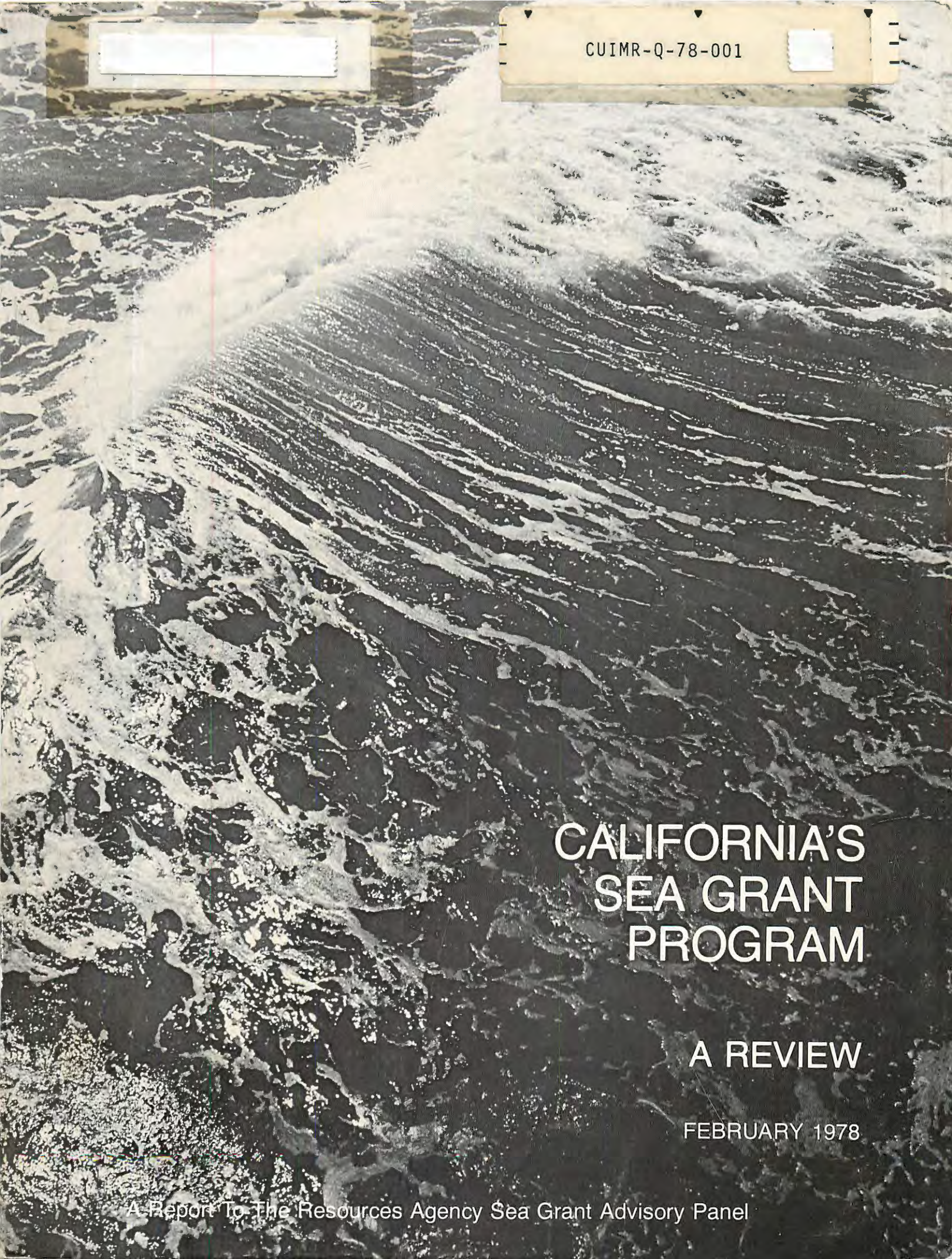

CALIFORNIA'S SEA GRANT PROGRAM

A REVIEW

FEBRUARY 1978

A Report To The Resources Agency Sea Grant Advisory Panel

PARTICIPATING CALIFORNIA SEA GRANT INSTITUTIONS

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 California, Cooperative Extension

California Academy of Sciences

California Institute of Technology

California State University, Long Beach

California State University, Northridge

Claremont College

Humboldt State University

Loyola Marymount University

Moss Landing Marine Laboratories, a consortium of California State University, Fresno; California State University, Hayward; California University, Sacramento; California State University, San Francisco; San Jose State University; California State College, Stanislaus

Occidental College

University of San Diego

San Diego State University

University of Southern California

Stanford University

CALIFORNIA SEA GRANT ADMINISTRATIVE OFFICES

University of California Sea Grant College Program
University of California, La Jolla, Ca. 92093

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University of Southern California, Los Angeles, Ca. 90007

CALIFORNIA'S SEA GRANT PROGRAM

A REVIEW

FEBRUARY 1978

A Report To The Resources Agency Advisory Panel
Prepared by Participating Sea Grant Institutions

University of California Sea Grant Publication 63
University of Southern California Sea Grant Publication I-78

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I. PURPOSE AND ORGANIZATION OF THE REPORT

In 1973 the State of California enacted legislation to provide $500,000 annually, from 1974 through 1979, 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 Act requires the legislature during the 1978-79 fiscal year to

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

This report has been prepared to inform the Resources Secretary of the status and accomplishments of California's Sea Grant Program to date and to assist him in making recommendations to the legislature as to the future directions of the program.

The focus of this report is a review of accomplishments from state supported Sea Grant activities. A summary of this report has been prepared and distributed as a separate document to increase the dissemination of the findings and recommendations among groups and individuals with interest in coastal and marine resources. Since state funding was initiated in 1974, the review concentrates on activities and accomplishments from 1974 to 1978. However, Sea Grant activities prior to 1974 are also discussed in order to connect ongoing projects and to place research, education, and advisory services in a programmatic context. This report is also intended to serve as a framework for conducting future programmatic reviews and evaluations of California's Sea Grant Program.

It should be noted that this report is not intended to be a review of scientific activities and research designs or to present technical results of projects. Readers interested in the detailed scientific and technical accomplishments of Sea Grant activities should refer to annual reports prepared by the university programs and specific publications cited in those reports.**

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*Appendix B is the Enabling Act.

**Annual Reports and listings of publications are available from: Sea Grant College Program (A-032), University of California, La Jolla, California 92093; and Sea Grant Program, University of Southern California, Los Angeles, California 90007.

II. CONCLUSIONS

California's coastal and marine resources management and planning needs are many, complex, and ongoing. The 1,845-mile coastline encompasses two distinctly different biological environments and six natural resource regions.* California's 22 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. Eighty per cent of the state's population live within the twenty counties bordering the Pacific Ocean or San Francisco Bay.

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

Sea Grant is, essentially, people working together to put good ideas into practice. On the surface this is a deceptively simple statement, one that belies the complexities of people working together, the development and refinement of good ideas, and the change inherent in putting something new into practice.

A review of California's Sea Grant Program, particularly since state matching funds were first provided in 1974, demonstrates that the Program has served the people of the state well in a wide variety of ways. The optimal utilization and management of California's vast coastal resources has been and continues to be of major state and national importance and of public interest. Progress has been good but the magnitude of diversity of opportunities, needs, and problems will require a continued effort.

Sea Grant research activities have increasingly focused on state-related issues since the passage of the state matching funds legislation in 1974. Table 1 illustrates that for the three years before state-match funding, 59% of the total program dollars were directed to state issues. In the four years after state match, the average jumped to 78%, increasing to 85% in 1977-78.

The continuing liaison between State and University personnel is an important mutual education process. The liaison brings to the

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*Including San Francisco Bay and the Channel Islands.

University an awareness of specific and general problems which need to be addressed by the State, as well as an appreciation of the role of State agency personnel operating under legal and institutional constraints not often recognized outside of government. Sea Grant provides state personnel with opportunities to consult a wide variety of university experts in addition to a means to keep abreast of current scientific and technical developments of importance in their employment. The Sea Grant administrative office assists in identifying and establishing contact with Sea Grant projects, either directly or in an advisory capacity. Easy and direct interaction between agency and university personnel can and does result in widening perspectives. Sea Grant communication with state agencies serves to define relevant and important research areas for University investigation. This information exchange also helps to broaden State understanding of coastal and ocean resources systems, particularly the implications of various resource management techniques which may be employed.

Because Sea Grant research often addresses controversial subjects, it is important that the work is conducted in an objective, third-party manner. State agencies with a vested concern in an ocean or coastal resources issue have frequently relied on Sea Grant to conduct investigations to avoid conflict of interest problems.

The practical results of Sea Grant research can be assessed in terms of four benefit areas: economic gains, environmental management, social opportunities, and institutional coordination and cooperation. For each benefit area, the processes and the outcomes have been outlined. Sea Grant's coordinated approach to ocean resources research and management represents a process achievement. The other benefits are usually measured in terms of outcomes and analyzed by using indicators such as employment, new or improved products, education, consumer prices, or natural hazards damage reduction.

Assistance with the development of California Coastal Plan and the Coastal Act, management of coastal bluff erosion, investigations into underutilized fisheries, and studies of harbor pollution control are some of the benefits derived in environmental management.

Experimentation has disclosed four new agricultural and pharmacological compounds derived from marine organisms, and improvements have been made in the utilization and marketability of processed seafood products by developing preservation processes and an automated processing machine. These results have contributed direct economic benefits to Californians by improving existing operations and developing new products.

More than 250 students with Sea Grant support have received practical marine training and experience and have carried this knowledge into more than 75 areas of government, industry, and university environments. Most of these employers are located within the state.

Marine advisory service provides public education as well as enhancement of public opportunities to use and enjoy marine resources. An audience of over one million in southern California is reached by the marine weather broadcast. 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, over 400,000 visitors see the aquarium/museum exhibits, and 60,000 school children participate in organized programs each year. Sport fishermen have enjoyed the fishing created by the 400,000 silver salmon hatched and released in the San Francisco Bay area.

The State's Sea Grant matching fund program is not unique. In fact, most other states have a state matching fund arrangement to effectively and efficiently influence and benefit from Sea Grant research, education, and advisory services. Of the states that have enacted hard money matching fund program, 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 the four-year period of state-federal matching funds, California Sea Grant programs and projects have received a total of $10.2 million from the federal government. Federal funds totaling $2.93 million (9.2% of the national total) have been granted to California's Sea Grant institutions for 1978. However, the proportion of state to federal funds distributed to the California Sea Grant Program has been declining since 1974. That year the ratio of state to federal funding was 21.8%. In 1977-78, this figure has decreased to 17.1%. This proportionate decline was due to substantial increases in federal funding of the California Sea Grant Program.

Also during the same period of time that state funding has remained constant at $500,000 and federal participation in the California Sea Grant Program increased, the high rate of inflation has reduced state support, in terms of 1973 dollars, by 24%.

In order to keep pace with the increasing level of federal funding to compensate for the costs of inflation, a substantial increase will be needed in the state's matching funds.

III. THE NATIONAL PROGRAM

The National Sea Grant Program was created by an Act of Congress in 1966 (P.L. 89-688) and amended in 1976. The Act authorizes grants and contracts primarily to universities to conduct research and educational activities and to provide advisory services, all related to the wise utilization of the ocean's resources.* For fiscal year 1978, on a national basis, $31.8 million was appropriated for grants to 54 institutions. The intent of the Act is to establish a national network of Sea Grant Colleges, patterned somewhat after the Land Grant Colleges.

Sea Grant 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. Typically, the Sea Grant Program involves action-oriented projects that:

- are of strong interest to state and local governments, the public, and industry;
- involve highly qualified scientists, engineers, planners, economists, lawyers, and others;
- are best accomplished 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, as well as the effective dissemination of research results.

The Sea Grant Act requires non-federal funding participation. At least one-third of the cost must come from non-federal sources--state, local, industrial, university, and other. 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 College. According to the Federal guidelines,

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*Appendix C presents a more detailed and comprehensive description of the National Program.

> One measure of the strength of an institutional program is its ability to obtain matching funds from non-Federal sources. Such sources include state legislatures, the university management, state agencies, and business and industry.

Consequently, Sea Grant colleges have a priority for federal funding within the total national budget.

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

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 may be necessary to solve fundamental problems of the physiology of reproduction, the etiology of parasites, the chemistry of culture media, behavioral patterns, nutritional requirements, or 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 the interdisciplinary investigations on energy, marine pharmaceuticals, and new food sources, for example. However, to qualify for Sea Grant support, the results of a project must have a clear possibility of application.

Within this utility of results principle, research proposals have been and continue to be considered in any field, discipline, or specialty.

Sea Grant is not simply a scientific activity; it encompasses the disciplines of business, law, economics, political science, and management. The research projects and practical results reflect this interdisciplinary approach to addressing local and state, as well as national needs. 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 citizens.

Sea Grant purposes cannot be achieved without innovation, and innovative research may fall in what is sometimes termed a high risk category. Such high risks are acceptable when warranted by the high potential benefit that may be achieved.

IV. CALIFORNIA SEA GRANT

In California, the Sea Grant Program began in 1968 when the first Sea Grant project was awarded to Scripps Institution of Oceanography to develop a new interdepartmental curriculum in Applied Ocean Science. Presently, seven campuses of the University of California (Berkeley, Davis, Santa Cruz, Los Angeles, Riverside, San Diego, Santa Barbara), University of Southern California, Humboldt State University, San Diego State University, Long Beach State University, CSU-Northridge, California Institute of Technology, Stanford University, University of San Diego, the Moss Landing Marine Laboratories Consortium (CSUC's-Sacramento, San Francisco, San Jose, Stanislaus, Hayward, Fresno), and the California Academy of Sciences, plus several community colleges are involved in California's Sea Grant Program.

During the nine years of Sea Grant funding to California institutions there has been a gradual consolidation of separate programs and growth in federal support. In the late 60's and early 70's there were as many as seven separate programs in California. In order to achieve greater inter-university coordination and to reduce administrative expenses at both the state and national level, programs within the University of California system and the California State University and Colleges system have been consolidated into one program--the University of California Sea Grant College Program. Researchers at the California Institute of Technology, the University of San Diego, Stanford University, and some other private institutions participated in the University of California program. The University of Southern California has the only other Sea Grant institutional program in California. Figures D-1 and D-2 in Appendix D present diagrams of the University of California and University of Southern California Sea Grant organizations.

In 1973, the University of California was designated a Sea Grant College--one of only twelve nationally at the present time. In the same year, with the enactment of the state matching funds legislation, the University's program became the largest nationwide. Since then it has remained in this preeminent position. The strengths and abilities of the Sea Grant Institutional Program at the University of Southern California complement and enhance the capability of Sea Grant in California to meet the regional and statewide needs. Through the diversity of people involved and the variety of cooperating organizations, Sea Grant funded university activities have facilitated information exchange not only through established networks but also through informal communication among scientists, advisors, advisory committee members, students, agency staffs, industry representatives, and the public.

The Sea Grant Program, both at the state and national level, comprises a mutually supportive set of three interacting activities: research, education, and advisory services.* 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 talents 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 derives from its sensitivity to regional and local perceptions of issues. Specific benefits derived from state support are described in Section VII and Appendix A.

Research Activities

The research activities range through a wide variety of subjects including coastal resources studies, waste management, fisheries and aquaculture, natural marine products, and ocean engineering and energy development. The research efforts focus on the wise utilization of marine resources but cover a wider range of interests. For example, areas of social, legal, and scientific projects include coastal zone management, fisheries conservation and management, productivity analysis of coastal wetlands, coastal bluff erosion control, aquaculture of a variety of marine plants and animals, undeveloped fisheries such as the squid and sea urchin, and salmon physiology and pathology.

Education Activities

Education is a basic function of the Sea Grant Program. Each year, graduate students with majors in diverse fields receive training and experience in practical marine research and carry this knowledge into government service and private industry. In the past ten years over 250 students supported by Sea Grant research activities

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*Appendix G is a fact sheet for 1976-77 on the state's program. Statistics on budget, institutional participation, and faculty-student involvement are outlined in the fact sheet.

have graduated and entered employment in more than 75 areas of government, industry, and university environments.* Recently, a pilot program has been developed to involve undergraduate students in practical marine research and information communication. Also, public education, through displays, outreach programs, and consumer workshops have reached over 500,000 people annually.

Advisory Service

The California Marine Advisory program provides a source of independent, ongoing information, advice, and assistance to people who enjoy, utilize, and/or manage California's coastal and marine resources. For example, commercial and sport fishermen, entrepreneurs, consumers, and governmental agencies obtain information from the advisory service, in person or through the many workshops, townhall meetings, conferences, and training sessions which have been held throughout the state. In turn, the advisory service feeds back the new problems and needs of the broad 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 information dissemination.

Seven local marine advisory service offices are located on the California coast, each office with regional coverage: Del Norte-Humboldt Counties; Mendocino-Sonoma-Marin Counties; San Francisco-San Mateo 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 resources, headquartered at Davis, cooperate with the marine advisors on developing projects and programs. In the Los Angeles office there are four specialists, in coastal zone management and planning, recreational management, marine information and communications, and information delivery. The local marine advisors consult the Los Angeles and Davis staff on questions that can draw on the seven specialists' expertise. The specialists in turn depend on the local advisors to keep informed on the local client group's needs for technical advice and response to past advice and assistance.**

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*Appendix I lists the degrees conferred and name of employer at time of graduation.

**Appendix K lists the various client groups that have been served by the Advisory Program.

V. RESOURCES AGENCY ADVISORY PANEL

The Resources Agency Sea Grant Advisory Panel ("RASGAP"), consisting of ten members appointed by the Secretary for Resources, was created by Chapter 1115, Statutes of 1973.* The Director of the California Department of Fish and Game currently chairs the panel. This legislation provides $500,000 annually, through 1978-79, 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 goal of the Panel is to select only those projects for state matching support, under the provisions of Chapter 1115, "which have a clearly defined benefit to the people of the State of California." RASGAP meets twice a year to review progress and establish research priorities as well as to select future projects for state support.

Review of Sea Grant research activities clearly indicates an increasing research emphasis directed at state-related issues since the enactment of the state matching funds legislation in 1973. Table 1 illustrates that during the three years before state-match funding, 59% of the total program dollars were directed to state issues. In the four years after state match funding, the average jumped to 76%, increasing to 85% in 1977-78. The Projects constituting the remaining percentage were still relevant to state interests, but were directed to a national or international audience.

Proposed research projects are not only reviewed by the RASGAP Panel but are also evaluated internally by university committees, as well as by peer reviewers and externally by the National Office of Sea Grant and its consultants at site visits.

This detailed, multi-level review of proposals helps ensure a responsive and coordinated set of research activities as well as vitality and integrity of individual projects selected for support.

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* The law specifies the panel be composed of representatives from the following organizations and industries: the Department of Navigation and Ocean Development, the Department of Conservation, the California Department of Fish and Game, California Coastal Zone Conservation Commission, State Lands Commission, the fish industry, the ocean engineering industry, the University of California, the California State University and Colleges, a private California institution of higher education which is participating in the National Sea Grant Program. (See Appendix B).

Table 1. TOTAL OFFICE OF SEA GRANT AND MATCHING FUNDS SPENT ON STATE RELATED PROJECTS

Grant Year	Dollars in State Related Projects	Dollars in All Projects	Dollars In State Related Projects as percentage of Total	Average
PRIOR TO STATE MATCH FUNDING				
1970-71	$1,096,016	$1,859,860	58%	
1971-72	$2,083,861	$3,060,283	68%	59%
1972-73	$1,827,084	$3,597,076	50%	
INCLUDING STATE MATCH FUNDING				
1973-74	$2,040,385	$2,736,559	74%	
1974-75	$3,075,533	$3,989,362	77%	
1975-76	$3,214,313	$4,160,244	77%	78%
1976-77	$3,696,739	$4,838,751	76%	
1977-78	$4,369,150	$5,115,078	85%	

RASGAP has divided state-supported research into seven program elements in order to provide a framework for both evaluating relevance to state needs and maintaining programmatic balance. These seven elements represent continuing concerns to the people of California and most deserving of attention from the Panel:

I. Coastal Zone Resources Planning and Management
II. Coastal and Marine Recreation
III. Living Marine Resources
IV. Energy Resources
V. Marine Mineral Resources
VI. Waste Management
VII. Marine Data Acquisition and Dissemination (Advisory Services).

The Panel has adopted and disseminated a policy statement for each of the above seven elements and has identified specific state needs that could be met through Sea Grant research. Projects receiving support from the state matching funds between 1974 and 1977 are listed in Table 2 according to RASGAP categories.* A scan of the project titles reveals the type of activities encompassed by each element. Table 3 depicts the incidence of benefits from state supported research to units of government, industry, public organization, and universities. Universities are counted if they do not receive direct Sea Grant support but receive the benefits of other Sea Grant supported research.

State funding is also provided within the seven RASGAP elements for rapid, short-term research response to unanticipated marine and coastal problems or opportunities and for new and innovative projects, thus eliminating lead time required for inclusion in the annual research proposal process. Rapid Response funds have supported a variety of activities, including technical and scientific advice in drafting the California Coastal Plan and Act, experimental investigation of potential aquaculture possibilities such as surfperch and purple hinge rock scallop, biochemical and genetic problems of culturing abalones for restocking or market, analyses of fouling by Sargassum muticum, and assessing the environmental effects of artificial reefs.

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*Appendix O lists all projects supported by Sea Grant funds from 1968 to 1977.

