

The California Sea Grant Marine Advisory Programs encourage and speed the adoption of new technologies in marine and coastal resource development. Marine advisors are an independent source of information, advice, and assistance to people who enjoy, utilize, and manage California's coastal and marine resources. Commercial and sport fishermen, entrepreneurs, consumers, and government agencies obtain information about new technologies from the marine advisors through the publications Sea Grant produces and the many workshops, town meetings, conferences, and training sessions it holds throughout the state.<sup>5</sup> The marine advisors and specialists, in turn, feed back information about the new problems and changing needs of the California

marine community to the university researchers. The research activities of Sea Grant investigators and others serve as a foundation for marine advisory activities and technology transfer.

The California Sea Grant College Program supports eight local marine advisory service offices on the California coast, each office with regional coverage: Del Norte-Curry Counties, Humboldt County, Mendocino-Sonoma-Marin Counties, San Francisco Bay Counties, Monterey-Santa Cruz Counties, San Luis Obispo-Santa Barbara-Ventura Counties, Los Angeles-Orange Counties, and San Diego County. Statewide specialists in aquaculture, seafood technology, and marine fisheries, headquartered at Davis, work with the marine advisors to develop projects and programs. The specialists in turn depend on the local advisors to keep informed on the local client group needs for new technologies.<sup>6</sup>

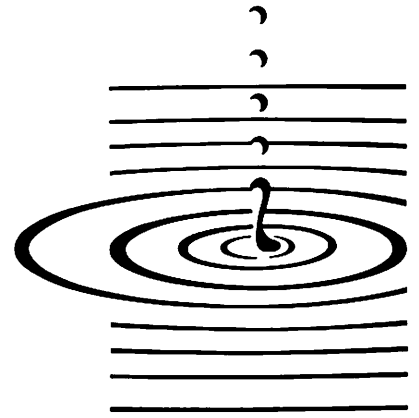
Working from locations both on campus and at Los Angeles Harbor, the USC advisory services program specializes in coastal planning, communications, marine energy sources, marine recreation, and marine transportation.

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<sup>4</sup>Trainee information beginning on page 40 includes degrees conferred and employers following graduation.

<sup>5</sup>See chart on page 43.

<sup>6</sup>Client groups served by the advisory program are included in the beneficiaries section starting on page 29.



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# **Economic Benefits of California Sea Grant**

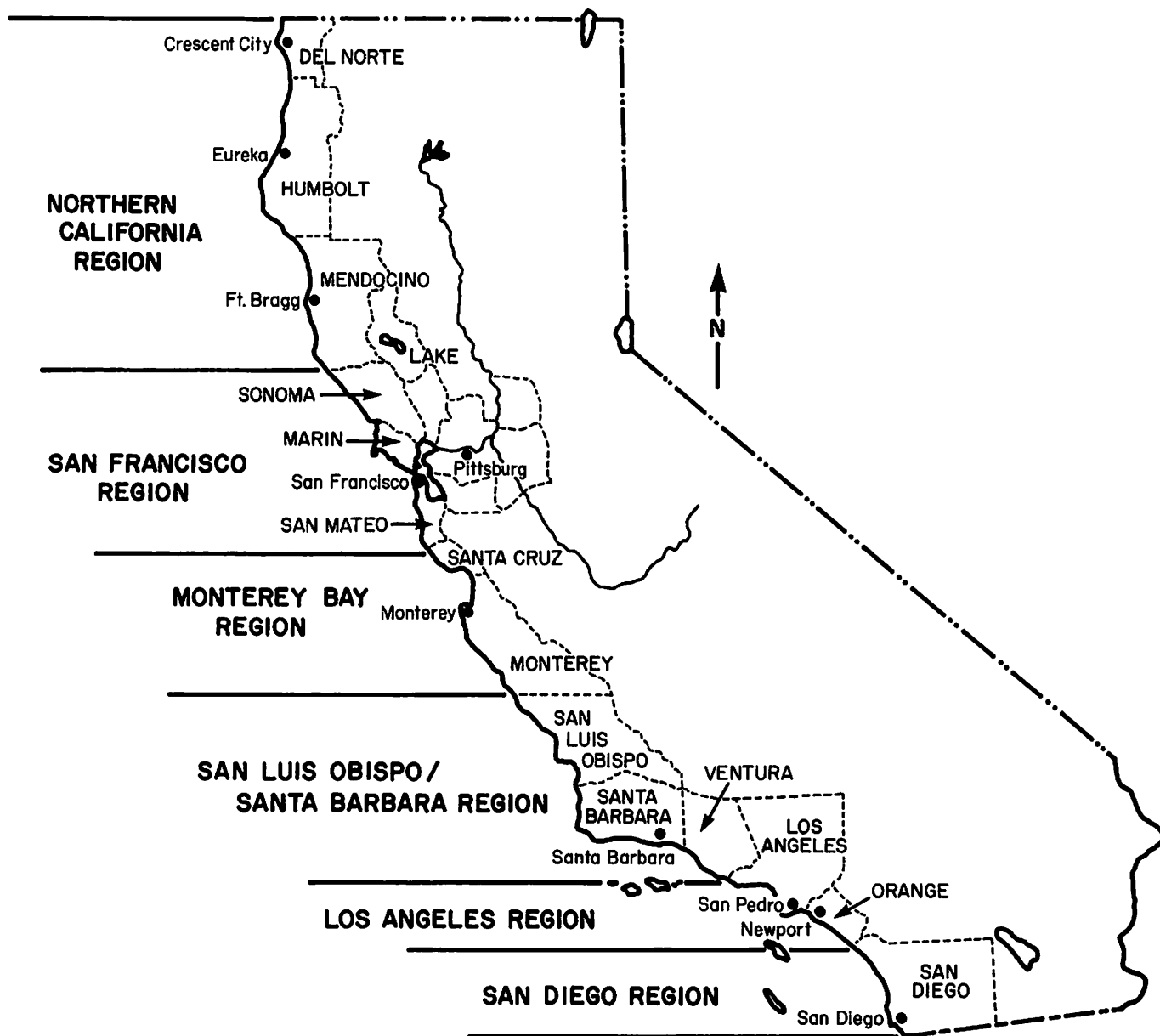
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## **Area Benefits**

*Statewide, Regional, National  
Northern California Region  
San Francisco Bay Region  
Monterey Bay Region  
San Luis Obispo/Santa Barbara Region  
Los Angeles Region  
San Diego Region*

## **Additional Benefits**

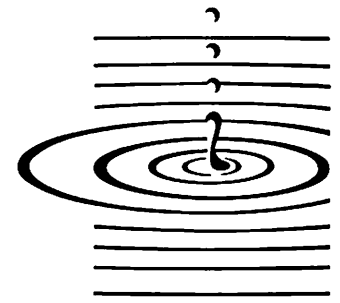
*Beneficiaries  
Cooperating Organizations  
Trainee Report  
Marine Advisory Program Workshops  
Publication Requests  
Regional 5-Year List of Projects*




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**CALIFORNIA SEA GRANT BENEFIT REGIONS**

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## Area Benefits:

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### *Statewide, Regional, National*

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**Regional** — Estimates have shown that west coast salmon and albacore fishermen could save \$500,000 yearly in fuel consumption by using remote sensing data to determine the location of fishing grounds. Marine Advisory Program staff, in cooperation with National Marine Fisheries Service, National Environmental Satellite Service, Jet Propulsion Laboratories, National Aeronautics and Space Administration/Ames, and Scripps Institution of Oceanography, held workshops to provide fishermen with satellite remote sensing temperature charts and information on their effective use, which could result in substantial fuel savings for the west coast fishing industry.

**National** — Paralytic shellfish poisoning (PSP) poses a major threat to the shellfish industry. The harvesting bans that result from PSP constrain the industry, and the resulting costs of monitoring shellfish populations are very high. For example, the current assay used to determine PSP toxicity involves injecting mice with shellfish tissue — a time-consuming and costly method.

USC Sea Grant has supported preliminary work on a promising assay that uses common houseflies instead of mice. Initial results show that the fly assay is as accurate as the mouse assay, much less expensive, and easier to perform. If further research confirms these results, the shellfish industry and related government agencies will experience great savings in both time and money.

**Statewide** — A need to better utilize California's abundant blue shark fishery prompted the Marine Advisory Program to conduct a feasibility study of an onboard mechanical skinning machine. The machine as conceived would remove the shark skin and keep the shark flesh intact for sale to fish wholesalers. The shark skin could be treated and sold overseas as a form of leather. The study showed that while the

technology is available to design a marketable skinning machine, the device would not be economically viable until a larger market for the blue shark is developed.

**Regional** — A related cooperative study between MAP advisors and the West Coast Fisheries Development Foundation resulted in further development of southern California's blue shark fishery and increased sales of blue shark in the area. Marine advisory staff will continue to work with the fishing industry in California and other Pacific coast states to further develop shark fisheries.

**Regional** — Shorelines are often valued for their scenic beauty alone, and many coastal management disputes result from conflicts involving visual aesthetics. As you can imagine, a region's scenic beauty is harder to quantify and evaluate than the region's economic value.

A USC Sea Grant researcher assembled and published a handbook of techniques for assessing shoreline visual characteristics. The techniques include aerial and panoramic photographs, computer-generated maps, cognitive maps drawn by citizens, and view shadow maps. With these tools, people who are concerned about maintaining the visual quality of the shoreline can provide a systematic and complete evaluation in confrontations involving conflicting land uses.

**Statewide** — Each year, MAP advisors and specialists offer a series of workshops, minicoursés, and training sessions to bring new technologies to fishermen and other user groups. Nearly 1000 commercial fishermen attend workshops annually to learn how lure speed, currents, and water temperature affect salmon catches, and they attend additional workshops on Pacific whiting utilization, abalone fishery enhancement, fisheries management, trawling and other gear development, salmon stream

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enhancement, antitrust laws, fisheries economics, and federal assistance programs. Because of these workshops, California fishermen are now fishing more efficiently using salmon lure speed information, and they are generating off-season income pursuing supplemental fisheries.

**Statewide** — Marine advisors and specialists regularly organize group meetings and make individual contacts among commercial fishermen, oil industry representatives, and resource management agencies, including the Department of Fish and Game, the Bureau of Land Management, the Pacific Outer Continental Shelf Office, the Coastal Commission, the State Lands Commission, and the Minerals Management Service. Communication among these groups has improved, and much progress has been made in resolving conflicts between fishermen and industry regarding seismic survey vessels, bottom obstructions, and underwater pipe lines.

**Statewide** — USC's coastal planning specialists in Los Angeles produced two publications describing the activities of the state's two coastal agencies: the California Coastal Commission and the California State Coastal Conservancy. USC Sea Grant sponsored 13 workshops on local government response to offshore oil production and sponsored two workshops in Los Angeles to clarify the local coastal program requirements. Sea Grant maintains close liaison with the state coastal commission, the six regional commissions, and dozens of southern California local governments to ensure the mutual availability of current information on coastal planning. Lectures to schools and civic groups, a television show on KCET, and answers to questions from individual citizens have increased the program's impact even further.

**Statewide** — The California Sea Grant College Program produced two valuable technical publications relevant to California and the Pacific region. *A Manual for Researching Historical Coastal Erosion*, written by a science writer intern from UC Santa Cruz, is a practical guide outlining the basic steps involved in researching historical erosion in a given area. The manual, which can be used by professionals and laymen, has been distributed to more than 850 individuals, including local, state, and federal agency officials; city and county planning directors; coastal commissioners; conservation organizations; university geology

department chairmen; state and federal elected officials; libraries; and interested individuals throughout the U.S. and abroad.

**Statewide** — The California Sea Grant College Program produced a valuable economic model as a working paper to make the report's preliminary data and research techniques available to government agencies, industry, fishermen, and related user groups. *The California Interindustry Fisheries (CIF) Model* can be used to evaluate the direct, indirect, and induced economic impact of fisheries on California's economy. To date the model has been used to determine the economic impact of four situations affecting the state: a proposed ban on gill-net fishing, the partial closure of the salmon season, a plan to translocate sea otters, and a proposal for a fish offloading facility for the port of Santa Cruz. Copies of the CIF model have been distributed by request to nearly 300 legislators, consultants, government agency officials, and private groups interested in determining the economic value of the state's fisheries.

**National** — In the past five years, the USC Sea Grant Marine Education Program developed a series of multidisciplinary marine education curriculum materials for a wide range of students, including handicapped and minority students, and trained teachers in the use of these materials and programs. For example, "Wet and Wild," a 400-page, multidisciplinary marine education curriculum guide, was written in English and translated into Spanish. It includes six units, each with an introduction, lesson plans, supplementary materials, and a bibliography. "Wet and Wild" has been accepted for publication by the National Evaluation, Dissemination, and Assessment Center for Bilingual Education at California State University, Los Angeles.

**Statewide** — Marine Studies Idea Books were developed for K-6 and 7-12 grade levels. The K-6 Idea Book is approximately 80 pages of graphically illustrated ideas, activities, and resource materials. The book was originally developed for use in inner-city schools and is now also being used by classroom teachers throughout the California school system. It has been translated into Spanish. The Idea Book for grades 7-12 was also originally developed for use in inner-city schools and has since been expanded to other school systems. A teacher training handbook for marine educators is being

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developed in a joint effort with the science director of the Los Angeles County Education Office.

**Statewide** — Each year USC Sea Grant conducts a series of teacher and student workshops for classroom teachers and special groups, including the School of Education at USC, the Head Start Program of Yolo County, the Project Learning Tree Education Leadership Workshop, the Visually Impaired Program, the Summer Youth Environmental Education Workshop, Project C.O.L.D. (Climate, Ocean, Land, Discovery), Mentally Gifted Minors, the Foundation for the Junior Blind, and the National Football League Youth Players Association Career Orientation. Nearly 1800 persons attend these annual workshops.

**National** — In 1979 it was estimated that by 1982, there would be 400,000 students with limited use of English in California schools, 80% of whom speak primarily Spanish.

Although marine topics are subjects of universal interest, they are usually left out of the classroom due to lack of teacher preparation and lack of teaching materials in Spanish. The USC Sea Grant Marine Education Program responds to these needs by translating marine education materials into Spanish and training bilingual teachers in their use.

In 1979-80, USC Sea Grant educators

conducted a Bilingual Marine Education Program in the Lennox School District using Spanish versions of USC's supplementary *Multidisciplinary Marine Education Curriculum Guide for Teachers of Grades K-7*. In the process, 15 bilingual teachers were trained to use the guide, and the teachers in turn helped develop three additional sets of bilingual student materials. The teachers also helped train approximately 300 other bilingual teachers in 20 additional workshops.

Based on this success, the guide is being published by the National Evaluation, Dissemination, and Assessment Center for Bilingual Education, and two other sets of materials — the Marine Studies Idea Books and the Mini-Information Booklets (on marine animals) — have also been translated into Spanish and are being disseminated to educators statewide, nationally, and internationally.

**Statewide** — Because the media is a conduit to much larger audiences than could be reached directly, the USC Sea Grant Program produced and distributed *A Reporter's Directory to Sea Grant Marine Research*. The directory, compiled with the help of the 29 Sea Grant programs nationwide, lists current Sea Grant research investigators, advisory personnel, educators, and communicators both geographically and by subject matter.

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## Northern California Region

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**Arcata** — To evaluate the effectiveness of an estuarine mitigation project, researchers at Humboldt State University assessed and monitored the fisheries resources of a salt marsh restored through tidal flushing in Humboldt County. They compared the area's fish abundance, diversity, and degree of usage with a nearby undisturbed salt marsh, and they developed an innovative sampling program to monitor the salt marsh habitat — a habitat which has historically posed problems to researchers conducting government-mandated field studies. Their data suggest that it can take at least several years for a fully developed salt marsh to be completely restored. Information from this study is helping local, state, and federal agencies assess the degree of restoration possible in wetland restoration projects. The U.S. Fish and Wildlife Service and five California

state and local agencies sought technical advice from the researchers and used their preliminary data to design mitigation projects required by permit-granting agencies.

**Arcata** — A common hatchery problem is disease control. At Humboldt State University, researchers inoculated 44,000 coho salmon and 34,000 steelhead trout, 56% of the total fish in the hatchery. The fish were tagged and released with noninoculated fish at the same time. A tally of the mature steelhead trout that returned to the Mad River hatchery in the winter showed that 60% of the returning fish were from the inoculated stock.

**Arcata** — With Sea Grant support, the Fred Telonicher Marine Laboratory at Humboldt State University provides the public with interpretive

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materials and activities related to marine environments in the Trinity Bay area and northern California. The lab's thematic displays and audiovisual presentations are quite valuable to summer weekend visitors. More than 1000 people visit the lab yearly during its 2-day open house, and the lab offers outreach presentations to clubs, service organizations, and elementary and secondary schools throughout the year.

**Fort Bragg** — A MAP demonstration project resulted in the development of a new industry in northern California. A Fort Bragg seafood processor who learned how to convert fish waste into houseplant food at a MAP workshop has successfully used that information to produce a plant food that is now being sold nationwide in a major supermarket chain.

**Fort Bragg/San Diego** — The first large-scale model of California fisheries and seafood industries to determine the direct, indirect, and induced economic impacts of those industries has been designed and constructed by Sea Grant researchers at San Diego State University.

The model links California's fishing and seafood industries with the rest of the state's economy and can be used to evaluate the effects of economic, biological, and regulatory changes on seafood industries. For example, using the model, researchers have shown that changes in fishery management policy resulted in a 25% increase in salmon landing in the Fort Bragg area in 1980. This increase generated an additional \$3 million in economic production and income for the state. Similar preliminary data and analyses are being used by federal and state fishery agencies as well as industry trade organizations representing both harvesters and processors.

**Humboldt/Trinidad** — Humboldt State University researchers investigated the coastline retreat in Humboldt County and monitored several active coastal earthflows in the Trinidad area. They produced geologic and geomorphic maps of the Trinidad and Shelter Cove areas — the first comprehensive work of its kind in this coastal area.

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## *San Francisco Bay Region*

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**Berkeley** — Timing the release of hatchery-reared coho salmon into seawater is a difficult problem for California salmon hatcheries. At UC Berkeley, Sea Grant researchers are solving the problem of why 50% of coho salmon raised in hatcheries become stunted in growth when transferred prematurely into seawater. The researchers looked for a developmental indicator to make sure the salmon enter the seawater at an appropriate stage, and they discovered a link between a surge in salmon thyroid hormone levels — a probable indicator of when smolting will occur — and the new moon after the vernal equinox.

Collaborative programs with the California Department of Fish and Game led to timed releases of tagged coho salmon in 1980-81 from the Trinity and Iron Gate hatcheries; the release dates were based on the lunar hypothesis of the smoltification-associated thyroid hormone peak. The discovery that salmon smoltification is related to the lunar cycle has generated considerable interest among hatcheries in California, Oregon, Washington, Canada, and Japan.

**Berkeley** — Many undersea resources off the west coast, particularly oil and gas deposits, are located in earthquake-prone areas. Sea Grant researchers at UC Berkeley developed a new analytical procedure and an associated computer program that more accurately predict earthquake effects on underwater structures. The research results can be used to design offshore structures in earthquake-prone areas, and the data will aid regulatory agencies, such as the Minerals Management Service, the Army Corps of Engineers, and the California State Lands Commission, to assess the safety of proposed designs.

The results of earlier Sea Grant studies conducted by these researchers were essential to the construction of new offshore oil platforms in earthquake-prone areas. Without those findings, they claim, no new platforms would have been built because oil companies would not have been able to meet environmental impact requirements.

**Berkeley** — Researchers at UC Berkeley isolated an extract from marine red algae that



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has been effective in helping laboratory mice resist infection with herpes simplex virus. The virus is notorious in causing a number of human diseases, including cold sores, encephalitis, a type of venereal disease, and possibly, a type of cervical cancer.

**Berkeley** — A 1981 California Sea Grant trainee helped develop a model land-use planning system for wetland watershed development with UC Berkeley researchers, while completing her M.L.A. in environmental planning (landscape architecture). In developing the model, the student gained extensive experience in quantitative impact assessment, aerial photography interpretation, applied hydrology and hydrologic assessment, and computer applications of environmental data and mapping measurement techniques — experience the trainee says allowed her "to step into an upper-level planning position in times of job scarcity." The former trainee now works as a county environmental planner and water management specialist in Washington.

**Berkeley/Moss Landing** — Urbanization, agricultural development, and forestry practices often affect the upstream watersheds that feed coastal wetlands. Researchers at UC Berkeley and at Moss Landing Marine Laboratories recognized this problem and designed a model planning system for coastal wetland watershed development around Elkhorn Slough. Their system is now the major basis for Monterey County's land-use program.

Land-use planners are considering adapting the system in other areas, including the Columbia River Estuary on the Washington-Oregon border, Yaquina Bay in Oregon, Gray's Harbor in Washington, and Chesapeake Bay on the east coast.

**Berkeley/Moss Landing/Elkhorn Slough** — An interdisciplinary team of researchers from UC Berkeley and Moss Landing Marine Laboratories conducted intensive studies on Elkhorn Slough's productivity, fishes, burrowing organisms, birds, siltation rates, and land use. Their work was especially valuable since Elkhorn Slough was designated an estuarine sanctuary. The county used the data developed by these Sea Grant researchers in developing its local coastal plan.

**Davis** — Salt-tolerant barley, wheat, and tomato crops have been developed in a 6-year effort by Sea Grant researchers at UC Davis. The researchers determined that certain strains of

barley, wheat, and tomatoes possess a high degree of salt tolerance. For example, a cross between a domestic tomato and a wild, salt-tolerant one produced a hybrid tomato plant that yields a tasty cherry tomato when grown in 70% seawater. Furthermore, the researchers' production of barley under saltwater conditions equaled the best yields currently obtained by conventional agriculture operations in coastal India.

Selected germplasm from this project is being supplied to tomato breeders for commercial development of salt-tolerant varieties. Several public and private institutes are selecting and breeding the salt-tolerant crops for application in arid and semiarid regions where agriculture is beset by soil salinity problems. Many coastal regions, such as those in Chile, Egypt, Israel, Libya, Mexico, Morocco, Peru, and Saudi Arabia, have sandy soil and a dearth of fresh water. Land in these countries could be developed for agriculture with the hearty, salt-tolerant plants, as well as could lands in the U.S., where increased brackish contamination of soils has resulted from the use of fertilizers, run-off from winter use of salt on roads, and domestic water softeners that use saltwater for regeneration. Scientists from Australia, Egypt, India, Israel, Mexico, and Pakistan have expressed interest in the results of this project.