TABLE 2: RESEARCH PROJECTS SUPPORTED IN PART BY STATE MATCHING FUND

I COASTAL ZONE RESOURCES PLANNING & MANAGEMENT
Predictive Methods and Information Systems in Coastal Zone Management (Twiss)
Physical Criteria for Coastal Planning (Inman)
Development and Assessment of Legally Permissible Methods for Coastal Management (Heyman)
Determination of Physical Changes of Southern California Coastal Lagoons (Phillips)
Subtidal Ecology of Carmel Bay (Thompson)
Management of Beach and Dune Vegetation (Barbour)
Management of Cumulative Impacts of Coastal Development (Dickert)
Issues of Coastal Governance (Lee, Scott)
San Francisco Bay Project: Reference Collection, Bibliography, Identification Keys and Specimen Depository (Lee)
Coastal Wetlands Management: Biological Criteria (Holmes *et al*)
Coastal Wetlands Management: Effects of Disturbance on Estuarine Function (Zedler, Mauriello)
Coastal Wetlands Management: Opening of Coastal Lagoons by Sand Fluidization (Inman, Nordstrom)
Participatory Planning for Coastal Decision-Makers (McCoy)
Geological and Historical Analysis of Coastal Zone Environment Hazards and Liability for Losses Caused by Them (Shepard, Hildreth)
Experimental Study of the Tomales Bay "Sneaker Wave" (Fischer)
Legal Techniques for Marine Resources Management (Bowden)
Design of a Computer-Automated Map (Pepper)
Organizational Arrangements for Coastal Management (Lee, Scott)
San Diego Law Review (Bratton)
Coastal Environmental Monitoring Data Base Inventory (Olsen, Hubay)
Onshore Impacts of the Development of Ocean Resources (Richardson, Gordon)
Planning Methods for Coastal Communities (Kreditor, Banerjee)
Uptake of Oxygen by Los Angeles Harbor and San Francisco Bay Sediments (Hammond)
Tide-Induced Currents in Harbors of Arbitrary Shape (Lee)
Coastal Engineering Data Network (Isaacs)
II COASTAL & MARINE RECREATION
Development of Interpretive Methods and Materials for Marine Parks in Northern California (DeMartini)
Interdisciplinary Study for a Semi-Protected, Hand-Launched Boat Facility (Stone)
The Environment and Living Resource Potential of Marina del Rey Harbor, California (Soule, Oguri, Soule)
III LIVING MARINE RESOURCES
Determination of Appropriate Levels of Fees for Vessels Fishing for Yellowfin Tuna in the Eastern Tropical Pacific (Flagg)
Ecological Studies of the Nearshore Zone (Dayton)
Ecology of Santa Cruz and San Mateo County Coasts (Doyle)
Naturally Occurring Halogenated Compounds: Their Interference in Pesticide Pollution Analysis (Fenical)
Economics of Aquaculture (Johnston)
Protective Measures for Lobster Aquaculture (Schapiro, Steenbergen)
Use of Thermal Effluent in Aquaculture (Ford, Van Olst)
Seaweed Resource Management (Neushul, Coon)
Salt-Tolerant Plants (Epstein)
Toxins from Marine Dinoflagellates (Rapoport)
Mass Culture of Toxic Dinoflagellates (Haxo)
Development of a Commercial Aquaculture System for the Crab *Scylla Serrata* (Harrison)
The California Market Squid Fishery (Thompson, Frey)
Optimal Mangement of Sea Urchin Fisheres (Dayton)
Effect of Fishing Sea Urchins on the Marine Ecosystem (Connell)
Protective Measures for Shellfish Aquaculture (Schapiro, Steenbergen)
Kelp Bed Mariculture Resource Management (Neushul, *et al*)
Effects of Public Regulations on the California Aquaculture Industry (Bowden)
New Antioxidants for Marine Lipids (Olcott)
Natural Fermentation of Marine Products (Crisan, Miller)
Histamine Toxicity from Fish Products (Olcott, Bjeldanes)
Limited Entry Assessment of California Fisheries (Wyner, Harding)
Pharmaceuticals from Marine Organisms (Faulkner)
Seaweed Products: Application in Algae Control, Mariculture and Agriculture (Fenical)
Antiviral Compounds from Algae as a Potential Marine Resource (Vedros)
Marine Natural Products Chemistry of Fouling Organisms (Faulkner)
The Development of the Science and Technology of Aquaculture (Hand)
Use of Thermal Effluent in the Culture of Crustacea and Fishes (Van Olst, Ford)
Protective Measures for Shellfish Aquaculture (Steenbergen)
Biochemical and Genetic Control Applied to the Critical Stages in Culturing Abalone (Morse)
Improved Marine Food Products and Marine Food Technology (Brown)

Research Supported Projects (Con't.)

Design and Development of a Squid Processing Machine (Singh)	Development of Multispecies Management for Kelp Bed Resources with an Emphasis on Sea Urchins (Tegner)	Seismic Hazards to the Development of Offshore Oil Resources (Prothero)
Bioconversion of Chitin Wastes (Carroad)	Surfperch Mariculture (Norris)	Side-Scan Sonar Mapping and Computer-Aided Interpretation of the Geology of the Santa Barbara Channel (Luyendyk, Simonett)
Coordinated Management of the Pacific Coast Salmon Fisheries and the Implications of Extended Jurisdiction (Moore *et al*)	Studies on the Ecology of the Red Abalone, *Haliotus rufescens*, in Northern California (DeMartini, Burge)	Nearshore Wave Power Source (Seymour)
Optimal Leasing Agreements for Marine Resource Development (Quirk/Lewis)	Studies on the Biology of northern Anchovy *Engraulis mordax*, and Pacific herring, *Clupea harengus pallasi*, in Humboldt Bay (Barnhart)	Power Generator Inertially coupled to Seawaves (Lee, Manalis)
Pharmacological Evaluation Program (Jacobs)	Sewage Fertilization of Brackish and Salt Water Ponds for Rearing Trout (Allen)	Studies on Thermophilic Microorganisms Located from Undersea Hot Springs, Electric Power Plant Condensers, and Ships' Heat Exchangers (Isaacs)
New Agricultural Chemicals from Marine Organisms (Fenical)	Sources, Types, and Seasonal Fluctuations of Microbial Pollutants and Aquatic Zoonoses in Humboldt Bay, California (Busch)	Oil and Tar Seeps off Southern California (Hammond)
Antileukemia Compounds from the Brown Seaweed *Dictvota* (Fenical)	Osmoregulatory Status of Juvenile Steelhead and Chinook Salmon in the Trinity River (Kerstetter)	Power from Salinity Gradients (Isaacs, Wick)
The Surf Grass Habitat as a Nursery for Juvenile Spiny Lobsters (Fauchald)	Development of a Marine Bioassay Utilizing *Urechis caupo* Larval Development (Lester)	Tilting Spar Directional Wave Sensor (Inman, Guza)
Food Resource Dynamics and Utilization in Channel Island *Macrocystis* Habitat (Brusca)	Hake Fishery Development (Ridenhour)	V MARINE MINERAL RESOURCES
The Energetic Role of Amino Acid and Protein Metabolism in the Kelp Bass *(Paralabrax clathratus)* (Dunn, Bever)	Development of a Self-destructing Escape Mechanism for Dungeness Crab Pots (Jolly)	Oceanographic Inventory of the Southern California Shelf (Fischer, Berry)
Phytoplankton and Red Tide as a Food Source for Inshore Communities (Abbott)	Benzo(a) pyrene Induction of Tumors in Flatfish (Puffer, Brewer, Wellings)	Offshore Sand and Gravel Resources, Southern California (Henyey, Osborne)
Kelp Forest Ecology of the Central California Coast (Pearse)	Effects of Water and Sediment Contaminants on Invertebrate Reproduction and Development in Los Angeles Harbor (Emerson)	Assessment of the Offshore Commercial Sand and Gravel Potential on the Central California Continental Shelf (Berry, Wilde)
Economics of Marine Resources Decision Modeling (Sullivan)	Aspects of the Biology of the Anchovy, *Engraulis mondax* in San Pedro Harbor (Brewer)	VI WASTE MANAGEMENT
Feasibility of a Black Cod Trap Fishery in Monterey Bay (Cailliet)	Studies of Fish Muscle Proteins and Fresh and Frozen Seafood Technology (Brown)	Impact of a New Secondary Treated Sewage Effluent on an Area of Previous Raw Sewage Seawater Disposal (Given)
Aquaculture of the Purple-Hinge Rock Scallop (Phleger, Leighton)	IV ENERGY RESOURCES	The Potential of Cannery Wastes to Enhance Receiving Water Nutrient Quality (Soule, Oguri, Soule)
Carrageenophyte Cultivation, Genetics, Population Dynamics, and Development of Agar Substitutes (Doyle, West, Abbott)	Wave Climate Modification in Harbors by Dynamic Breakwater (Isaacs)	VII MARINE DATA ACQUISITION AND DISSEMINATION
Toward Seawater Based Crop Production (Epstein)	New Applied Developments (Isaacs)	Marine Advisory Services (Cummings)
California Aquaculture Law (Bowden)	Biological Effects of Waste Heat Effluents of Coastal Power Plants (Smith, Hand)	Publications and Public Advisory Services (Sullivan)
Protective Immunization of Anadromous Salmonids Again *Aeromonas salmonicida* and *Vibrio anguillarum* (Kerstetter)	Earthquake Loading on Large Offshore Structures in Deep Water: A Study for the Correlation of Analytic and Physical Models (Wiegel)	Marine Advisory Program (USC, Leopold)
Endocrinology of Salmon Smoltification and Adaptation to Seawater (Bern)		Marine Advisory Extension Service (Ludwig)
		Ocean Education for the Public (Wilkie)

References: Report on the Humboldt State University Sea Grant Program, September 1974 - September 1976; University of Southern California Annual Report; and University of California Sea Grant Program Annual Report, 1975-1976

TABLE 3: BENEFICIARIES OF RESEARCH PROJECTS SUPPORTED IN PART BY STATE FUNDS

Program Elements	Local Government	Regional Government	Federal Government	Industry	Public*	University**
Coastal Zone Resources Planning & Management	16	19	19	16	15	19
Coastal & Marine Recreation	1	1	1	23	10	
Living Marine Resources	4	2	37	121	18	53
Energy Resources	5	1	13	7	1	
Marine Mineral Resources	2	3	10	7	2	8
Waste Management	7	4	3	16	4	4
Marine Data Acquisition & Dissemination	16	6	4	18	111	2
Total	51	36	87	208	161	86

*includes: associations, commissions, union, leagues, clubs, societies, schools (kindergarten - 12th grade)

**multiplier effect only not including university where project is being conducted

Source: Volume II Revised Sea Grant Proposals, UC Sea Grant Annual Reports

TABLE 3: BENEFICIARIES (contd.)

Program Elements	State Government: Total for all Other Agencies	Dept. of Fish & Game	California Coastal Commission	Dept. of Conservation	State Lands Commission	Dept. of Navigation & Ocean Devel.	Grand Total
Coastal Zone Resources Planning & Management	64	10	26	6	2	1	213
Coastal & Marine Recreation	11		4	5		2	58
Living Marine Resources	51	32	8		2		328
Energy Resources	4			1		4	36
Marine Mineral Resources	12			3	3	4	54
Waste Management	2						40
Marine Date Acquisition & Dissemination	10	1	1			1	170
Total	154	1	1	5	7	2	899

VI. FUNDING

In the years since the enactment of the matching funds legislation the programs and projects in California have received $10.2 million in federal funds. In 1978, $2.93 million of federal funds have been granted to California; 9.2% of the national total.*

The bulk of the non-federal matching funds typically comes from participating universities (Appendix H, Table H-1). Initiators or potential beneficiaries of a Sea Grant activity--such as industry, public organizations, and government agencies--also contribute a sizeable share of the non-federal matching funds.

Annually, RASGAP has reviewed project proposals and recommended the allocation of that year's $500,000 state match funds to projects deemed of "a clearly defined benefit to the people of the State." This careful review and financial commitment by the State has forged a unique partnership in California among the state and federal government and universities. Establishing this multisource "core" funding has resulted in significantly new capabilities for increasing the understanding, assessment, development, utilization, and conservation of ocean and coastal resources. In return, the capabilities developed have increasingly been utilized by state agencies in fulfilling their responsibilities through direct interaction and contracts with the university researchers.

There are two aspects to consider regarding Sea Grant funding levels: inflationary effects and the proportion of state to federal funds.

The high rate of inflation over the last four years has reduced state support, in terms of 1973 dollars, by 24%. Assuming a 6% inflation rate this year and next, $723,000 in 1979-80 state matching funds will be required just to maintain the original buying power of the $500,000 state grant. If the 6% inflation rate is projected over the next 4 years, by 1983-84, $913,000 will be needed to equal the 1974 state dollars, as depicted by Figure 1.

Secondly, the proportion of state to federal funds distributed to the California Sea Grant Program has been declining since 1974. Figure 2 depicts the relative increases in federal, university, and other Sea Grant funds since 1973-74 in contrast to the level amount of state funds.

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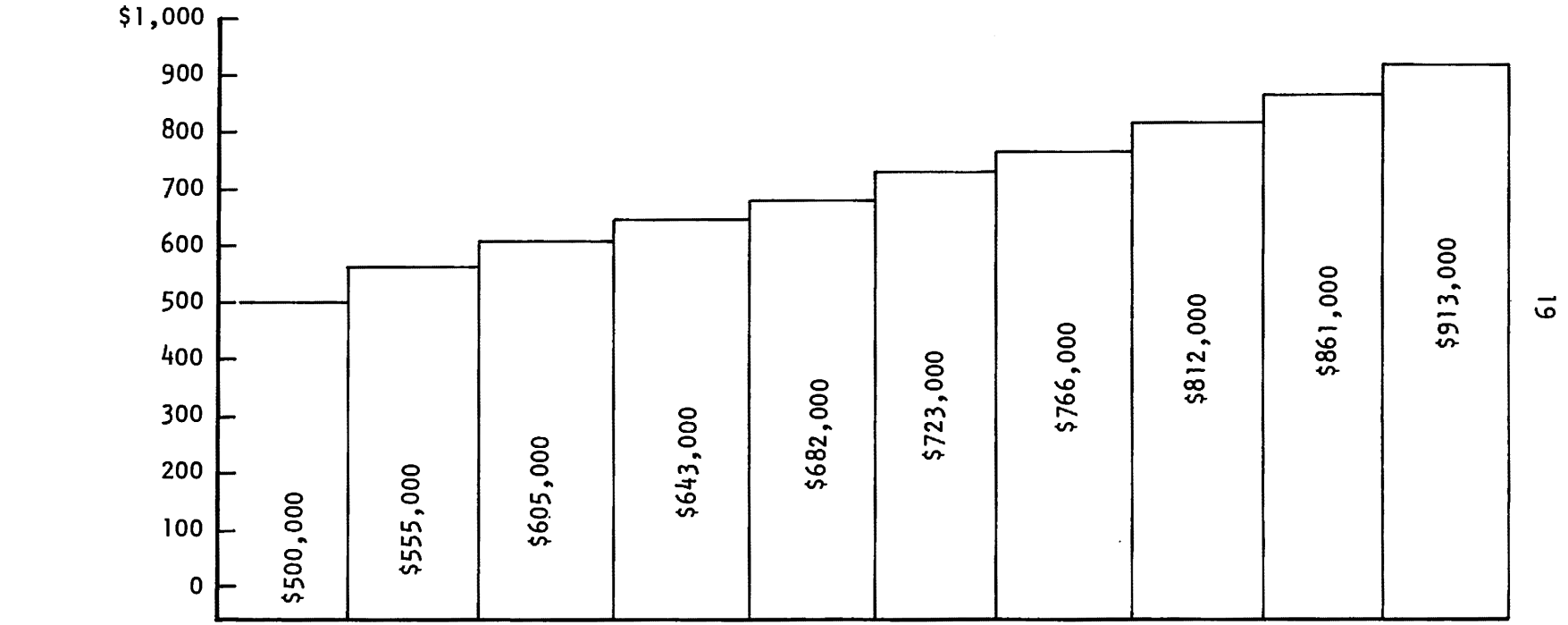
* By law no state can receive over 15% of the total federal appropriation.

FIGURE 1

FUNDING NEEDED TO EQUAL BUYING POWER
OF $500,000 IN 1974 DOLLARS

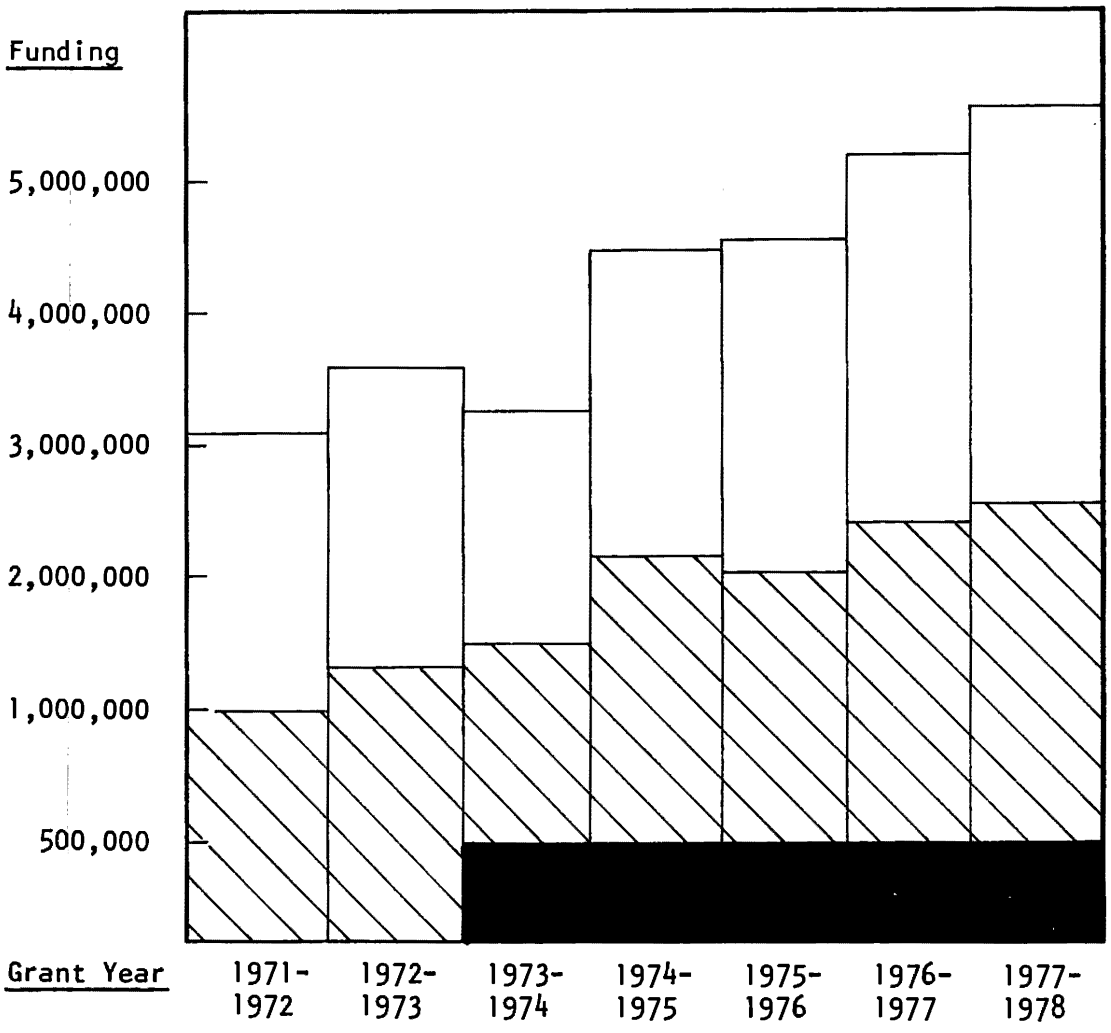


Source: U.S. Bureau of Labor Statistics, Monthly Labor Review, October 1977

FIGURE 2

RELATIVE PROPORTION OF STATE, FEDERAL, AND OTHER MATCH FUNDING

1971 - 1978*



*See Tables for further details on Funding

Federal

University and other

State Match Funds

In 1974, the proportion of state to federal funds distributed in California was 21.8%. In 1977-78, this figure has decreased to 16.1%. This proportionate decline was due to substantial increases in federal funding of the California Sea Grant Program. In the last three years federal Sea Grant funds granted in California have increased at the rate of 8.5% per year.

The amount of "hard" dollars the state appropriates to match Federal Sea Grant funds is important since it is the primary indicator of a state commitment to its Sea Grant program. In this regard, California will be competing with at least fourteen states that make a specific appropriation to match the Federal Sea Grant funds.

Substantially increasing the state appropriation would have a positive effect in the Federal budget process for future Federal Sea Grant support. California, by demonstrating such a renewed commitment to the Sea Grant program through increasing direct funding would then be in a favorable position to compete with other coastal states for federal funds.

VII. A SUMMARY OF BENEFITS

A standard procedure in program evaluation is distinguishing achievements in process and outcomes or results. Facilitating coordination of ocean resources research is an achievement of the program's process. New marine products or increasing the optimal yield of a fishery are examples of program results.

Analysis of research, education, and advisory projects supported by state funds indicates four general areas of benefits.

- Economic gains
- Environmental management
- Social opportunity
- Institutional coordination and cooperation

Institutional coordination and cooperation is largely a process achievement, whereas the other three benefits are usually measured in terms of outcome indicators, such as employment and dollars saved per unit of production, or clean water.

Economic Gains

New product development and improving the effectiveness and efficiency of existing operations are the major economic gains of Sea Grant research and advisory activities.

There are many notable examples of new products developed or being developed by state supported research activities, including the tethered float breakwater, new strains of hybrid kelp for commercial harvesting, a new domestic market for Pacific hake, a sand fluidizer to open estuary inlets and maintain tidal exchange, a data collection system for monitoring inshore wave climate, antioxidants for fish preservation, marine algal derivatives as pesticide and herbicide agents, and salt-tolerant strains of crops that will grow with seawater irrigation.

Employment, increased levels of investment, cost savings per unit of production, and satisfaction of consumer needs as reflected in the market value of the product or service, are commonly used as indicators to measure the economic benefits of new product development.

For example, it has been estimated that the cost of the tethered float breakwater (TFB), developed by Sea Grant, the U.S. Navy, and Department of Navigation and Ocean Development, is one-fifth the cost of the conventional rip-rap breakwater. Considering that it costs approximately $10,000 per foot to build a solid-fill breakwater at a depth of 35 feet, the tethered float alternative could result in savings from hundreds of thousands to

over a million dollars for a typical harbor development project. The tethered sphere breakwater will enable harbor development in areas and water depths where solid-fill construction would be technically impossible, prohibitively expensive, or environmentally undesirable. Expanding harbor development with the TFB system would create employment and generate sales in producing tethered sphere components. More important, the TFB system would have the spinoff effect of generating employment and increasing tax revenues from construction of additional harbors that would otherwise not be economically feasible or environmentally acceptable.

One application for the TFB system is protection of channel entrance dredging operations by the U.S. Army Corps of Engineers. The cost of coastal dredging, which is about $500 million per year in this country, can be significantly reduced if dredges can operate under a wide range of wave conditions.

State beneficiaries of TFB system development would include the Department of Navigation and Ocean Development, the Coastal Commission, Department of Parks and Recreation, port districts, harbor districts, the shipping industry, the recreational boating industry, and recreational boaters.

A second example of new product development is the development of salt-tolerant crops able to use seawater or brackish water. Research investigations have developed barley and tomato strains having salt tolerance to seawater irrigation. To date tests on barley indicate production per plant is better than one-half the average world yield but also less than one-half the average U.S. yield.

The development of salt-tolerant crops should result in a significantly reduced cost of agricultural products. Costs savings would be realized in a number of ways. The supply of agricultural land may be increased. Coastal lands with highly sandy soils and limited freshwater supplies could be brought into production. Farmers should also realize considerable savings in the purchase of fertilizers and freshwater supplies. For California, perhaps the most important benefits of this research will be the development of crop varieties with a higher salt tolerance, thereby enabling continued production on inland areas that are becoming increasingly saline as a result of past irrigation practices.

This project represents a timely, even an urgent enterprise, considering not only the world food and energy situation but also the sky-rocketing costs of fertile land, good water, and fertilizers. It

is expected that state beneficiaries of saltwater irrigation research would be the Department of Agriculture, the agricultural industry, farm workers, and consumers of farm products.

A number of analytic and production techniques that have been developed for fish processing are examples of improvements made in existing operations. Refrigerated storage in carbon dioxide or carbon monoxide atmospheres has been shown to reduce deterioration and discoloration of fish thereby increasing shelf life and marketability. More efficient assay techniques have been developed to detect potential food poisoning in fish. Another rapid assay method was developed for trimethylamine, an indicator of spoiled fish.

California's Sea Grant Program has been heavily involved in the development of new aquaculture processes. Extensive research has been conducted on systems for monitoring water quality, on the determination of suitable diets, and on the control of pathogenic agents. A comparative cost analysis was also made of the various aquaculture system components and has been used as a tool in determining the research priorities for aquaculture development.

The saxitoxin assay technique illustrates the multiple benefits that can accrue from an improvement in processing operations. Saxitoxin is a naturally occurring poison concentrated by shellfish and is the main factor in closure of clam and mussel beds during summer months. Its detection is of vital importance to the shellfish industry as well as shellfishing recreationists. The new saxitoxin assay permits many analyses to be run simultaneously and can significantly reduce the time necessary to analyze samples for an entire region. Furthermore, the new assay is one hundred times more sensitive in detecting the toxin than previous methods. The simplicity of technique now enables anyone to perform the analysis after a brief training session. The assay's sensitivity to low levels of toxin, the simplicity of operation, and the brief time period for a region-wide analysis should facilitate detection of acceptable levels of toxic shellfish during months when the beds are usually closed. The technique will thereby permit a longer season and a greater harvest of shellfish for both commercial and recreational purposes. Long-term economic benefits would be tons and dollar value of additional shellfish landed, additional employment in the industry, and increased recreational activity as measured by number of participants and expenditures of recreationists. The saxitoxin assay should benefit the Department of Fish and Game, the Department of Health, the shellfish industry, recreationists, restaurants, and consumers.

Another major fish processing improvement is the squid-cleaning machine which is presently under development. This project is a companion one to the major squid fishery development project in Monterey Bay. It is expected that the machine will increase the market for squid in two ways. Most of the cost of dressed squid is the labor involved in cleaning by hand. Automation should reduce, by at least a factor of twenty, the cost of processing squid. The machine should also process the meat in forms such as fillets which are far more visually appealing to the consumer than the whole, uncleaned squid. Economic benefits will be the total cost reduction to consumers of cleaned squid, demand for a new product--a fillet, and increased employment and investment in the fishery in response to the greater consumer acceptance. Beneficiaries of the squid-cleaning machine would be the seafood industry, the fishing industry, restaurants, and consumers.

Environmental Management

Historically Sea Grant has had a strong commitment to develop and improve the capabilities of public agencies responsible for managing coastal and ocean environments. One focus of research activity has been to determine the optimal yield of coastal fishing stocks. Research on the biology and population dynamics of sablefish, red sea urchin, and market squid identified many parameters of sustained yield management for these fisheries. Investigation has also been conducted on managing kelp forests, agar weed, and porphyra and for harvesting these seaweed stocks on resource maintenance basis.

In numerous locations along the California coast, overfishing, marine pollution, and habitat degradation are suspected of having reduced many fisheries to levels that will not sustain commercial and recreational harvesting. In such locations, Sea Grant research and advisory activities have endeavored to understand the fundamental processes operating and where appropriate to recommend enhancing the fisheries by augmenting the stocks, modifying harvesting practices, or improving the habitat. A major advisory service effort in cooperation with the National Marine Fisheries Service and the Department of Fish and Game has been the introduction of juvenile silver salmon in San Francisco Bay, Tomales Bay, and along the Mendocino County Coast. More than 400,000 silver salmon have been hatched and released in San Francisco Bay. Pioneering research has been conducted on arresting the drastic decline of abalone populations by state limitation on the number of licenses issued to commercial divers. Another research project studied the juvenile stage of the California spiny lobster, as it utilizes the surf grass for its protected habitat. This declining fishery may

now stand a chance of recovery since the Department of Fish and Game and the Coastal Commission are now aware of this habitat relationship.

Conserving coastal resources has been an objective of the projects directed at developing analytic methods for coastal zone management. Presently, analysis directed towards the effects of land use activities in estuary watersheds on the maintenance and productivity of estuarine resources is underway. In conjunction with the coastal zone management effort, a coordinated set of wetlands management projects was initiated in 1976. The wetlands research is designed to determine the resource values of these environments and how the values may be affected by various development activities.

Research on biological effects of effluents in coastal waters will help determine the parameters for environmental impact assessment as well as test existing standards. Analysis of thermal effluent impacts should enable evaluation of policy and criteria on power plant outfalls. Scientists have also been investigating the cannery discharges into Los Angeles harbor. Findings on impacts of the discharge have served to determine the extent to which cannery wastes can be used to beneficially enhance the biological productivity of Los Angeles harbors.

The analysis of limiting the entry of commercial divers in the abalone fishery is also a notable example of the benefits that can be derived from conservation and enhancement projects. According to the analysis, if the Department of Fish and Game follows the set of recommendations on limited entry outlined by the project's Final Report, the abalone populations should increase over the years, and concomitantly, a higher level of sustained yield will be possible. The reduction in the number of commercial divers and the increase in the abalone stock should also decrease the cost per unit effort in utilizing this resource. The increased harvest can be measured in dollars of commercial landings. Eventually the increased harvest may permit more commercial divers to participate and thus increase the productive employment in the fishery industry. Increased taxes on the harvest can also be counted as a benefit since it is expected that tax revenues will support further research on abalone conservation and enhancement. An increased supply of abalone plus the decrease in fishing costs should decrease the presently high prices consumers are paying (or at least dampen the price rise). The analysis of limited entry now provides the fishery management framework necessary to structure applied research such as the investigations on the enchantment of abalone populations currently being undertaken by Sea Grant and the Department of Fish and Game.

The California coast and offshore waters are a hazardous environment. Coastal erosion, tsunamis, storm events, coastal flooding, landslides, and earthquakes pose continued threats to human safety and even greater risks

to property. Several research projects have dealt with various kinds of coastal hazards. The shelf and shore system of tethered monitoring devices has enabled analysis of the inshore wave climate as a means of predicting coastal erosion and deposition patterns. Downcoast erosion caused by breakwaters and jetties can be greatly reduced or eliminated by the operation of crater sink and fluidizer systems that will transport sand across harbor entrances and inlets as well as maintain inlet openings without breakwaters.

Presently, research is underway to demonstrate how geologic information can be provided in a manner that will enable local governments to guide development in hazard-prone areas. The project will also outline the liabilities local governments may face if they choose or do not choose to restrict development in hazard areas. The potential hazards to offshore platforms, pipelines, and wells due to seismic activity and fault motion are also being analyzed by Sea Grant researchers. An up-to-date, active fault and seismicity map of the sea floor in the Santa Barbara Channel is being prepared. In another project, various models of submerged offshore structures are being tested by a seismic shake simulator under laboratory conditions. Findings from both projects should enable the oil industry to construct platforms and facilities that will be less susceptible to earthquake damage. State agencies such as the State Lands Commission, the Coastal Commission, and Division of Mines and Geology will also be able to use the analysis technique to assess the seismic safety of proposed offshore facilities.

The benefits derived from research on coastal hazards can be measured in terms of property damage minimized or avoided, lives saved, as well as in terms of resources preserved. Other important indicators are the development of new technologies in comparison to presently employed methods and of investments that could be made as the result of protecting an area from hazard risks.

California coastal cities and counties have spent millions on repairing or replacing roads, water lines, and sewers that were improperly located in hazard areas. Local governments and coastal property owners may have spent even more money on engineering works to protect their investment from damage and destruction in hazard-prone locations. Sea Grant research on coastal hazard management should therefore be of direct benefit to coastal governments, service districts, and coastal property owners.

Social Opportunities

There are three dimensions to Sea Grant's role in increasing social opportunities to use and gain knowledge of ocean resources: public education, manpower development, and recreation opportunities.

Public Education

Sea Grant efforts in this area seek to develop and promote greater understanding and appreciation by the public of the marine environment and marine-related issues. Demonstrations, workshops, conferences, brochures, newsletters, exhibits, and answering requests are the commonly used techniques in public education programs.

Most of the advisory services work is oriented to public education although in most cases it is targeted to specific groups within the public. It is estimated that over 415,000 people a year have been reached by Sea Grant sponsored advisory programs. Commerical and sport fishermen, recreational boaters, harbor operators, fish processors, local government officials, divers, youth groups, and consumers are the primary recipients of advisory service education activities. Advisory agents periodically hold conferences, workshops, and short courses on topics of vital concern to these groups. Topics have included fishing gear improvement, tax problems of the independent fisherman, the tuna-porpoise controversy, new techniques for fish preservation, limited entry into commercial fishing, the provisions of California's coastal management program, harbor management, state and local government relations in coastal zone management, diving safety, and marine recreation. The advisory services newsletter informs over 3,000 sport and commercial fishermen of latest developments in the industry.

The diving safety research project conducted by Sea Grant investigators has and is continuing to improve the standards for safe, effective diving. Modification of the attitudes of various training agencies is being affected by research and information dissemination with regard to adequate learning and reinforcement schedules for critical SCUBA skills.

Local adult education and post-professional legal education courses have presented material on coastal zone environmental management. High school teachers have also been assisted in developing classes about the ocean environment. One project at USC, "California and the Oceans," is training teachers and developing kindergarten-through-high-school curricula ideas for integrating marine education into the current educational structure. In conjunction with this effort, Sea Grant participated in the creation of a marine education journal for dissemination of ready-to-use curriculum materials, articles, and activities for teachers in California. The exhibits and student programs of the Scripps Aquarium/Museum have attracted over 60,000 students in organized groups annually. Conservation of marine resources, with particular

reference to California's intertidal animals, is stressed. The Marine Science Institute Community Education Program at UC-Santa Barbara has provided more than 13,000 visitors with the opportunity to observe and learn about local marine resources and University research activity.

A new demand on the education program has been facilitating public participation in California's coastal zone management program. A brochure was developed to inform all sectors of the public on the various ways they can get actively involved in shaping the State's policies on coastal development and conservation. An extensive bibliography of documents on coastal planning and directories of state and federal agency responsibility in coastal resources management have served to inform the public of the literature and institutional complexitites of coastal zone management.

Manpower Development

Sea Grant efforts in this area seek to satisfy current and anticipated needs for trained personnel through the development of curricula, courses, and training programs in marine-related disciplines.

The most important dimension of manpower development is the education and training that students and postgraduate specialists receive when working on practical research projects, education programs, and advisory service activities. In the past ten years, over 250 students and postgraduate specialists have worked on various Sea Grant projects. Students and research specialists have gained experience in a wide range of disciplines including fisheries biology, zoology, marine biology, oceanography, city and regional planning, law, economics, public policy, landscape, architecture, transportation engineering, hydraulics engineering, structural engineering, library science, agricultural economics, botany, home economics, physical education, food science, and business administration. Usually students are involved half time as trainees, interns, or research assistants during the school year and full time in the summer months. In most cases the students and postgraduate researchers work on the project for at least a year and thus become very well experienced with all aspects of the research effort. The subsequent employment of these highly trained graduates further facilitates the transfer of information and technology from the Universities to other organizations within the state and nation.

Research projects and workshops also serve as training grounds for new and rapidly expanding career opportunities such as coastal zone management for which there are no specific academic programs

within the University. For instance, one Sea Grant sponsored "Laboratory-Workshop in Coastal Zone Planning" produced students who have since assumed new roles in the City of Long Beach Planning Department, the USEPA, and the California Coastal Commission.

Curriculum development is another important aspect of manpower development. On several campuses marine resources management and marine policy courses have been established on a test basis. Recently a pilot program has been developed to involve undergraduate students in marine research and marine science writing.

Indication of benefits derived from manpower development include numbers of people trained or educated in a respective program, degrees conferred, creation of new employment opportunities, and number of employment offers per graduate. One hundred seven Sea Grant supported students received master degrees and another eighty-five students received doctoral degrees. In most cases, graduates have been employed in a position that is directly related to their Sea Grant work. It is recognized that manpower development benefits are considerably greater for those sectors in which there is a higher demand for graduates than in an already overcrowded one. Appendix I indicates the number and diverse scope of institutions that have employed Sea Grant supported students.

Recreational Opportunities

Sea Grant advisory services, education programs, and a number of research projects have been designed to increase the public's opportunities to use coastal and marine resources. The main activity in this benefit area is increasing recreational opportunities. Recreational areas and facilities are a vital and integral part of California's coastal environment. The Program has sought to increase recreational opportunity in a manner that strikes a reasonable balance between public use of coastal environments and resource protection.

Advisory service programs have produced and widely distributed pamphlets describing various ocean and coastal recreational opportunities, such as an access guide to beaches in the Los Angeles region, a diving safety guide, and a recreational map of Humboldt Bay. In the Los Angeles region, a marine weather broadcast on CBS News Radio (KNX) informs weekend marine recreationists of pertinent information for their own enjoyment and safety.

Recreational supply and demand analysis has been another means of increasing public opportunities. Analysis of the demand for recreational boating in Monterey Bay and the Los Angeles region

helped State and local agencies to plan for more dry and wet berths. Similarly a topographical and ecological inventory of Los Angeles County's underwater resources assisted in the formulation of an underwater parks plan to accommodate the rapidly increasing number of SCUBA recreationists. The inventory method has been used by the State in its plan to designate underwater park areas.

The first national Conference on Marine Recreation was organized and hosted by California's Sea Grant program. The conference enabled advisory agents, researchers, and users to identify the diverse interest groups that should be involved with marine recreational planning. A series of marine recreation guidelines for state and local government were also developed by conference participants.

Analyses developed by the coastal zone management projects should result in increased public recreation opportunities. Highway capacity analysis procedures can be used to determine the extent to which residential development may congest coastal roads and thereby impair transportational access to the coast by recreationists.

Development of public parks, open space lands, and public accessways should be facilitated by a set of case study analyses in Half Moon Bay, in Del Norte County, and in Laguna Beach of the resultant fiscal impacts that government may incur when the Coastal Act is implemented. The studies concluded that local governments would either realize a financial benefit or at worse incur slightly greater costs than revenues as a result of agricultural land preservation or acquisition of parklands. As a result of these analyses, local governments may be more inclined to reserve additional lands for park and open-space purposes.

Institutional Coordination and Cooperation

It is clear that improvements in institutional coordination and cooperation has been one of the major benefits of Sea Grant activities. New arrangements have been established in five ways: intracampus, interuniversity, interagency, state-university, and university-industry. The organizational arrangement of Sea Grant in California places the program in a unique position to facilitate the development and coordination of ocean and coastal research and education activities among all the institutions of higher learning. It is the only "institution" in the state that links together practical ocean and coastal research conducted by researchers from the University of California's nine campuses, the

nineteen State Universities, California Institute of Technology, Stanford University, and the University of Southern California. These arrangements developed by the Sea Grant Program form the foundation upon which the economic, environmental, and social benefits are built.

Interuniversity and intracampus communication, coordination, and cooperative research have always been stressed by Sea Grant in its program development. Within the University of California Program, coordinator positions have been established in six subject areas: plant aquaculture, animal aquaculture, fisheries development and enhancement, fisheries product development, energy resources, and new marine products development. At USC, intercampus coordination is achieved through a management team consisting of program leaders in six multidisciplinary areas: marine education and training, marine advisory services, living marine resources, nonliving marine resources, socio-economics, and coastal engineering.

State, university, and industry coordination has been achieved by formation of scientific and advisory panels on aquaculture, marine geology, seafood industry, and marine recreation. The infusion of state matching funds and the allocation process have had a strong influence on the integration of universities and state agencies into a cooperative network. In particular, interaction among members of the RASGAP panel established new communication channels between the university community and state agencies. Since the inception of RASGAP in 1973, a close working relationship has developed between the state agencies with ocean management responsibilities and the universities conducting ocean research, education, and advisory services. This working relationship is helping structure a framework for California's ocean and coastal research and education programs.

The degree of coordination can be measured by a reduction in the amount of unneccesary overlapping and duplicative efforts, the number of projects which involve two or more institutions, and economies realized by cooperative arrangements or by new projects which build upon existing work. Appendix F lists cooperating organizations.

Indicative of Sea Grant's integrative style and synergistic effect on research is the proposed experimental abalone enhancement project. This effort to determine if restoring depleted abalone stocks can be accomplished evolved from several individual research projects and the investigations by the Department of Fish and Game.

Past work conducted in southern and central California on kelp forest ecology and sea urchin populations has extended scientists' understanding of abalone habitats. This research, coupled with several short-term studies on biochemical aspects of abalone culture, helped define biological and ecological mechanisms in abalone culture, growth, and survival.

Political scientists have built on the biological research in their assessment of managing California's abalone fishery. According to an analysis, limiting the number of commercial divers should increase the abalone populations over the years and perhaps allow a higher level of sustained yield. The combination of public policy analysis, biological investigations, and ecological studies has provided an agenda for future research activities for sound abalone management.

Another goal of Sea Grant's coordination efforts is to develop agreement among regulatory agencies on baseline studies and standards to be used in impact assessment. A number of studies, such as research on thermal effluents and fish cannery discharges, have been aimed at reducing interagency controversy on environmental impact assessment. These studies have established procedures for determining baseline conditions of coastal environments and for evaluating the appropriateness of various agencies' environmental standards.

The extent of coordination can be assessed by the number of intracampus and intercampus research projects. For example, researchers at UC-San Diego, San Diego State University, UC-Santa Barbara, and UC-Davis are conducting complementary research on the many dimensions of wetlands management. Joint projects involving UC-Berkeley, UC-Santa Cruz, and Moss Landing Marine Laboratory faculty are relating the wetlands research to California's coastal zone management program. Coastal zone management specialists at UC-Berkeley and USC convened with local and state government officials at a two-day workshop to discuss common problems that may occur in preparing the city and county coastal plans that are mandated by the California Coastal Act. Geologists at UC-San Diego are working with lawyers at the University of San Diego on management strategies that local governments could use to reduce hazards associated with unstable shorelines. Marine biologists at UC-Berkeley, UC-Santa Cruz, and Stanford are cooperating on research to develop substitutes for agar-producing seaweed. San Diego State University, UC-Riverside, and UC-Davis are conducting cooperative and interdisciplinary research on crustacean aquaculture and shellfish pathogens. Since coastal zone management is a multidisciplinary field, research and advisory projects on this topic require interdepartmental efforts and often

involve intercampus arrangements. Consequently, environmental planning, law, economics, political science, transportation engineering, geology, and hydrology have been integrated by the coastal zone management projects.