**Davis** — The shelf life of fresh fish has been doubled by researchers at UC Davis who are testing the use of modified atmospheres (MA) in storing various fish products, including round fish, fish fillets, and minced fish.

The researchers have shown that high carbon dioxide levels (80%) in modified atmospheres prevent fish spoilage, extend shelf life from 7 to 14 days, and lessen skin color fading on Pacific red snapper. Dungeness crab meat stored for more than a month in an atmosphere containing CO<sub>2</sub> exhibited no deteriorative microbial or chemical changes. Rockfish fillets stayed fresh in refrigerated modified atmospheres for 14 days — twice the average shelf life. Field tests were conducted with the TransFresh Corporation using modified atmospheres in commercial shipments of more than two million pounds of dressed salmon from Anchorage to Seattle in the summer of 1978. The salmon were refrigerated (not frozen) and shipped by steamship in Sea-Land vans gassed to 65% CO<sub>2</sub> by TransFresh. There were no losses because of spoilage, and TransFresh realized a savings of more than \$400,000 in this shipment alone.

The results of this project could substantially

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influence the handling, distribution, and cost of a variety of seafood products. Three major seafood industries are providing technical support and fish products for this study; one firm has already used the results of this study for commercial shipping of seafood products. Cooperative studies will continue between Sea Grant and the seafood industry to develop this technology so that fresh (nonfrozen) fish can be shipped anywhere in the U.S. at a reasonable cost.

**Davis** — Researchers at UC Davis have initiated aquaculture studies of sturgeon in California. Their initial work has provided the basis for development of a pilot sturgeon hatchery using technology developed at UC Davis and by researchers in the U.S.S.R. This work was carried out with additional financial support from the U.S. Fish and Wildlife Service.

**Davis/Bodega Bay** — The development of a diversified and economically viable crustacean aquaculture industry in California is the goal of Sea Grant researchers at Bodega Marine Laboratory. There, researchers from UC Davis are conducting interdisciplinary Sea Grant projects dealing with crustacean aquaculture, particularly that of shrimp, lobster, and brine shrimp. To date the researchers have 1) successfully raised juvenile lobsters to 1-pound market size on an exclusively artificial diet, 2) determined optimum levels of nutrients to formulate cost-effective rations, 3) supplied artificial diets to industry and researchers for raising prawns and lobsters, 4) developed techniques for totally controlled reproduction in the marine shrimp *Sicyonia ingentis* (Penaeidae), and 5) developed a flow chart identifying pathogenic marine bacteria that will help mariculturists treat diseases more rapidly and effectively, and 6) provided disease diagnosis to several California fish hatcheries.

**Davis/Sacramento** — The use of water recycling in shrimp processing was tested by researchers at UC Davis to reduce water consumption and waste processing treatment costs in the shrimp processing industry. Mechanical shrimp processing requires large volumes of water and produces high flows of effluent. Researchers surveyed the Pacific shrimp processors in California to determine design changes that would reduce water use and pollution output.

The researchers selected a large Sacramento-based shrimp processing plant for

detailed processing studies. Their preliminary results showed that water consumption for the mechanical shrimp peelers used by California's Pacific shrimp processors can be reduced from 70 gallons per minute — recommended by the equipment manufacturers — to 40 gallons per minute without affecting efficiency, yield, or shrimp quality.

Shrimp peeling requires 20-40 gallons of water per pound of finished product, or more than 90 million gallons of water annually. The modifications proposed in this study could save 39 million gallons of water annually — a 43% savings — and could reduce the amount of wastewater generated by the same amount. Based on these results, the shrimp processing plant used in the study has adopted a lower gallons-per-minute water load in its mechanical shrimp peelers and is experiencing significant savings in water use costs.

**Davis/Santa Cruz** — 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 to restaurants, fast-food chains, and consumers.

At the request of the California seafood industry, Sea Grant engineers at UC Davis developed a prototype machine that beheads squid, then skins and eviscerates them using powerful water jets. The machine's design vastly improves the speed and efficiency of the squid cleaning process; a pound of squid can be cleaned in seconds — a job that takes 20 minutes by hand. The machine has been patented by the University of California and is currently being developed by Young Development in Santa Cruz, California. 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.

**Oakland** — In cooperation with the Port of Oakland, the Marine Advisory Program conducted a survey of wood piling performance and presented a research forum on ports and transportation. The forum supplied important information on dock piling specifications and maintenance programs to port and harbor districts concerned with minimizing dock deterioration. Several port and harbor

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authorities requested additional information on seafood handling and processing needs; and the California Coastal Commission and county, city, and local coastal programs requested information on harbor expansion planning, projected vessel berthing needs, and commercial marine fisheries.

**San Francisco** — In northern California, a project to develop Pacific whiting markets led to the expansion of the Pacific whiting fishery in that region. Marine advisory technical assistance in a San Francisco Bay salmon enhancement project resulted in increased sport and commercial catches in the 1980 and 1981 seasons. More than 1000 king salmon released in a 1977 salmon enhancement project, in cooperation with the Tyee Foundation (a San Francisco sportsmen's group) and National Marine Fisheries Service, were harvested with a market value of more than \$50,000.

**San Francisco/Los Angeles** — Pollutants entering the sea may become attached to suspended particles and eventually be buried in sediments after the particles settle, according to research conducted in San Francisco Bay by a USC Sea Grant researcher. Using naturally occurring radioactive tracers as pollutant analogs, the Sea Grant researcher showed 1) pollutants take approximately a day to attach to suspended particles, 2) particles settle to the bottom in 8-11 days, and 3) particles may be resuspended 10-20 times before they are deeply buried. Thus, pollutants may be rapidly transferred to the sediments, but they remain available for resuspension for several decades. This research information will be important in decision making regarding waste management in California.

**San Francisco/Los Angeles** — The amount of dissolved oxygen in the water is critical to the health of the marine ecosystem. Two USC Sea Grant projects examined the exchange of oxygen and other gases between the water and the sediments and between the water and the air to determine humankind's effect on the marine ecosystem.

The sediment research established the value of using radon/radium ratios to measure the exchange rates, and it established the critical importance of benthic marine organisms in cycling oxygen across the sediment-water interface. In San Francisco Bay, at least, it appears that the sediments are a major sink for oxygen.

The work on air-sea gas exchanges, which is still being analyzed, has established new laboratory techniques for measuring water turbulence (rather than wind or current velocity) in relation to gas exchange rates. Field work indicates that gas exchange shows a clear relationship to wind shear and no clear relationship to current velocity. The results of both projects will improve calculations of the effects of human intervention in the marine ecosystem.

**San Francisco/Pacific Grove** — At Stanford University's Hopkins Marine Station, Sea Grant researchers explored ways of integrating two marine fisheries: the existing winter herring eggs-on-seaweed fishery that is harvested for consumption in Japan, and the potential mariculture of *Gracilaria*, a seaweed that produces agar, a substance of great commercial value to the biomedical community.

Both fisheries require a stable and predictable seaweed source, and if the *Gracilaria* crop can be cultivated within the herring spawning grounds, the two can be harvested for their separate uses. The researchers successfully cultivated a crop using monoline techniques. The crop was transplanted to San Francisco Bay for the herring spawning season, where it was twice spawned at commercially harvestable levels.

The commercial value of bacteriological grade agar is approximately \$52 per kilogram (about 2.2 pounds). The commercial value of cured herring eggs-on-seaweed ranges in Japan from \$6000-\$20,000 per wet ton. The demand for this delicacy can fluctuate dramatically from year to year. Development of this industry could have a substantial impact on California's export economy.

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## Monterey Bay Region

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**Moss Landing** — With Sea Grant support, Moss Landing Marine Laboratories (MLML), a

research-teaching facility operated by a consortium of six California state universities,

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was able to satisfy overwhelming demands of area schools by extending its Visitors Days program. More than 1300 preschool through high school students visit MLML during the week-long science program designed to show the marine life of Monterey Bay. More than 6000 people attend MLML's open house each year.

MLML also offers marine science minicourses to students at a local continuation school and a 2-week marine science summer workshop for highly motivated children in grades 5-8, in addition to its student intern program, weekly ad hoc tours, and scheduled outreach presentations.

**Moss Landing/Berkeley** — Urbanization, agricultural development, and forestry practices often affect the upstream watersheds that feed coastal wetlands. Researchers at UC Berkeley and at Moss Landing Marine Laboratories recognized this problem and designed a model planning system for coastal wetland watershed development around Elkhorn Slough. Their system is now the major basis for Monterey County's land-use program.

Land-use planners are considering adapting the system in other areas, including the Columbia River Estuary on the Washington-Oregon border, Yaquina Bay in Oregon, Gray's Harbor in Washington, and Chesapeake Bay on the east coast.

**Moss Landing/Berkeley/Elkhorn Slough** — An interdisciplinary team of researchers from UC Berkeley and Moss Landing Marine Laboratories conducted intensive studies on Elkhorn Slough's productivity, fishes, burrowing organisms, birds, siltation rates, and land use. Their work was especially valuable since Elkhorn Slough was designated an estuarine sanctuary. The county used the data developed by these Sea Grant researchers in developing its local coastal plan.

**Pacific Grove** — World shortage of some seaweed colloids such as agar, used in biomedical research, and carrageenan, used in food preparation, has made the study of seaweed resources important. Sea Grant researchers at Stanford University's Hopkins Marine Station grew two kinds of red algae in tanks at rates better than those from natural populations in the ocean. Their studies also indicate that some red algae washed up on beaches still contain usable colloids, in addition to the residual minerals that for centuries have made drift seaweeds useful as fertilizer.

**Pacific Grove/San Francisco** — At Stanford University's Hopkins Marine Station, Sea Grant researchers explored ways of integrating two marine fisheries: the existing winter herring eggs-on-seaweed fishery that is harvested for consumption in Japan, and the potential mariculture of *Gracilaria*, a seaweed that produces agar, a substance of great commercial value to the biomedical community.

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**San Jose/Moss Landing** — The distribution and resource potential of phosphorites off central California's shores have been determined by Sea Grant researchers at San Jose State University. The extensive phosphorous-rich deposits, which could provide a valuable source of the mineral for use in fertilizers, were located and mapped offshore Pt. Sur and Cape San Martin, and minor deposits were found off Pescadero Point.

Sea Grant extended this 3-year project to allow researchers to supplement raw chemical data with bottom photographs to estimate the volume and concentration of the phosphorite deposits. The results of this Sea Grant project will help federal and local government agencies that lease offshore mineral rights and chemical companies that want to mine this resource.

**San Jose/Moss Landing** — The popularity of using elasmobranchs — primarily sharks — as food is increasing, yet very little is known of the species' life history. At Moss Landing Marine Laboratories, researchers from San Jose State University are testing several techniques for determining the age of elasmobranchs. The researchers identified several aging techniques to count rings in elasmobranch vertebrae, as no one technique works with all species. With the

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techniques they determined the ages of more than 1100 specimens from 23 species of sharks, skates, and rays. The researchers verified that elasmobranchs grow slowly, mature late in life, and produce a small number of offspring. Their data emphasize the importance of wise management to ensure survival of this fishery.

**Santa Cruz** — With Sea Grant support, the Center for Coastal Marine Studies (CCMS) at UC Santa Cruz supplements its traditional interpretive program with unique activities that provide academic training to student interns working at Natural Bridges State Park, Long Marine Laboratory, Elkhorn Slough, and Año Nuevo Park. UC faculty present and discuss their current research findings and field techniques in a unique seminar program for student interns. The center's growing interpretive and public information programs attract more than 11,000 people each year.

**Santa Cruz/Davis** — 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 to restaurants, fast-food chains, and consumers.

At the request of the California seafood industry, Sea Grant engineers at UC Davis developed a prototype machine that beheads squid, then skins and eviscerates them using powerful water jets. The machine's design vastly improves the speed and efficiency of the squid cleaning process; a pound of squid can be cleaned in seconds — a job that takes 20 minutes by hand. The machine has been patented, and it is currently being developed by Young Development in Santa Cruz, California. 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.

**Santa Cruz/Menlo Park** — A 1978-81 trainee in Sea Grant's Marine Chemistry and Pharmacology Program received his Ph.D. in chemistry from UC Santa Cruz and is now a staff research chemist at SRI International in Menlo Park, California — a position he attributes to his 3-year trainee experience.

As a Sea Grant trainee, the student investigated the chemistry of a common

gorgonian coral, *Briarium asbestinum*, and successfully identified a variety of diterpene metabolites — just a few of the new, potentially bioactive, natural marine products that have been discovered in the pharmacology research program. By accompanying project investigators on collecting expeditions to Honduras and the Tonga Islands, the student says he gained valuable field experience and expanded his knowledge of coral reef inhabitants.

With exposure to many aspects of analytical organic chemistry, the student was well prepared for a research position in private industry.

**Santa Cruz/Monterey Bay** — At UC Santa Cruz, researchers investigated Indochinese refugee adaptation to the Monterey Bay fishing industry. As a result, Sea Grant's marine advisors worked together to provide the Indochinese fishermen with California Fish and Game regulations translated into several Indochinese languages.

**Santa Cruz/Pt. Loma** — Sea Grant awarded its first John D. Isaacs Scholarship in 1980 to a senior at Point Loma High School (San Diego), for her study of environmental impacts on tidepool limpets. The 4-year, \$10,000 award recognizes the research excellence of California high school seniors and encourages further pursuit of marine science education at the state's colleges and universities. The student is currently majoring in biology at UC Santa Cruz.

**Santa Cruz/Santa Barbara/La Jolla** — A major new neuromuscular toxin, lophotoxin (LTX), was isolated and defined by researchers at Scripps Institution of Oceanography. LTX occurs in sizeable quantities in six species of gorgonian coral from the Pacific coast. Like common pain killers, LTX inhibits neuromuscular transmission, but with a potency 10 times that of curare, a known muscle relaxant.

This new product resulted from Sea Grant's Marine Chemistry and Pharmacology Program, now in its sixth year. The program is a collaborative one among UC researchers from San Diego, Santa Barbara, and Santa Cruz and the pharmaceutical industry. The researchers are defining the biological properties and therapeutic value of chemicals derived from marine organisms, including tropical soft corals, algae, sponges, and nudibranchs, collected from widely dispersed geographic regions.

Since the program began in 1977, researchers have isolated 625 marine substances; of those, 65 have been retained for follow-up and 10 are

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being actively investigated. The researchers have discovered three distinctly interesting compounds.

Lophotoxin (LTX), mentioned above, is the first compound without nitrogen found to exhibit such neurotoxic properties. As a result, an entirely new class of compounds can now be explored for their potential analgesic properties. Besides its potential use as a pain killer, LTX, by virtue of its novel functional groups, represents a new tool for application in research involving neurological disease.

The UC San Diego researchers also made substantial collections of a Palau sponge and prepared a sponge derivative that appears to be an effective topical anti-inflammatory agent.

A potent cytotoxin, stypoldione, isolated by the

Sea Grant research team, was evaluated by the National Cancer Institute and was found to possess potentially useful activity. The researchers also isolated an unusual cell division inhibitor from the Caribbean purple sea whip, which may be useful in studying basic cell division.

The researchers also developed a new assaying technique that uses fertilized sea urchin eggs to detect potential anticancer activity of chemical compounds. The National Cancer Institute has added this assay to its group of screening procedures. The compounds with significant development potential are submitted to Syntex Laboratories, Inc., a major pharmaceutical company in California, for additional screening and evaluation.

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## *San Luis Obispo/Santa Barbara Region*

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**Santa Barbara** — Bait and trap functions were analyzed by Sea Grant researchers at UC Santa Barbara to improve efficiency of commercial shellfishing operations, particularly those of crab and lobster. They conducted field and laboratory experiments to determine the most effective composition, solubilization rate, and concentration of bait, and the role of certain behavioral and environmental variables, principally light and water movement, in lobster foraging behavior.

Preliminary results from this project demonstrate that some baits are used inefficiently by commercial fishermen and seafood industries. For example, most shellfish fishermen prefer to use abalone bait — a potent, expensive bait that is in short supply. Sea Grant research shows that fishermen can halve the amount of abalone bait they presently use and maintain the same catch yields. Research also shows that mackerel bait, a less expensive and less potent bait, increases in effectiveness when it is ground. The potential cost savings of these two findings should have a substantial impact on the economy of shellfish fishing.

**Santa Barbara** — At UC Santa Barbara, researchers analyzed several biologically interesting compounds identified previously in the Sea Grant Marine Chemistry and Pharmacology Program: a neuromuscular toxin, an anti-inflammatory and analgesic agent, and six compounds that inhibit cell division.

Several industries, including Syntex

Laboratories, Inc. in California and Lilly Laboratories in Indianapolis, Indiana, are collaborating with the researchers to translate the results of this research into new products. Once initial discoveries are made, substances are transferred to the proper collaborating industry for more costly testing and possible development. The National Cancer Institute in Washington is providing particularly important support for the biotesting of potential anticancer drugs.

**Santa Barbara** — At UC Santa Barbara, researchers have developed new sonar techniques for mapping the sea floor and the sediment underlying it. With these techniques they are able to identify potential submarine hazards to offshore structures in more detail than was previously possible. The researchers also produced a detailed geologic map of the Anacapa Passage near Santa Barbara, California. Additional research on sonar mapping is being done to reduce the potential danger of offshore drilling operations.

**Santa Barbara** — Other scientists at UC Santa Barbara designed and tested a small, seismic-data-gathering capsule that, when released to the sea floor, enables shipboard or landbased scientists to locate the epicenter of an earthquake with greater precision than possible previously. Because many geological faults exist in the petroleum-rich Santa Barbara Basin, it is crucial to know where earthquake epicenters are

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to assist in both the discovery of additional oil resources and the placement of offshore structures.

**Santa Barbara** — A software package for advanced magnetic modelling in geological science research was developed by researchers at UC Santa Barbara. Research geophysicists are using magnetic modelling on propagating rift geometries, on data from the Red Sea, and for a proposed study of the Vema Fracture Zone intersection with the Mid-Atlantic Ridge. Information from this project can be used by geologists and geophysicists in industry and in government agencies concerned with the hazard and resource potential of the southern California borderlands. Mining and petroleum companies can use the advanced magnetic modelling techniques for inexpensive land reconnaissance.

**Santa Barbara** — New techniques for improved production of commercially valuable shellfish have been developed by Sea Grant researchers at the Marine Science Institute at UC Santa Barbara. With the cooperation of commercial shellfish producers, the researchers developed techniques that inexpensively and reliably control reproduction, larval development, settlement, metamorphosis, and survival, and will aid production of more commercially-valuable species of abalone hybrids and other shellfish, including some previously considered too difficult to produce.

One biomedical technique developed for inducing larval settlement and metamorphosis is less expensive and more useful than current methods and may prove applicable to other species of valuable shellfish. The researchers have also identified principal factors responsible for the slow growth rate of cultivated abalones, and they identified two natural hormones that safely accelerate abalone growth rate.

**Santa Barbara** — Researchers at UC Santa Barbara conducted a four-part Sea Grant study, "The Politics and Policy Implications of Deep Seabed Mining: U.S. Options," which provided valuable information in congressional deliberations on ocean mining. The study included an analysis of the ocean mining industry, U.S. government actions regarding international ocean resource problems and policies, the support of a New International Economic Order at the Third U.N. Conference on the Law of the Sea, and possible precedents for management regimes for Antarctica and outer space. The final report was used by the House

Merchant Marine and Fisheries Committee and by the Ocean Mineral Company in policy considerations for developing ocean mining activities.

**Santa Barbara** — Researchers from UC Santa Barbara conducted coastal wetland studies in Mugu Lagoon to determine the proper biological criteria needed to make coastal wetlands management decisions. Like researchers at San Diego State University who conducted similar studies in the Tijuana Estuary, the researchers discovered southern California's coastal wetlands are unique, and wetlands research on the east coast cannot be directly applied here to make planning decisions.

**Santa Barbara** — In 1968 Sea Grant funded a proposal by Santa Barbara City College (SBCC) to develop a 2-year Marine Diving Technician Program. It was the first of a series of grants Sea Grant provided to develop Santa Barbara's diving program and similar marine training programs at other California colleges.

Today, "Marine Tech" at SBCC is still going strong. The curriculum covers all aspects of modern diving technology, including new magnetic particle and ultrasonic inspection techniques, plus such practical skills as welding and boat handling. "The goal of the program is to train people to enter the job market," says program director Bob Christensen. Because a large part of that job market is provided by oil companies interested in offshore oil and mineral development, partial funding for the Santa Barbara program is now provided by a yearly grant from Exxon Company, U.S.A.

**Santa Barbara** — More than 3700 scheduled visitors tour the Marine Science Institute at UC Santa Barbara annually to view the displays and research projects and discuss the lab's research activities. Each quarter the marine lab offers a public education program for visitors and residents interested in learning more about southern California's marine resources. Special collections provide samples of organisms found in the Santa Barbara Channel area; tanks and aquaria display local plants and animals; and microscope stations, touch tanks, and field research displays provide the public with a closer look at ocean life.

With Sea Grant support, the laboratory was able to extend its hours into the evening, allowing students to bring their parents and families to the center to learn more about California's marine resources.

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**Santa Barbara/La Jolla/Santa Cruz** — A major new neuromuscular toxin, lophotoxin (LTX), was isolated and defined by researchers at Scripps Institution of Oceanography. LTX occurs in sizeable quantities in six species of gorgonian coral from the Pacific coast. Like common pain killers, LTX inhibits neuromuscular transmission, but with a potency 10 times that of curare, a known muscle relaxant.

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**Santa Barbara/San Diego** — The proposed abalone enhancement methods being studied at UC San Diego are being analyzed in a related project at UC Santa Barbara, where an economic model of the California abalone fishery has been developed to provide cost-benefit estimates of the proposed abalone enhancement methods.

Testing the model with historical data on commercial catch, effort, prices, and cost components of the pink abalone fishery, the results strongly indicate that the declining catches observed in the fishery since 1950 are not primarily due to overfishing. Rather, the decline is due to 1) introduction of a commercial fishery into a previously unexploited population, 2) the increased harvesting size limit imposed on the fishery in 1970, and 3) the introduction of a limited entry program in 1977.

**Santa Maria/Santa Barbara** — In 1982 the California Sea Grant College Program awarded its second John D. Isaacs Scholarship to a senior at Santa Maria High School for his study of nudibranchs. The \$10,000 award, allocated over a 4-year period, encourages high school students to pursue marine education in California's colleges and universities. The 1982 Isaacs scholar is currently majoring in aquatic biology at UC Santa Barbara.

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## Los Angeles Region

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**Los Angeles** — There is a small but rapidly growing market in southern California for the sea cucumber, *Parastichopus parvimensis*. The cucumber, usually exported to the Orient, is increasing in popularity among southern California's burgeoning Oriental population. At present there is no management regime for the fishery. Anticipating the fishery's development, a

USC Sea Grant researcher investigated the sea cucumber's behavior and life cycle.

The researcher found that sea cucumbers migrate annually to deep water from August to November and return to shallow water in December and January. Adult cucumbers prefer rocky bottoms, while juveniles prefer kelp holdfasts. The very largest cucumbers are



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usually found on sandy bottoms, while the greatest densities of cucumbers are found in rocky areas. Fish predation on adult cucumbers is rare. Normal techniques for measuring size and growth do not work because the sea cucumber has a soft body that contracts and expands at will. The investigator is testing the use of tetracycline, which is taken up by the calcareous ring in the cucumber, thus possibly allowing age determination techniques to be used.

This research effort has received the cooperation and assistance of the National Marine Fisheries Service, the California Department of Fish and Game, and from commercial seafood buyers who process sea cucumbers. All of these groups, and others concerned with the management of the species to prevent overfishing, will benefit from the results of the project.

**Los Angeles** — Ports and harbors, while important to the nation's economy, represent complex problems in coastal management. To help solve these problems, a USC Sea Grant researcher developed a series of graduate-level courses in seaport management. The courses, which cover seaport planning, financial management, and coastal planning interactions, were attended by seaport managers now working in southern California and throughout the state, and by policy students interested in coastal and environmental problems.

Teaching materials resulting from this project include 14 case studies and articles and include a bibliography on seaport management, now in its second edition. This effort is providing better trained seaport managers for southern California and coastal regions throughout the state and nation.

**Los Angeles** — A 3-year cooperative project among USC Sea Grant researchers, private industry, and government agencies investigated the importance of the nearshore region for growth and development of several commercially valuable fishes.

The project amassed considerable data on such factors as temperature, salinity, and chlorophyll, as well as larvae and egg counts. The researchers employed techniques used in CalCOFI offshore research to allow a comparison of the data bases.

The data showed that a low correlation exists between larval species dominant nearshore and those dominant offshore. Because human interventions along the coast (power plants,

marinas, etc.) usually have the greatest effect on nearshore areas, this data will be valuable in future environmental analyses, as well as fishery stock models. The project was aided considerably by contributions from Southern California Edison and from the Hyperion Treatment Plant of the City of Los Angeles.

**Los Angeles** — USC Sea Grant researchers thoroughly assessed the sand and gravel resources in water off Los Angeles and Orange counties, with assistance from the Army Corps of Engineers. In San Pedro Bay and Santa Monica Bay, the project demonstrated the existence of voluminous offshore sand and gravel deposits — about 450 million cubic yards, suitable for beach replenishment but not for construction aggregate. There are also deposits off Orange County, one with material suitable for construction aggregate, the other with material suitable for beach replenishment.

The deposits identified in Los Angeles County and Orange County do not appear to be economically competitive with land-based deposits at this time. Research has been extended to offshore San Diego County with funding from the State Department of Boating and Waterways and the Army Corps of Engineers.

**Los Angeles** — Recreational activities are of great interest to the more than 85% of the state's residents who live within 30 miles of the coast. USC Sea Grant programs include activities for beginning and advanced diving groups, in cooperation with Los Angeles area diving instruction associations. Sea Grant also sponsors a series of marine weather broadcasts on KNX radio. Now in its tenth year, the series' 25 reports each weekend reach more than a million people. A recent survey showed that the series is the principal AM radio source of weather information among recreational boaters. KNX donates air time for the series.

A booklet entitled "Weather to Go Boating," which gives tips on everything from recognizing weather signs to using visual distress signals, is the most requested Sea Grant publication in the Los Angeles area. Information for the booklet was supplied by the California State Department of Boating and Waterways, the U.S. Coast Guard, and the Southern California Boating Safety Advisory Group; cartoons were supplied by Hanna-Barbera Productions. The booklet, which has been revised and updated, is in its fourth printing. Reprintings were sponsored by KABC-TV and by the Hartford Insurance Company.

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**Los Angeles/Long Beach** — A series of USC Sea Grant projects, developed with assistance from the California Institute of Technology, has improved our ability to determine the effects of waves and tides on shorelines and coastal structures.

Starting with simple models and then elaborating on them, Sea Grant researchers developed mathematical modelling techniques that describe wave behavior in irregularly-shaped harbors, over sharp changes in depth, and under piers and other horizontal platforms built above the surface. The tide-induced currents in the Los Angeles and Long Beach harbors have been modelled as well.

The models demonstrate, among other results, that discontinuities in depth effectively block certain wave lengths of surface waves, and in shallow harbors laminar viscosity is relatively more important than eddy viscosity. As they are developed, these models will play an important role in harbor design, coastal construction, and water quality management in California and the Pacific region.

**Long Beach** — Researchers at California State University at Long Beach created a mobile marine science outreach program with Sea Grant support. They renovated and outfitted a mobile van display unit with specially-designed marine science display materials and took the van on 37 visits to schools, shopping centers, and civic groups, visiting more than 10,000 individuals in a 1-year period.

The response to the van was tremendous; it will take more than 3 years to visit all of the schools that are presently on the waiting list. The School of Natural Sciences at CSU Long Beach will continue funding the project now that Sea Grant's role in development and implementation is complete.

**Los Angeles** — In cooperation with Channel 58 TV and the Los Angeles Unified School District, USC Sea Grant developed two television scripts and accompanied the station's film crew aboard the RV SEA WATCH to USC's Catalina Marine Science Center. The programs were aired in January 1982 to an audience of more than 344,000. Approximately 25,000 guides that accompany the series are distributed to teachers in Los Angeles schools each semester.

**Los Angeles** — Because the university is located in an area populated primarily by blacks and hispanics, many USC marine programs are aimed at the needs of minority students.

In the Sea Grant Marine Studies Inner-city Schools Program, USC students from all departments prepare and present a series of 10 lessons in an inner-city elementary or high school. The students work closely with Sea Grant, the Joint Education Project on campus, and with their professors preparing materials and integrating marine concepts into their disciplines.

In 1981 and 1982, a special 4-day education program was offered to 10 inner-city high school students who had a special interest in science. The students went by boat to USC's Catalina Marine Science Center where they learned how to conduct oceanographic experiments on board a research vessel, listened to lectures by scientists and graduate students, and interacted with the instructors. Of the 10 students who participated in the program, one had never seen the ocean and seven had never been on a ship.

**Los Angeles** — In cooperation with the Braille Institute of Los Angeles, USC marine educators planned a field trip for a group of visually impaired and sighted children to visit a beach tidepool.

KCET-TV filmed these children at the beach and aired the trip in two segments on the "Summer Faire" television program. This initial interest led to the development of three pilot marine studies programs for visually impaired youngsters, funded by the Department of Health, Education and Welfare. The program mainstreamed visually impaired students with their sighted peers, with the cooperation of the Los Angeles County Superintendent of Schools and the Braille Institute.

In conjunction with classroom activities and field trips, USC marine educators developed specimen kits, tapes, and a book in both braille and large letters. A 10-minute documentary on the program was also produced for presentation to civic and private organizations.

**Los Angeles** — Working with the Los Angeles Unified School District, USC Sea Grant created and coordinated a week-long marine education program for summer camps. An identical series of lessons and activities was conducted in three camps with approximately 150-200 students at each camp. The five instructor/counselors at each camp attended a workshop to acquaint them with the materials and activities that could be used in an open-air type environment.

**Los Angeles** — A USC Sea Grant trainee who assessed sand and gravel resources offshore

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Santa Monica and San Pedro is now doing related work at Getty Oil Company. In her traineeship, the student learned computer analysis and other valuable geological research techniques which led to an attractive job offer with Getty Oil. She completed her master's degree while employed and now supervises a group of geologists who are doing computer analysis similar to the analysis she did in her traineeship.

**Los Angeles/San Francisco** — Pollutants entering the sea may become attached to suspended particles and eventually be buried in sediments after the particles settle, according to research conducted in San Francisco Bay by a USC Sea Grant researcher. Using naturally occurring radioactive tracers as pollutant analogs, the Sea Grant researcher showed 1) pollutants take approximately a day to attach to suspended particles, 2) particles settle to the bottom in eight to eleven days, and 3) particles may be resuspended ten to twenty times before they are deeply buried. Thus, pollutants may be rapidly transferred to the sediments, but they remain available for resuspension for several decades. This research information will be important in decision making regarding waste management in California.

**Los Angeles/San Francisco** — The amount of dissolved oxygen in the water is critical to the health of the marine ecosystem. Two USC Sea Grant projects examined the exchange of oxygen and other gases between the water and the sediments and between the water and the air to determine humankind's effect on the marine ecosystem.

The sediment research established the value of using radon/radium ratios to measure the exchange rates, and it established the critical importance of benthic marine organisms in cycling oxygen across the sediment-water interface. In San Francisco Bay, at least, it appears that the sediments are a major sink for oxygen.

The work on air-sea gas exchanges, which is still being analyzed, has established new laboratory techniques for measuring water turbulence (rather than wind or current velocity) in relation to gas exchange rates. Field work

indicates that gas exchange shows a clear relationship to wind shear and no clear relationship to current velocity. The results of both projects will improve calculations of the effects of human intervention in the marine ecosystem.

**Pasadena/Corona Del Mar** — More than 300,000 tons of particulate matter from rain runoff and treated sewage are dumped into southern California's coastal waters every year, creating a particle "stew" that includes chlorinated hydrocarbons and toxic metals such as chromium, lead, and arsenic.

With Sea Grant's support, researchers at the California Institute of Technology (Caltech) have designed and built a 6-foot submarine equipped with lasers to observe these potentially harmful chemicals.

Technically called a "laser-based velocimeter," the little submarine is part of a larger Sea Grant project investigating the chemistry and physics of particulates in seawater. By combining this information with the mathematical models developed in supporting Sea Grant research, the investigators are determining the fate of potentially hazardous chemicals that enter the waters each year off southern California's coast.

Most of the fieldwork is being conducted out of the Kerckhoff Marine Biological Laboratory at Corona del Mar. Additional funds for this research are provided by the Office of Marine Pollution Assessment, which, like Sea Grant, is part of the National Oceanic and Atmospheric Administration; by the National Science Foundation; and by a Mellon Foundation grant to Caltech.

**Riverside** — Researchers at UC Riverside developed a technique for collecting viable sperm from live male lobsters that should be directly applicable to aquaculture technology for lobsters and other crustaceans. The technique, which electrically induces extrusion of lobster spermatophores, provides a source of sperm, in its natural packet, for further experimentation, artificial insemination, and genetic crossing. The researchers also began testing a technique they developed for long-term storage of sperm, which will lay the groundwork for future development of sperm banks for lobster aquaculturists.

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## *San Diego Region*

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**Carlsbad/San Diego** — Warm water discharged by power plants in California coastal areas was long assumed to be a serious threat to nearshore marine organisms. Researchers at San Diego State University assisted the utilities industry and regulatory agencies by undertaking a 2-year Sea Grant study to acquire information about the effects of temperature on bottom-dwelling marine invertebrates. The research, conducted at San Diego State University and at the San Diego Gas and Electric Company (SDG&E) Encina Power Plant in Carlsbad, showed that most test species were not adversely affected by changing water temperature conditions.

With their data, the researchers evaluated a California regulation that requires new coastal generating stations to use expensive, offshore discharge systems, and they concluded that these requirements may be unnecessarily strong. Properly designed across-the-beach discharge systems, such as that of the Encina Power Plant, appear to be an acceptable alternative, both from an ecological standpoint and in terms of engineering complexity and cost. New units added at the Encina station use the existing discharge system at no additional cost. However, if the discharge requirements are to be met, a new unit would cost an additional \$30,000,000 (1974 dollars), according to SDG&E.

**Del Mar/La Jolla** — Researchers at Scripps Institution of Oceanography installed benchmarks and surveyed the horizontal and vertical location of the Longard Tube — a beach erosion control alternative being tested in Del Mar. Future changes in these data points can now be quantified and used to assess the tube's erosion control effectiveness.

**La Jolla** — At Scripps Institution of Oceanography, researchers conducted a meticulous investigation of historical coastal erosion and discovered that, contrary to what was previously known, domestic watering of plants on coastal bluffs may actually enhance soil erosion instead of preventing it. The researchers carried their message to more than 70 community groups in 1978 alone, and a coastal erosion research manual for use by coastal planners was published and distributed to all members of the California Coastal Commission.

**La Jolla** — Most geologists have perpetuated the belief that erosion is a slow, continuous process, an almost imperceptible process. This has resulted in widespread belief that structures built to within 25 feet of the sea cliff edge are safe because it will take many years to erode the cliff.

Researchers at Scripps Institution of Oceanography brought into question this long-held belief. Using old photo files, old maps, county records, and newspaper accounts, they discovered that coastal erosion in southern California can be quite rapid. As much as 20-60 feet of a sea cliff may be eroded in one season. This new information is obviously crucial to decisions about coastal development.

**La Jolla** — In previous Sea Grant research, investigators at Scripps Institution of Oceanography at UC San Diego developed significant, basic information concerning hybridization in California abalone. Armed with a better understanding of abalone fertilization, the researchers produced hybrid abalones by carefully controlling final sperm concentration and by adding sperm quickly to newly spawned eggs. The survival and growth rates of the hybrid juveniles are encouraging, and the results of this project should lead to the production of a superior breeding stock. The ability to produce heterotic hybrids in a controlled manner will be widely applicable to commercial abalone aquaculture.

**La Jolla** — The relationships between large kelp beds and the water currents and mixing rates within them are being studied by researchers at Scripps Institution of Oceanography. Their results are of great interest to Sea Grant investigators at California Institute of Technology and UC Santa Barbara who have received support from the Department of Energy and the American Gas Institute to determine the feasibility of farming kelp as a potential energy source. Knowledge of the role currents play in the dispersion of nutrients, fertilizers, and larvae will help determine kelp farming's potential, and it will aid other kelp fertilization projects as well as enhancement programs for lobster, crab, and abalone.

**La Jolla** — The Thomas Wayland Vaughan Aquarium-Museum at Scripps Institution of Oceanography (UC San Diego) is open year-

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round to residents and visitors interested in learning about California's marine life. The aquarium-museum receives more than 350,000 visitors a year; more than 34,000 preschool-through college-level students annually take part in the museum's organized education programs, which include 20 summer workshop courses for high school students and 17 1-week courses in area schools as part of the state-mandated Gifted and Talented Education Program. Docents in the aquarium-museum's outreach program make presentations each year to more than 2000 school students unable to visit the aquarium, and monthly lectures and field trips are held for students participating in the Junior Oceanographer Corps.

**La Jolla/Palos Verdes** — Enhancing California's abalone population is the aim of Sea Grant fisheries specialists at Scripps Institution of Oceanography (UC San Diego), who are testing four abalone enhancement approaches: seeding, broodstock transplantation, habitat modification, and closure.

The researchers studied the effects of habitat by looking at size-specific survivorship and monitoring changes in abalone populations resulting from previous seeding experiments and the closure at Palos Verdes. They completed experimental plants of red and green abalone seed at Palos Verdes Peninsula and Santa Cruz and San Miguel Islands, and they conducted a drift-bottle experiment to study green abalone larval dispersal.

Preliminary results from this research are encouraging, and the data are already being used by management agencies and private industry. The Department of Fish and Game and the California Legislature used the Sea Grant research data to extend fishing closure from Palos Verdes Point to Dana Point for a second 5-year period.

**La Jolla/San Diego** — Survival and healthy growth — not weight control — are the reasons rock scallops at Scripps Institution of Oceanography (SIO) are dieting today. Using a specially-designed laboratory at SIO, Sea Grant researchers at San Diego State University have refined and developed aquaculture technology for the purple-hinge rock scallop. The researchers have shown 1) adult broodstock remain healthy and continue to grow on a single diet of *Tetraselmis suecica*, 2) temperature and photoperiod control allow maturation of the scallop broodstock during late summer and fall months, 3) larvae produced by artificially

conditioned broodstock are normal, 4) a mixture of food algae provides a superior diet for the juvenile rock scallops, and 5) the nutritional value of food algae varies with the algae's culture growth stage. Results of this ongoing project should stimulate the commercial development of rock scallop aquaculture.

**La Jolla/Santa Barbara/Santa Cruz** — A major new neuromuscular toxin, lophotoxin (LTX), was isolated and defined by researchers at Scripps Institution of Oceanography. LTX occurs in sizeable quantities in six species of gorgonian coral from the Pacific coast. Like common pain killers, LTX inhibits neuromuscular transmission, but with a potency 10 times that of curare, a known muscle relaxant.

This new product resulted from Sea Grant's Marine Chemistry and Pharmacology Program, now in its sixth year. The program is a collaborative one among UC researchers from San Diego, Santa Barbara, and Santa Cruz and the pharmaceutical industry. The researchers are defining the biological properties and therapeutic value of chemicals derived from marine organisms, including tropical soft corals, algae, sponges, and nudibranchs, collected from widely dispersed geographic regions.

Since the program began in 1977, researchers have isolated 625 marine substances; of those, 65 have been retained for follow-up and 10 are being actively investigated. The researchers have discovered three distinctly interesting compounds.

Lophotoxin (LTX), mentioned above, is the first compound without nitrogen found to exhibit such neurotoxic properties. As a result, an entirely new class of compounds can now be explored for their potential analgesic properties. Besides its potential use as a pain killer, LTX, by virtue of its novel functional groups, represents a new tool for application in research involving neurological disease.

The UC San Diego researchers also made substantial collections of a Palau sponge and prepared a sponge derivative that appears to be an effective topical anti-inflammatory agent.

A potent cytotoxin, stypoldione, isolated by the Sea Grant research team, was evaluated by the National Cancer Institute and was found to possess potentially useful activity. The researchers also isolated an unusual cell division inhibitor from the Caribbean purple sea whip, which may be useful in studying basic cell division.

The researchers also developed a new assaying technique that uses fertilized sea

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urchin eggs to detect potential anticancer activity of chemical compounds. The National Cancer Institute has added this assay to its group of screening procedures. The compounds with significant development potential are submitted to Syntex Laboratories, Inc., a major pharmaceutical company in California, for additional screening and evaluation.

**Pt. Loma/Santa Cruz** — Sea Grant awarded its first John D. Isaacs Scholarship in 1980 to a senior at Point Loma High School (San Diego), for her study of environmental impacts on tidepool limpets. The 4-year, \$10,000 award recognizes the research excellence of California high school seniors and encourages further pursuit of marine science education at the state's colleges and universities. The student is currently majoring in biology at UC Santa Cruz.

**San Diego** — The stability of landfill areas during an earthquake is being studied by Sea Grant researchers in the Civil Engineering Department at San Diego State University. The researchers are studying the soil conditions and liquefaction potential of Harbor Island, a 70-acre landfill built in San Diego Bay in 1961. They are considering the construction history of the island and the regional seismology of the area to determine the potential liquifying effect of earthquakes most likely to affect the island. The findings will be used to recommend possible mitigative measures to the Unified Port District of San Diego. The study of Harbor Island could serve as a model for studying the stability of similar coastal fills elsewhere.

**San Diego** — Successful mass-culturing of shrimp is occurring at the pilot-farm stage in Hawaii, Texas, Mexico, and Central and South America, but problems of reproduction, nutrition, and disease pose major obstacles to successful commercial shrimp production. Researchers at San Diego State University are working with colleagues from the University of Arizona to develop an easily administered vaccine for *Fusarium* disease — the most serious to affect shrimp.

Building on their previous development of microassay and respirometric techniques, the researchers demonstrated that injections of heat-killed vaccines will immunize shrimp against *Fusarium* disease. Although the vaccination process is labor-intensive, vaccine use has considerable potential in protecting broodstocks for further aquaculture propagation.

**San Diego** — A survey of existing coastal transit services in California was completed by researchers at San Diego State University. Using information provided by 50 organizations in the state, including the park service, transportation departments, park agencies, local governments, planning agencies, and transit operators, the researchers drafted tentative planning guidelines that will help coastal zone planners design transit services for coastal recreation areas.

**San Diego** — Ecological guidelines for restoring and creating wetland communities have been developed and disseminated by researchers at San Diego State University in a unique cooperative project between Sea Grant and federal, state, and local agencies.

In response to requests from the U.S. Navy, the U.S. Fish and Wildlife Service, the California Department of Parks and Recreation, the City of San Diego, and the Port of San Diego, the researchers provided advice on wetlands management guidelines and specific management and mitigation plans. They served on wetlands management advisory panels, consulted during wetlands project planning, and provided guidance to agencies responsible for managing California's coastal wetlands.

This Sea Grant project grew out of previous ecosystems research in the Tijuana Estuary and San Diego Bay. Several organizations have already put to use the results of California Sea Grant research on coastal wetland restoration. The U.S. Navy, which owns much of southern California's Tijuana Estuary and must protect its wildlife, worked with Sea Grant researchers to increase cordgrass distribution in the estuary, providing a better habitat for the endangered clapper rail and other species that live there.

**San Diego** — Creating a wildlife habitat out of an 80-acre dredge waste island is a problem the Unified Port District of San Diego is solving using results of Sea Grant research at San Diego State University. The island was created in south San Diego Bay when a nearby boat basin was dredged. Test-plantings of marsh vegetation on the island's dike are providing information that will be used by the port district when the island is ready for planting.