APPENDICES

APPENDIX A

ACCOMPLISHMENTS BY GEOGRAPHICAL REGION

Northern California Region
San Francisco Region
Monterey Bay Region
San Luis Obispo/Santa Barbara Region
Los Angeles Region
San Diego Region

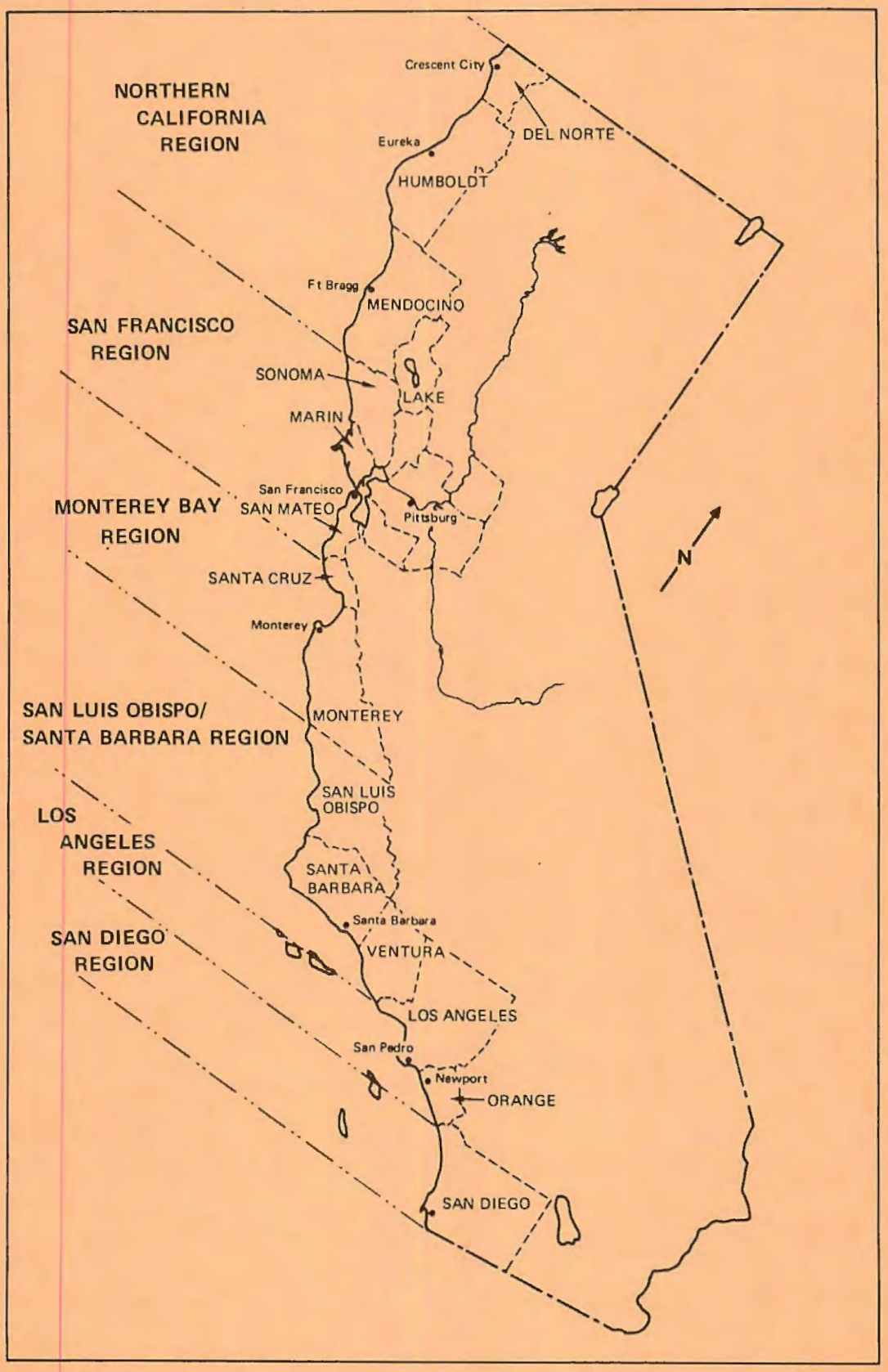
INTRODUCTION TO GEOGRAPHICAL REGION

The Sea Grant Program is an applied, interdisciplinary coastal and marine resources program which seeks, in an innovative and cooperative fashion, to link together the efforts of universities, government, and industries. Research, advisory, and educational projects have sought and are continuing to promote the wise utilization, conservation and management of the coastal and marine resources in the State of California. Selected examples of these efforts of Sea Grant supported staff follow, listed in separate paragraphs, by contribution and in terms of RASGAP program element. Geographical sections help illustrate where these projects' results have contributed to the enhancement of California's resources.

Many of the research, education and advisory efforts have been coordinated, intercampus and interdisciplinary efforts, with accomplishments generating benefits in more than one geographical area.

Furthermore, marine advisory efforts and accomplishments are so intertwined with research and educational work that it is not readily possible to identify all the areas in which the advisory service has conducted valuable services. Therefore, advisory accomplishments are mentioned not only under the program element of marine data acquisition and dissemination but also under the other elements where the advisory service has worked closely with the research investigators.

The listing by geographical sections attempts to highlight only locations where major accomplishments accrue although reference is made to other locations which have benefited from Sea Grant research activities.



MAP A-1: CALIFORNIA ACCOMPLISHMENT REGIONS

NORTHERN CALIFORNIA REGION

See Map A-1
(Page A-3)

Coastal Zone Resources Planning and Management

The California Coastal Zone Conservation Commission in February 1975 requested a study be made of the effects of park acquisition on local governments. Such information was needed in regard to a proposed extensive acquisition of land for preservation and recreational use along the California coast. Research conducted by Sea Grant investigators developed and outlined methods for assessing the economic benefits and costs of the impacts of acquisition and development, and applied the methods to a case study of the acquisition of Lakes Earl and Talawa and surrounding areas in Del Norte County. Also, a state survey of park impact assessment and a bibliography of existing literature on park impacts to local governments were completed in cooperation with Del Norte County and the State of California Department of Parks and Recreation. This information coupled with research for other geographical areas should be useful in a decision-making context at both the county and state levels, in particular to the California Coastal Commission for their park acquisition planning.

Coastal and Marine Recreation

In northern California, the California Department of Parks and Recreation has designated two State Underwater Parks: one at Salt Point near Fort Ross, Sonoma County, and the other adjacent to the town of Mendocino, Mendocino County. Sea Grant scientists are developing interpretive materials and resource management plans for the two parks. The goal is not only to conserve these valuable resources but also to increase visitor appreciation and enjoyment of coastal parks and their marine environments.

Living Marine Resources

Age, growth, and diet studies on adult salmon captured off the northern California coast were completed by scientists in Humboldt at the request of California Department of Fish and Game. The information generated helped provide the basis for lowering size limits and extending the fishing season by two weeks. The project has had a significant and positive economic impact for the commercial salmon fishing industry by increasing catch, profits, and existing jobs for several weeks.

In order to mitigate the loss of salmonid spawning areas resulting from contruction of two large dams on the upper Trinity River, the Trinity River Hatchery was built as part of the Trinity

project. The hatchery has raised and released large numbers of juvenile steelhead and salmon, but returns of adult steelhead and salmon have been poor. Recent information from other investigations indicates that changes in river water temperatures adversely affect ability of juvenile salmonids to adapt to seawater. At the request of California Department of Fish and Game, Sea Grant researchers in northern California determined that changed water temperatures resulting from construction of the reservoirs in the Trinity watershed had adversely affected the seawater transition of salmonids and that smolting occurred earlier in the season than previously suspected. Insights gained from this project provided a stronger basis for timing the release of young steelhead from Trinity Hatchery. From this research better data was developed to more effectively manage this fishery resource.

Humboldt Bay is an important spawning area for herring, and each summer large numbers of anchovy move into the Bay. In 1973 a commercial anchovy fishery was proposed by albacore fishermen who use anchovy for bait. In 1974 a commercial herring fishery was begun with the assistance of the Sea Grant Marine Advisory Service. Controversies concerning the effects of both of these fisheries on existing stocks and on salmon stocks arose, and an anchovy fishery was disallowed by the California Legislature. Sea Grant funded investigators have gathered the biological information necessary for management of commercial fisheries. As a consequence, the herring fishery has been reestablished. Moreover, establishment of a new commercial fishery of anchovies in Humboldt Bay is anticipated. Both represent significant benefits to the local economy. An increased quota on herring has resulted as a consequence of Sea Grant research recommendations. This higher quota will allow a more economically profitable fishery. This information has also been used by the Humboldt Bay Harbor Recreation and Conservation District, the U.S. Army Corps of Engineers, and the California Coastal Commission--agencies which have primary control over the development and protection of Humboldt Bay.

The gaper clam is another important sport species along the Pacific Coast with extensive beds in Humboldt Bay. Research has provided necessary information for sound management of gapers, and the findings were published in a report given to the California Department of Fish and Game who incorporated the data in an environmental impact statement on the status of the fishery in Humboldt Bay. The data and conclusions were applied to changes in regulations for optimal management. A reduction in the daily bag from 50 to 25 clams per day was implemented by the Department of Fish and Game.

Pacific hake is an abundant but currently underutilized ocean fish. Large numbers are harvested by Russian and Polish ships off the Pacific Coast, and some of the product apparently enters the

country via Polish ships off-loading at Ensenada. A test marketing program for this species is currently being undertaken to determine if a domestic fishery is feasible. Hake will be off-loaded at Eureka, processed into frozen blocks of minced flesh (and possibly fillets), and marketed through brokers in Los Angeles. A cost analysis from fishermen to retail outlets will be done. The project is being carried out in cooperation with local seafood processors, Fishermen's Marketing Association, Inc., local fishermen and the National Marine Fisheries Service. The potential result is a new commercial fishery in northern California with benefits to the fisherman, processor, and consumer.

Dungeness crabs molt in late summer and early fall and require two to four months to recover to a meat-content point high enough for value as a market product. Research has determined that crabs captured just prior to molt could be held under controlled conditions and fed a diet based on fish wastes in hopes of speeding the recovery process. The objective was achieved--captive crabs reached market readiness fully one month before their wild counterparts. Market conditions to date have not justified a commercial application of these results. However, continued efforts by other institutions to rear crabs from eggs have been able to use the results of research, and it is anticipated that techniques developed under this project may be applied in a complete aquaculture enterprise. Results have been widely disseminated, particularly to aquaculturists on the Pacific Coast.

Although red abalone are not harvested commercially north of San Francisco, abalone sport diving is extensive between Fort Ross and Shelter Cove. Scattered reports before 1970 indicated that the catch was decreasing and population density was declining. Research was therefore undertaken to better understand the reasons for the population decline. Determination of growth rates including geographical, ecological, and annual variations was completed for evaluating the present size limit of seven inches for red abalone in northern California. Growth-rate and maturity studies at Fort Bragg indicated that the size limit should be reduced, and thus the daily limit was changed from five to four red abalone per day. Originally Fort Bragg was thought to be representative of the whole north coast from Fort Ross at the south to Shelter Cove about 50 miles to the north, but research has indicated that Fort Bragg abalones may not reflect growth patterns closely enough to serve as a standard for the entire north coast. This has resulted in growth data being generated for two additional areas, Point Arena and Fort Ross. Because of the mobility along the north coast, a reduction in size limit for only the Fort Bragg area would generate an untenable law enforcement problem for game wardens. Thus, a uniform size limit is necessary for the entire coast north of San Francisco. Seasonal

growth rate studies have shown that growth occurs during the summer. The outcome of this investigation has been revision of Department of Fish and Game regulations, most importantly the closure of abalone harvesting during July. The consequences of this research and these regulations should be an improved resource management program that ensures a self-sustaining recreational and commercial harvest.

Squid and razor clam pieces are preferred baits for crab pots in northern California, but both are unavailable at times, require refrigeration, and have a limited effective fishing time. It was felt that a bait consisting of a binder into which a slowly-released attractant was incorporated would be economically useful to the crab industry. A polycrylamide gel binder has been developed and has been partially successful when used with razor clam extract as an attractant. Efforts are being devoted to investigating additional efficient attractants which will further increase fishing time and, potentially, subsequent catch.

A new center is being developed for the state of California, on the north coast, with the dual purpose of developing marine resources of that region and conducting research on a multitude of questions relating to those resources. Some areas of research will be directed toward information on fishery stocks and market demand analysis for the Pacific Regional Fisheries Management Council. In addition to fish, other ocean resources in or under the ocean waters off the state's north coast also have potential importance.

Sustained offshore research capability in the region will be established with this center, including exploration of offshore placer deposits of value, and for the presence of deep aquifers surfacing on the ocean floor of the continental shelf. Ongoing identification of relevant research needs and establishment of research projects will continue through the consortium including the California State University system, the University of California system, the California Department of Fish and Game, as well as other departments within the Resources Agency.

Waste Management

Kraft Pulp Mill Effluent (KME) contains large amounts of toxic chlorinated lignins, and two pulp mills in Eureka discharge approximately 50 million gallons per day of KME directly to the ocean. The bacteria which break down toxic components of KME have potential applications in biological filtration systems. Sea Grant supported research has resulted in isolation of strains of anaerobic bacteria and of aerobic bacteria, all of which are involved in the breakdown of lignins. More importantly, the researchers have shown that detoxification of the Kraft Pulp Mill Effluent occurs only when an anaerobic

digestion process is followed by an aerobic process. Current treatment of KME involves only settling ponds with some high volume aeration. Under these conditions, 28 days at ambient temperature are required for a 50% drop in the toxic compounds. Research has developed a treatment method which will achieve a 95% drop in the toxic compounds in a 6 hour period. In parallel with the bacteriological work, a new and rapid bioassay, using embryos of a marine worm, was developed. Results of the project have been given to Louisiana Pacific and Crown Simpson corporations, both of which cooperated and contributed in the research, and techniques are being developed in utilizing this research to reduce the toxic effluents. Reduction in this toxic effluent will mitigate a public health hazard and decrease the total environmental pollution load discharged by the pulp mills.

Bioassays of draft pulp mill effluent (KME) in the marine environment typically employed finfish as test subjects and required 96 hours for completion. They lack sensitivity, and the time and space requirements preclude rapid, on-site tests. A new 30 minute and highly sensitive bioassay for toxic pulp mill effluent (KME) in ocean outfalls has been developed. This assay requires less equipment as well as less time; consequently, there has been a reduction in overall cost of the tests. Eggs of a marine worm, Urechis caupo, are exposed to various dilutions of effluent for a predetermined time period on the order of minutes. The test has wide applications for pollution studies of marine environments, in particular for studies of bacterial breakdown of kraft pulp mill effluent. Inquiries about the technique have already been received from workers in the state of Washington, and details of the technique have been presented by the Marine Advisory Service to local processors.

Humboldt Bay presently has large commercial oyster beds and extensive beds of sport clams, but seasonally high levels of bacteria in the waters of the Bay have led the shellfish division of the U.S. Food and Drug Administration and the State Health Department to classify the area as "conditional" for growing and harvesting shellfish. The high bacterial count coincides with periods of rain and may originate from agricultural lands bordering the Bay. If so, much of the bacterial pollution may be of no significance to human health. This project seeks to classify bacterial pollutants in Humboldt Bay as to type, origin, longevity in the marine environment, and potential public health impact. Removal of the conditional classification would allow the oyster industry to plan for future years with a great deal more confidence than is now possible.

Marine Data Acquisition and Dissemination

In the past four years more than 13 workshops, conferences, and townhall-type meetings have been held by the Marine Advisory Service in northern California for over 850 commercial and recreational fishermen, seafood processors, homemakers, and planners. Such topics have included: refrigeration systems for fishing boats; use of new survival equipment for fishermen; first aid for the fishermen; methods for financing capital construction; new developments in trawling; fishing business management; limited entry into the commercial fishery; improving methods for gathering weather information; economic potential of North Coast marine resources (a symposium); and Coastal Zone management problems (a symposium).

Advisors have convened meetings on seafood inspection and seafood waste disposal in conjunction with federal and state officials. The meeting on seafood inspection helped answer many questions local processors had regarding new inspection procedures. This fish plant waste meeting held in Fort Bragg helped identify the present and future disposal problems, and advisors and marine specialists are staying in touch with these problems of the processors.

The advisory program has made a promotional movie on the Dungeness crab, organized and published an educational nature trail guide for the Trinidad State Park area, and set up a Marine Electronics course for fishermen in a local community college in the Humboldt area. A quarterly newsletter for fishermen, processors, and sportsmen is published by the Marine Advisory Service and has a circulation of 1,500 people in the northern California region.

Local marine advisors, in cooperation with the National Environmental Satellite Service and other area marine advisors, have been developing a reliable reporting system and disseminating the information for the sea-surface-temperature imagery generated by the satellite to the fishermen. Temperature data displayed as imagery show the paths of ocean currents and upwelling of cold waters. The upwelling brings up plankton and other fish foods, luring albacore and salmon to certain areas. Benefits to the fishermen arise from better and faster location of ocean surface temperature patterns which are important indicators of commercial quantities of fish. By rapidly locating these patterns, fishermen can save vast amounts of time and fuel which would otherwise be expended in searching for schools. A recent study by NMFS shows that fuel costs are a major overhead in the fishing industry, especially to the albacore industry which benefits most from the surface temperature charts. Other benefits are derived from putting vessels in productive areas faster which makes those few fishable days of the season more economical.

Fishermen have credited temperature charts with increased catches of salmon and albacore, ranging in value from $2,000 - $14,000. A modest savings of 10% on each fisherman's fuel bill for the West Coast's approximately 1,000 salmon and albacore vessels could result in an annual fuel savings of $438,288 (in 1975 dollars) to the fleet. Adding an additional catch worth $2,000 per vessel (approximately two tons of albacore), a total annual benefit of $2,438,228 would result to those vessels on the West Coast. In order to familiarize fishermen, resource managers, and politicians with the remote sensing capabilities of the satellite, workshops have been conducted on a variety of occasions, and more than 500 people have attended. Marine advisors also conducted and analyzed results of a questionnaire to sample user feelings on the satellite program, and the results were used for recommendations to improve this joint cooperative program.

One marine advisor for this area and a statewide marine specialist in seafood technology worked with a Fort Bragg fisheries plant, Schnaubelt Fisheries, on a fish silage process for fish processing waste. The company now sells a liquid plant fertilizer for $850 per ton instead of paying to have wastes hauled to a dump. They conducted experiments at the UC-Davis campus Food Science and Technology Department processing pilot plant with fish-waste conversion to a liquid form for use as a fertilizer, animal feed additive, or other possible uses.

Advisors have been continually receiving questions and requests regarding pot fishing, trawling, and salmon fishing. These marine advisors have assisted in presenting salmon introduction information, in planning and installing on a fishermen's boat experimental mid-water trawl for rockfish, and by acting as a liaison with the California Department of Fish and Game to get help for the herring fishermen of Tomales and San Francisco Bays in mitigating the problems of regulation and congestion. Through this interaction with the fishing industry, the advisors have identified areas for research. Research projects developed by and closely interactive with the work of the advisors have included a major study on endocrinology of salmon smolting and their adaptation to seawater. Close contact with the fishing industry has also enabled the advisors to disseminate information on the continuing research efforts on hake, Northern anchovy, and the Pacific herring.

Marine advisors have also worked closely with the commercial fishing industry to develop data necessary to justify a U.S. Coast Guard Helicopter Search and Rescue Facility in the Humboldt area, and the facility has since been built. In addition Sea Grant staff coordinated a meeting of the United States - Soviet Fisheries Claims Board in Eureka so that local fishermen could file damages claims on lost fishing gear. Since the meeting, one claim estimated at $30,000 has been processed for a northern California fisherman.

SAN FRANCISCO REGION

See Map A-1
(Page A-3)

Coastal Zone Resources Planning and Management

Sea Grant funded investigators' involvement with the California Coastal Commission (CCC) dates from shortly after the organization of their planning staff in February 1973. They have dealt with the state-level commission staff in drafting a programmatic outline redefining and clarifying the planning requirements set forth in Proposition 20. The outline was an adjunct to the state commission's own outline and served as a foil for comparing the state's suggested programmatic approach with one from Sea Grant investigators' perspective. Literature research was conducted on anadromous fisheries, coastal soils, coastal flooding, and the relationship between beaches and sediments derived from coastal watersheds. Reports prepared on these topics were directly incorporated into the commission's plan element on coastal land environment. A literature search was also conducted on unconventional sources of energy (wind, geothermal, solar, tidal) for the plan's element on energy. Preliminary drafts of coastal plan elements were reviewed and comments given to the commission staff. Particular attention was given to the elements on: Coastal Appearance and Design, Marine Environment, Coastal Development, Coastal Land Environment, Funding, Government Organization and Powers, and Recreation. A method for identifying, inventorying, and evaluating the lands visible from the coastal highway was developed for the Appearance and Design Element of the Coastal Plan. Analysis of the inland extent of the coastal scenic resource was of particular importance to the CCC as a criterion for defining the inland limit of the coastal zone. The research team developed a methodology, mapped the inland extent of coastal scenic resources, and prepared a report describing the entire process ("Identification and Mapping of California's Coastal Viewshed Corridor"). Researchers supported by Sea Grant have also devoted much of their efforts in the "intensity of development" element. A working paper was prepared which outlines a process that the Coastal Commissions may use to develop subregional plans. The process provides both a means for controlling the cumulative impact of development and a framework for coordinating the commission's policies with the planning and management activities of local government, regional organizations and state agencies.

The environmental impact identification networks developed by research have been used to assist in the review of projects proposed for the coastal zone of California and other coastal states. These were reviewed and tested by the U.S. Geological Survey (Resources and Land Investigation Program) for application to the preparation and review of impact statements as mandated by the National Environmental Policy Act of 1969. The Geological Survey envisions using an approach similar to the impact identification networks developed by Sea Grant research. A coastal zone management library was developed which includes over 1500 documents and 2200 citations and has been

used by the staff of the Coastal Commission, coastal interest groups, and students. A bibliography was prepared to list documents on planning resources management and impact assessment. Two directories on state and federal responsibility in the California coastal zone were published. These directories, "Federal Involvement in the California Coastal Zone" and "State Involvement in the California Coastal Zone," are arranged according to topic headings (e.g., wetlands, oil and gas extraction).

Since 1973, the work by Sea Grant funded investigators in the San Francisco region has consisted of an in-depth interview, policy analysis, and writing effort devoted to the experience and future of the California Coastal Commissions, the six regional commissions, and related governments. This work enabled the investigators to act as consultants to the California Coastal Commission staff and to prepare the report entitled "Governing California's Coast," which was used by Coastal Commission staff in preparation of the planning element on government, powers, and finance. Another study explored future questions likely to confront decision-makers in trying to develop practical policies with respect to the seaward side of California's coast. A variety of topics were examined with respect to the seaward side of California's coast: particular attention was paid to governmental jurisdictions and private sector institutions having responsibilities in that geographical region. The information and findings will be published by the Institute of Governmental Studies and made available to policy-makers and decision-makers. Because of the study's emphasis on federal-state interaction, the findings should be helpful to the other regional, state, and federal agencies - in California and elsewhere - that have a continuing interest in what happens on the seaward side. Institutions in the private sector that may be involved in seaward-side development have also found the information and policy analysis developed by the project useful for their needs.