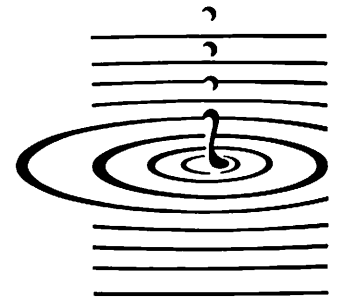
**San Diego** — At the request of the U.S. Fish and Wildlife Service, Sea Grant researchers from San Diego State University wrote a 110-page community profile of southern California salt

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marshes. *The Ecology of Southern California Coastal Salt Marshes: A Community Profile* describes the history, functions, and resources of the salt marsh ecosystem, and it presents common problems and possible solutions — developed in Sea Grant research — to aid government agencies responsible for managing southern California's marsh areas.

The publication serves as the model for a series of community profiles. Fish and Wildlife is producing for major local, state, and federal agencies in coastal areas throughout the United States and for universities, libraries, and interested individuals.

**San Diego/Fort Bragg** — The first large-scale model of California fisheries and seafood industries to determine the direct, indirect, and induced economic impacts of those industries has been designed and constructed by Sea Grant researchers at San Diego State University. The model links California's fishing and seafood industries with the rest of the state's economy and can be used to evaluate the effects of economic, biological, and regulatory changes on seafood industries. For example, using the model, researchers have shown that changes in fishery management policy resulted in a 25% increase in salmon landings in the Fort Bragg area in 1980. This increase generated an additional \$3 million in economic production and income for the state. Similar preliminary data and analyses are being used by federal and state fishery agencies as well as industry trade organizations representing both harvesters and processors.



# Additional Benefits

## Beneficiaries 1977-82<sup>1</sup>

*A beneficiary is any company, agency, university, organization, or group that has applied or utilized project results, scientific or technical advice, advisory services, or other products resulting from Sea Grant-sponsored research, education, and advisory services.*

*Out-of-state beneficiaries result from applications of California Sea Grant research results to similar problems elsewhere.*

### Regional and Local Governments

ABC Unified School District  
Brentwood Magnet School  
Cabrillo Museum  
Carlsbad, City of  
Channel 58  
Culver City High School  
Del Mar, City of  
El Rancho Unified School District  
Eureka, City of  
Humboldt Bay Harbor and Recreation District  
Humboldt County  
    Department of Planning  
    Department of Public Works  
    Department of Natural Resources  
Laguna Beach, City of  
Long Beach, Port of  
Los Angeles County  
    Department of Beaches and Harbors  
    Department of Parks and Recreation  
    Museum  
    Sanitation Districts  
    Superintendent of Schools  
Los Angeles, Port of  
Los Angeles Unified School District  
McKinleyville Community  
Merced County School District  
Monterey County Planning Department  
Oceanside, City of  
Orange County Sanitation Districts

Oxnard Unified School District  
San Bernardino County School District  
San Diego City Lifeguard Service  
San Diego County  
    Integrated Planning Organization  
    Land Use and Environmental Regulations  
    Sanitation and Flood Control  
    Tax Assessors Office  
San Diego Unified Port District  
San Diego Unified School District  
San Diego Water and Sewer Utilities Department  
San Pedro Harbor Occupational Center  
San Pedro Marine Science Magnet School  
Santa Barbara County Parks Department  
Santa Cruz County  
    Board of Supervisors  
    Fish and Game Commission  
Southern California Coastal Water Research Project  
Thirty-Second Street Magnet School  
Trinity County School District  
Ventura County  
Whatcomb County, Washington  
Yolo County Head Start

### State Governments

Alaska Commission on Statehood and Intergovernmental Relations  
Arizona Department of Fish and Wildlife  
California  
    Coastal Commission  
    Department of Boating and Waterways

<sup>1</sup>Sources: California Sea Grant annual reports and records.



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California

Department of Education  
Department of Finance  
Department of Fish and Game  
Department of Parks and Recreation  
Department of Transportation  
Division of Mines and Geology  
Interagency Curriculum Materials Task Force  
Public Utilities Commission  
State Coastal Conservancy  
State Lands Division  
State Water Quality Control Board

Delaware State Government

Hawaii Department of Land and Natural Resources

Maryland State Government

Massachusetts State Lobster Hatchery

Maine State Government

New York State Government

Oregon

Department of Land Conservation and Development  
Museum of Science and Industry

Virgin Islands Government

Washington

Department of Fisheries  
Department of Natural Resources

**Federal Government**

California Cooperative Oceanic Fisheries Investigations

Channel Islands National Park

Coast Guard

Department of

Energy  
Justice, Community Relations Service

Environmental Protection Agency

Fish and Wildlife Service

Geological Survey

Indochinese Resettlement Assistance Program

Marine Mammal Commission

Merchant Marine and Fisheries Committee, House of  
Representatives

Micronesian Mariculture Demonstration Project  
National

Aeronautics and Space Administration  
Cancer Institute  
Institute of Allergy and Infectious Diseases  
Marine Fisheries Service  
Park Service  
Oceanic and Atmospheric Administration  
Science Foundation

Weather Service

Wetlands Technical Council

Navy Office of Wildlife and Natural Resources

North Pacific Fishery Management Council

Nuclear Regulatory Commission

Office of

Coastal Zone Management

Ecology, NOAA

Marine Pollution Assessment

Technology Assessment, Congress

Pacific Fishery Management Council

Redwoods National Park

Santa Monica Mountains National Recreation Area

Smithsonian Institution

Soil Conservation Service

U.S. Army Corps of Engineers

Wildlife and Natural Resources Office, Navy

**Foreign Governments**

Australia

Department of Fisheries

Department of Agriculture

Tasmanian Fisheries Development Authority

Brazil

Instituto de Botanico

Canada

Department of Fisheries and Oceans

Pacific Biological Station, Nanaimo

Chile

Ministry of Education

China

Academy of Agricultural Science

Egypt

Ministry of Agriculture

England

Environmental Research Council

Glasshouse Crops Research Institute

Plymouth Laboratory

Germany/Peru

Procopa

India

Central Salt and Marine Chemicals Research Institute

Central Soil Salinity Research Institute

Tata Energy Institute

Ireland

Shellfish Research Laboratory

Israel, Government of

Japan, Government of

Mexico

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Department of Fisheries  
National Science Foundation  
Office of Evaluation of Resources  
Pakistan  
Atomic Energy Agricultural Research Centre  
Qatar  
Ministry of Industry and Agriculture  
Saudi Arabia  
Trading and Industrial Group  
South Africa, Government of  
Tahiti  
Gerdat-Irat Mission de Recherche Agronomique

### **Private Industry**

Alberta Gas Company  
ALESA Alusuisse Engineering Ltd.  
American Gas Association  
Amfac Corporation  
Aquaculture Enterprises  
Arizona Fuels Pilot Plant  
Arthur D. Little, Inc.  
Association of Diving Contractors  
Atcheson, Topeka, and Santa Fe Railroad  
Batelle Columbus Laboratories  
Battle Creek Trout Company  
Bechtel, Inc.  
Brown and Caldwell  
Bruinsma  
Bumble Bee Tuna  
Calaqua, Inc.  
California  
Abalone Association  
Fish Growers, Inc.  
Sea Farms, Inc.  
Seafood Institute  
Sunshine, Inc.  
Campbell Soup  
Chevron Oil Field Research Company  
Chico Game Fish Farm  
Children's Television Workshop  
Comex  
Commercial Shrimp Culture International  
Crown Zellerbach  
Cryovac  
Dynasen Mariculture, Inc.  
Eastman Kodak Company  
EDAW, Inc.  
Edward C. Jordan Company  
Elk Grove Florin Catfish Farm

Elkhorn Sea Farms  
ESA/Madrone  
Eureka Fisheries  
Evans-Hamilton Company  
Exxon Corporation  
Far West Services, Inc.  
Ferry-Morse Seed Company  
FMC Corporation  
Foremost Foods  
General Electric Company  
George Ray Fish Breeders  
Ghio Seafood Products  
Golden Bear Aquaculture  
Handel Film Corporation  
Happy Jack Ranch  
Hubbs-Sea World Research Institute  
International  
Investment Bank  
Plant Research Institute, Inc.  
Telephone and Telegraph, Inc.  
Shellfish, Inc.  
Interstate Electronics  
Johnson Oyster Company  
Jones and Stokes  
*Journal of Marine Education (later Sea World, then Current)*  
KCET-TV  
Kelco  
KMEX  
KNX-AM  
Leighton and Associates  
Leisure World  
Lilly Research Laboratories  
Lockheed Industries  
Machado Fisheries  
Mariculture Northwest, Inc.  
Marine  
Colloids, FMC  
Nutritional Systems  
Research Inc.  
Meredith Fish Company  
National Fisheries Institute  
Newberry Crayfish Hatchery  
North Coast Laboratories, Ltd.  
Ocean Miners Company  
Oceaneering International  
Oceanic Institute  
Ogilvie Mills  
Oltmans Construction, Inc.  
Pacific Ocean Farms

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Perry Oceanographics  
Petaluma Wholesale Fish and Lobster Company  
Pigeon Point Aquaculture Center  
Point Saint George Fisheries  
Pratt and Whitney Aircraft  
Prince William Sound Aquaculture  
Race Street Fish and Poultry  
Rainbow Ranch  
Ralston Purina  
Red Lobster of Honduras  
San Diego Gas and Electric  
Santa Barbara  
    Abalone Fishermen's Association  
    Mariculture Foundation  
Santa Catalina Island Corporation  
Schnaubelt Fisheries  
Scott Laboratories  
Sea World, Inc.  
Seafood Specialties, Inc.  
Shadow Lake Ranch  
Sintef  
Southern California Edison Company  
Standard Oil  
Starkist Foods  
Stauffer Chemical Company  
Stickel and Associates  
Sushi Seafoods  
Swiss Technical Cooperation, Inc.  
Syntex Corporation  
Tarantino Fish Company  
Tidewater Seafoods  
Tom Lazio Fish Company  
TransFresh Corporation  
TRW Systems, Inc.  
Union Carbide  
Union Oil Company  
Valley Fish Farms  
W.R. Grace and Company  
Winzler and Kelly  
Woodward-Clyde Consultants  
Zoecon Corporation

**Universities and Colleges**

Alfateh University, Libya  
Baylor College of Medicine, Texas  
California State Universities and Colleges at  
    Fullerton  
    Humboldt  
    Long Beach

Los Angeles  
Moss Landing Marine Laboratories (a consortium of six  
    northern California state universities and colleges)  
Northridge  
Pomona  
San Diego  
San Francisco  
California State Universities and Colleges at  
    San Jose  
Southern California Ocean Studies Consortium (a  
    consortium of six southern California state  
    universities and colleges)  
Cornell University, New York  
Cuesta College  
Dalhousie University, Canada  
East Carolina University, North Carolina  
Gujaret Agricultural University, India  
Louisiana State University  
Marine Resources Institute, South Carolina  
Massachusetts Institute of Technology  
Max Planck Institute, Germany  
North Dakota State University  
Shantung College of Oceanography, China  
Shasta College  
Southern University, Louisiana  
Stanford University Hopkins Marine Station  
Taiwan National University  
Texas A&M University  
Universita degli Studi de Catonia, Italy  
University of Arizona  
University of California at  
    Berkeley  
    Bodega Marine Laboratory  
    Davis  
    Irvine  
    Los Angeles  
    Riverside  
    San Diego  
    Santa Barbara  
    Santa Cruz  
    Scripps Institution of Oceanography  
University of  
    Delaware  
    Hawaii  
University of  
    Maine  
    Melbourne, Australia  
    Miami  
    Nevada

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Puerto Rico  
Reno, Nevada  
Rhode Island  
Southern California  
Utah  
Virginia  
Waikato, New Zealand  
Washington  
Wisconsin  
Woods Hole Oceanographic Institution, Massachusetts

**Nonprofit and General Public Organizations**

Agricultural History Society  
American  
    Association of Retired Persons  
    Association of University Women  
Asian Law Alliance  
Audubon Society  
Bodega Bay Fishermen's Association  
Boy Scouts of America  
Braille Institute of Los Angeles  
California  
    Association for Bilingual Education  
    Science Teachers Association  
Coast Guard Auxiliary  
Coastal  
    Society Conference, 6th Annual  
    Zone '80 Conference  
Elderhostel  
Environmental Defense Fund  
Foundation for the Junior Blind  
Girl Scouts of America  
Greater Los Angeles Council of Divers  
Hoopa Valley Tribe  
League of Women Voters of California  
Los Angeles  
    County Underwater Diving Instructors Association  
    Press Club  
    Science Teachers Association  
Marina Foundation  
Marine Technology Society  
National  
    Association for Underwater Instructors  
    Football Youth Players Association  
    Institute for the Advancement of Career Education  
    Marine Education Association  
    Propeller Club Association  
    Science Teachers Association  
Newport Harbor Chamber of Commerce

Oceanic Society  
Pacific Fisheries Technologists  
Point Fermin Summer Camp  
Project  
    COLD (Climate, Ocean, Land, and Discovery)  
    Learning Tree  
Rotary Club, Arcata Chapter  
San Fernando Valley Power Squadron  
San Pedro Chamber of Commerce  
Santa Barbara  
    Fishermen's Association  
    Fishermen's Festival  
Save Our Salmon  
Scripps Industrial Associates  
Sierra Club  
Skidaway Institute of Oceanography Conference  
Southern California  
    Association of Science Supervisors  
    Boating Safety Advisory Group  
    School Administrators Conference  
Southwest Marine Education Association  
Town Hall of Los Angeles  
Trinidad Garden Club  
United Fishermen's Organization  
Year of the Coast Coalition

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## Cooperating Organizations 1977-82

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*Sea Grant's unique link among universities, government agencies, and related industries makes it an attractive and knowledgeable source of up-to-date information and technology affecting the marine sphere. Many marine-related organizations, including public, private, local, state, and federal groups, provide valuable cooperation and assistance in the development of Sea Grant research, education, and advisory activities. More than 500 organizations provided financial support, technical information, goods and services, or staff expertise in 1977-82 in support of California Sea Grant activities. The list below and on the following pages lists some of those organizations.*

**Table 1**  
**California Sea Grant Cooperating Organizations<sup>2</sup>**  
**1977-82**

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Local and Regional Governments	155
State Governments	42
Federal Government	46
Foreign Governments	6
Industries	124
Universities and Colleges	105
Nonprofit Organizations and General Public	66
<b>Total</b>	<b>544</b>

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ARCO Foundation	California, City of
Alaska, State of, Department of Fish and Game	Arcata
American Shellfish	Avalon
Argonne National Laboratory, Radiological and Environmental Research Division	Beverly Hills
Atlantic Richfield Corporation, Los Angeles and Bakersfield, California	Carlsbad
Audubon Society, El Dorado Chapter, Long Beach, California	Chula Vista
Billfish Fishery Management Plan Development Team	Coronado
Braille Institute of Los Angeles	Dana Point
Brigham Young University, Department of Biology, Provo, Utah	Del Mar
Bristol-Myers Corporation	El Segundo
Bureau of Land Management	Hermosa Beach
CER, San Diego County Department of Education	Huntington Beach
Cabrillo Marine Museum	Imperial Beach
California Abalone Association	Laguna Beach
	Long Beach
	Los Angeles
	Manhattan Beach

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<sup>2</sup>Source: California Sea Grant annual reports.

Mission Beach	Lands Commission
National City	University, Long Beach
Newport Beach	University, Northridge
Oceanside	Campus-Industry Action Committee
Oxnard	Canada
Pacific Beach	Department of the Environment, Vancouver, British Columbia
Palos Verdes Estates	Packers Company, Ltd., Ontario, Canada
Port Hueneme	Castroville Community Center
Rancho Palos Verdes	Catherine Davis Foundation
Redondo Beach	Centro de Investigacion Cientifica y Educacion Superior, Ensenada, Baja California
Riverside	Charles River Associates
San Buenaventura	Chesapeake Fish Company, San Diego, California
San Diego	Citizens League, Minneapolis, Minnesota
San Pedro	Claremont College
Santa Barbara	Clean Seas, Incorporated
Santa Monica	Coca-Cola Bottling Company of Los Angeles
Seal Beach	Colorado
South Laguna	Environmental Affairs and Planning, Denver, Colorado
California, County of	Land Use Commission, Denver, Colorado
Del Norte	Municipal League, Wheat Ridge, Colorado
Humboldt	Columbia Broadcasting System, KNX Radio
Mendocino	Columbia University, Lamont-Doherty Geological Observatory
Monterey	Commercial
Orange	Abalone Divers Association of Santa Barbara
San Diego	Diving Center, Wilmington, California
San Francisco	Fishermen of Santa Barbara, California
San Luis Obispo	Processors for Abalone, Tuna, and Salmon
San Mateo	Shrimp Culture International, Port Isabel, Texas
Santa Barbara	Commission of the Californias
Sonoma	Comprehensive Planning Organization for the San Diego Region, San Diego, California
Ventura	Concerned Mayor's Task Force
California, State of,	Conservation Foundation, The, Washington, D.C.
Coastal Commission & Regional Coastal Commissions	Coordinating Council of Higher Education, HEW
Department of Boating and Waterways	Cousteau Society
Department of Education	Covington and Burling, Washington, D.C.
Department of Fish & Game: Region I, Iron Gate Hatchery, Mad River Hatchery	Crown Simpson
Department of Health Services	Cryovac Corporation
California	Cyprus Mines
Conservation Corps	Dames and Moore, Incorporated
Cooperative Fishery Research Unit	Datatronics Systems Corporation
Council for the Humanities	Davey's Locker, Incorporated
Gillnetters Association, Los Angeles, California	Delaware Planning Office, Dover, Delaware
Institute of Technology	Diving Equipment Manufacturers Association, Long Beach, California
Institute of Technology, Kelp Habitat Improvement Project, Pasadena, California	Domingues-Carson Chamber of Commerce
Interagency Curriculum Materials Task Force	Dravco Corporation, Pittsburg, Pennsylvania
California State	
Coastal Conservancy	

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Dungeness Crab Fishermen  
 EG&G, Incorporated  
 East Carolina University  
 Environment Canada, Fisheries and Marine Sea Landing  
     Sportsfishing  
 Environmental  
     Research Laboratories, Puerto Penasco, Sonora, Mexico  
     Research Laboratory, Tucson, Arizona  
     Resources Office of Santa Barbara County  
 Escuela Superior de Ciencias Marinas, Ensenada, Baja  
     California  
 Eureka Fisheries, Eureka, California  
 Evans-Hamilton Company  
 Exploratory Career Experience Program, San Diego City  
     Schools  
 Exxon, Environmental Engineering Department  
 Exploratorium, San Francisco, California  
 FMC Corporation  
 Fisheries Research Board of Canada  
 Fisherman's Unions  
 Fishermen and Allied Workers Union, Local 33, I.L.U.,  
     Terminal Island, California  
 Fishing Vessel JJ  
 Flavor-Tex  
 Florida Coastal Coordinating Council, Tallahassee, Florida  
 Florida, State of, Department of State Planning, Tallahassee,  
     Florida  
 Food Technology Research and Development Center, Division  
     of Food Technology  
 Foremost Foods, Research and Development, Dublin,  
     California  
 Foundation for Ocean Research, San Diego, California  
 Friends of the Sea Otter  
 Fullerton Junior College, Fullerton, California  
 G.D. Searle and Company, Chicago, Illinois  
 Galway Mariculture Laboratory, Ireland  
 Ghio Seafood Products, San Diego, California  
 Global Marine  
 Glosten Associates  
 Goleta Sanitary District  
 Government of Canada, Department of Fisheries and Oceans  
 Governor's Office of Planning and Research, Sacramento,  
     California  
 H&M Wholesale Lobster Company, Petaluma, California  
 Hanna-Barbera Productions  
 Harbor Occupational Center, Commercial Fishermen Class,  
     San Pedro, California  
 Harbor Occupational College  
 Hartford Insurance Company  
 Hawaii Department of Planning and Economic Development,  
     Honolulu, Hawaii  
 Hawaii Land Use Commission, Honolulu, Hawaii  
 Henkel Corporation, Minneapolis, Minnesota  
 Hoffman-La Roc  
 Hokaido University, Department of Botany, Sapporo, Japan  
 Hopkins Marine Station of Stanford University, Pacific Grove,  
     California  
 Hueneme Fish and Bait Processors, Port Hueneme  
 Hubbs-Sea World Research Institute  
 Humboldt County  
     Department of Natural Resources  
     Department of Planning  
     Department of Public Works  
 Humboldt State  
     University, Arcata, California  
     University Foundation  
 Hydroproducts  
 IBM Foundation  
 IET Industries, Incorporated  
 Iccle Seafoods Incorporated, Seattle, Washington, and  
     Hormer, Alaska  
 Idaho Department of Fish and Game  
 Immaculate Heart College  
 Industria Aquaculture Labs, Mexico  
 Institute of  
     Geophysics and Planetary Physics, La Jolla, California  
     Marine Resources, University of California  
 Inter-American Tropical Tuna Commission, La Jolla,  
     California  
 International  
     Biological Consultants  
     Pacific Halibut Commission  
     Plant Research Institute, San Carlos, California  
     Shellfish Enterprises, Incorporated, Moss Landing,  
         California  
     Japanese National Institute for Basic Biology  
     Johns Hopkins School of Advanced International Studies,  
         Washington, D.C.  
     Jones and Stokes, Environmental Consultants, Sacramento,  
         California  
     Journal of Marine Education  
     KABC-TV, Channel 7  
     KCET-TV, Chanel 28  
     KCOP, Channel 13  
     KLVE-FM  
     KNX-AM  
     KPFK-FM  
     KZLA-AM/FM

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Kennecott Explorations, Incorporated, Ocean Operations  
 Division, San Diego, California  
 Kinnetics Laboratory Incorporated, Santa Cruz, California  
 Kordon Incorporated, Hayward, California  
 Korean Institute of Science and Technology, Seoul, Korea  
 LFE Environmental Analysis Laboratories, Richmond,  
 California  
 Lawrence Radiation Laboratory, Berkeley, California  
 Lazio Fish Company, Eureka, California  
 League of Women Voters  
 Lennox School District  
 Leonard Greenstone Company, Los Angeles, California  
 Letterman Army Research Institute  
 Leslie Salt Company, Newark, California  
 Lilly Research Laboratories  
 Local and Regional Water Quality Control Boards  
 Lockheed  
 Center for Marine Research  
 Missiles and Space Company  
 Long Beach  
 Chamber of Commerce  
 Harbor Department  
 Los Angeles  
 City Planning Department  
 Chamber of Commerce  
 Los Angeles County  
 Department of Beaches and Harbors  
 Department of Parks and Recreation  
 Museum of Natural History, Los Angeles, California  
 Regional Planning Commission  
 Sanitation District  
 Small Craft Harbor Commission  
 Superintendent of Schools  
 Los Angeles  
 Flood Control District  
 Unified School District  
 Yacht Club  
 Louisiana State Planning Office, Baton Rouge, Louisiana  
 Lowie Museum  
 Loyola University of Los Angeles  
 Lyceum of the Monterey Peninsula  
 Maccaferri Gabions, Incorporated, Flushing, New York  
 McCutcheon, et al., Attorneys at Law, Los Angeles  
 McGill University, Department of Microbiology and  
 Immunology, Montreal, Canada  
 McMaster's University, Department of Biology, Hamilton,  
 Ontario, Canada  
 Maine  
 Department of Environmental Protection, Augusta, Maine  
 Natural Resources Council, Augusta, Maine  
 State Planning Office, Coastal Planning Group, Augusta,  
 Maine  
 Malaspina Junior College  
 Marconsult, Incorporated  
 Marina Del Rey Chamber of Commerce, Lessee's Association  
 Marine  
 Bioassay Laboratories, Watsonville, California  
 Colloids of FMC, Rockville, Maine  
 Commodities International, Incorporated, Brownsville,  
 Texas  
 Technology Society  
 Marineland of the Pacific  
 Maritime Administration, Washington, D.C.  
 Market News and Statistics  
 Maryland  
 Department of Natural Resources, Annapolis, Maryland  
 State Land Use Planning Program, Baltimore, Maryland  
 Massachusetts  
 Institute of Technology  
 State Lobster Hatchery  
 Matson Navigation Company, San Francisco, California  
 Merck, Sharp and Dome Laboratories  
 The Mellon Foundation  
 Mentally Gifted Minor Program  
 Meredith Fish Company, Sacramento  
 Mission Bay Associates, San Diego, California  
 Minnesota Coastal Zone Program, State Planning Agency, St.  
 Paul, Minnesota  
 Monsanto Company  
 Monterey and Santa Cruz County Offices of Education  
 Monterey City, Planning and Public Works Department  
 Monterey Indochinese Resettlement Assistance Program  
 Moss Landing Marine Laboratories  
 Mu Seafood Company  
 Nacional Hotelera, Ensenada, Baja California, Mexico  
 National  
 Association of Underwater Instructors, Colton, California  
 Cancer Institute, Bethesda, Maryland  
 Canner's Association, Washington, D.C.  
 Canner's League, Sacramento, California  
 Environmental Data Service  
 Evaluation, Dissemination and Assessment Center for  
 Bilingual Education at California State University, Los  
 Angeles  
 Fisheries Institute  
 Geophysical and Star Terrestrial Data Center  
 Institute for the Advancement of Career Education  
 Institutes of Health, Bethesda, Maryland

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Marine Education Association  
 Marine Fisheries Laboratory, Cook, Washington  
 Marine Fisheries Service, Tiburon Laboratory  
 Marine Fisheries Service, Northwest and Alaska  
     Fisheries Centers  
 Marine Fisheries Service, Southwest Fisheries Center  
 Museum of Natural History, Washington, D.C.  
 Oceanic and Atmospheric Administration  
 Park Service  
 Science Foundation

Nautilus Press

Naval

    Medical Research Institute, Behavior Sciences  
         Department, Bethesda, Maryland  
     Ocean Systems Center  
     Oceanographic Office  
     Submarine Training Center, Hawaii

New England Regional Fisheries Management Council

New York

    Department of Environmental Conservation, Albany, New  
         York  
     Department of State Planning, Albany, New York  
     State University, Albany, New York  
     State University, Department of Public Administration,  
         Albany, New York

North Monterey County

    Unified School District  
     Mentally Gifted Minor Program

Nossaman, Waters, Krueger, Marsh and Riodan, Los Angeles,  
 California

Oakland,

    Port of, Oakland, California  
     World Trade Club, Oakland, California

Ocean Labs Incorporated, Irvine, California

Oregon

    Department of Fish and Wildlife  
     Department of Land Conservation and Development,  
         Salem, Oregon  
     Executive Department, Local Government Relations  
         Division, Salem, Oregon  
     League of Women Voters, North Bend, Oregon

Oyster and Abalone Research Institute, Japan

Pacific

    Alaska LNG Company  
     Biological Station, Nanaimo, B.C., Canada  
     Coast Federation of Fishermen, Incorporated  
     Coast Fisherman's Organization, Sausalito, California  
     Gas and Electric, Department of Research and  
         Development

    Lighting Services Company  
     Marine Exchange, San Francisco, California  
     Marine Fisheries Commission, Portland, California  
     Merchant Shipping Association, San Francisco,  
         California

    Palos Verdes Estates  
     Peterson Publications, Incorporated  
     Plessey Corporation, San Diego  
     Point St. George Fisheries, Santa Rosa, California  
     Point Reyes Bird Observatory

Port of

    Long Beach, California  
     Los Angeles, California  
     Oakland, California  
     San Diego, California  
     San Francisco, California  
     Seattle, Washington

    Prairie Creek Fish Hatchery, Humboldt County, California  
     Ralston Purina, St. Louis, Missouri  
     Regional Water Quality Control Board, Oakland, California  
     Research Institute, Charleston, South Carolina  
     Resources for the Future, Washington, D.C.

Rhode Island

    Statewide Planning Program, Providence, Rhode Island  
     University of, Coastal Resources Center, Kingston,  
         Rhode Island

Royal Norwegian Council for Scientific and Industrial  
 Research, Oslo, Norway

Salk Institute, La Jolla, California

San Diego

    City Planning Department, San Diego, California  
     City School District, Volunteer Office  
     County Department of Education, Community Education  
         Resources  
     Department of Education  
     Gas and Electric Company, Encina Power Plant  
     Museum of Man  
     Natural History Museum  
     State University, Departments of Biology and  
         Microbiology

San Jose State University

San Mateo County, Assessor's Office and County Planning  
 Department

Sanders Associates, New Hampshire

Santa Barbara

    Abalone Fishermen's Association  
     City College  
     Museum of Natural History

Santa Catalina Island

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Santa Cruz City Museum  
 Save Our Shellfish  
 Sea Otter Management Education  
 Seafood Specialties, Incorporated, Santa Barbara  
 Senate Office of Research  
 Sierra Club, Minneapolis, Minnesota  
 Signal Oil Company, Long Beach  
 Silliker Laboratories, Vernon, California  
 Soil Control Lab, Watsonville, California  
 Soil Control Lab/Marine Bioassay Laboratories  
 Sonoma County Planning Commission  
 South Carolina Marine Resources Research Institute  
 Southern California  
     Boating Safety Advisory Group  
     Edison Company, Research and Development Program  
 Southwest Marine Education Association  
 St. Andrews Biological Station, Fisheries Research Board of  
     Canada, New Brunswick  
 Standard Oil, California, and Ohio  
 Star-Kist Foods, Terminal Island, California  
 State Lands Commission  
 Stauffer Research Laboratory  
 Tarantino Seafoods  
 Tasmanian Fisheries Development Authority, Australia  
 Tatman Foundation  
 Tinker Foundation of New York  
 TransFresh Corporation  
 Treaty Indian Organizations of California, Oregon,  
     Washington, Alaska  
 Tyee Club, Tiburon, California  
 U.S.  
     Army Corps of Engineers, San Francisco, Sacramento  
     Bureau of Land Management  
     Coast Guard  
     Department of Energy  
     Department of Health, Education, and Welfare  
     Department of Interior, Fish and Wildlife Services  
     Departments of Commerce, Interior, and State  
     Environmental Protection Agency  
     Fish and Wildlife Services, Laguna Niguel, California  
     Food and Drug Administration  
     Forest Service  
     Geological Survey, Menlo Park, California  
     House Merchant Marine and Fisheries Committee  
     Marine Mammal Commission  
     National Science Foundation  
     Naval Air Station, Pt. Mugu, California  
     Naval Submarine Training Center  
     Navy, Office of Naval Research  
     Navy, Navy Facilities Engineering Command  
     Wildlife and Natural Resources Office  
 United Fishermen's Organization, Los Angeles, California  
 University  
     College, Department of Botany, Galway, Ireland  
     College of North Wales, Marine Biology Department  
     Cooperative Extension, Sonoma County, California  
 University of Alaska, Sea Grant Program  
 University of Arizona, Environmental Research Laboratory  
 University of California  
     Agricultural Experiment Station  
     Berkeley  
     Berkeley, Department of Botany  
     Bodega Marine Laboratory  
     Cooperative Extension  
     Davis  
     Davis, Aquaculture Program  
     Davis, College of Agriculture and Environment  
     Davis, Department of Agronomy & Range Science  
     Davis, Department of Avian Sciences  
     Departments of Zoology, Entomology, Botany  
     Division of Agricultural Sciences  
     Earthquake Engineering Research Center, Richmond,  
         California  
     Irvine  
     Los Angeles, Chicano Studies Center  
     Riverside, Department of Entomology  
     San Diego  
     San Diego, School of Medicine  
     Santa Barbara  
     Santa Barbara, Computer Systems Laboratory  
     Santa Barbara, Department of Geography  
     Santa Cruz  
     Santa Cruz, Long Marine Lab  
 University of  
     Florida, Gas Research Institute  
     Hakodate, Japan  
     Montana, Department of Zoology, Missoula, Montana  
     Nebraska  
     Oregon, Oregon Institute of Marine Biology  
     San Diego Law School  
     Southern California  
     Texas, Project on Control in Economics and the Center  
         for Economic Research  
     the Pacific  
     Tokyo  
     Washington, Economics, Seattle, Washington  
     Washington, Institute for Environmental Studies, Seattle,  
         Washington

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Ventura County  
Washington State University, Cooperative Extension  
Wayne State University  
West Coast Fisheries Development Foundation  
Western Fishboat Owners' Association  
Winzler and Kelly, Incorporated  
Wisconsin Department of Natural Resources  
Woodward-Clyde Consultants  
Young Adult Conservation Corps  
Zoecon Corporation, Palo Alto, California

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## ***California Sea Grant Trainees<sup>3</sup>***

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*In 1977-82, approximately 275 graduate students worked in Sea Grant research activities through the Sea Grant trainee program. These students earned a total of more than 100 master's degrees and more than 160 doctorates during the 5-year period. More than 140 degrees are still in progress.*

*Most Sea Grant trainees were employed by private industries and research-oriented universities immediately following their traineeships. Table 2 below and the list on the following page show where Sea Grant trainees are now working.*

**Table 2**  
***Present Employment of  
California Sea Grant-Supported Students  
1977-82***

<b>Employment</b>	<b>Masters</b>	<b>Ph.D.</b>	<b>Total<sup>4</sup></b>
Regional, Local, & State Government	16	9	25
Federal Government	4	6	10
Private Industry	26	39	65
Academia	55	93	148
Place of Employment Unknown	12	15	27
<b>Totals</b>	<b>113</b>	<b>162</b>	<b>275</b>

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<sup>3</sup>Source: California Sea Grant trainee records.

<sup>4</sup>Numbers projected based on a 45% return of a 1982 trainee survey.

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## *Employment Following 1977-82 Traineeships<sup>5</sup>*

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### **Regional, Local, and State Government**

Alaska Department of Fish and Game  
California Coastal Commission  
California Department of Boating and Waterways  
Central Regional Coastal Commission  
Contra Costa County  
Council of State Governments  
New York Legislature, Economic Analyst  
Oregon Department of Fish and Wildlife  
Port of Long Beach  
Port of Los Angeles  
South Coast Regional Coastal Commission  
State of California Air Resource Control Board

### **Federal Government**

Department of Conservation, Division of Oil and Gas  
National Institutes of Health  
National Research Council, Commission on International Relations  
Naval Systems Lab, Hunters Pt. Naval Station  
United Nations  
U.S. Department of Agricultural, Economical, and Statistical Cooperative Service  
U.S. Fish and Wildlife Service  
U.S. Geological Survey

### **Private Industry**

Aerotherm Acurex Corporation  
Amoco Production Company  
Aquaculture Systems International  
Arete Association  
Arco Oil and Gas Company  
Armour-Dial  
Atlantic Richfield Company  
Auslam and Associates  
Brian Watt Associates, Incorporated  
Castle and Cook Company  
Center for Natural Areas  
Chambers Consultants and Planners  
Channel Island Resource Program  
Commercial Diving Center  
Cousteau Society  
Eli Lilly Research Labs  
Environmental Research Group

Failure Analysis Associates  
Getty Oil Company  
Gulf Oil  
Hughes Aircraft  
International Plant Research Institute  
International Shellfish  
Intersea Research Corporation  
Interactive Structural Engineering Consultants, Incorporated  
Kelco  
Kelp Ecology Project  
Kerckhoff Marine Laboratory  
LGL Ecological Association  
Linkabit Corporation  
Lockheed Center for Marine Research  
Marine Physical Therapy Medical Corporation  
Marine Research Company  
National Canner's Association  
ORCA  
Plantronics  
Research Group Limited  
Science Applications, Incorporated  
Schoericke and Runyon  
SCS Engineering  
Shell Oil Company  
Social Research Institute  
SOHIO Petroleum Company  
Tenneco Oil Company  
Tetratex, Incorporated  
Union Oil  
Westmark Real Estate Investment Service  
Woodward-Clyde Consultants

### **Academia**

Augustana College  
Bodega Marine Laboratory Aquaculture Program  
Bowling Green State University, Department of Political Science  
California Academy of Sciences  
California Institute of Technology, Division of Human and Social Sciences  
California State Universities at Long Beach and San Francisco  
California State University at San Diego, Department of Microbiology, Natural Sciences, and Marine Laboratory  
Humboldt State University Marine Laboratory

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<sup>5</sup>Source: California Sea Grant trainee reports.

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Institute of Oceanography, Vancouver  
Instituto de Investigaciones Electricas, Mexico  
Lawrence Berkeley Laboratory  
Lehigh University  
Loyola Marymount University  
Marymount Palos Verdes College  
Moss Landing Marine Laboratories  
Occidental College  
Oregon State University  
Scripps Institution of Oceanography  
    Advanced Ocean Engineering Laboratory  
    Marine Biology Research Division  
    Ocean Research Division  
    Shore Processes Laboratory  
Skidaway Institute of Oceanography  
Stanford University, Hopkins Marine Station  
University of California, Berkeley  
University of California, Davis  
    Department of Agricultural Economics  
    Department of Land, Air, and Water Resources  
    Department of Environmental Toxicology  
University of California  
    Extension Wildlife and Sea Grant  
    Riverside, Department of Biology  
    San Diego  
    San Francisco  
    Santa Barbara  
    Santa Cruz  
University of  
    Guam  
    Massachusetts Marine Station  
    Minnesota, Department of Food Science  
    Southern California  
    Virginia, Department of Biology  
    Wyoming, Department of Agricultural Economics  
Woods Hole Oceanographic Institution  
Yuba College

## California Sea Grant Marine Advisory Program Workshops<sup>6</sup>

**Table 3**  
**1977-82**

<b>Audience</b>	<b># of workshops</b>	<b># of attendees</b>
Commercial and Recreational Fishermen	128	8,250
Aquaculturists	37	2,475
Seafood Processors and Dealers	35	3,550
Government & University Professionals	43	745
Environmental Educators	24	857
Marine Business People	4	128
Home Economists & Nutritionists	19	662
General Public	3	200
<b>Total</b>	<b>293</b>	<b>16,867</b>

## California Sea Grant Unsolicited Publication Requests<sup>8</sup>

**Table 4**

<b>Audiences<sup>7</sup></b>	----- Calendar Year -----					<b>Totals</b>	<b>% of 5-Year Total</b>
	<b>1978</b>	<b>1979</b>	<b>1980</b>	<b>1981</b>	<b>1982</b>		
Government Agencies	4,558	21,130	3,633	5,498	1,979	36,798	37%
Academia	5,150	6,237	2,063	5,017	3,252	21,719	21%
Industries	883	2,990	1,135	2,209	1,636	8,853	9%
General Public	4,952	17,542	4,031	3,421	2,879	32,825	33%
<b>Totals</b>	<b>15,543</b>	<b>47,899</b>	<b>10,862</b>	<b>16,145</b>	<b>9,746</b>	<b>100,195</b>	<b>100%</b>

<sup>6</sup>Source: California Sea Grant MAP and MAS monthly reports.

<sup>7</sup>Key to Audiences:

Government Agencies = Federal, state, local government organizations; non-profit organizations (includes Sea Grant).

Academia = Universities, secondary schools, libraries, students.

Industries = Related industries, seafood processors, commercial fishermen, professionals.

General Public = Individuals who cannot be placed in any other category.

<sup>8</sup>Source: California Sea Grant publications request reports.

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# California Sea Grant Publications<sup>9</sup>

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**Table 5**  
**1977-82**

<b>Program Elements</b>	<b>Sea Grant/IMR Publications</b>	<b>Sea Grant Technical Pub. (Reprints)</b>	<b>Conference Papers</b>	<b>Dissertations and Theses</b>	<b>Sea Grant Reports<sup>10</sup></b>	<b>Sea Grant Working Papers</b>	<b>Marine Advisory Program</b>	<b>Misc.<sup>11</sup></b>	<b>Total</b>	<b>% of Total</b>
Education	2	7	3	—	1	—	—	19	32	4%
Advisory	19	1	2	—	—	2	50	15	89	12%
Coastal Resources	6	55	33	20	29	15	—	2	160	22%
Aquaculture	3	96	63	11	8	10	—	2	193	26%
Fisheries	1	60	25	16	13	7	—	1	123	17%
New Marine Products	—	63	4	2	2	2	—	—	73	10%
Ocean Technology	2	21	8	7	7	3	—	—	48	6%
Marine Affairs	—	17	1	2	4	3	—	—	27	3%
<b>Totals</b>	<b>33</b>	<b>320</b>	<b>139</b>	<b>58</b>	<b>64</b>	<b>42</b>	<b>50</b>	<b>39</b>	<b>745</b>	<b>—</b>
<b>% of Total</b>	<b>4%</b>	<b>43%</b>	<b>19%</b>	<b>8%</b>	<b>9%</b>	<b>5%</b>	<b>7%</b>	<b>5%</b>	<b>—</b>	<b>100%</b>

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<sup>9</sup>Sources: California Sea Grant annual reports and archives.

<sup>10</sup>Includes Sea Grant publications printed through university departments.

<sup>11</sup>Includes newsletters, brochures, booklets, monographs, films, and presentations.