Living Marine Resources

A review of past studies of the benthic fauna of the San Francisco Bay-Delta System, and resulting attempts to assess the "health" of the Bay, has indicated that nearly all such studies have been of limited value because of a series of problems related to the taxonomy of the Bay fauna. Scientific literature for Bay-Delta fauna has been sparse, many organisms could not be identified by presently available keys, and there was no facility for the deposition of collected material. A joint effort of the California Academy of Sciences, San Francisco State University, and Sea Grant has been resolving these

problems by providing a reference collection central information source of all the benthic and intertidal invertebrate fauna; background information and bibliography on the taxonomy and biology of the various species; general information on the geology, hydrology, and history of the San Francisco Bay-Delta Area; a series of simplified annotated, illustrated identification manuals to the various invertebrate groups of the Bay-Delta System; a program to train students; and a permanent specimen repository. This project has provided assistance to many different types of researchers, formulators, and decision-makers, all united by a common need for detailed, accurate, intelligible, and readily available information concerning the Bay-Delta System and its invertebrate fauna. To date the private and public organizations that have used this project's results include the U.S. Geological Survey, Diablo Valley College, Regional Water Quality Control Board, the California Department of Fish and Game, various environmental consulting firms, and local governmental agencies.

The information derived from the cooperative Sea Grant research on the development of aquaculture systems will allow an evaluation of the economic feasibility of lobster cultivation by a future aquacultural industry by providing data on optimum diets and by providing techniques for controlling diseases, breeding, reproduction, and the continuous production of new generations of lobsters. The tanks, rearing facilities, and related technology can be applied directly; the water quality management and waste treatment technology can be used in the design of systems to maintain environment quality and to meet the ocean discharge requirements. The data from the Sea Grant studies of lobsters will be potentially applicable to the aquaculture of other crustacean species as well. The specially developed lobster foods and diets will provide the commercial feed industry with a basis for the production by them of products that will enhance their economic base. Research on Dungeness crab may trigger the future establishment of crab hatcheries that could provide hatchlings for tagged-release studies, restocking, aquaculture ventures, and laboratory test animals.

Economists have developed and maintained a computerized budgeting model for lobster production that provides a framework for viewing the technical problems of cost of production and production cost sensitivity, and is useful in determining research priorities in lobster aquaculture. Cost for lobster aquaculture was estimated at $5.65 per 500 gram/animal target weight in a closed system. The framework of this model is also generalized to many other species and systems, and other aquaculture programs have modified and applied the model to their projects. Other accomplishments include the publication of an annotated bibliography of recent papers with empirical estimates of demand relationships for fish

and shellfish and related studies, which has been requested by universities, industry, and governmental agencies. Work under this project benefits collaborating scientists in California and elsewhere in North America. In the longer run public and private researchers and decision-makers will have access to production, demand, and marketing output for species with potential for aquaculture. Aquaculture research will help to provide the means for economically feasible commercial cultures which will serve to increase human food supplies where natural stocks are insufficient to meet demand. Furthermore, culturing systems can provide local sources of highly valued fish where there are no locally indigenous stocks of the resource. These factors can reduce cost as well as increase supplies of high-quality protein to the consumer. The technology developed in aquaculture research can be applied to restocking and hatchery programs; therefore, the sound biological data and technical developments can enhance the effective management of the fisheries resource.

Research on saxitoxin, which is a paralytic poison sometimes present in shellfish and red tide organisms, has devised a 30-minute assay method about 100 times as sensitive as the methods presently used. It is reliable at low levels of toxin and can be applied at a reduced cost and with less training than the previous method. This new method of assay can increase the reliability of shellfish eatability tests thus reducing the incidence of illness to the consumer. The assay technique will also permit a longer season for commercial harvest since the shellfish beds will be closed for fewer days.

A methodology for reducing the discoloration in frozen tuna loins has been developed by vacuum packing. The cooked loins are sealed in a plastic wrap that is impermeable to water and air, and then frozen. This is an economical means for the tuna industry to enhance marketability. The resulting loins do not show the brown discolorations when subsequently thawed and canned. This research has been conducted in cooperation with seafood industries and the marine advisors, and furthermore the information has been presented to the National Canners Association and the United States Food and Drug Administration at their request. Edible coatings for fish products have also been tested and found to be effective while not imparting any off-odor or flavor.

When the tissue of fish degenerates with spoilage, an unappealing brownish coloration results. Lipid oxidation has been found to be partially responsible for this browning problem. Sea Grant research has established a previously unrecognized mechanism for the action of

numerous antioxidants, including some in fish meal which may further prevent the discolorations. The reactions elucidated the conversion process of nitrogen-containing antioxidants into active antioxidant forms, thus providing the basis for possible manufacture and use of these highly effective antioxidants. Commercial trials using these techniques have been made on salmon where the fish was shipped in refrigerated vans for a total transport time of six days and were found to be of the quality and appearance of day-old fish. Marketability was also shown to be good. These developments will greatly reduce potential spoilage which presents a public health hazard and an economic loss for the food packing industry.

In a related intercampus project, also stimulated by industry concerns communicated to the advisory service, scientists have investigated the causes of occasional illness from consuming scombroid fish (tuna, mackerel) and have developed a rapid, low-cost, thin-layer chromatographic assay for histamine in fish products. These investigations have also discovered that certain diamines present in toxic tuna greatly enhance the biological activity of orally administered histamine in laboratory animals. This continuing research expects the answers to major questions concerning cause and prevention of scombroid fish poisoning which has been economically disadvantageous to the seafood industry as well as a public health problem.

Trimethylamine (TMA) is one of the major components of the smell of spoiled marine fish. An increased TMA level is so characteristic of spoilage that the TMA levels have been used as an objective index of fish quality. A specific electrode was developed by Sea Grant funded scientists in order to simplify the measurement of TMA. This electrode is suitable for the measurement of TMA in aqueous solutions and in homogenates of fish muscle. The widely used colorimetric method involves several steps, is tedious, and the chemicals are toxic and expensive. Another method using gas chromatography is rapid and accurate, but the preliminary sample handling is tedious and the equipment requires a high initial investment, constant maintenance, and a cumbersome gas supply. The newly developed TMA electrode offers many advantages for fish quality control; it is fast, accurate, and economical to use. TMA determinations can be done with only a fraction of the materials, apparatus, sample handling, and time required for the conventional picric acid procedure. The electrode is much simpler and demands much less laboratory skill than the conventional method. The electrode's small size, simple operation, and simple instrumentation requirements recommend it for field work.

Sea Grant funded researchers discovered a substance in an alga that is active against herpes simplex virus. This potential break-

through in the development of an immunization for herpes simplex, -- a virus responsible for common cold sores, one prevalent form of venereal disease, and an eye infection that causes about 18,000 cases of blindness in the U.S. each year--is particularly promising because there are so few effective antiviral agents available for use in medicine.

Energy Resources

Knowledge of the effects of thermal effluents on benthic marine organisms is being sought by various agencies, (e.g., California Fish and Game, California State Water Quality Control Board, EPA, Nuclear Regulatory Commission, Energy Research and Development Administration) that are involved in setting environmental protection standards. Although standards are based entirely on biological considerations, they profoundly affect design and siting considerations of power companies. Sea Grant studies on the biological effects of waste-heat effluents from coastal power plants of Southern California Edison, San Diego Gas and Electric, and Pacific Gas and Electric supply data directly applicable to evaluation of these standards and may help reduce costs of locating, construction, and effluent monitoring and cleaning. Fear of adverse ecological impacts resulting from possible thermal pollution has caused strict regulation of the temperature regime of outfalls. These regulations are costly to the builder of power plants and in turn have their impact on the cost of power construction and eventually the cost of power. Furthermore, such studies have potential applicability to the utilization of "waste-heat" in aquaculture projects adjacent to power plants and thus are of importance in promoting energy conservation and improvement of local food production. In general the studies increase the body of information upon which to base the solution of engineering problems with minimal or at least predictable environmental consequences.

Waste Management

University investigators have been working with the State Water Resources Control Board to assess long term effects of toxicants and biostimulants in the waters of San Francisco Bay and have established an ongoing monitoring system. To help assess the "health" of San Francisco Bay, a low-cost towed, submerged environmental monitor has been developed and has monitored the distribution and dispersal of environmental "pollutants" for continuing assessment of the Bay. Also, a seawater analysis method has been developed to monitor the pollution parameters in the Bay. The methods developed by this project have been used to further improve environmental assessment and management of Bay waters.

Marine Data Acquisition and Dissemination

Advisory personnel in conjunction with Sea Grant investigators, and co-hosted by USC and the University of Washington, convened a timely workshop on State-Local Coastal Planning for Washington, Oregon and California. Comparisons were made of problems encountered in developing local coastal plans as mandated by acts of the respective states. As a result of this workshop, a network was established among the planners involved at the state and local levels of government. Follow-up workshops are proposed which will enable better cross-education through the exchange of knowledge gained as the states implement their coastal management plans.

A major Sea Grant advisory program effort, now in its fourth year, has been the initiation and coordination of the introduction of silver salmon in San Francisco Bay. The National Marine Fisheries Service-Tiburon Laboratory, the California Department of Fish and Game, and the Tyee Club of San Francisco cooperated in obtaining juvenile silver salmon from the State's Mad River Hatchery at Arcata to be placed in floating pens at Tiburon in San Francisco Bay for growth and release, providing a sportsfishing resource which did not previously exist. In the current year, more than 400,000 silver salmon were raised and released in five locations; San Francisco Bay at Tiburon, Tomales Bay at Lawson's Landing, and on Three Rivers in Mendocino County. There have been enthusiastic responses from sportsfishermen and commercial fishermen's organizations who actively support this effort of enhancing the salmon resource.

The San Francisco area advisor, in cooperation with the California Coastal Commission, Federal Aviation Administration, San Mateo Harbor District, San Mateo Planning Commission, Pacific Gas and Electric Company, and other agencies, assisted six commercial boat builders in getting boats, valued at approximately $420,000 and built a short distance inland, moved into launching position at Pillar Point Harbor. In addition to acting as liaison among the agencies and fishermen, the advisor explored the various alternatives and their economic feasibilities to allow passage of the boats. Through the efforts of this advisor, a cost savings of $7,050 to the boat builders was realized by determining that a permanent, taller pole was more economically feasible than the original plan--of placing the electrical wires underground.

In San Mateo County, the area marine advisor is facilitating the establishment of biological preserves within the state park system for the protection and culture of wild beach strawberry, a species indigenous to dune environments along California's central coast. The state's foremost authority on strawberry culture considers cross-

breeding the wild beach strawberries with commercial varieties to be a vital necessity in maintaining the productivity of California's 130-million dollar strawberry industry in order to build disease resistance, drought tolerance, salinity tolerance, and to reduce fertilizer demands.

However, residential development and recreational use of the coast now threatens the survival of the wild beach strawberry in habitats that can serve as a gene pool for crossbreeding purposes. The marine area advisor facilitated the establishment of a biological preserve for wild strawberries in Ano Nuevo State Park by bringing together county and state agricultural extension experts with staff of the San Mateo County Planning Department, the Coastal Commission, and the State Parks and Recreation Department. Additional biological preserves are being considered for other coastal parks to both serve the crossbreeding needs of the strawberry industry and to protect indigenous communities of coastal flora.

In 1976 the San Francisco Bay Fishermen's Association was formed, with the assistance of a local marine advisor, to sell and process herring and other fishes. Sea Grant advisory personnel held two workshops on cooperatives to help members get organized and aided with resolving technical problems of grading and processing herring for roe. Production of herring in the 1976-77 season was 195 tons, for which co-op fishermen averaged a price of $50 per ton over what non-co-op fishermen received for their catch. In the 1976-77 season, 11 co-op fishermen caught 164 tons of herring, and they averaged about $100 per ton more for their catch than non-co-op fishermen. Also, in 1977-78 co-op fishermen received $200 per ton in cash retainers which was used to purchase a $30,000 fish pump. More than 5 and possibly as many as 14 co-op fishermen received approximately $9,750 in 1976-77 and $16,400 in 1977-78 in additional earnings by being members of this cooperative. Furthermore, the co-op has helped set prices at a higher level at the beginning of the annual season and thus has benefited the fishermen through an increase in profit.

Marine advisors have also helped in coordinating gear studies with the equipment industry, scientists, and fishermen. For trawlers, various 3-strand wires have been obtained, and studies are underway to test for better trawl wire in terms of its breaking strength, corrosion, and wearability. Sound tests for boat noise and electrical system tests to reduce stray voltages throughout vessels have been conducted, and boat operators have been assisted in solving these problems.

A variety of local workshops have been coordinated and conducted by marine advisors and specialists and have been attended by more than 800 people. Programs have included diverse topics such as seafood exporting and processing, marine business and insurance, acoustics, seafood consumer education, and aquaculture.

MONTEREY BAY REGION

See Map A-1
(Page A-3)

Coastal Zone Resources Planning & Management

University personnel with Sea Grant support have assisted the California Coastal Commission (CCC) and the Governor's Office of Planning and Research in providing a technical and analytical basis for the preparation and review of local/subregional implementation programs. Local implementation programs are the major aspect of the regulatory system proposed by the Coastal Plan and Coastal Act of 1976. The need for state/local planning in order to deal with cumulative impact problems has been recognized by several states besides California in current program plans. An operational approach developed in California would be relevant for use in other states. In addition, the methods for cumulative impact assessment will be useful in the preparation of environmental impact statements for other governmental agencies. Testimony and advice were given to the legislative committees drafting the Coastal Act of 1976. The case studies of Half Moon Bay, Big Sur, and other geographical areas provided a useful test of the workability of the state-local system proposed in the Coastal Act. Testimony and assistance were provided on several issues, including the content of the local coastal programs, the appropriate inland extent of the coastal zone boundary, and the potential fiscal impacts of the legislation upon local units of government. The extensive data on environmental factors, land use, resources, property ownership, etc., collected for the Half Moon Bay case study area were used to explain the implications of policies proposed in the legislation. Through participation in a Coastal Act Task Force organized by the Bay Area Council, additional input was made. Since the Council is an organization representing regional business and industry, the task force provided a broad forum for discussing the implications of the research.

One of California's more acute coastal zone management problems is transportational access to the coastal recreational area. Levels of congestion on coastal highways and parking areas during the summer holiday and weekend periods are increasing each year. Congestion is particularly acute in beach communities on the outskirts of metropolitan areas and rural, two-lane sections of the Pacific Coast Highway. In most cases, the transportational access problem boils down to a traffic congestion conflict between visitors seeking coastal recreation attractions and residents of coastal communities. The recently enacted Coastal Act of 1976, recognizing this conflict, lays out several policies to prevent coastal residential development from impeding transportational access by recreational visitors. In response to a request by the California Coastal Commission, an analysis was designed to portray competition for subregional highway capacity between residents and visitors during peak recreation periods.

Two areas were selected for developing and testing the procedure: Big Sur and southern Orange County. A report describing these techniques was published and its information has been applied in preparing the Coastal Plan and in the preparation and review of the local subregional implementation programs. This report contains a review of related transportation and recreation methods, a presentation of existing data for each subregion, and a description of the application of the approach in context with the California Coastal Act of 1976.

In a cooperative Sea Grant venture, two small planning data banks, one for the North Coast of Santa Cruz, and one for Half Moon Bay Region, were assembled to demonstrate, through example, the advantages in cost of a sophisticated planning approach that would estimate cumulative effects of coastal development; test implications of proposed policies; and portray alternative futures in graphic and map form. Extensive data on environmental factors, resources, land use, public service systems, property ownership, and assessed valuation were collected and analyzed in context with the proposed and adopted coastal commission policies. The data bank should enable local government and other interested parties to apply, test, and evaluate the CCC policies for plans to manage cumulative impacts of coastal development.

These university personnel have assisted the CCC, the Legislature and local government agencies in effectively meeting their responsibilities related to the planning and management of California's coastal resources by analyzing the socio-economic impacts of various growth alternatives utilizing the Coastal Plan as a guideline. Results of this research have been included in the California Coastal Plan.

Studies have also estimated the local government cost and revenue impacts and the private sector impacts of six hypothetical residential and commercial growth scenarios for a 58 square mile coastal watershed basin surrounding Half Moon Bay. Generally, the analysis indicated that the more growth there is, the more per person public service costs tend to exceed government revenues. Furthermore, the analysis indicated that more development leads to more private sector economic activity. The government expenditures exceed revenues by an ever increasing margin on a per person basis as the population gets larger. The ever widening gap is caused primarily by the additional water and wastewater capital costs.

It was found that the adoption of the Coastal Plan could cause geographical shifts of various kinds, but these would be localized effects. Case studies as used in this research reflect the rural-urban diversity of the state allowing evaluation of impacts to be politically relevant to legislators representing diverse areas in the state.

Coastal and Marine Recreation

Public and private owners of beach and dune areas will benefit from the study of beaches and dunes that indicates that management of beach and dune vegetation will reduce erosion, promote sand stability, and increase community stability so that increased human use of the land will be possible. Those who live just inland from such areas will similarly benefit from reduction of shifting sand that tends to invade adjacent inland areas. Morro Bay, Bodega Bay, and San Diego communities, for example, have recurring dredging expenses because of sand movement. National, state, and local parks on beach and dune land will benefit by information on how they might reclaim severely disturbed areas and maintain them in some condition approaching natural diversity of plant cover and landscape indigenous to that region of the state. This work is a cooperative effort with the U.S. Park Service through Point Reyes National Seashores. Researchers are also estimating manpower and resource (water and fertilizer) costs for establishment of native plant cover on coastal dunes. Such data will facilitate state and local governments as well as individuals in determining the resources necessary for reestablishing and managing the dune systems.

Living Marine Resources

The development of salt-tolerant crops able to use seawater or brackish water would be a revolutionary development for crop development, using less costly, naturally rich in mineral nutrient saltwater and rendering useful resources that are not only useless for crop production but actual threats to it (coastal areas, wetlands, etc.). Research investigations have developed barley and tomato strains with commercial market potential which show tolerance to seawater.

Seawater contains high concentrations of most of the major plant nutrients - potassium, calcium, magnesium, and sulfur. At the present time, only nitrogen and phosphorus will have to be added, and there is promise that the limitation can be overcome. Seawater also contains adequate concentrations of all micro-nutrients (trace elements). But both the water and the nutrients it contains are useless for crop production because of the high salt content of seawater and sensitivity of existing crops to that salinity.

The creation of salt-tolerant crops would tap that immense resource of water and nutrients and would do so with large savings of energy (pumping of irrigation water and use of fertilizer). For crops on small areas (like tomatoes), seawater or brackish water hydroponics would be suitable.

In view of the world food and energy situation on the one hand, and of existing and impending scarcities and high costs of fertile land, good water, and fertilizers on the other, this project represents a timely enterprise.

News of the successful field test of seawater-irrigated barley resulted in a flood of inquiries from people and agencies, including various businesses in California, the U.S. Department of Agriculture, universities, and foreign nations.

The yield of the best strains of barley developed to date are better than one half of the world yield but also less than one half of the U.S. yield. For 1975, the mean world yield was 1710 kilograms/hectare (1527 lbs/acre) and the U.S. was 2370 kilograms/hectare (2116 lbs/acre). True sand (that is, sand low in silt, clay, and other organic matter) is the best. With true sand there appears to be no retention of salt, and the same area can be used indefinitely because the good drainage would provide for return of the seawater to the ocean.

As part of an intercampus study, Sea Grant investigators are developing strategies to modify energy flow and nutrient cycles within kelp beds to produce human food and other marine products within the carrying capacity of these ecosystems.

Data has been collected on energy flow, population dynamics, and ecological interactions within the kelp forests of the Monterey Bay region in order to develop sound kelp harvesting strategies and manipulation of important grazers and predators for optimal utilization.

Most of the work is being done within the kelp forest of the Hopkins Marine Preserve off Pacific Grove, California. This kelp forest is within the established range of sea otters, which are particularly important predators regulating herbivore densities. Studies there have concentrated mainly on the production of giant kelp, which is a major energy base for animals within and beyond the boundaries of the kelp forest. Studies are also being done off Santa Cruz Point, Santa Cruz, California, outside the established range of sea otters, where large populations of sea urchins limit kelp production.

This program has provided information about the dynamic interactions of economically important resources for industry, commercial and sports fishing, and recreation within the kelp forest habitats of central California to better enable sound management. In particular, data had been acquired on the production and disposition of drift kelp, the major food base in these forests, and on the influence of sea otters on community composition. This information has been used by the Central California Coastal Commission, California Department of Fish and Game, and other governmental agencies for better understanding of this rich

and productive marine habitat by the public, and to help provide guidelines for the regulation of human coastal activities which may threaten or modify the maximum potential of these forests.

Investigators funded by Sea Grant have completed an assessment of the availability of standing crops of the seaweed Iridaea cordorata on the central California coast and have found them to be larger than those in the Pacific Northwest and similar to those of Chondrus crispus now harvested on the East Coast. Researchers have also determined the optimal seasons for harvesting the most-needed type of carrageenan which has numerous uses in the food, biomedical, pharmaceutical, brewing, and textile industries.

The quality and quantity of carrageenan extracted from West Coast Iridaea is comparable to that from the commercially harvested East Coast Chondrus crispus (L.) Stackhouse, which is presently our only developed domestic source. Since we now import to meet our needs, the large West Coast Iridaea crop is a valuable potential resource. The studies on the distribution, population biology, nutrition, seasonal crops, and growth will contribute to the sound management of natural or mariculture Iridaea crops.

In addition, this information is an important assessment and contribution to the basic nutrition biology of the marine algae in general and for the development of a mariculture program.

This intercampus effort is also designed to better understand the potential production of carrageenan, which is used extensively as a stabilizer-emulsifier in the food and pharmaceutical industries. Through this study genetic methods to select and hybridize strains will be employed for the improvement of kappa-carrageenan production, and high yield kappa-carrageenan for Iridaea cordata crops will be developed through experimental manipulation of a net aqaculture system.

Furthermore, the techniques developed and the genetic strains obtained through this research may be valuable in developing more seaweeds by hydrocolloid industries in the U.S. and elsewhere. This is one approach toward alleviating the current carrageenan shortage (demand is perhaps 10-20 times greater than present resources provide).

The California market squid is one of the last remaining underutilized species off the California coast. The extent to which the

the harvest of this animal could be increased is presently unknown but appears to be substantial. The world market for squid is expanding, yet there is some fear that the resource could be overharvested.