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## 5-Year List of Projects by Region

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### NORTHERN CALIFORNIA REGION

#### Humboldt State University

- M/A-1G Program Management (Kerstetter, 1977-82)
- R/MR-1 Development of Interpretive Methods and Materials for Marine Parks in Northern California (DeMartini, 1977-78)
- R/F-29 Protective Immunization of Anadromous Salmonids Against *Aeromonas salmonicida* and *Vibrio anguillarum* (Kerstetter, 1977-78)
- R/F-27 Development of a Mechanism to Allow Release of Dungeness Crabs from Lost or Abandoned Pots (Jolly, 1977-78)
- R/CZ-47 A Study of the Entrance Problems at Humboldt Bay (Isaacs/Kerstetter, 1978-80)
- R/F-46 Artificial Imprinting of Chinook Salmon in a Multispecies Hatchery (Hassler, 1978-80)
- A/PE-1E Ocean Education for the Public (DeMartini, 1979-82)
- R/CZ-53 Investigation of Coastal Bluff Retreat for the Trinidad Headland Area of Northern California (Carver *et al.*, 1979-80)
- R/NP-1-9C Evaluation of the Mad River Estuary (Crandell, 1979-80)
- R/NP-1-9E The Role of Nutrients in Supporting Phytoplankton Productivity in Humboldt Bay (Pequegnat, 1979-80)
- R/NP-1-9I Aerial Survey of Humboldt Bay, California (Stork/Costa, 1979-80)
- R/NP-1-9L Ova Development Success as a Function of Temperature and Delay in Fertilization Post Spawning (DeMartini/Ebert, 1979-80)
- R/F-72 Vital Statistics of the Female Stock of Dungeness Crab (*Cancer magister*) in Northern California (Hankin, 1980-82)
- R/CZ-56 Salt Marsh Restoration: An Ecological Evaluation of an Estuarine Mitigation Project (Barnhart/Boyd, 1980-81)
- R/NP-1-10F Investigation of Coastline Retreat, Humboldt County, Northern California (Rust, 1980-82)
- R/F-77 Artificial Imprinting of Chinook and Coho Salmon in a Multispecies Hatchery (Hassler, 1981-82)
- R/F-79 Biochemistry of Fat Depletion During Salmonid Smolt Transformation (Kerstetter/Allen, 1981-82)
- R/NP-1-11F The Effects of Environmental Factors on the Ability of Chemical Cues to Trigger Settlement and Metamorphoses of Bivalve Larvae (Shaw, 1981-82)

### SAN FRANCISCO REGION

#### Fort Mason Foundation

- R/NP-1-9D Golden Gate Marine Center (Caya, 1979-80)

#### San Francisco State University

- R/NP-1-10H Workshop on Coastal Wetland Restoration and Enhancement (Josselyn, 1980-82)

#### San Jose State University

- R/F-15 The California Market Squid Fishery (Recksiek/Frey, 1977-78)
- A/PE-1D Ocean Education for the Public (Foster/Stewart, 1977-82)
- R/CZ-45B Wetlands Management in Coastal Zone Planning: A Prototype Framework for Relating Natural Science and Land-Use Planning (Nybakken, 1978-80)
- R/CZ-54 Phosphorites Along the Central California Continental Margin (Mullins, 1979-81)
- R/F-57 Assessment of Aging Techniques and Their Application to Elasmobranch Fisheries (Cailliet, 1979-81)



## Stanford University

- R/A-17C Carrageenophyte Cultivation, Genetics, Population Dynamics, and Development of Agar Substitutes (Abbott, 1977-78)
- R/A-34 Aquaculture of Red Algae (Abbott, 1978-80)
- R/MP-19 Neuronal Blocking Substances from California Gobiidae (Fuhrman, 1978-79)
- R/F-58 Multiple Species Utilization of the Herring Eggs-on-Seaweed Fishery (Abbott, 1979-81)
- R/A-49 Physiological Aspects of *Porphyra perforata* Mariculture: The Effect of Desiccation on Photosynthesis and on the Control of Epiphytes (Abbott, 1981-82)

## University of California, Berkeley

- R/CZ-33A-3 Coastal Wetlands Management: Biological Criteria (Pitelka, 1977-79)
- R/CZ-41 Coastal Governance 1977-1978: First Steps in Implementing California's 1976 Legislation (Lee/Scott, 1977-78)
- R/CZ-42 Coastal Zone Management: Methods for Plan Development, Evaluation and Monitoring of Local Programs (Dickert, 1977-78)
- R/A-17B Carrageenophyte Cultivation, Genetics, Population Dynamics, and Development of Agar Substitutes (1978-79 project title was: Genetic Program for Improvement of Carrageenan Production in *Gigartina*) (West, 1977-79)
- R/F-25 Endocrinology of Salmon Smoltification and Adaptation to Seawater (Bern, 1977-78)
- R/F-43 Amine Toxicity of Fish Products (Bjeldanes, 1977-79)
- R/E-12 Stray Electrical Current Hazards to Prestressed Concrete Construction in Seawater (Cornet, 1977-78)
- R/E-14 Earthquake Loading on Large Offshore Structures in Deep Water: A Study for the Correlation of Analytic and Physical Models (1978-80 project title was: Earthquake Loading on Large Offshore Structures—An Application of Experimental Data to Practical Structure Forms) (Wiegel, 1977-78; Penzien, 1978-80)
- R/F-37 A Multispecies Bioeconomic Fisheries Model Under Uncertainty (Just, 1977-78)
- R/E-17 Marine Vehicle Safety Analysis (Webster, 1977-78)
- R/MP-12 Assessment of the Quantitative Distribution to Therapeutic Potential of an Anti-Herpesvirus Polysaccharide in Marine Algae from Northern California (Vedros, 1977-78)
- R/CZ-45A Wetlands Management in Coastal Zone Planning: A Prototype Framework for Relating Natural Science and Land-Use Planning (Dickert, 1978-80)
- R/CZ-49 Coastal Governance in California, With Special Reference to State-Local Collaborative Planning (Lee/Scott, 1978-79)
- R/F-45 Endocrinology of Normal and Abnormal Salmon Smoltification and Adaptation to Seawater (Bern, 1978-81)
- R/MP-20 Antiviral Compounds from Algae (Vedros, 1978-80)
- R/NP-1-8F Methods of Increasing Diver Effectiveness Through CO<sub>2</sub> Absorbers and Decompression Computers (Mote, 1978-79)
- R/NP-1-8H Recreation Transportation Analysis for Coastal Planners: A Technical Report on the Methods Used in California (Kanafani, 1978-79)
- R/NP-1-8K Feasibility Study to Assess the Development of an Applied Marine Research Directory (Gage, 1978-79)
- E/G-8 Ocean Engineering and the Future: Long-Range Planning (A Graduate Seminar) (Webster/Tulin, 1979-80)
- R/CZ-57 Planning Methods for California's Coastal Wetland Watersheds (Dickert, 1980-82)
- R/OT-1 Earthquake-Induced Forces on Non-Axisymmetric Offshore Structures (Wiegel, 1980-82)
- R/OT-2 Hydrodynamics of Harbor Entrances and the Maneuverability of Ships Moving Through Entrances (Webster, 1980-82)
- R/F-78 Endocrine Control of Salmonid Development and Seawater Adaptation (Bern/Nicoll, 1981-82)
- R/OT-5 Development of a Methodology for the Design, Construction, and Quality Assurance of the Core of Rubble-Mound Breakwaters (Gerwick, 1981-82)

## University of California, Davis

- M/A-1C Program Management (Schweigert, 1977-82)
- R/A-19 The Development of the Science and Technology of Aquaculture (Hand, 1977-78)
- R/A-27 Astaxanthin from Yeast for Fish Diets (Lewis, 1977-78)
- R/A-22 Toward Seawater-Based Crop Production (Epstein, 1977-79)
- R/F-32 Improved Marine Food Products and Marine Food Technology (Brown, 1977-80)
- R/F-33 Design and Development of a Squid Processing Machine (Singh, 1977-80)
- R/F-34 Bioconversion of Chitin Wastes (Carroad, 1977-80)
- R/A-28 Development of the Science and Technology of Crustacean Aquaculture (Clark *et al.*, 1978-81)
- R/F-50 Genetic Improvement of a Chitinase-Producing Microorganism (Ogrydziak, 1978-80)
- R/F-52 Economics of Fisheries and Aquaculture Development (Johnston *et al.*, 1978-81)
- R/NP-1-8B Investigation of Population Genetic Structure in Abalones (Hedgecock/Morse, 1978-79)
- R/NP-1-8J Procurement of Wildstock Sturgeon (Clark/Doroshov, 1978-79)
- R/A-42 Food and Fiber From Seawater, Sand, and Solar Energy (Epstein, 1979-81)
- R/NP-1-9A An Economic Analysis of the Gains from Joint Management of Fishery Stocks (Johnston/Howitt, 1979-80)
- R/NP-1-9B Feasibility of Mechanical Skinning of Blue Shark (Singh/Katz, 1979-80)
- R/NP-1-9H Pathology and Bacteriology of a Disease of Crustaceans Caused by a Marine Bacterium (Baumann/Bowser, 1979-80)
- R/A-41 Regulation of the Production of Dormant Cysts by the Brine Shrimp, *Artemia salina* (Crowe, 1979-81)
- R/F-68 Seafood Science and Technology: Modified Atmosphere Storage (Brown, 1980-82)
- R/F-69 Seafood Science and Technology: Microbiology of Fish (Barrett/Ogrydziak, 1980-82)
- R/F-71 Water Conservation and Pollution Abatement in Seafood Processing Through Water Recycling (Carroad/Price, 1980-82)
- R/MA-4 Analysis of Industrial Organization of Commercial Pacific Marine Fishery Markets (Garoyan, 1980-82)
- R/MA-3 Improved Procedures for Salmon Management in California: Bioeconomic Approaches (Wilén/Botsford, 1980-81)
- R/F-70 Chitin Waste Utilization (Carroad/Ogrydziak, 1980-81)
- R/MA-1 Statistical Forecasting Methods for Fisheries Management (Wilén/Howitt, 1980-82)
- A/C-P-1 Use of Underwater Habitats as Coral Reef Research Tools (Neudecker, 1980-81)
- R/A-45 Aquatic Animal Production (Clark/Conklin, 1981-82)
- R/A-47 Variation in Intracellular pH and Its Effect on Hatchability of Cysts of the Brine Shrimp *Artemia salina* (Crowe, 1981-82)
- R/F-76 Genetic Structure of Coho Salmon Populations on the Pacific Coast (Gall/Utter, 1981-82)
- R/NP-1-11B Economic Analysis of the Impact of Aquaculture on Commercial Fisheries (Johnston/Wilén, 1981-82)
- R/NP-1-11G Control of Egg Drop in the Lobster, *Homarus americanus* (Talbot/Hedgecock, 1981-82)

## MONTEREY BAY REGION

### University of California, Santa Cruz

- M/A-1F Program Management (Doyle, 1977-82)
- E/UG-1 Marine Education: Undergraduate Independent Research (Doyle, 1977-79)
- A/PE-1C Ocean Education for the Public (Doyle, 1977-82)
- R/A-16C Kelp Bed Mariculture and Resource Management (1978-79 project title was: Kelp Forest Ecology of Central California) (Pearse, 1977-79)
- R/A-17A Carrageenophyte Cultivation, Genetics, Population Dynamics, and Development of Agar Substitutes (Doyle, 1977-78)
- R/A-13 California Aquaculture Law (Bowden, 1977-78)

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- R/MP-14 Marine Plants as a Source of Insect Growth Inhibitors (Crews, 1977-80)
  - R/F-54 Economics of Swordfish Vessel Participation and Catch (Holt, 1978-79)
  - R/NP-1-8K-2 Feasibility Study to Assess the Development of an Applied Marine Research Directory (Cameron, 1978-79)
  - R/F-61 Economics of Multipurpose Fishing Vessels: Assessment and Policy (Holt, 1979-81)
  - R/NP-1-9N A Preliminary Investigation of Indochinese Refugee Adaptation to the Monterey Bay Fishing Industry (Orbach, 1979-81)
  - R/F-65 Parasites as Biological Tags for Pacific Herring Stock Identification (Moser, 1980-81)
  - R/MP-24 Marine Chemistry and Pharmacology Program: Natural Products from Toxic Marine Organisms (Crews, 1980-82)
  - R/MA-8 The Role of Individual Perception and Structural Position in the Development of Fishery Management Policy (Orbach, 1980-81)
  - R/CZ-58 Sea Urchin Diseases (Hinegardner *et al.*, 1980-82)

## **SAN LUIS OBISPO/SANTA BARBARA REGION**

### **University of California, Santa Barbara**

- M/A-1B Program Management (Holmes, 1977-82)
- A/PE-1B Ocean Education for the Public (Coon, 1977-82)
- R/CZ-33A-1 Coastal Wetlands Management: Biological Criteria (Holmes *et al.*, 1977-79)
- R/A-16A Kelp Bed Mariculture and Resource Management (Neushul/Coon, 1977-78)
- R/A-25 Biochemical and Genetic Control Applied to the Critical Stages in Culturing Abalone (Morse, 1977-78)
- R/F-31 Coordinated Management of the Pacific Coast Salmon Fisheries and the Implications of Extended Jurisdiction (Moore *et al.*, 1977-78)
- R/MP-15 Pharmacological Evaluation Program (Jacobs, 1977-80)
- R/E-15 Seismic Hazards to the Development of Offshore Oil Resources (Prothero, 1977-79)
- R/E-18 Side-Scan Sonar Mapping and Computer-Aided Interpretation of the Geology of the Santa Barbara Channel (Luyendyk/Simonett, 1977-80)
- R/E-20 Power Generator Inertially Coupled to Seawaves (Lee/Manalis, 1977-78)
- R/F-39 Santa Barbara Inshore Party Boat Fishery: Emphasis on the Olive Rockfish (Ebeling, 1977-78)
- R/NP-1-7C Limited Entry in the California Abalone Fishery; A Longitudinal Analysis (Cicin-Sain, 1977-79)
- R/CZ-46 An Experimental Program to Develop Methods for Kelp Bed Expansion and Enhancement (Neushul/Coon, 1978-80)
- R/A-32 Biochemical and Genetic Control of Critical Physiological Processes in Molluscan Life-Cycles: Basic Mechanisms, Water-Quality Requirements, and Sensitivities to Pollutants (Morse, 1978-80)
- R/F-47B Experimental Abalone Enhancement Program (Connell, 1978-80)
- R/F-48 Sensory and Behavioral Effects of Pollutants on the Crab and Lobster Fishery (Case, 1978-80)
- R/F-51 Coordination of Federal, Regional and State Policies for Managing Marine Fisheries (Moore *et al.*, 1978-80)
- R/F-53 An Economic Analysis of the California Abalone Fishery (Deacon, 1978-81)
- R/E-22 A Condensing Turbine for the Distillation of Seawater (Manalis/Lee, 1978-80)
- R/A-37 An Exploratory Study of the Vegetative Propagation of Benthic Marine Algae (Gibor/Neushul, 1978-81)
- R/NP-1-8B Investigation of Population Genetic Structure in Abalones (Hedgecock/Morse, 1978-79)
- R/NP-1-8E Coastal Wetlands Management: Review of and Recommendations About Local Plans (Onuf, 1978-79)
- R/NP-1-8I The Politics and Policy Implications of Deep Seabed Mining: U.S. Options (Mann, 1978-81)
- E/UG-2 A History of the Santa Barbara Channel (Talbot, 1979-80; 1981-82)
- R/CZ-52 Coastal Wetlands Management: Application of Biological Criteria (Onuf *et al.*, 1979-82)
- R/A-43 Biochemical Engineering for Improved Production of Commercially Valuable Marine Shellfish (Morse, 1980-82)
- R/F-67 Improving Efficiency of Commercial Shellfishing by Analysis of Bait and Trap Functions (Case, 1980-82)
- R/MP-21 Marine Chemistry and Pharmacology Program: Pharmacological Screening and Evaluation (Jacobs, 1980-82)

- R/MA-7 A History of the Commercial Fishermen of Monterey Bay—The Role of Public Policy (Brownlee, 1980-82)
- R/MA-9 Marine Mammals/Fisheries Conflict: Emphasis on Sea Otter/Shellfish Fisheries Conflicts in California (Cicin-Sain, 1980-81)
- R/NP-1-10A Application of Advanced Methods for Magnetic Reconnaissance (Macdonald/Miller, 1980-82)
- R/F-75 Effect of Nemertean Egg Predators on the Dungeness Crab Fishery (Kuris, 1981-82)
- R/F-74 Field Evaluation of an Abalone Enhancement Test Plant (Schmitt, 1981-82)
- R/NP-1-11A Vegetative Propagation of Commercially Important Benthic Algae (Gibor, 1981-82)
- R/NP-1-11H Exploring Conflicts Between Offshore Oil Development and Commercial Fishing in California (Mann, 1981-82)

## LOS ANGELES REGION

### California Institute of Technology

- R/F-35 Optimal Leasing Agreements for Marine Resource Development (Quirk/Lewis, 1977-78)
- R/CZ-48 Analysis of Coastal Ocean Mixing Models (List/Morgan, 1979-81)

### California State University, Long Beach

- R/NP-1-9J Mobile Marine Science Outreach Program (Bauer, 1979-81)

### University of California, Irvine

- R/A-33 Culture of Marine Bivalves: Effects of the Uptake of Amino Acids (Stephens, 1978-81)
- R/F-64 Anchovy Management and Stock Assessment: Seabird Reproduction as an Indicator (Hunt, 1980-82)
- R/A-48 Culture of Marine Bivalves: Nutritional Role of Dissolved Organic Solutes (Stephens, 1981-82)

### University of California, Los Angeles

- R/NP-1U An Ethnography of the San Pedro Wetfish Fishing Fleet (Velez, 1977-78)
- R/NP-1-8G Wetlands Restoration Option Study—Ballona Wetlands (Clark, 1978-79)

### University of California, Riverside

- R/NP-1-7B Control of Reproduction in the Lobster (Talbot, 1977-78)
- R/A-29 Control of Reproduction in the Decapod Crustaceans (Talbot, 1978-81)
- R/A-46 Development of Procedures for Artificial Insemination and Sperm Storage in Lobsters (Talbot, 1981-82)
- R/NP-1-11G Control of Egg Drop in the Lobster, *Homarus americanus* (Talbot/Hedgecock, 1981-82)

### University of Southern California

- R/CM-1 Coastal Environmental Monitoring Data Base Inventory: Phase I (Olsen/Hubay, 1977-78)
- R/CM-3 The Impact Upon California of World Ocean Decisions (Friedheim, 1977-78)
- R/CM-7 Planning Methods for Coastal Communities (Kreditor/Banerjee, 1977-78)
- R/CM-10 Onshore Impacts of the Development of Ocean Resources (Richardson/Gordon, 1977-78)
- R/EQ-16 Uptake of Oxygen by Los Angeles Harbor and San Francisco Bay Sediments (Hammond, 1977-78)
- R/RD-5 The Environment and Living Resource Potential of Marina del Rey Harbor, California (Soule *et al.*, 1977-78)
- M-2/8.3 Evaluation of Bioincorporation and Host Response to Various Microporous Polymeric Implant Materials (White/Nelson, 1977-78)

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- M-2/8.4 The Metabolism and Physiological Role of Trimethylamine Oxide (TMAO) in Kelp Bass and Migrating Pacific Salmon (Dunn/Charest, 1977-78)
- R/EQ-2 Benzo(a)pyrene Induction of Tumors in Flatfish (Puffer *et al.*, 1977-78)
- R/EQ-3 The Energetic Role of Amino Acid and Protein Metabolism in Kelp Bass (*Paralabrax clathratus*) (Dunn/Bever, 1977-78)
- M-2/8.1 Feasibility Study of an Underwater Engine Having Improved Efficiency with Increasing Depth (Gerstein, 1977-78)
- M-2/8.2 An Investigation of the Interaction of Waves and Structures (Lee, 1977-78)
- R/CE-2 Tide-Induced Currents in Harbors of Arbitrary Shape (Lee, 1977-78)
- R/RD-3 Offshore Sand and Gravel Resources in San Pedro and Santa Monica Bays, Southern California (Osborne/Henyey, 1977-79)
- R/EQ-5 The Potential of Cannery Wastes to Enhance Receiving Water Nutrient Quality (Soule *et al.*, 1977-78)
- AS-1 Marine Advisory Services (Leopold *et al.*, 1977-78; Ross *et al.*, 1978-82)
- E/PE-1 "California and the Oceans": A Statewide Marine Education Curriculum Development Program (Bjur, 1977-78)
- E/PE-2 Marine Education Mini-Courses (K-12) (Bjur/Gardner, 1977-78)
- E/PE-3 The Journal of Marine Education (Bjur, 1977-78)
- E/M-1 Sea Grant Graduate Student Trainee Program (Bjur, 1977-82)
- M-1 and M-2 Program Development, Administration and Management (Keach/Hartney, 1977-80; Friedheim/Ross, 1980-82)
- M-2/9.2 Demographic Change and Economic Development in the Pacific Islands from an Oceanographic Standpoint (Davis, 1978-80)
- M-2/9.3 The Impacts of Maritime Transportation in the Long Beach/Los Angeles Harbors: Pollution, Environmental Regulations and Economics (Bakus/Friedheim, 1978-79)
- M-2/9.4 Geologic Hazards Study: Mass Movement in the Santa Barbara Basin, California, Continental Borderland (Gorsline/Thornton, 1978-79)
- R/CM-11 The Economic Impact of Marine Related Industries on Southern California (Richardson/Gordon, 1978-79)
- R/EQ-20 Ecology of a Small Tidal Lagoon Under the Influence of Urban Recreational Use (Kremer/Kremer, 1978-80)
- R/EQ-22 Sediment Accumulation and the History of Pollutant Accumulation in San Francisco Bay (Hammond, 1978-80)
- R/AS-1 Impact Criteria for Access Management in Rocky Coastal Ecosystems (Devinny, 1978-79)
- M-2/9.5 Pollution Flow Through the Food Web of the Los Angeles/Long Beach Harbors: A Pilot Study (Young *et al.*, 1978-79)
- R/EQ-18 Heterotrophic Metabolism of Marine Dinoflagellates (Abbott *et al.*, 1978-81)
- R/RD-6 Southern California's Nearshore Marine Environment: A Significant Fish Nursery (Brewer/Lavenbert, 1978-81)
- M-2/9.1 Mixing Processes in the Coastal Zone (Maxworthy/Didden, 1978-79)
- R/CE-4 Problems of Harbor Modeling (Lee/Wellford, 1978-80)
- R/EQ-19 The Role of Natural Populations of Microheterotrophs in Carbon Cycling in Southern California Coastal Waters (Sullivan, 1978-80)
- R/CD-1 Curriculum Development Research Study to Support an Academic Field in Harbor/Port Management (Price/Siegel, 1978-79)
- E/E-1 Marine Education in California (Bjur/Rojas, 1978-82)
- R/CM-12 The Port Authority as a Public Enterprise: Organizational Adjustment to the Conflicting Demands for Economic Vs. Environmental Quality Goals (Boschken/Weschler, 1979-81)
- M-2/10.2 Effect of Changes in Bed Slopes on the Development of Roll Waves (Lee, 1979-80)
- R/RD-9 Offshore Sand and Gravel Resources, Orange County, California (Osborne, 1979-80)
- M-2/10.1 Variations in Oocyte Volumes as an Indicator of Environmental Stress in Opportunistic Species (Kudenov, 1979-80)
- E/CD-1 Evaluation of a Masters of Public Administration Curriculum Specialization in Port/Harbor Management (Price/Siegel, 1979-81)
- R/CM-15 The Impact of Major Interest Conflicts on the Evolution of the Coastal Planning "Partnership" between the Coastal Commission and Local Government (Wingo/Fawcett, 1980-81)
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- R/CM-17 Residential Resources in the Coastal Zone: The Planning and Regulation of Housing Opportunities for Low- and Moderate-Income Households (Baer *et al.*, 1980-81)
  - R/EQ-26 Gas Exchange Rates at the Air-Sea Interface in Coastal Waters (Dickey *et al.*, 1980-82)
  - R/CE-6 Waves and Currents in Coastal Regions of Sharply Changing Water Depth (Lee/Wellford, 1980-82)
  - R/EQ-24 Nitrogen Transformations Associated with the Discharge of the Terminal Island Treatment Plant, Los Angeles Harbor (Dugdale/Kiefer, 1980-82)
  - M-2/12.1 Understanding and Management of Dinoflagellate Induced Health and Seafood Problems (Abbott/Ross, 1981-82)
  - M-2/12.2 HPLC: Gut Contents Analysis in Copepods (Kleppel, 1981-82)
  - R/RD-13 Factors Affecting the Survival of Nearshore Larval Fishes (Brewer/Kleppel, 1981-82)
  - R/RD-14 Aspects of the Biology of the Sea Cucumber, *Parastichopus parvimensis*, a Developing Commercial Fishery (Kastendiek/Muscat, 1981-82)
  - R/CE-7 Wave Uplift Pressures on Horizontal Platforms (Lee/Wellford, 1981-82)
  - R/EQ-28 Microbially Mediated Entry of Pollutants in Marine Food Webs (Sullivan/Taylor, 1981-82)
  - E/CD-2 Curriculum Development in Seaport Management with a New Course in the Application of Systems Analysis and Operations Research to Seaports (Price, 1981-82)

## SAN DIEGO REGION

### California Western School of Law

- R/NP-1-9"O" The Deep Seabed Hard Mineral Resources Act: Was There a Need to Precede the Development of International Law Through U.S. Unilateral Action? (Lynch, 1979-80)

### San Diego Natural History Museum

- R/NP-1-9F Multispecies Aspects of CalCOFI 1955-59 Ichthyoplankton Data: A Source of Information for Variations in California Current Fisheries Resources (Loeb, 1979-81)

### San Diego State University

- M/A-1D Program Management (Ford, 1977-82)
- R/CZ-33C Coastal Wetlands Management: Effects of Disturbance on Estuarine Function (Zedler/Mauriello, 1977-79)
- R/A-21 Use of Thermal Effluent in the Culture of Crustacea and Fishes (Van Olst/Ford, 1977-79)
- R/A-15 Protective Measures for Shellfish Aquaculture (Steenbergen, 1977-78)
- R/A-24 Aquaculture of the Purple-Hinge Rock Scallop (Phleger/Leighton, 1977-78)
- R/F-38 An Economic Study of the U.S. Pacific Albacore Jig Boat Fishery (Holt, 1977-78)
- R/F-42 Re-establishment of Anadromous Fishes in Southern California (Van Olst/Ford, 1977-78)
- R/A-31 Studies to Refine Hatchery and Ocean Rearing Methods for the Purple-Hinge Rock Scallop (Phleger/Leighton, 1978-80)
- R/E-23 Temperature Tolerances of Benthic Marine Invertebrates and Their Relationship to Regulatory Requirements for Thermal Effluent (Ford/Van Olst, 1978-80)
- R/CZ-51 Coastal Wetlands Management: Restoration and Establishment (Zedler, 1979-82)
- R/A-38 Protective Measures Against *Fusarium* Disease in Shrimp (Steenbergen/Lightner, 1979-81)
- R/F-59 Storage Stability of the Purple-Hinge Rock Scallop, *Hinnites multirugosus* (Josephson, 1979-80)
- R/A-44 Artificial Control of Gametogenesis, Spawning, and Larval Production in the Purple-Hinge Rock Scallop (Phleger/Leighton, 1980-82)
- R/MA-5 A Study of Direct and Indirect Economic Linkages Associated with the California Seafood Industry and an Analysis of Their Impacts on the Employment, Income, and Level of Economic Activity in California (King, 1980-81)
- R/MA-10 Coastal Transit Service Options and Policy (Banks/Stutz, 1980-82)
- R/CZ-61 Liquefaction Potential of Coastal Fills (Noorany, 1980-81)
- R/NP-1-10D An Isotopic Aragonite-Water Temperature Scale Determined from Selected Shell Bearing Marine Organisms (Shull, 1980-81)

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- R/NP-1-11D The Distribution and Interpretation of the 1980 CIF Model and the Refinement of User-Oriented Computer Programs (King, 1981-82)
- R/NP-1-11J Vitamin and Mineral Methods Development and Standardization for Assessing the Nutritional Value of Cooked Fish (Josephson/Spindler, 1981-82)

## University of California, San Diego

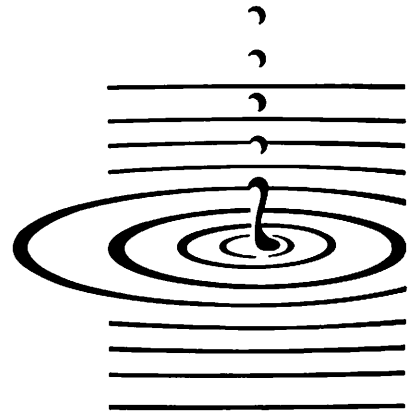
- A/PE-1A Ocean Education for the Public (Wilkie, 1977-82)
- R/CZ-33D Coastal Wetlands Management: Opening of Coastal Lagoons by Sand Fluidization (Inman/Nordstrom, 1977-78)
- R/CZ-43A Geological and Historical Analysis of Coastal Zone Environmental Hazards and Liability for Losses Caused by Them (1978-79 project title was: Geological and Historical Analysis of Coastal Zone Environmental Hazards) (Shepard, 1977-79)
- R/F-36 Development of Multispecies Management for Kelp Bed Resources with an Emphasis on Sea Urchins (Tegner, 1977-80)
- R/MP-16 Marine Natural Products for Pharmacological Evaluation (Faulkner, 1977-80)
- R/MP-18 New Agricultural Chemicals from Marine Organisms (Fenical, 1977-80)
- R/MP-17 Antileukemia Compounds from the Brown Seaweed *Dictyota* (Fenical, 1977-78)
- R/E-19 Nearshore Wave Power Source (Seymour, 1977-78)
- R/E-21 Studies on Thermophilic Microorganisms Located from Undersea Hot Springs, Electric Power Plant Condensers, and Ships' Heat Exchangers (1978-79 project title was: Thermophilic Marine Microorganisms from Undersea Hot Springs and Seawater Cooled Heat Exchangers) (Isaacs, 1977-78; Isaacs/Nealson, 1978-79)
- R/CZ-31 Thermal Variability in Coastal Waters in the Southern California Bight (Winant, 1977-79)
- R/CZ-32 Internal Waves Over Shelf and Canyon (Cox, 1977-78)
- R/F-56 Demographic Analysis of Porpoise Populations Subject to Time-Varying Tuna-Net Mortality (Goodman, 1979-81)
- R/NP-1-9G Sea Cliff Erosion and Beach Accretion Along San Onofre State Park and Camp Pendleton, San Diego County, California (Shepard, 1979-80)
- R/NP-1-9K A Preliminary Survey of the Impact of Limited Entry Regulations Upon California (Pettersen/Bailey, 1979-80)
- R/CZ-59 Water Currents and Mixing Rates in Kelp Beds (Jackson/Winant, 1980-82)
- R/F-62 A New Method for Estimating the Energy Available to Fisheries (Mullin/Goodman, 1980-82)
- R/F-63 Functional Structure of Fish Assemblages of the Southern California Sublittoral Soft-Bottom Habitat (Rosenblatt, 1980-81)
- R/MP-22 Marine Chemistry and Pharmacology Program: Chemical Studies of Tropical Marine Algae and Coelenterates (Fenical, 1980-82)
- R/MP-23 Marine Chemistry and Pharmacology Program: Chemistry of Sponges and Opisthobranch Molluscs (Faulkner, 1980-82)
- R/OT-3 TV/Sonar Imaging System (Anderson, 1980-82)
- R/MA-2 Management of Multispecies Systems: The Pacific Hake Example (Goodman, 1980-82)
- R/NP-1-9M Bioelectric Toxicity Assaying (Phase II) (Anderson, 1980-81)
- R/NP-1-10B Seasonal Growth Responses of Vegetative Axes and Spores of an Agar-Producing Marine Alga (Stewart, 1980-81)
- R/F-30 Comparative Analysis of the Social and Political Systems of the Tuna Fleets of San Diego and Ensenada (D'Andrade, 1977-78)
- R/F-44 The Effects of Food Availability on the Growth and Survival of California Jack Mackerel Larvae (1978-80 project title was: The Effects of Food Availability on the Growth and Survival of the Larvae of the California Jack Mackerel) (Mullin/Lasker, 1977-80)
- R/NP-1-7A Experimental Abalone Enhancement Program (Tegner, 1977-78)
- R/CZ-47 A Study of the Entrance Problems at Humboldt Bay (Isaacs/Kerstetter, 1978-80)
- R/F-47A Experimental Abalone Enhancement Program (Tegner, 1978-81)
- R/NP-1-8A Cardiopulmonary Resuscitation in the Water (West, 1978-79)
- R/CZ-P-1 Acoustic Tomography (Munk, 1978-79)
- R/NP-1-8C Dioxins—Historical Record of Fluxes in Lake Michigan Sediments (Goldberg, 1978-79)
- R/NP-1-8D Development of a Prototype Course in Marine Policy (Sorensen, 1978-79)

- 
- R/NP-1-8K-1 Feasibility Study to Assess the Development of an Applied Marine Research Directory (Sorensen, 1978-79)
- R/A-39 Assessment of Sperm-Egg Interactions During Fertilization and Hybrid Formation of California Abalones (Vacquier, 1979-81)
- R/NP-10C Studies of Light and Life in Natural Waters (Tyler, 1980-81)
- R/NP-1-10E Coastal Zone Geology and Related Sea Cliff and Bluff Erosion: Oceanside South to Batiquitos Lagoon, Carlsbad, Oceanside Littoral Cell, San Diego County, California; 1880-1980 (Shepard, 1980-81)
- R/NP-1-10G Longard Tube Survey and Documentation, Del Mar, California (Flick, 1980-81)
- R/MA-6 Technological Change in the Salmon Canning Industry: Blaine, Washington, 1890-1930 (Scheiber, 1980-81)
- R/NP-1-10I Aquarium Energetics and Growth Rates of *Anoplopoma fimbria* (Somero, 1980-82)
- R/F-73 Evaluation of the Experimental Abalone Enhancement Program (Tegner, 1981-82)
- R/OT-6 Design of a Sea-Floor Work System (Anderson, 1981-82)
- R/NP-1-11E Reorganizing and Updating an Advanced Course in Marine Policy (Revelle, 1981-82)

### **University of San Diego**

- R/CZ-43B Geological and Historical Analysis of Coastal Zone Environmental Hazards and Liability for Losses Caused by Them (Hildreth, 1977-78)





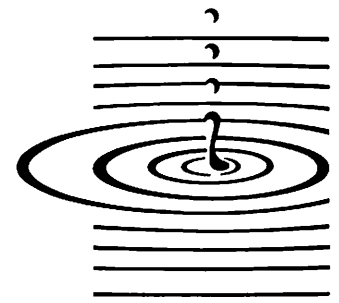
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## **Fiscal Data**

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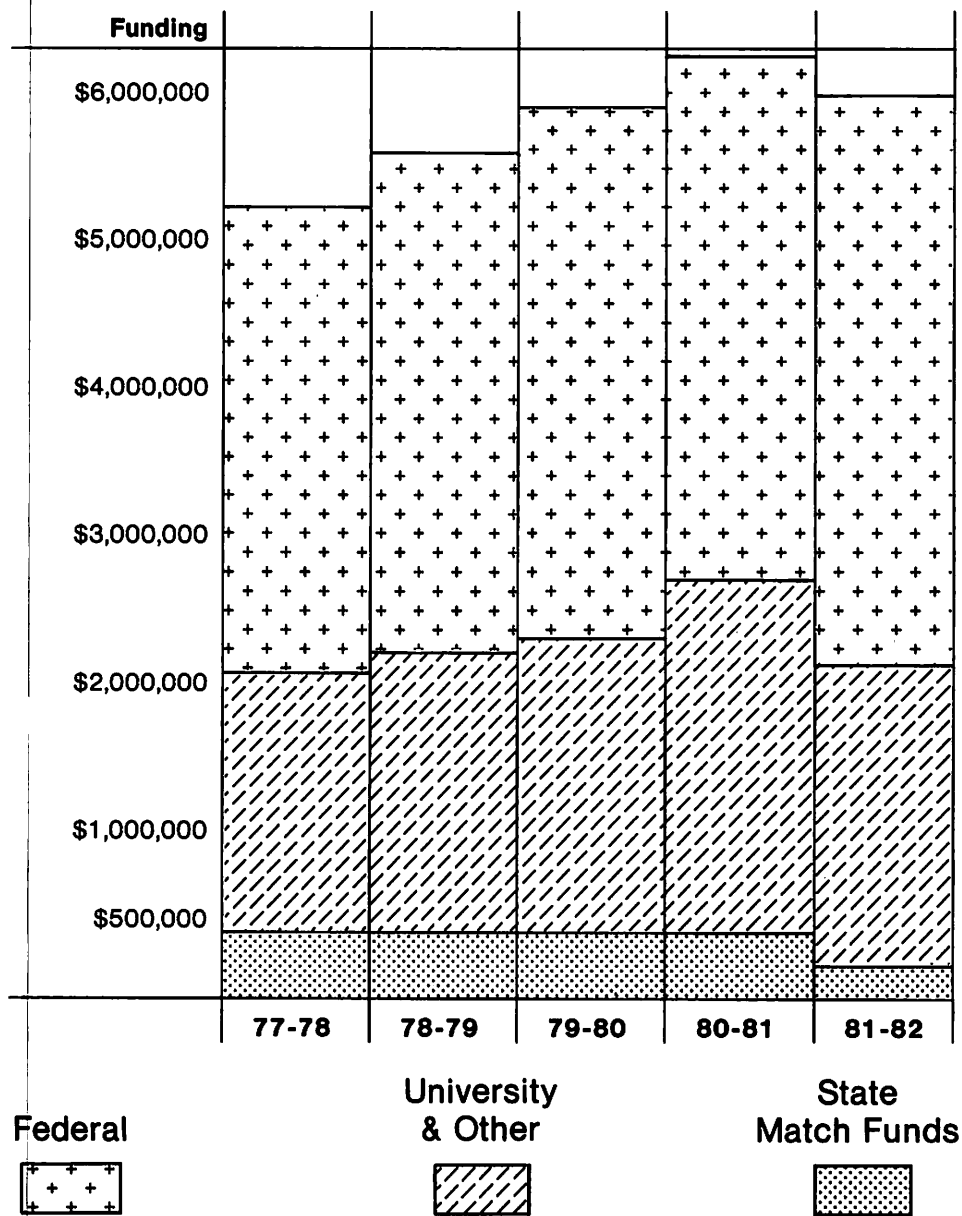
*Federal, State, Other Matching Funds  
5-Year Funding  
Matching Funds Sources  
Fact Sheet  
Individuals and FTEs*

# Fiscal Data



## California Sea Grant: Federal, State, Other Match Funding<sup>1</sup>

**Table 6**  
**1977-82**



<sup>1</sup>Source: California Sea Grant revised proposals.

# California Sea Grant Funding 1977-82<sup>2</sup>

**Table 7**

<b>Year</b>	<b>Federal Funds</b>	<b>State Matching Funds</b>
1977-78	\$2,930,000	\$500,000
1978-79	3,267,500	500,000
1979-80	3,415,000	500,000
1980-81	3,785,000	500,000
1981-82	3,765,000	245,000

## Sources of California Sea Grant Matching Funds<sup>3</sup>

**Table 8**

**1977-82**

<b>Sources</b>	<b>1977-78</b>	<b>1978-79</b>	<b>1979-80</b>	<b>1980-81</b>	<b>1981-82</b>	<b>Totals</b>
Universities and Colleges	\$1,581,510	\$1,396,004	\$1,403,997	\$1,812,036	\$1,555,149	\$ 7,748,696
State Government Departments and Agencies	100,686	240,175	201,742	86,873	108,793	738,269
Stull Funds	500,000	500,000	500,000	500,000	245,000	2,245,000
Private Industries	194,883	164,153	177,961	207,365	171,560	915,922
Public Organizations, Foundations, etc.	192,001	79,788	97,180	69,210	38,281	476,460
<b>Totals</b>	<b>\$2,569,080</b>	<b>\$2,380,120</b>	<b>\$2,380,880</b>	<b>\$2,675,484</b>	<b>\$2,118,783</b>	<b>\$12,124,347</b>

<sup>2</sup>Source: California Sea Grant revised proposals.

<sup>3</sup>Source: California Sea Grant fiscal records.

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# California Sea Grant 1982 Fact Sheet<sup>4</sup>

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**Table 9**

10	Industrial firms participated
15	Educational institutions participated
7	State and local government agencies participated
377	Individuals involved
136	Total FTE
44	Advisory service staff, 18 FTE
172	Faculty and professional staff, 57 FTE
69	Graduate trainees
16	Undergraduate students
20	Graduate research assistants
63	Number of projects
196	Publications resulting from Sea Grant support (journal articles, reports, books, papers, newsletters)

<b>FY 1982</b>	<b>NSGCP Support</b>	<b>% of Total</b>
Research	\$1,893,205 <sup>5</sup>	50%
Education	613,716	16%
Advisory	900,884	24%
Total Grant	3,765,000 <sup>6</sup>	100% <sup>6</sup>

In fiscal year 1982, California Sea Grant received \$3.765 million.

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<sup>4</sup>Source: California Sea Grant fiscal records.

<sup>5</sup>Includes rapid response.

<sup>6</sup>Includes management.

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## California Sea Grant Individuals and FTE 1977-82<sup>7</sup>

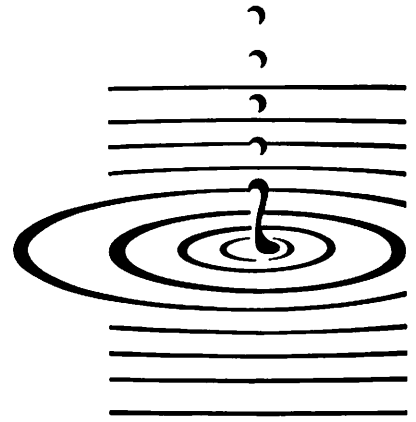
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**Table 10**

<b>Number of Individuals</b>	<b>1977-78</b>	<b>1978-79</b>	<b>1979-80</b>	<b>1980-81</b>	<b>1981-82</b>
Faculty and Professional	242	222	219	223	149
Graduate Students	106	99	102	104	86
Undergraduates	41	38	34	23	16
Technicians	36	36	39	43	43
Clerical	52	57	94	85	59
Other	51	41	41	45	24
<b>Totals</b>	<b>582</b>	<b>493</b>	<b>529</b>	<b>519</b>	<b>377</b>
<b>Full-Time Equivalents</b>					
Research	100.27	92.82	96.26	88.12	61.95
Education	41.76	40.87	35.81	42.00	28.93
Advisory	30.36	29.98	32.33	34.5	26.12
Management	18.52	17.26	15.47	15.4	14.06
<b>Totals</b>	<b>190.91</b>	<b>180.93</b>	<b>179.87</b>	<b>180.02</b>	<b>131.06</b>
 Total Number of Research Projects	 57	 51	 52	 54	 44
 Average Size of Research Projects Extramural Funds	 \$31,332	 \$38,071	 \$38,894	 \$40,794	 \$48,053

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<sup>7</sup>Source: California Sea Grant fiscal records.



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## Appendices

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- A The National Sea Grant College Program*
- B California Public Resources Code*
- C Resources Agency Sea Grant Advisory Panel*
- D Organizational Structure*
- E Program Committees*

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of the organism may be required. Such development might also require engineering a culture system and analyzing the system's economic viability, analyzing the social impact of aquaculture development and the legal regimes under which culture will take place, and determining state and federal regulations, marketing preferences, and methods.

### **Research**

Sea Grant research activities must contribute to the advancement of one or more of the purposes specified in the Sea Grant Act. Sea Grant research is "applied research" because the results must be in the form of information or products usable by the marine community.

Sea Grant research is structured with milestones that permit reasonable estimates of the total effort, cost, and time necessary to achieve the proposed result. Most results are accomplished in 1, 2, or 3 years. Renewal of research projects, including those which are part of institutional or coherent programs, depends on results achieved within a reasonable time frame.

### **Education and Training**

Education and training are an important part of the National Sea Grant College Program. Sea Grant educational activities are designed to supplement, not duplicate, the activities of other federal agencies, and take into account the realities of the manpower market.

Sea Grant awards a very limited number of fellowships and scholarships. Instead, Sea Grant recognizes the important contributions of graduate research by supporting traineeships as a part of specifically approved research projects.

### **Marine Advisory Services**

"Marine Advisory Services" describes the means by which scientific research results and new technology are communicated to ocean and coastal users, who in turn apply the results to obtain economic or social benefits for the state. The methods include producing publications, holding conferences and seminars, informing mass media, and extending personalized statewide extension services.

In addition to disseminating useful information, Sea Grant Marine Advisory Services are an important source of information and guidance to the Sea Grant programs, providing a "feedback loop" through which problems and opportunities, as seen by user communities, are communicated to program administrators and researchers.

Sea Grant Advisory Services not only disseminate information developed through Sea

Grant, they collect and disseminate information from any source to the communities they serve. Such information may come from federal laboratories, state agencies, businesses and industries (when not proprietary in nature), from universities not part of the Sea Grant system, and from other nations.

Advisory Services are tailored to the needs of the specific region served by the Sea Grant programs. In addition to business and industry, Sea Grant provides information and assistance to state and local agencies and to the interested public. The essence of Sea Grant Advisory Services is "self help," with the information and assistance designed to assist this process.

### **Cooperative Activities**

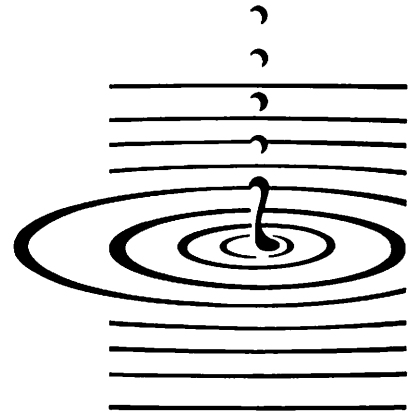
All Sea Grant recipients are encouraged to enlist the cooperation of appropriate groups, such as state and local agencies, businesses and industries, nonprofit organizations, federal laboratories and installations, and educational institutions. By working with these groups, researchers ensure that their research results will find immediate application.

Sea Grant strongly encourages the participation of business and industry in the activities carried out by academic and other nonprofit institutions. Such participation may take several forms: joint research activities with researchers from industry working directly with university researchers; industry provision of experts, facilities, equipment, supplies, or services; and cooperation in providing on-the-job experience for students.

This involvement helps keep research and training projects firmly based on economic and employment realities and on state-of-the-art technology. Profit-making organizations are significant employers of students educated and trained under Sea Grant-supported research. Industry-identified problems or needs are an important source of ideas for Sea Grant research projects.

### **Types of Grants**

The National Sea Grant College Program awards four kinds of grants: individual project, coherent area, institutional, and, a special earned category of support, the Sea Grant College Program. There are currently 29 Sea Grant programs: 3 coherent programs, 7 institutional programs, and 19 Sea Grant college programs.