In order to facilitate an expanded harvest of Loligo opalescens and its rational management, a cooperative Sea Grant/California Department of Fish and Game/California Marine Research Committee program has been assembled. The results of this program have been applied to assist management agencies and the fishing industry in devising methods for increased harvest of squid in determining acceptable levels of harvest to insure that squid are utilized on a sustained yield basis and in assessing the impact of an increased squid harvest upon other living resources of the California Current by investigating what squid consume, what they compete with, and the extent to which other species are dependent upon squid as a food resource.

Also, the California Department of Fish and Game used Sea Grant research results in providing management planning input for California marine resources to the Regional Fisheries Management Councils. This management planning process on the part of the Department regarding market squid has been influenced by the increased information now available as a result of this project.

In the Northeast Pacific Ocean, a large potential catch of squid, Loligo opaliscens, is estimated at 600,000 tons/year. However, landings around Monterey amounting to 15,000 tons/year are attributed to the low utilization of the resource. The major reasons are generally low acceptability by the consumer and extremely high costs of cleaning squid before cooking. The low acceptability is usually related to the appearance of raw squid and the tedious work of cleaning, skinning, and the removal of tentacles. If, on the other hand, the consumer is given a clean fillet of squid, the acceptability of the product should increase. The handling and cleaning of squid by the seafood industry currently are done manually. With high costs of labor, the cleaning operation is unusually expensive. Thus, it appears that if a machine is developed that will automatically clean and skin squid, the operational costs will considerably decrease and consumer acceptability of the product should increase. Through advisory service, instigation and industry cooperation, an automated squid processing has been developed by Sea Grant funded scientists. Since the now prohibitive processing costs could be reduced, making squid cleaning economically feasible, a substantial increase in utilization of this resource would likely follow. The seafood industry would be able to inexpensively process enough squid to allow for new product development, such as battered squid fillets, squid-fish sticks or patties, or snack foods. One large restaurant chain now spends up to $10,000/year on squid cleaning. Such costs

could be effectively reduced. The current manual cleaning costs vary from $0.60 to $1/lb of cleaned squid and takes about 30 seconds per animal. Initial estimates indicate that cleaning costs by machine will be considerably reduced. The engineering analysis is anticipated to provide information which would lead to improvements in processing other seafoods. The experience gained in developing a squid cleaning machine will be used to improve other unit operations in the seafood industry. This is an indirect benefit which could have significant effects on future research in this area.

Energy Resources

Scientists funded by Sea Grant have completed a survey on parasites in fish living in the test and control areas of Diablo Cove and adjacent coves to establish baseline data for environmental monitoring of thermal pollution from coastal power plants. This type of information on the effects of thermal pollution on the numbers and activities of parasites of fish can be of major importance in power plant design and aquaculture of fish. The advantage of rapid growth and development of fish living in warm-water effluents may be offset by an increase in numbers and pathogenicity of some of their parasites, thus seriously compromising the expectations of planned fish farming. Individuals and agencies engaged in mariculture of fish and people concerned with commercial and sport fishing will benefit from the results of our proposed studies.

Marine Data Acquisition and Dissemination

There has been an approximately 5000-ton decrease in squid catch since 1974. This decrease appears to be the result of poor squid returns to the traditional fishing grounds off Monterey. However, squid populations occur off the coast that are not being utilized by local fishermen with their traditional fishing methods. It is anticipated that squid landings in Monterey will be increased to their former level of 7,250 tons through the advice of marine advisory personnel on altering gear for midwater trawling and acoustic location of squid populations. A 5000-ton increase to the former level of squid landings would have an annual value to the fishermen of $1,000,000, based on 1977 landing statistics.

The marine advisor in this region helped initiate the Monterey Bay Salmon and Trout project. This citizens' non-profit aquaculture research group, which, with marine advisory staff leadership, Sea Grant, and other university research support and industry cooperation, is a continuing organization that has developed effective pen design, water quality assessment, and handling of fish for salmon and trout rearing.

Through a cooperative, inter-university marine advisory workshop, Monterey Bay area harbor managers and local economic development officials were provided information on methods of determining recreational boating demand.

More than 35 other workshops have been conducted by marine advisory service personnel for the commercial fishermen and processors and for the general public in the Monterey Bay region. Over 2200 people have attended these workshops on seafood exporting, marine business and insurance, acoustics, albacore fishing, underutilized fisheries, seafood consumer education, oceanography, and the description and application of the satellite imagery program for commercial fishermen.

SAN LUIS OBISPO/SANTA BARBARA REGION

See Map A-1
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Living Marine Resources

The kelp beds of California are highly productive and unique ecosystems that are used extensively as a source for alginates, fish, and shellfish. However, the primary producers in these forests, the marine plants (kelps and agar weeds), are still uncultivated, "wild" plants. Efforts by the California Department of Fish and Game and by Merck are being made in the reforesting of the harvested southern California beds. While these "hand-planting" efforts are proving to be effective, Sea Grant scientists are searching for less labor-intensive methods of utilization and management.

Resource Management studies of the giant kelp, Macrocystis, have been supported by Kelco Company and Stauffer Chemical Co., commercial kelp harvesting firms in California. The standing crop of Macrocystis, a plant used for the production of algin, and its rate of growth and plant mortality have been estimated; work toward a resource utilization model for this most valuable California marine crop plant has been carried out. It is estimated that the annual value of some 122,447 metric tons (wet) harvested in 1968 was worth between 1.6 and 2.6 million dollars. A management model would serve to maintain the optimal sustainable yield and may ultimately be used by the California Department of Fish and Game for conservation purposes as well as by the commercial kelp industry to enhance and continue harvesting of Macrocystis.

Extensive resource management studies on the agar weed Gelidium have also been conducted. The consumption of agar in the U.S. is in excess of one million dry pounds per year, with about 40% of this going to laboratory, pharmaceutical, and medical uses, 30% to bakery and confectionery industries, 10% to meat packing, and the rest to other uses. In 1973 the Gelidium harvest in California was approximately 800 metric tons (wet weight), the value being $360,000. In 1969 the Japanese harvest was 15,700 tons (wet weight), the value being 3.49 million dollars. The U.S. imports (through San Francisco) approximately 600 dry tons of Gelidium per year (1973). The infant Gelidium-harvesting program model which has been developed incorporates elongation rates, seasonal agar contents, and the seasonal variation of harvesting efficiency - and other factors - to arrive at an optimal harvest policy. According to this model, a natural population will have about 500 grams per square meter as a standing crop. If this is harvested and the population is allowed to recover for 14 quarters, the standing crop will be 900 grams per square meter and can be harvested again with mimimum effects on the survival of the population. A shorter time between the initial and subsequent harvests will produce significantly smaller yields. Changes in variables and functions allow one to use the model to predict yield under various management schemes. This management tool can be used extensively by California agencies regulating marine resources, as well as by the kelp industries to optimize management and harvesting of Gelidium.

Standing crop and economic estimates of natural populations of Porphyra nereocystis were studied, and some management guidelines for improving yield were established. This marine plant previously had never been harvested in California, yet it is estimated that $40,000 worth of Porphyra seeds itself, grows and dies yearly on the 55 miles of coastline study area. Furthermore, there appears to be a distinct possibility of increasing standing stock of this algal crop by a factor of 15, resulting in a potential value exceeding one-half million dollars a year. Distribution of Porphyra nereocystis along the 55-mile stretch of California coastline was determined and preliminary harvests were made. Evaluation of the feasibility of a small-scale harvesting operation and commercial "nori" sheets were evaluated, and it was determined that 390,000 nori sheets could be produced from this study area, with a value in excess of $23,000 (1970). Now, the California Department of Fish and Game is considering leasing areas for extensive Porphyra harvest.

Through application of this intercampus research there have been new approaches to the direct manipulation of highly productive coastal zone ecosystems as well as the provision of assistance and advice for individuals and groups. The accumulation of hard data from these investigations is essential for any national assessment and management of Californian marine plant resources. Results have been utilized by industry and the government and have assisted the Department of Fish and Game in surveying sites for monitoring studies of sea otter effects on kelp beds.

The concern over these resources is reflected in the actions of agencies of the State Government and Stauffer, Merck Chemical and American Agar Companies, whose raw materials now come from publicly owned kelp forests that are leased from the state.

A major accomplishment of political scientists funded by Sea Grant has been the completion of a report, "Management Approaches for Marine Fisheries: The Case of California Abalone," which has immediate relevance and application to present legislative, administrative, and industrial efforts for the solution of continuing critical problems in the California abalone fishery. Limited entry to this fishery has been established; however, the specifics for this needed regulation of enforcement had not been investigated.

The results of this research effort that analyzed the various approaches and problems to managing limited entry have been of value to state and federal level public officials and to industry representatives. It has provided a comprehensive data base useful as background information both to policy makers and to industry representatives. The examination of existing limited entry programs and explicit comparisons with analogous industries will identify pitfalls

to be avoided in the drafting and implementation of regulatory policies for the fishing industry. Evaluation of alternative management options in terms of their political and administrative feasibility and their economic and human impact support specific policy recommendations (and criteria for evaluation) that should, at a minimum, serve as focal points for discussions among public officials and industry members. The principles investigated on abalone are also broadly applicable to management of other fisheries. Results and copies of the project report have been and will continue to be made available to State of California legislators; administrators, biologists, and enforcement officers of California Department of Fish and Game; members of the Pacific Regional Fisheries Management Council, NMFS, abalone fishery groups, and individuals; all major processors; the California Abalone Association; and 50 individual divers, officers of 66 sport diving clubs, and the California Seafood Institute. Other organizations include Friends of the Sea Otter, Sierra Club, and the Tuna Research Institute.

Sea Grant investigators, in cooperation with state laboratories and the Santa Barbara Mariculture Foundation, have discovered an inexpensive, safe and reliable method, by which a small amount of hydrogen peroxide is added to seawater to induce the synchronous spawning of male and female abalone, oysters, and mussels. As difficulties in the control of reproduction have presented the greatest obstacles to the economical development of all shellfish mariculture industries, this discovery may have numerous applications in both mariculture production as well as the genetic management and improved breeding of these protein-rich and highly palatable food resources.

Marine biologists funded by Sea Grant have turned a drawback for aquaculturists, the fragility of early larval marine fishes, into an advantage by using the delicate young fishes as indicators of environmental changes and dysfunctions. Methods have been developed to mature and spawn a variety of marine fish in captivity to provide for these experiments. Laboratory investigations on rearing marine fish larvae have shown that larval fishes can be used to detect pollutants in seawater at concentrations which could not be detected by other means. At the time of the Santa Barbara oil spill, these investigators applied the anchovy larvae technique for determining toxicity of the oil spill disperant Corexist. Further investigations, using the techniques devised under Sea Grant, are now part of a larger effort by NMFS to determine the recruitment of fishes in the sea as well as to further research on the detection of pollutants. The Environmental Protection Agency and the U.S. Army Corps of Engineers have shown interest in this technique. Also, the information resulting from this project has, in part, been used by aquaculture researchers to improve their understanding and to enhance development of fisheries aquaculture.

Marine Data Acquisition and Dissemination

Advisory staff, assisted by Cooperative Extension and the Costagnola Fish Company, held a seafood seminar to familiarize consumers with fish species, selection, handling, and cooking. More than 250 local consumers attended four more of the popular consumer-seafood education workshops which were held in the Santa Barbara area. A cooperative multiuniversity and area marine advisory study has been investigating minced fish products obtained from northern California fish. The marine advisor, in conjunction with other advisory personnel and 4-H youth club members, served seafood specialty samples to more than 1800 people at the 1977 annual Santa Barbara fishermen's festival.

Sixteen other workshops have had more than 1000 participants on topics in seafood consumer education, salmon aquaculture, marine financial assistance programs, satellite images used in fisheries, LORAN-C, and sharks and shark fishing.

Courses have also been prepared and presented by University researchers to assist Ventura County School teachers in developing courses about the ocean and the Department of Harbors in enhancing the coastal and recreational potential of the region. To help continue this rapport with the local citizens, newsletters by the Advisory Service are devoted to helping educate the public on a local, day-to-day basis.

An interdisciplinary project among Sea Grant researchers, the California Department of Fish and Game, and local marine advisors is studying the scientific and economic feasibilities of different methods for enhancing abalone populations in depleted areas. The local marine advisors in Santa Barabara and San Diego have organized meetings to familarize and discuss the experimental abalone enhancement project and concerns with this resource. These meetings have been valuable for exchange of ideas and assistance among researchers, investigators, divers, and government officials. Studies have led to the description of red and pink abalone local nursery grounds. Further experimental approaches to abalone enhancement include transplanting of adult abalone, seeding of hatchery-reared juveniles and of larvae, as well as temporary habitat modification or restriction to improve natural recruitment. Many of these efforts grew out of previous Sea Grant funded research.

With the assistance of the San Luis Obispo/Ventura/Santa Barbara marine advisor, communication and cooperation has been established among fishermen, oil companies, and the government regulatory agencies. Work is now under way to identify, map, and in some cases remove these obstructions.

One important problem that trawlers of groundfish and shrimp face in the Santa Barbara Channel area are uncovered oil wellheads and core hole pipes that have not been cut below the surface of the ocean floor. Most of these obstructions have not been charted, and a net snagged on one of these obstructions nearly always results in the loss of trawl gear. If the entire net and outer doors are lost, the cost often runs to $5,000. This cost is in gear alone, and the loss of fishing days must also be considered. The loss of production affects the processor, the income of his employees, and the retailer, who may not be able to obtain fresh fish locally. These costs cannot be figured directly but can be considerable, especially when people are out of work due to loss of fish production. There is one particular wellhead in the Channel trawl grounds which has claimed over $10,000 worth of gear alone from four different trawl vessels.

There has been a promise to remove the one wellhead previously mentioned, and progress has been made in obtaining locations of other oil industry-related obstructions. A protocol has been developed for reporting the loss of gear and determining the responsible party. There is still much to do in refining this process and in obtaining information on exact locations of uncovered wellheads and core holes. Work is continuing with both the U. S. Bureau of Land Management and the U. S. Geological Survey to assure that these conflicts are minimized in future offshore oil developments.

This project could save each trawler in this area thousands of dollars each year in gear costs and production losses. It may also open new areas to trawling where it traditionally had not been feasible due to obstructions.

LOS ANGELES REGION

See Map A-1
(Page A-3)

Coastal Zone Planning and Management

Sea Grant seeks to be an active link between the University and the public - working together to solve local problems. It achieved this goal, and more, with one particular project.

Working with local and regional public officials, agency representatives, and citizens, Sea Grant project leaders prepared a specific subregional plan for Marina del Rey. In the process, the project illustrated both the importance and feasibility of citizen participation in coastal planning. Further, the Plan itself received much attention. The information on future development, potential traffic congestion, and public access has been used by the Coastal Commission and Los Angeles County in issuing permits. It also won the 1976 Southern Section of the American Institute of Planners (AIP) award for community planning.

Case studies conducted by the staff of the California Coastal Commission in Huntington Beach and by Sea Grant investigators in Marina del Rey were used to test the transferability of the analytic steps to all local units of government within California's coastal zone. A report was completed that describes the step-by-step process that local governments should use in developing a coastal plan that conforms with the coastal commission's policies.

Another example of Sea Grant's successful response to local identified needs concerned the public debate on the future environmental quality of the coastal areas within the state. On one end of the scale were those who believed that any use of the coastal zone threatened to degrade and defile nature, while at the other end, there were many who believed that the coast is a resource for human consumption and should be planned to maximize that consumption. So it was that the question of aesthetics in the urbanized coastline became one of the most frequently debated planning issues in the public forum.

Sea Grant investigators developed a framework for managing the aesthetic resources that consisted of a methodology for developing a visual quality index for the coastal zones; planning policies for preservation and protection of suitable areas; and for reclamation, enhancement, and augmentation of public experience in urban areas of the coastal zone. The framework was incorporated into the South Coast Regional Commission's Appearance and Design Element for the Coastal Plan.

Sea Grant's interest in effective coastal zone planning and management can also be found in several courses on that subject which it sponsored at the University. Out of its first "Laboratory/ Workshops in Coastal Zone Planning" came students who have been of direct help to the State as they assumed new roles in the City of Long Beach Planning Department, the US EPA, and the California Coastal Zone Conservation Commission.

These functional laboratories obviously did not work in an academic vacuum, and to further testify to this point, two instances need be cited. First, during the summer of 1973, five of the laboratories' participants worked for the Coastal Commission and on the Regional Commission's Transportation Plan Element. Secondly, a joint California Marine Advisory Program (CMAP) publication entitled Procedures and Programs to Assist in the Environmental Impact Statement Process was produced which was a prototype study, requested not only by State officials, but by planning professionals all over the world.

The development of ocean resources has major impacts not only on the resource base of the national economy but also on economic and social conditions in coastal regions. This latter aspect has not received much research attention. Yet, especially in the cases where the exploitation of ocean resources creates potentially serious environmental risks (e.g. the onshore facilities associated with extraction of offshore energy resources), the implications of ocean resource development for coastal populations are an object of serious concern.

Unfortunately, the economic and environmental impact methodologies currently in use do not provide satisfactory estimates of these impacts. The main reason for this is that they focus on net impacts; i.e., the direct growth-inducing effects of the development, such as the increases in output or jobs created. Particularly in a highly urbanized region such as southern California, a major new development such as a large onshore terminal facility will lead to a number of complex offsetting changes that cannot be measured with a net impact model.

A Sea Grant project was initiated to develop and refine a gross impact model for a metropolitan region which would assess the effects of terminal facilities related to outer continental shelf development on population, employment, and economic activity within subcounty size jurisdictions. The results of the research will be disseminated to local planners, public officials, and citizen groups to enable them to identify the implication that offshore resource development will have for their communities; it will also be given to the Coastal Commission for accurate investigation of feasible alternative locations for onshore facilities if that step be necessary.

Case studies were performed by Sea Grant investigators on park acquisition in Laguna Beach, Orange County, and for Marina del Rey. The Laguna Beach area was one of the Commission's pilot local coastal planning programs. Several acquisitions of open space land were proposed within the city's jurisdiction. One of the major issues that emerged was the potential fiscal impact of proposed park acquisition. In cooperation with Laguna Beach, Orange County, state agencies, and the South Coast Commission, this study was made of the cost/revenue effects of such park acquisition in the city of Laguna Beach. The Commission envisioned that this issue would continue to be a source of debate in future planning efforts and is using this case study to obtain a better dimension on future economic costs of park acquisition.

It was found through scientific research that man-made structures in the nearshore off southern California do affect the surrounding soft bottom community. Fishes attracted by artificial reefs annihilate sea pens (a benthic organism) over a considerable surrounding area. Oil platform structures also tend to cause an organic build-up in the sediment, and this leads to an increase in deposit feeding animals around the structure. Southern California Coastal Water Research Project (SCCWRP) used the results of Sea Grant research underneath Oil Platforms Hilda and Hazel in their report on oil platforms. The results of this work underneath Oil PLatform Eva were also reported to the Los Angeles office of the U.S. Bureau of Land Management in conjunction with their assessment of environmental impacts of offshore structures.

Coastal and Marine Recreation

University personnel with Sea Grant support worked with the County of Los Angeles, Department of Beaches. Researchers have inventoried the coast's topography and underwater ecology and assisted in the formulation of a coastline recreation plan and the citing of the underwater park at Abalone Cove and of the future park at San Nicolas Canyon which have been acquired by the County for park land. These parks enhance the recreational areas available to the people of southern California as well as help maintain the marine environment for continual recreation and study. The report on the underwater inventory has been widely used in the County of Los Angeles by groups involved in the planning, development, and management of the coastal zone, including the California Department of Parks, the regional and state Coastal Commissions, Standard Oil of California, Southern California Edison, real estate developers, and contractors.

The diving safety research project conducted by Sea Grant investigators has and is continuing to improve the understanding of the requirements for safe, effective diving. This research encompasses training, equipment, adaptation responses, and emergency procedures as well as the development of instrumentation and of methodology for the evaluation of diving equipment. By consulting with diving manufacturers, new, safer equipment is being developed. Results of this study are interfaced directly with concerned agencies such as L.A. County Departments of Beaches and Parks and Recreation, instructor organization, national life saving groups, emergency services personnel, health and safety advisors, equipment manufacturers, and retail organizations with programs involving diving. Modification of the attitudes of various training agencies is being affected by this research, and information is being widely disseminated with regard to adequate learning and reinforcement schedules for critical scuba skills.

Living Marine Resources

Red tides are an increasingly prevalent phenomenon in coastal waters and harbors of developed countries. In many areas of the world, they have been linked to unpleasant odors, the mass mortality of sea life, and human poisonings. However, the organisms which produce red tides may well play an important role in the food web under certain conditions. Further, in harbor conditions, where the level of nutrient effluent can be controlled, the red tides could eventually be used to augment fish production. This innovative way of looking at a seemingly "bad" environmental phenomenon has evolved from the work of Sea Grant researchers.

The results of this particular project will enable water quality monitoring agencies to accurately gauge the impact of red tides upon the harbor plankton biota and will permit fisheries management analysts to assess and possibly predict fish abundance through monitoring their food resources.

The fishery for California's spiny lobster (Panulirus interruptus) once was a valuable enterprise. From peak landings of nearly one million pounds in the 1950's, the commercial fishery has declined steadily to the point where the 1974 harvest was the second smallest since 1888. The severity of this decline in commercial production prompted a California Department of Fish and Game investigation. Since the survival of juvenile lobsters will determine the adult population size in future years, it was essential to learn more about the juvenile stages in order to increase the number of marketable lobsters.

Surf grass is a submersed marine vascular plant that grows in dense beds on surf-swept rocks just below the 0.0 tide level. Recent Sea Grant studies indicate that these grass habitats are occupied by juvenile lobsters.

During the past three years, Sea Grant has studied the relationship between surf grass and young spiny lobsters. With data gathered during this project, a proper management and development program can be devised for both the surf grass and lobster resources so that neither will be adversely affected by coastal zone modification; and both sport and commercial lobster fisheries can be enhanced, for example, by the creation of new surf grass habitats through transplantation programs.