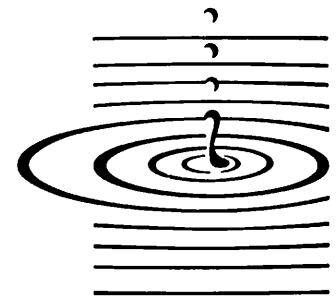
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## **Appendices**

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- A The National Sea Grant College Program*
- B California Public Resources Code*
- C Resources Agency Sea Grant Advisory Panel*
- D Organizational Structure*
- E Program Committees*





# Appendix A

## *The National Sea Grant College Program<sup>1</sup>*

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### Introduction

The National Sea Grant College Program was created on October 15, 1966, when President Lyndon B. Johnson signed Public Law 89-688, The National Sea Grant College and Program Act. The purpose of the Act was to accelerate development of the nation's marine resources, including their conservation, proper management, and maximum social and economic utilization.

The name "Sea Grant" emphasizes the parallel between the nation's marine development needs and its land development needs, which are being met by the Land Grant Program, established in 1862.

The intent of Congress, when it established Sea Grant, was 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 the broad and prompt dissemination of knowledge and techniques."

As Land Grant has played a major role in developing the nation's superiority in agriculture, so Sea Grant was created to achieve a similar success in the marine area. Like Land Grant, Sea Grant supports research at universities and colleges where research is conducted to solve practical marine-related problems of the nation and the world. Sea Grant's Marine Advisory Service, which parallels Land Grant's Cooperative Extension Service, communicates the results of Sea Grant research to ocean and coastal user groups to help fill vital needs of coastal and ocean users.

The National Sea Grant College Program, originally assigned to the National Science Foundation, became part of the National Oceanic and Atmospheric Administration, U.S. Department of Commerce, in 1970.

On October 8, 1976, President Gerald R. Ford signed into law P.L. 94-461, the Sea Grant College Program Act of 1976. The Act officially recognized the national and international aspects of Sea Grant by formally establishing special grant categories of national and international projects.

The 1976 Act also formally incorporated the concepts underlying designation of Sea Grant Colleges and Sea Grant Regional Consortia, established Sea Grant Fellowships, established the Sea Grant Review Panel to replace the Sea Grant Advisory Panel, and created the International Cooperation Assistance Program, now known as the Sea Grant International Program.<sup>2</sup>

### A Multidisciplinary Approach

Many marine resource problems cannot be solved without new approaches to legal, institutional, or economic structures. Lawyers, political scientists, sociologists, social psychologists, anthropologists, public administration specialists, and economists all need to be involved. Sea Grant activities in every field range from basic research to practical techniques and encompass the entire system involved in the particular field. For example, to develop the aquaculture of a marine organism, investigations into the reproductive cycle, environmental requirements, and nutrition

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<sup>1</sup>Adapted from:  
*Compendium for the National Sea Grant College Program*. March 1982. National Sea Grant College Program.  
Rockville, Maryland.

*The National Sea Grant Program: Program Description and Suggestions for Preparing Proposals*. May 1972. National Sea Grant College Program. Rockville, Maryland.

<sup>2</sup>See: December 18, 1979, *Federal Register*, "Guidelines for Sea Grant Colleges and Regional Consortia."

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of the organism may be required. Such development might also require engineering a culture system and analyzing the system's economic viability, analyzing the social impact of aquaculture development and the legal regimes under which culture will take place, and determining state and federal regulations, marketing preferences, and methods.

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### **Cooperative Activities**

All Sea Grant recipients are encouraged to enlist the cooperation of appropriate groups, such as state and local agencies, businesses and industries, nonprofit organizations, federal laboratories and installations, and educational institutions. By working with these groups, researchers ensure that their research results will find immediate application.

Sea Grant strongly encourages the participation of business and industry in the activities carried out by academic and other nonprofit institutions. Such participation may take several forms: joint research activities with researchers from industry working directly with university researchers; industry provision of experts, facilities, equipment, supplies, or services; and cooperation in providing on-the-job experience for students.

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### **Project Support**

Sea Grant project support is awarded to an individual investigator or project director to carry out a clearly defined Sea Grant activity over a finite period of time. The project may be in research, education, or advisory services. Project support is intended for individual researchers or small disciplinary groups who address a singular, relatively short-term problem.

### **Coherent Area Support**

Coherent area programs generally consist of several related projects in either research, education, or advisory services. These grants have two main purposes. The first purpose is to bring into the Sea Grant program institutions of higher education that have core capability in some aspect of marine affairs, but which do not at present qualify (or wish to qualify) for institutional support. Coherent area support in such cases enables the institution to apply its existing competence to its regional problems and opportunities while it develops a broader base that will lead to institutional support.

Secondly, the grants bring into the Sea Grant program qualified entities that have rare or unique capability in a specialized field of marine affairs. Such institutions need not be institutions of higher education.

### **Institutional Support**

Sea Grant institutional support is awarded to an institution of higher learning (or a combination of institutions) that has an existing broad base of competence in marine affairs. To qualify, the institution must make a positive, long-range commitment to Sea Grant objectives, as evidenced by:

- (1) commitment of the institution's own resources in the form of matching funds,
- (2) creation of the organization necessary for management of the Sea Grant program,
- (3) establishment of interdisciplinary research teams, and
- (4) development of advisory service mechanisms for strong interaction with marine communities in its region.

A Sea Grant institution provides intellectual leadership in assisting its region to solve problems and to realize opportunities of its marine environment. To the extent possible, an institutional program should involve all appropriate elements of the institution and devise cooperative or mutually supporting programs with other institutions of higher education, federal and state agencies, local agencies, and related industries. An institutional program should have substantial strength in the

three basic Sea Grant activities of research, education, and advisory services. Some of these elements may be accomplished through cooperative programs with other specialized institutions in the region.

### **Sea Grant College and Regional Consortia**

Sea Grant colleges and regional consortia are designated from among "suitable public or private institutions of higher education" receiving institutional support. The designation is based on the quality, quantity, and productivity of the institution's or consortium's research, education, and advisory services; in the degree and nature of its service to marine communities; in its leadership in the region over a period of not less than 3 years under institutional support; and in the efficiency and competency of program management.

The formal designations "Sea Grant College" and "Sea Grant Regional Consortium" symbolize a mutual recognition of continuing responsibility, both by the Department of Commerce and the institutions so designated, to develop and maintain excellent and useful marine programs. This recognition is reflected in the increased discretionary authority granted to the Sea Grant college program director.

### **Matching Funds**

One of the special aspects of the Sea Grant Program is its matching funds requirement. According to the 1976 legislation, NOAA funding for an approved Sea Grant program (or project) may not exceed two-thirds of its total cost.

# Appendix B

An act to amend Section 6217 of the Public Resources Code amended and approved by the Governor September 26, 1978, made the following appropriation:

(d) To the Resources Agency, the amount of five hundred thousand dollars (\$500,000) for the 1978-79 fiscal year, and six hundred thousand dollars (\$600,000)<sup>4</sup> for each of the fiscal years 1979-80, 1980-81, 1981-82, 1982-83, and 1983-84 for distribution for public and private higher education for use as up to two-thirds of the local matching share for projects under the National Sea Grant College and Program Act of 1966 (P.L. 89-688) approved, upon the recommendation of the advisory panel appointed pursuant to this subdivision, by the Secretary of the Resources Agency or his designee. During the fiscal year 1983-84, the Legislature shall consider recommendations from the Secretary of the Resources Agency and other interested parties on the benefits to the people of the State of California derived from this program and shall determine whether or not to continue similar appropriations for subsequent fiscal years.

The Secretary of the Resources Agency shall appoint an advisory panel, which shall do all of the following:

(1) Identify state needs which might be met through Sea Grant research projects, including, but not limited to, such fields as living marine resources, aquaculture, ocean engineering, marine minerals, public recreation, coastal physical processes and coastal and ocean resources planning and management, and marine data acquisition and dissemination.

(2) Review all applications for funding under this subdivision and make recommendations based upon the priorities it establishes.

(3) Periodically review progress on Sea Grant research projects subsequent to their approval and funding under this subdivision.

(4) Make recommendations to the Secretary of the Resources Agency with respect to the implementation of this subdivision.

The members of such advisory panel shall

serve at the pleasure of the Secretary of the Resources Agency. The advisory panel shall consist of 11 members composed of the following persons:

(1) A representative of the Department of Navigation and Ocean Development.

(2) A representative of the Department of Conservation.

(3) A representative of the Department of Fish and Game.

(4) The executive director of the California Coastal Zone Conservation Commission or his designee.

(5) A representative of the fish industry.

(6) A representative of the aquaculture industry.

(7) A representative of the ocean engineering industry.

(8) A representative of the University of California.

(9) A representative of the California State University and Colleges.

(10) A representative of a private California institution of higher education which is participating in the National Sea Grant Program.

(11) A representative of the State Lands Commission. The Secretary of the Resources Agency shall designate one member of the panel to serve as its chairman. Panel members shall serve without compensation.

The Sea Grant research projects selected for state support under this subdivision shall have a clearly defined benefit to the people of the State of California. The Legislature hereby finds and declares that the funding provided by this subdivision is needed to stimulate the development and utilization of ocean and coastal resources by working constructively with private sector firms and individuals. Nothing in this subdivision shall be construed to preclude the application for funding of any project which would be eligible for funding under the terms of the National Sea Grant College and Program Act of 1966.

<sup>3</sup>Source: Cal. Stats., 1978, Chapter 1255: Section 6217 of the Public Resources Code, as amended.

<sup>4</sup>Governor Brown reduced this appropriation to \$500,000 for each of the fiscal years.

# Appendix C

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## *Resources Agency Sea Grant Advisory Panel (RASGAP)*

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The Resources Agency Sea Grant Advisory Panel (RASGAP) was created by Section 6217 of the California Public Resources Code, which appropriates \$500,000 annually to the Resources Agency "for distribution for public and private higher education for use as up to two-thirds of the local matching share for projects under the National Sea Grant College and Program Act of 1966...." The 10-member panel was expanded to 11 members when Section 6217 was amended in 1978.

The Secretary of Resources appoints the panel members and designates one member to serve as its chairman. Two of the panel's most important responsibilities are to:

- (1) Identify state needs which might be met through Sea Grant research projects, including but not limited to such fields as living marine resources, aquaculture, ocean engineering, marine minerals, public recreation, coastal physical processes, coastal and ocean resources, planning and management, and marine data acquisition and dissemination.
- (2) Review all applications for funding under this subdivision and make recommendations based upon the priorities it establishes.

Under the provisions of Section 6217, the panel selects only projects for state matching support which clearly benefit the people of California.

Sea Grant research activities have increasingly emphasized state-related issues since the enactment of state matching funds in 1973. During the 3 years before state-matching funding, 59% of the total program dollars were directed to state issues. In contrast, 4 years after state funding, the average jumped to 80%, as indicated in table 11. The remaining funds were allocated to projects of local, regional, national, and international concern.

Proposed research projects are reviewed by the RASGAP, university committees, peer reviewers, and the National Office of Sea Grant staff and consultants. The detailed proposal

review process ensures a responsive and coordinated research program comprised of projects that have vitality and integrity.

RASGAP identified seven program elements to evaluate project relevance to state needs and maintain program balance:

- I. Coastal Zone Resources Planning and Management
- II. Coastal and Marine Recreation
- III. Living Marine Resources
- IV. Energy Resources and Ocean Engineering
- V. Marine Mineral Resources
- VI. Waste Management
- VII. Marine and Coastal Information Acquisition, Dissemination, and Advisory Services

The panel adopted and disseminated a policy statement identifying specific state needs for each program element. Most of the projects in 1977-82 received support from state matching funds. A 5-year projects list begins on page 45. A list of the local, regional, and national beneficiaries of these research projects begins on page 29.

State funding also supports rapid, short-term research responses to unanticipated marine and coastal problems and new and innovative projects, thus eliminating lead time of the annual proposal process. Rapid response funds supported about 100 projects from 1977-82, most of these in the RASGAP "Living Marine Resources" category. Examples include studies on anti-herpesvirus polysaccharide in marine algae, experimental abalone enhancement programs, improved procedures for salmon management in California, mechanical skinning of blue shark, recommendations on local plans for coastal wetlands management, sea cliff erosion and beach accretion, economic linkages associated with California's seafood industry, and analysis of the seafood industry's impact on the state's employment, income, and economic activity.

# Total Funds Spent on State-Related Projects<sup>5</sup>

**Table 11**

Year	Total Budget <sup>6</sup>	Budget for State-related Projects	% of Total	Average
<b>Prior to State Match Funding</b>				
1970-71	\$1,859,860	\$1,096,016	58%	
1971-72	3,060,283	2,083,861	68%	59%
1972-73	3,597,076	1,827,084	50%	
<b>Including State Match Funding</b>				
1977-78	5,115,078	4,194,061	82%	
1978-79	5,562,620	4,367,452	79%	
1979-80	5,795,880	4,881,742	84%	80%
1980-81	6,460,464	5,393,799	84%	
1981-82	5,888,783	4,176,546	71%	

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<sup>5</sup>Source: California Sea Grant revised renewal proposals.

<sup>6</sup>Total budget includes National Sea Grant College Program, the Resources Agency, and grantee matching funds for California Sea Grant.

<sup>7</sup>Members serving in 1980-82.

# Appendix D

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## *California Sea Grant Organizational Structure*

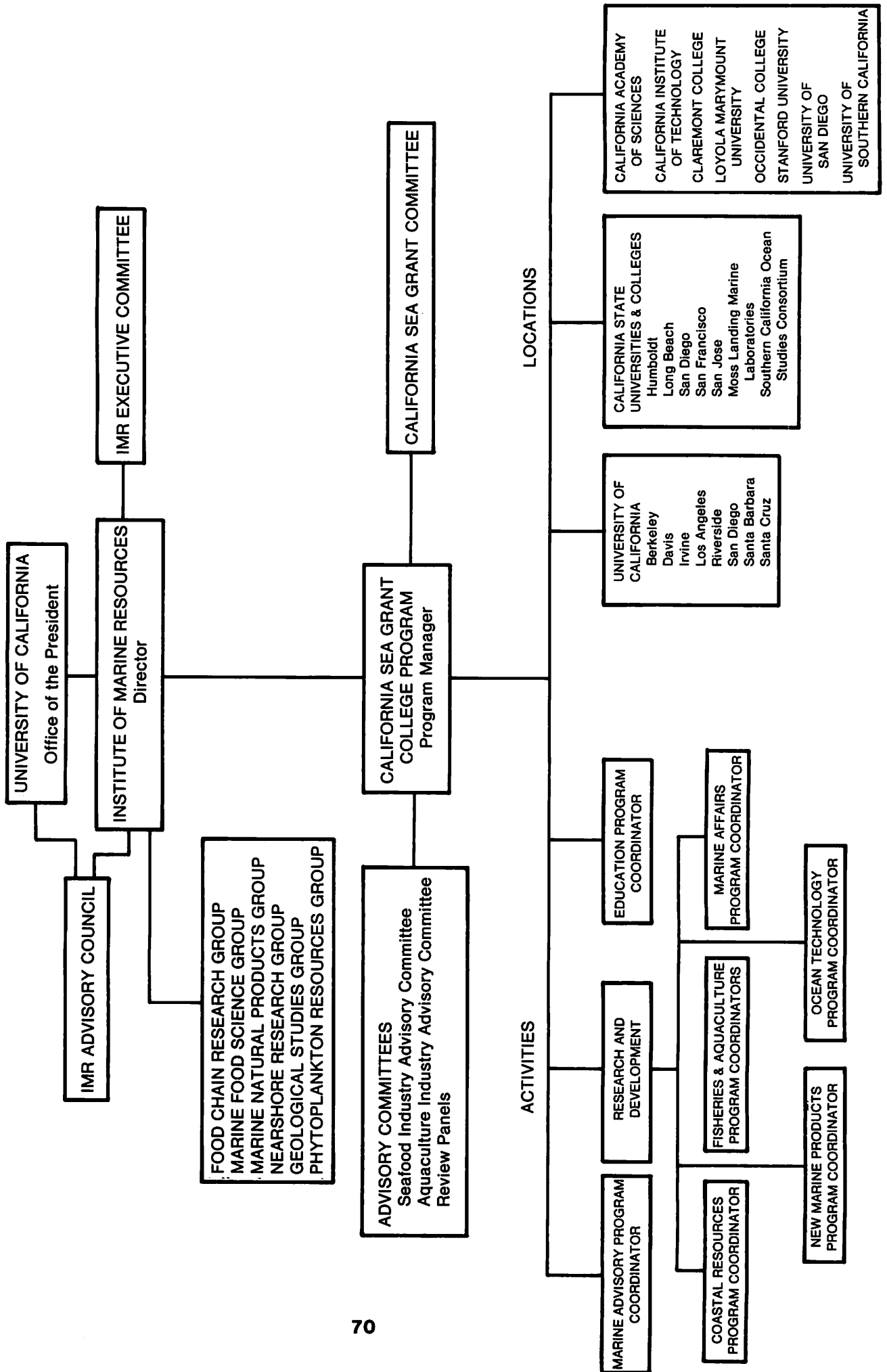
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The California Sea Grant College Program is administratively housed in the statewide University of California Institute of Marine Resources (IMR), headquartered on the UC San Diego campus. The IMR Advisory Council, appointed by the President of the University of California, provides policy guidance; the Director of Scripps Institution of Oceanography chairs the council. The California Sea Grant Committee, composed of seven members from the University of California, three from the State University and College System, and one from the University of Southern California, advises the Sea Grant College Program Manager on administrative matters pertaining to the program and acts as the review committee for the program subject areas. To aid the committee in its program policy-making task, a seafood industry advisory committee and an aquaculture industry advisory committee have been established, and several other advisory committees are being formed.

At USC, the Sea Grant Institutional Program is a major component of the Institute for Marine and Coastal Studies (IMCS). The IMCS manages the University's major marine research programs in addition to its Sea Grant Institutional Program. The director of IMCS reports to a senior vice president at the university.

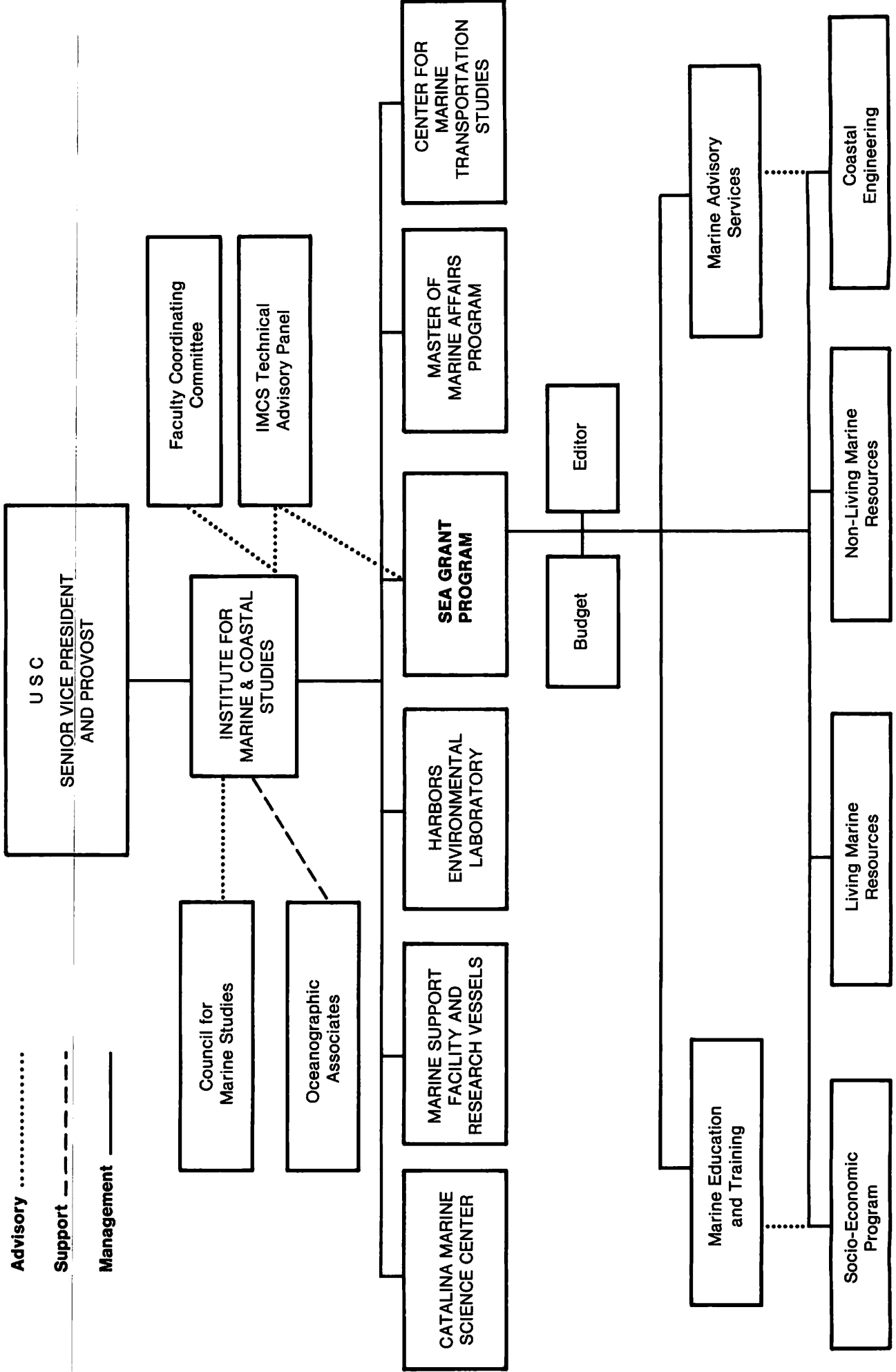
USC Sea Grant's interuniversity coordination and review is complemented by a technical advisory panel of representatives from a range of marine perspectives, including related industries, local governments, and universities in the area. Panel members meet twice a year to plan and evaluate the program. A majority of the members reside in the southern California region, which makes them familiar with the area's marine-related characteristics and available for consultation. The members are a vital link in the project peer review process. The advisory panel also provides guidance to the IMCS management.

# ORGANIZATION OF THE CALIFORNIA SEA GRANT COLLEGE PROGRAM





# ORGANIZATION OF USC SEA GRANT INSTITUTIONAL PROGRAM



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<sup>9</sup>Terms ended August 1981.

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