Marine Mineral Resources

Acquisition and collation of oceanographic data on southern California for EIR preparation has been conducted for the Federal Power Commission and California Regional Water Quality Control Boards. Marine baseline data was developed for Pacific Lighting Service Company to utilize in filing for a Federal Power Commission permit, and cooperative research is ongoing.

Oil and tar seeps off southern California have been analyzed for the State Lands Commission in order to determine natural and man-made oil slicks and potential petroleum locations.

Due to the reopening of oil and gas leasing on the southern California outer continental shelf, the importance of recognizing the environmental effects of man-induced petroleum spillage versus that which is a result of natural cases has been amplified. One very important aspect deals with the interaction of floatable oil and tars with commercial and recreational facilities such as beaches. The problem is innately two-fold: environmental and aesthetic.

Earlier Sea Grant sponsored studies have investigated the relationship of natural seepages in geologic structure on the shelf between Point Conception and Newport Beach, using high resolution seismic profiling. Results indicated that most seepage could be associated with geologically youthful structural trends which are fault-controlled and generally occur in areas with little or no cover by unconsolidated sediments. In such areas, faults and/or truncated strata often intersect the sea floor.

Structural studies now include the relationship of seismicity to regions of active seepage. Inasmuch as areas of seepage are prime targets for offshore drilling, the seismic data is particularly

useful in assessing earthquake risk (ground slippage, shaking, slumping, etc.) and blowout potential associated with drilling and platform deployment in such areas.

The research so far has uncovered a previously unknown gas-seep province offshore and has produced an up-to-date, active fault and seismicity map of the coastal zone. This map is available to the public through the California Division of Mines and Geology.

The Sea Grant investigators, in cooperation with the California State Lands Division, have initiated an assessment of offshore sand and gravel potential of the southern California coastal zone. Reports by various state and local agencies have emphasized the fact that onshore deposits of sand and gravel aggregate will be in short supply in the major southern California metropolitan areas within the next 10-20 years. Environmental and urban pressures are combining with the high-cost economics of transportation to increase this problem. Aggregate is vital to the construction industry, which is already beset with depressed economics. Alternate sources of supply which are environmentally and economically acceptable must be explored. Part of the Sea Grant effort has been centered in San Pedro and Santa Monica Bays. Potential sources of aggregate, free of Holocene overburden, may occur at the mouths of Ballona Creek and the San Gabriel River in the form of relic channels and Holocene discharge and/or backfilling concomitant with eustatic sea-level rise. An estimate of the extent of the Ballona Creek deposit is 1 square mile by 30 feet thick (30,000,000 cubic yards), which makes it potentially of economic importance. As an example, in terms of onshore economics, this deposit might be roughly 50,000,000 tons which would be equivalent to $100,000,000 and about 25 years of continuous operation. Potential sources of sand for beach replenishment exist 2 to 3 miles offshore in Santa Monica Bay. For example, one deposit is about 3 square miles, is an average of about 30 feet thick, and is covered with less than 20 feet of Holocene material. This would be an ample sand supply for Santa Monica Bay beaches for several decades - perhaps indefinitely.

Waste Management

For some years, Sea Grant investigators have been monitoring on effluent discharges into the Los Angeles Harbor from the local tuna canneries. This research has assisted in developing data on the potential bioenhancement to receiving waters by the cannery wastes.

Since the cannery business is international in scope, the results from the research, either positive or negative as they reflect on cannery wastes, will be of importance to several developed as well as developing areas of the world. If the data continues to show a positive nutrient input to the harbor ecosystem, this may save the canneries from 1 to 1.5 million dollars for the initial hook-up to a special sewer arrangement. This is not even considering steep monthly charges for its continued use. The Cannery Steam Company estimated that because of this data which gave water quality officials positive input on cannery wastes, a two-week shut-down was avoided in 1976. In dollars, this adds up roughly to $25 million in sales and employment for that two-week period, based on sales approximately $2 million/day with 5,000 employees out of work. Because of testimony made by the investigator of this Sea Grant project, a permanent shut-down at Star Kist Tuna was avoided which would have put approximately 2,300 employees out of work for an indefinite period of time.

In response to a mid-year request from the California Coastal Zone Conservation Commission for information regarding the quality of storm water discharge from small drainage systems, the Los Angeles County Flood Control District (LACFCD) and the Sea Grant investigators jointly undertook an effort to investigate the environmental quality of storm runoff to the ocean from small drains.

The problem rested on the fact that as a regulatory agency charged with responsibility for the protection of the coastal environment, the California Coastal Zone Conservation Commission required scientific data on possible water quality effects in order to act on applications for construction in the coastal zone. However, it was up to the Los Angeles County Flood District, the operational agency with specific responsibility for flood control, to upgrade these types of facilities, especially in areas that were not served by large drains or channels.

In order to assist both governmental parties, an 18-month study was conducted on the characteristics of surface runoff - both dry weather stream flow and storm water runoff - and their possible ecological impacts on the southern California coastal waters in terms of pollutant loading. Tests run on samples determined the following characteristics for each discharge site: general characteristics; oxygen consumption effects; aesthetic effects; toxic effects; and biostimulants. Results to date indicate that the ecological impact, if any, of pollutants discharged into coastal waters would be an intermittent, short-term effect. It is expected that total concentrations of contaminants would be rapidly reduced to acceptable levels by tidal action and prevailing ocean currents.

Also, land use patterns are believed to have an impact on the character of the storm waters. Directions indicated for further study might include collection of water samples from street surface runoff in different areas as a means of further evaluating contaminant loading from the various land use patterns.

This information, reported to the Los Angeles County Flood Control District, has been used to set guidelines for permit applications to construct drainage systems in the coastal area and as design criteria for planned storm drainage projects.

Marine Data Acquisition and Dissemination

Sea Grant research and education programs have benefitted the people of Orange, Los Angeles, and Riverside Counties. The "California and the Ocean" curriculum course has assisted Orange County school teachers in developing classes about the ocean environment. Local adult education and post-professional legal education courses have presented material taught and prepared by Sea Grant researchers on coastal zone environmental management.

The South Coast Coastal Commission assumes a two-fold responsibility - regulation and planning, as do the other regional commissions. Because of the numerous development permit applications, the Commission in cooperation with the Sea Grant Marine Advisory Services developed a SCORECARD system.

The key to the SCORECARD concept is the utlization of a computer to maintain a comprehensive management system on the permits. The variables used for classifying the permit applications include physical location, physical characteristics, economic characteristics, and administrative characteristics. The SCORECARD also provided the Commission staff with a synthesized, empirical and accurate accounting in perspective. The SCORECARD takes no position of impact or compatibility, it merely provides the information in a tangible form whereby each Commissioner may weigh and decide the impact or compatibility.

The Commission staffs have been the major recipients of this information and where applicable the data was used in preparation of both the permit recommendations for Commission action and the regional draft planning elements. The public, legislators, news media, agencies, and interest groups have also used the objective, empirical data available for scrutiny.

The marine advisory service has assisted the staff of the California Senate Select Committee on Land Use Management Organization to develop an agenda and a workshop on "The Law Of the Sea--The Impact upon California of Changes in Territorial Jurisdiction." The hearings

and workshop were held at the State Capital in cooperation with Mc George School of Law. Each panel member, a lawyer, discussed an area of the management implications of laws affecting marine resources within the state's territorial waters. The workshop audience included members of the Resource Agency legal staff, the Assembly Office of Research, the California Coastal Commission, the Department of Ocean Navigation and Development, and the relevant commercial and industrial interests from the morning hearings.

Marine Advisory personnel provided information to over 75 members of the Recreational Boating Council concerning environmental quality studies of Los Angeles Harbor, employment versus tonnage of harbors nationwide, and California Coastal Act implications for expansion of boating within existing harbor areas. In providing a continuing source of information on marine recreational opportunities and issues to public decision-makers, private developers and industry, and users, Sea Grant investigators have published and prepared 10,000 safety pamphlets in cooperation with Los Angeles County Interagency SCUBA Committee.

A two and one-half day Harbor Managers Conference which brought together University professors and professionals from the fraternity of harbor managers all over California addressed the issues expressed by the managers as being timely for their special needs. The program consisted not only of lectures but roundtable discussions and gaming and information question/answer periods. Interaction has continued between the harbor organizations and Sea Grant to such an extent that further conferences have been planned to respond to other articulated needs.

Another major contribution to the field of marine education, this time, directed towards teachers, Kindergarten through 12th grade, was the creation of the Journal of Marine Education. Its purpose is to provide a medium through 'ready-to-use' curriculum materials, articles, and activities for teachers in California and nationally can be disseminated. The Journal's production has now been undertaken by Sea World, San Diego, through their marine education publication series.

One portion of our Advisory Services is devoted to the realm of marine recreation which, within the last few years, has changed from an avocation to an industry in southern California. Because of its growing economic importance that carries with it certain demands on the coastal zone, the Advisory Services Recreational component has sought to 1) develop among public decision-makers, private

developers, recreational firms, and general users an awareness of the importance and impact of marine recreation and policies in the California Coastal Zone Conservation Plan; and 2) assist communities along the entire California coast to develop alternative strategies for recreational utilization and management of their coastal resources.

Of State and national significance was the first National Conference on Marine Recreation, held October 2-4, 1975 at Newport Beach, California, which was a major step toward meeting these two stated goals. The conference was planned and organized by the Advisory Services' Recreational component. The Proceedings are now available and are in much demand. The conference enabled the staff to identify diverse interests with potential input to marine recreational planning. Also, working with an editorial board, Advisory Services developed a series of policy guidelines for marine recreation to be explored and implemented at State and local levels. These have since gained national recognition.

Serving the Los Angeles area for over four years has been Advisory Services' "Marine Recreational Watch," broadcast every hour over KNX (CBS) News Radio. This public service broadcast is aired on Fridays, Saturdays, and Sundays, so listeners can tune in at peak recreational times for the latest coastal weather conditions. This program expanded last year as Sea Grant and the National Weather Service joined forces. Prior to this time, site-specific weather information was given for the major ports and harbors along the coast from Point Conception to the Mexican Border. Now, this same site-specific information is given, along with the National Weather Services' overall coastal weather forecast. Advisory Services has received several letters of appreciation from KNX's listening audience for their efforts. It is estimated that KNX draws approximately one million listeners during the weekends, so Advisory Services can rightfully say that the "Marine Recreational Watch" is both a potent and appreciated program to the people of Southern California.

SAN DIEGO REGION

See Map A-1
(Page A-3)

Coastal Zone Resources Planning and Management

A data acquisition system for making measurements in the nearshore environment, the shelf and shore instrumentation system (SAS), and sensors have been developed and applied by scientists in the San Diego area. The basic unit of the instrumentation system is the shelf station, which is a buoyant, tilting spar that provides a platform for sensors and has a telemetering transmitter for data transfer to shore. Data obtained as part of the project have been used to gain insight into the physical processes of the nearshore environment and have been translated into practical planning criteria for the coastal zone. A significant part of this research consisted of the dissemination of project results. This has been accomplished through direct contact with potential users and participation in meetings where there was an exchange of information with people having a mutual interest in the results. Most notable of these meetings was the Sea Grant Conference on Physical Variables in the Coastal Zone, convened at the Scripps Insitution of Oceanography in 1975. Wave measurements have been undertaken for a long period of time to determine wave climate for the San Diego area. Coastal zone problems, such as beach erosion of Silver Strand and Oceanside, a proposed second channel at San Diego Bay, and maintenance of tidal inlets for coastal lagoons, have been studied and advice given to the San Diego County Planning Division. Much of this information has been contributed to the California Coastal Plan, the regional commission, and to the planning criteria for the report for San Diego on the coastline by the Comprehensive Planning Organization. At the present time at least five other research groups are using systems adapted from our SAS. Researchers have assisted each of these groups in developing their own system using our basic concepts, but tailored to their needs.

Living Marine Resources

Knowledge of the natural variation occurring within nearshore marine communities is of fundamental importance to rational coastal and marine management. Baseline investigations developed and reported by Sea Grant scientists concern the development, pattern, and variation of several nearshore community components of commercial and recreational interest. These studies include the subtidal fouling community, kelp beds, rocky intertidal, and nearshore sands. Since the uses of these resources are numerous and often in conflict, the La Jolla Ecological Preserve was established to maintain an intertidal and subtidal rocky habitat in an optimal state for the reestablishment of former population levels. Researchers have compared the success of this preserve status with an unprotected intertidal zone at Bird Rock. This project has provided information needed by coastal planners in determining possible effects of man's activities in the

coastal zone and distinguishing these from natural variation. The results of this research have also provided information to those concerned with harvesting various natural populations along the nearshore zone regarding consequences of various harvest and pest control techniques. Furthermore, baseline data and general information has been furnished to the Advisory Committee of the San Diego-La Jolla Underwater Park in their continuing effort to provide the public with a relatively pristine marine environment.

Sargassum muticum, a large kelp-like form, was first noted by the marina operators in Mission Bay, San Diego. By 1972, Sargassum muticum had established a large population in the bay, where it grows in a dense band bordering the rip-rap embankments. There was concern the alga might spread further out into the bay interfering with boat traffic, water skiing, and swimming. In addition, dense growths of seaweed in the marinas blocked moorings, snarled propellers, and clogged water intakes of boat engines. Sea Grant research indicated that there is no danger of the population expanding into the open areas of bays where the silt and sand bottoms prevent the settlement of Sargassum embryos. The local nuisance problems to boaters and swimmers can be solved simply by manually harvesting the seaweed and hauling it away. The plant has a tendency to regenerate from any portion left attached to the rock, thereby making the optimal time for harvesting February through March when the plant is just beginning to reproduce and the probability of regeneration is reduced. In conclusion, the recent introduction of Sargassum muticum into southern California appears to be without significant negative consequences to the native marine community. The few instances of conflict with the recreational use of bays and marinas are localized and capable of being solved. Research by Sea Grant investigators recommends that the present course of action should consist in carefully monitored sea urchin additions to those areas where problems occur.

Research staff supported by Sea Grant provided and developed the data base and information concerning optional harvesting strategies for maintaining a sustained yield fishery for the urchin industry and for the California Department of Fish and Game, the regulatory agency charged with protecting the marine resources. The effective utilization and management of sea urchins will help optimize kelp bed ecology, kelp production, and management. This program of gathering life history data for urchin species enables us to suggest reasonable fisheries management practices to maximize the yield of sea urchins, in particular the red sea urchin, while minimizing the disturbance that a fishery might cause to the kelp bed community.

The investigator, as a member of the scientific advisory committee to the Marine Mammal Commission, has directly applied

the findings of the study on otter-urchin dynamics to the development of a sea otter management program.

Sea Grant investigations have been under way since 1970 to evaluate the feasibility, as well as the potential benefits and dangers, of introducing the American or New England lobster (Homarus americanus) into California as a fishery resource. The study was prompted by interest from the private sector in attempting to transplant the species and by concern among governmental agencies and the scientific community about possible adverse ecological effects that might result. This study assessed such potential effects of the New England lobster transplants on two native species, the California spiny lobster and rock crab. The analysis should provide the concerned state and federal agencies with the information necessary to make a rational decision about the transplant. The approach, which has involved interrelated studies of behavior, ecology, and aguaculture described in this report, may serve as a model for transplant evaluation studies conducted in the future.

Homarus americanus was proven by Sea Grant research to be too aggressive a companion for California crustaceans in nature and would most likely cause an adverse outcome if introduced into southern California. However, the American lobster does take well to controlled aquaculture in warm water effluent from a San Diego Gas and Electric Company power plant. Several members of the research team have provided advice and assistance to the California Department of Fish and Game in developing standard guidelines and procedures for the evaluation of proposals to introduce exotic species into the state. These individuals have been asked to serve as part of an advisory group to this agency, which will assist in evaluating future proposals for species introductions.

The results of the study also provided much information about the behavior and food requirements of the California spiny lobster and rock crab that is directly applicable to ongoing ecological and fisheries management studies on these important native species.

Considerable progress by Sea Grant investigators has been made in developing techniques for the culture of the American lobster, Homarus americanus, and assessing the benefits and problems involved in using thermal effluent as an economical source of heat to accelerate growth. Evaluations of growth, survival, and accumulation of potentially toxic chemicals in lobsters cultured in thermal effluent from four coastal power plants, operated by San Diego Gas and Electric Company and the Southern California Edison Company, have been performed,

and no problems have been found to be associated with the effluent. Further, lobsters grew at over twice the rate at the temperature of the natural environment, the New England coast.

These findings have implications for more rapid and therefore more economical aquaculture of lobsters and also for the culture of many marine organisms. The information produced by the research is of considerable practical value to the emerging aquaculture industry in developing commercially viable aquatic farming operations. Through the utilization of power plant thermal effluent, an estimated production cost of $2.90 per pound of lobster would be saved by the culturist. This beneficial use of thermal effluent may offer an alternative to conservation and environmental groups concerned with power plant effects.

More information has been obtained which indicates that the use of thermal effluent in aquaculture should result in a significant reduction of production cost. In areas where ambient seawater temperatures are about 12°C, production costs are decreased by more than 56%. These computations further stress the potential benefits to be derived from the use of thermal effluent in aquaculture.

Power companies can demonstrate several positive environmental effects, such as effective use of surrounding land, and reuse of waste heat. Cost-savings in decision time may result from reduced controversy over the environmental impacts of plant sitings.

Sale or lease of thermal effluent use rights could provide additional source of revenue to the power industry, which currently is unable to utilize about 50% of the energy in the fossil fuels used to produce electricity. This energy is presently lost as waste heat in cooling water, but if the goal of large-scale thermal effluent is realized, a significant portion of it could be utilized for beneficial purposes with positive environmental effects.

The indigenous California spiny lobster, Panulirus interruptus, has been drastically overfished: an aquaculture farming operation using the New England or American lobster could provide an alternative source of shellfish for the seafood industry in California. At least four lobster-farming operations have been established and are making direct use of Sea Grant research results.

Sea Grant investigators have been exploring the marine environment for new natural products which can find applications in controlling algae (to combat eutrophication), in controlling shrimp bacterial pathogens, and in agriculture. These projects are specifically aimed at developing new and environmentally safe substances

to replace existing algicides, herbicides, insecticides, and antimicrobials which are dangerous to aquatic life. Working with pharmaceutical and agricultural industries, including Stauffer Agricultural Research Laboratory and Searle Company, Sea Grant scientists have developed four potent new biodegradable herbicides and two compounds which show insecticidal activity against agricultural pests. The results of basic research on chemical communication between marine organisms have been applied to the finding of useful products from these organisms. Many organisms use chemicals to deter other, predator, organisms. The chemicals used for chemical defense are often biologically active. For example, chemicals exuded by "parasite free" organisms are often active against marine bacteria and may be used to treat bacterial diseases in shellfish. The Environmental Research Laboratory, a commercial shrimp aquaculture venture, has utilized algal antibiotics in the basic shrimp diet. Stauffer Agricultural Chemical Company has applied for a patent to utilize the new insecticide from Laurencia. Based on compounds isolated by Sea Grant scientists, Stauffer has reinvestigated bromophenolic compounds as herbicides.

Basic research on the metamorphosis of the barnacle led to development of a bioassay which has been used to identify toxins from marine organisms.

Research conducted by Sea Grant supported investigators has elucidated the basic biology and ecology of gaffkemia in lobster, caused by the pathogen Aerococcus viridans, and has developed procedures for immunizing adult American lobster, Homarus americanus. Monitoring and culture systems have been perfected to reduce incidence of infection of all types, including Leucothrix, in the American lobster. The investigators, acting in cooperation with the California Department of Fish and Game, have checked induction of gaffkemia in the California spiny lobster, Panulirus interruptus, and are continuing to assist in monitoring for disease and developing guidelines for the importation of exotic species.

The research results have also helped minimize lobster mortality in holding tanks. These findings will directly benefit wholesale and retail shellfish dealers. Wholesalers estimate that gaffkemia and Leucothrix infections account for a 10% loss in marketed shellfish. Control of gaffkemia and Leucothrix should eliminate or at least sharply reduce this loss. The dollar savings from preventing such a loss can be considerable; for example, 10% of the American catch in 1973 was 2.6 million pounds, worth approximately 5.4 million dollars.

Immunization procedures will permit the protection of breeding stocks and juveniles of lobsters in aquaculture systems, thus minimizing the mortality of the organisms and reducing costs due to losses.

It is estimated that 30% of larval lobsters are lost mostly due to disease. This research conducted, in collaboration with commercial and university aquaculturists, carries with it potential cost-savings from the growing, care, and feeding for this 30% mortality rate of larvae.

Through these studies on protective measures, better aquaculture systems conducive to growth and longevity will be devloped for lobsters. The results of these studies are presently being directly utilized by industry and other research projects. Also, the systems and techniques developed may be used for shellfish other than lobster, thus lowering losses and costs in other areas of aquaculture and increasing the growth of aquaculture industry.

In future years, 19% annually of the total landings of American lobster could be saved through the techniques developed in this project.

These techniques are being applied through consultations with other research groups. Autopsies have been routinely performed on animals received from other groups, including the Environmental Research Laboratory at Tucson (shrimp), Aquaculture Enterprises at Monterey (lobsters), Jerry Robertson at Encinitas (Macrobrachium), and the Sea Grant groups in San Diego and Bodega Bay (trout and lobsters). The lobster autopsy procedure includes a macroscopic check for gross lesions and a microscopic examination of gill tissue for Leucothrix, Laginidium, and other infections.

Waste Management

The results of Sea Grant funded research have developed more reliable testing methods that can be applied to making more accurate assessments of pollution of the marine environment, particularly in the continental shelf areas, and consequently can enhance the effective management, conservation, and utilization of our marine resources. Investigations have shown that marine species produce halogenated organics similar in structure to the pollutants DDT, PCB's, etc. This research showed that current analytical techniques cannot distinguish "natural" molecules from "pollutants" (electron-capture GC analysis) and helped determine more accurate methods for precise analysis of chlorinated hydrocarbons in the marine environment. Greater accuracy will enable more effective identification of man-made pollutants and the better health of the natural environment.

Energy Resources

The first functional tethered-float breakwater (TFB) was installed at a permanent site where it provides ship-wake protection to fishing

boats in San Diego Bay. This prototype installation demonstrated that the system is very effective in both wind waves and ship wakes. The installation showed that a small-scale breakwater, suitable for harbors, lakes, and marina protection, could be installed easily and economically. The performance of the breakwater also showed that the predictive model developed in previous Sea Grant supported work is equally effective in predicting performance at this scale. Use of low-cost wave monitoring hardware has been established and verified.

Researchers also provided scientific support to the Tethered Float Breakwater Ocean Experiment, a major federal/state cooperative program, and completed a design manual to transfer the complete technology developed under this program to public and private users. Twice daily wave spectra from four field stations were published monthly by the third working day of the following month.

A San Diego Unified Port District now has a functional breakwater as an outgrowth of this TFB program, and the California Department of Navigation and Ocean Development (DNOD) has programmed the construction of a breakwater at Folsom Lake. The investigators have also been active in presenting breakwater and wave measurements results in major international technical meetings. As a result of this exposure companies are now actively considering entering the business of supplying ocean scale TFB's.

The Maritime Administration has funded a study, independent of the breakwater development project, to evaluate the economics of a number of potential breakwater applications including protection of offshore dredging, ocean pipelaying installation of ocean outfalls and discharge of containerized cargoes where deep water port facilities are available.

One of the applications for this ocean unit is for protection of inlet dredging operations by the U.S. Army Corps of Engineers. The cost of coastal dredging, which is about $500 million per year in this country, can be significantly reduced if dredges can operate under all wave conditions.

DNOD recognized the potential of the wave statistics gathering system for establishing much needed data on the coastal wave climate to support rational planning for shoreline erosion protection and other coastal management activities. The Coastal Engineering Data Network, developed with Sea Grant support, is an automatic system for gathering data on the coastal wave, current, and wind climate. The system now has six stations along the California coast. Additional funding from the U.S. Army Corps of Engineers and the State of California will add ten more stations to monitor waves, currents and wind. The U.S. Army Corps of Engineers has proposed to expand the network to approximately

100 stations over the next few years to provide complete coverage of the California coastline; this system will then be the prototype for a national program of nearshore data gathering in supporting maintenance dredging and shoreline erosion protection. At a recent symposium on oceanwave measurement sponsored by NOAA, a panel of experts on coastal processes estimated that the annual savings possible if good wave data were available would exceed $1 billion. A natural system of the type developed under this Sea Grant program could be operated for only a few percent of these potential savings.

Marine Mineral Resources

Intercampus investigations on shelf sand and gravel deposits of southern California are of importance to the general public and governmental agencies. Utilization of offshore sand and gravel, the interrelationships between offshore sand and gravel deposits and the sediment on coastal beaches are the primary issues this research has addressed.

A reconnaissance assessment of sand and gravel of the southern California shelf has been completed. The total volume of sand and gravel deposits over the 460 km length of the southern California shelf is nearly 30 km^3. Off Los Angeles, ancient river channels filled with sand and gravel are potentially economic deposits. Along San Diego and Orange County shelves, a nearly continuous sand lens may be a vital source of sand for beach replenishment.

At present, offshore sand and gravel deposits are probably non-economic as a source of gravel, but they are economically and environmentally important sources of beach sand. However, since the anticipated lifespan of all onshore deposits in southern California is at most 30 years (and in many locations there is only a ten year supply), mining offshore sand deposits should become economically feasible by 1981.

Techniques and research results were presented at scientific meetings, including the American Association of Petroleum Geologists, Dallas, the Geological Society of America, Miami, and its Cordilleran Section Meeting in Los Angeles, and the Offshore Technology Conference. Seminars were presented to the Shore Processes Group, Scripps Institution of Oceanography, the Bureau of Land Management--Southern California Bight "Baseline Study" meeting in Long Beach and various academic institutions.

Government agencies need this data to decide whether it is more economical to exploit offshore sand and gravel sources or find and develop new deposits onshore. The potential effects that exploitation of offshore sand and gravel will have on contiguous beaches in particular and on the system of longshore sediment

transport in general must be carefully considered. Southern California citizens are concerned about the price of sand and gravel (and attendant general construction costs), about the unsightly growth of sand and gravel pits, and about maintaining the beauty and usefulness of the beaches (both as a source of income and pleasure). Data and information from this Sea Grant project are of value to local, state, and federal agencies. Sediment isopach maps for the continental shelf off San Diego County are being used by the County of San Diego, the State Lands Division, and the U.S. Geological Survey in response to their requests. Other data which relate sediment deposits to oilseep activity have been supplied to the California Division of Oil and Gas. A complete set of the offshore sand and gravel maps and reports by county will be published by the Department of Navigation and Ocean Development. These maps will be used by the state for long range planning and for the master plan of offshore sand and gravel mining.

Marine Data Acquisition and Dissemination

The Scripps Aquarium/Museum provides wider availability of marine sciences information through exhibits, advisory and education programs centered around this exhibit. Over 400,000 people, including 60,000 students in study programs--many from the San Diego region--visit the Aquarium/Museum annually. Greater understanding of environmental issues and conservation measures can be gained through better understanding of marine resources. Conservation, with particular reference to California's intertidial animals, is stressed for the visiting general public and students. These advisory and educational experiences will have implications for the present generation and for generations to come in their understanding and respect for the marine environment and its proper use.

The Scripps Aquarium/Museum has become a statewide resource and the basis for establishing other public education programs. Through the multimedia approach and advisory work of the aquarium-museum, two new educational programs will be established at Moss Landing Marine Laboratory and at Humboldt State University. Educational programs and displays have been developed for marine science programs located in Santa Barbara and Santa Cruz. These have been designed to increase the community and student awareness of marine resources of the state and local regions.

In just the past two years, a marine advisor has been working out of a water-front office, where he communicates directly with the fishing community. In addition to regular assistance and information

on the best fishing spots, gear developments, and tax and management problems, he is consulted for knowledge and interpretation of existing and potential regulations affecting the fishing industry. The "Fisheries Newsletter" deals with subjects of interest to San Diego region fishermen and is distributed monthly to approximately 1,300 fishermen, processors, retailers, government agencies, and media people. This marine advisor in cooperation with marine advisory specialists and others has presented a timely panel discussion on the tuna-porpoise controversy. Other workshops on marine financial assistance programs, business management, and seafood consumer education have been attended by over 300 marine businessmen, commercial fishermen, and the general public. Also, a cooperative presentation by marine advisors and specialists at a San Diego food exposition was a big success with more than 500 people attending.

APPENDIX B

CALIFORNIA PUBLIC RESOURCES CODE SECTION 6217

CALIFORNIA PUBLIC RESOURCES CODE
SECTION 6217*

(d) To the Resources Agency the amount of five hundred thousand dollars ($500,000) for each of the fiscal years 1974-75, 1975-76, 1976-77, 1977-78, 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 1978-79, the Legislature shall consider recommendations from the Secretary of the Resources Agency and other interested parties on the benefits to the people 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 10 members composed of the following persons:

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

*Reproduced from Deerings California Codes, 1976 edition, Public Resources Code, Section 6217

(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 ocean engineering industry.

(7) A representative of the University of California.

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

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

(10) 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. 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.

(e) To the Capital Outlay Fund for public higher education, the balance of all revenue in excess of that distributed under subdivisions (a), (b), (c), and (d) of this section.

The commission may, with the approval of the State Board of Control, authorize the refund of moneys received or collected by it illegally or by mistake, inadvertence, or error. Claims authorized by the commission and approved by the State Board of Control shall be filed with the State Controller and the Controller shall draw his warrant against the General Fund in payment of such refund from any appropriation made for that purpose.

All references in any law to Section 6816 shall be deemed to refer to this section.

Added Stats 1968 Chapter 981 Section 4; Amended Stats 1973 Chapter 1115 Section 1; Stats 1975 Chapter 600 Section 1.

Amendments:

1973 Amendment: (1) Substituted subd (d) for former subd (d) which read: "To the Capital Outlay Fund for Public Higher Education, all revenue in excess of the amount deposited in the General Fund pursuant to subdivision (a) of this section, and in excess of the amount deposited in the California Water Fund pursuant to subdivision (b) of this section, and in excess of the amount deposited in the Central Valley Water Project Construction Fund pursuant to subdivision (c) of this section."; and (2) added subd (e).

1975 Amendment: (1) Substituted "this division, and under Chapter 138 of the Statutes of 1964, First Extraordinary Session" for "Division 6 (commencing with Section 6001)" in the introductory paragraph; (2) substituted subds (b) and (c) for former subds (b) and (c) which read: "(b) To the California Water Fund each fiscal year such amount which shall, when combined with revenues deposited in such fiscal year in the California Water Fund pursuant to Section 12 of Chapter 138 of the Statutes of 1964, First Extraordinary Session, amount to eleven million dollars ($11,000,000) for the fiscal years 1967-68, 1968-69 and 1969-70, and thereafter such amount which shall, when combined with revenues so deposited pursuant to Section 12 of Chapter 138 of the Statutes of 1964, First Extraordinary Session, amount to twenty-five million dollars ($25,000,000). Reference in this subdivision to the California Water Fund shall, during the balance of the fiscal year 1967-1968 and the fiscal years 1968-1969, 1969-1970, 1970-1971, and 1971-1972, be deemed to refer to the Central Valley Water Project Construction Fund."

"(c) To the Central Valley Water Project Construction Fund each fiscal year such amount which shall, when combined with revenues deposited in such fiscal year in the Central Valley Water Project Construction Fund pursuant to Section 12.1 of Chapter 138 of the Statutes of 1964, First Extraordinary Session, amount to five million dollars ($5,000,000)"; (3) amended the third paragraph of subd (d) by (a) substituting "10" for "nine" in the introductory clause; (b) designating the former second and third sentences of subsection (9) to be the second and third sentences of subsection (10); and (c) adding the first sentence of subsection (10).

Former Section: Former Section 6217 relating to disposition of moneys collected by commission, was added by Stats 1941 Chapter 1273 Section 2, amended by Stats 1961 Chapter 892 Section 5, effective June 30, 1961, operative July 1, 1961, and repealed by Stats 1968 Chapter 981 Section 3.

Cross References:

Department of Parks and Recreation: Sections 500 et seq.
The State Lands Commission and the Division of State Lands: Sections 6101 et seq.
Revenue, including taxes generated by sales of hydrocarbons, subject to terms and conditions enumerated in this section: Section 6815.2.
California Coastal Zone Conservation Commission: Sections 27000 et seq.
Capital Outlay Fund for Public Higher Education: Ed C Sections 22510 et seq.
Department of Fish and Game: F & GC Sections 700 et seq.
Controller to draw warrants: Gov C Section 12440.
Boards and departments under Resources Agency, designation: Gov C Section 12805.
State Board of Control: Gov C Sections 13900 et seq.
State funds: Gov C Section 16300 et seq.
How warrants to be drawn: Gov C Section 17000.
Department of Navigation and Ocean Development: H & NC Sections 50 et seq.
Central Valley Water Project Construction Fund: Wat C Sections 11810 et seq.
California Water Fund: Wat C Sections 12900 et seq.

Collateral References:

Cal Jur 2d Mines and Minerals Section 152.
54 Am Jur 2d Mines and Minerals Section 120.
National Sea Grant College and Program Act of 1966 (P.L. 89-688): 33 USCS Sections 1121 et seq.

Attorney General's Opinions:

27 Ops Atty Gen 291 (right of State Lands Commission to expend State Lands Funds for purpose of geophysical and core-drilling surveys of state submerged lands).

APPENDIX C

NATIONAL OFFICE OF SEA GRANT DOCUMENT

THE NATIONAL SEA GRANT PROGRAM

The following material may be found with a more complete description in "The National Sea Grant Program: Program Description and Suggestions for preparing proposals." Office of Sea Grant/NOAA/ Dept. of Commerce, Rockville, Maryland. Part I (U.S. Government Printing Office; 1972) 511-317/41.

ORIGIN AND PURPOSE

The National Sea Grant Program was created on October 15, 1966, with the signing of Public Law 89-688, THE NATIONAL SEA GRANT COLLEGE AND PROGRAM ACT. The purpose of the Act is to accelerate national development of marine resources, including their conservation, proper management and maximum social and economic utilization. The term "Sea Grant" was chosen to emphasize the parallel between the present needs of the nation in the marine environment and the need for development of the land at the time of the Morrill Act of 1862, which established the Land Grant Program. The Sea Grant Program follows the pattern of the Land Grant Program only to a limited extent; it provides the means through which scholars and institutions of higher education can apply their knowledge and talents to the practical needs of the nation and the world, and it includes the Land Grant concept of advisory services through which scientific research results may be most directly applied to real problems.

The National Sea Grant Program originally assigned to the National Science Foundation, was transferred to the National Oceanic and Atmospheric Administration, U.S. Department of Commerce, in the President's Reorganization Plan #4, in October, 1970. Within NOAA, the Program is administered by the Office of Sea Grant.

The three principal activities of the Sea Grant Program are research, education, and advisory services.

[Currently there are Sea Grant programs in 26 coastal and Great Lake states as well as Guam, American Samoa, Micronesia, and the District of Columbia.]

BASIC APPROACH

Traditional marine scientific and engineering disciplines or specialties provide a base on which Sea Grant activities in an institution can be structured, but to achieve Sea Grant objectives as stated in the Act, traditional fields must be augmented by other disciplines and specialties.

Many marine resource problems cannot be solved, or opportunities realized, without new approaches to marine and coastal legal, institutional, or economic structures. Participation is needed of research lawyers, political scientists, sociologists, social psychologists, anthropologists, public administration specialists, and economists.

The scope of the Sea Grant activities in any field range from basic considerations to techniques for final application, encompassing the entire system involved in the particular field. For example, the aquaculture of a marine organism may require investigation into the reproductive cycle, environmental requirements, and nutrition of the organism, but it also requires the engineering of the culture system, consideration of the economic viability of the system in comparison with other sources of the organism or comparable organisms, social impact of the aquaculture development, examination of the legal regimes under which culture will take place, problems of meeting State and Federal regulations for processing the product into marketable form, and marketing preferences and methods.

The systematic, multidisciplinary approach necessary for achieving Sea Grant goals requires a kind of organization and reorientation to which most institutions of higher education are not accustomed. Once the organization is created, and the university's colleges and departments become skilled at working together in a programmed, focused manner, it is important to maintain continuity so long as the quality and relevance of the university's Sea Grant work warrants support.

The emphasis, however, is not on continuity as such, but on the application of the institution's talents to specific activities directly relevant to the area it serves. Such relevance must be determined by close interaction with public and community leaders.

COOPERATING ACTIVITIES

All Sea Grantees are encouraged to enlist the cooperation of all appropriate entities within their areas on matters of mutual interest or concern. Such entities should include state or local agencies, business and industry, organizations, Federal laboratories and installations, and educational institutions. In a research activity, cooperation by researchers with potential users of the results will help to ensure the early application of the research.

MATCHING FUNDS

The National Sea Grant College and Program Act of 1966 states:

"The total amount of payments in any fiscal year under any grant to or contract with any participant in any program to be carried out by such participant under this title shall not exceed 66-2/3 per centum

of the total cost of such program. For purposes of computing the amount of the total cost of any such program furnished by any participant in any fiscal year, the Foundation shall include in such computation an amount equal to the reasonable value of any buildings, facilities, equipment, supplies, or services provided by such participant with respect to such program (but not the cost or value of land or of Federal contributions.)"

In accordance with this requirement, institutions proposing Sea Grant activities must propose an entire program or project, identifying those portions for which NOAA funds are requested, and those for which the institution itself will pay. The NOAA portion may not exceed two-thirds of the total cost. The remaining one-third must be from non-Federal sources. Further, there is no upper limitation on the percentage of matching funds. The Office of Sea Grant often receives proposals in which the non-Federal matching funds are substantially more than the required one-third. (Emphasis added).

SEA GRANT RESEARCH

The distinguishing characteristic of Sea Grant-sponsored research is that it must contribute to the advancement of one or more of the purposes specified in the Sea Grant Act, as stated in Section I. That is, it must be research with a specified end use as its objective, justified in terms of the ultimate value and utility of the results to be achieved.

"Applied research" often is used in connection with Sea Grant, with consequent misunderstanding. "Application" describes the end result and may not describe the research itself; it depends on the state of knowledge in a particular field and what must be learned before an economic or social result can be obtained.

Sea Grant research must be structured with reasonable milestones which permit at least a reasonable estimate of the total effort, cost, and time necessary to achieve the proposed result. The proposal should show where the researcher expects to be in completion of his research plan in one year or two, depending on the length of the effort. Renewal of research projects, including those which are part of institutional or coherent programs, depends on results achieved within a reasonable time frame.

SEA GRANT EDUCATION AND TRAINING

The National Sea Grant College and Program Act of 1966 specifies education and training as an important part of the National Sea Grant Program. Although the Act does not impose limitations on the kinds and numbers of persons to be educated or trained, Sea Grant educational activities are constrained by the need to supplement, and not duplicate, the activities of other Federal agencies, and are limited by the realities of the manpower market.

Course Development

The Sea Grant Program does not, as a general rule, support graduate education programs in physical, biological, chemical, or geological oceanography. However, as the national ocean program grows, more social scientists will be needed. There is opportunity in the Sea Grant Program for a limited number of well-designed graduate courses in the marine applications of the social sciences and humanities.

Ocean engineering usually is considered to be a graduate subject. Within the Sea Grant Program, it is an integral part of most institutional educational programs, although some separate projects for course development have been initiated.

Graduate Student Support

The Sea Grant Program does not award fellowships or scholarships, except for a very limited number which may be awarded by Sea Grant Colleges. However, the Program does recognize the important contributions that may result from graduate research and provides funds to grantees for graduate research assistantships as a part of specifically approved research projects. Even though there is an educational aspect to such support, it is considered Sea Grant research.

Marine Technician Programs

A marine technician is a person who has acquired the specific vocational skills and background that will fit him or her for immediate employment in a marine field upon graduation. Sea Grant technician programs commonly are for two years and generally are conducted in community or junior colleges or technical institutes. Technician programs of shorter or longer duration also are considered.

Sea Grant technician training is vocational in nature. Even though some students may decide to go on to higher education, it must be assumed that student technicians are studying for a vocation and that they expect to graduate into jobs.

Innovative Education And Training

The Sea Grant Program does not assume that traditional education and training methods or standard curricula are necessarily the ultimate for producing specialists to meet national needs. Innovative proposals, experimental courses, experience projects, and new ideas are welcome so long as their objectives accord with the purposes of the Sea Grant Program.

SEA GRANT ADVISORY SERVICES

"Advisory Services" is a general term for the variety of means by which the results of scientific research or engineering development are communicated to those who will apply the results to obtain economic or social benefits. The methods may include publications, conferences and seminars, mass media, or personalized extension services.

Feedback Through Advisory Services

In addition to dissemination of useful information, a well-designed and staffed Sea Grant Advisory Service is also an important source of information and guidance to the Sea Grantee, providing a "feedback loop" through which problems and opportunities, as seen by user communities, may be communicated to program administrators and researchers.

Advisory Service Concepts

Sea Grant Advisory Services do not deal only in information developed under Sea Grants; they collect and prepare for dissemination, from any source, information of use to the communites they serve. Such information may be obtained from Federal laboratories, state agencies, business and industry (when not proprietary in nature), from other universities - whether or not part of the Sea Grant system - and from other nations. For reasons of credibility, as well as common courtesy, the source of a particular item always should be given full credit.

Advisory Services should be tailored to the needs of the specific region served by the Sea Grantee. In addition to business and industry, Sea Grant Advisory Services are expected to provide information and assistance to state and local agencies, and to the interested public. The essence of Sea Grant Advisory Services may be summed up as "self help," with the information and assistance designed to enable or assist the self-help process.

TYPES OF SEA GRANT PROGRAMS

Three categories of support are available for the conduct of Sea Grant activities: Institutional, Coherent Project, and Project. In general, Institutional and Coherent Project grants are made with expectation of renewal, so long as the grantee maintains a high level of quality and relevance in its activities. Sea Grant Projects generally are for a single grant item but may be renewed under certain conditions; each renewal is negotiated individually.

The two continuing Sea Grant categories of support, called "Institutional" and "Coherent Project" grants, are actually for support of a large number of related multidisciplinary activities within a single

institution or combination of institutions. Each activity under these categories is subjected to detailed scrutiny and evaluation by NOAA'S Office of Sea Grant, and each activity is supported or rejected on its individual merits. Combing the activities within a given institution under a single Sea Grant is a matter of administrative efficiency and convenience, both to NOAA and the grant recipient. Sea Grant policy is to encourage, and to press as necessary, for genuine multidisciplinary activites when made necessary by the desired result. Such multidisciplinary "team" participation is a requirement under Institutional (or Coherent Project) Support, and is desirable to varying degrees, depending on the subject, under Project Support.

Continuity of support depends solely on the quality and consistency of the university's efforts in meeting the goals of its approved Sea Grant activities. If quality, consistency and productivity are high enough after at least three years of Institutional Support, the university may qualify as a Sea Grant College.

(There are 54 Sea Grant programs currently receiving support from the 31.8 million dollars of federal funding. These include 28 Project grants, 9 Coherent Area programs and 17 Institutional programs. Of the Institutional programs, twelve have been designated Sea Grant Colleges. March 1977)

SEA GRANT COLLEGES

Sea Grant Colleges are designated from among institutions of higher education receiving Institutional Support. The designation is based on quality, quantity, and productivity of performance by the institution in the categories of research, education, and advisory services; the degree and nature of cooperation with and service to its marine communities; the exercise of leadership in the institution's region over a period of not less than three years under Institutional Support; and the efficiency and competence of its Sea Grant program management.

The designation Sea Grant College symbolizes a mutual recognition of continuing responsibility, both by the Department of Commerce and the institution so designated, to develop and maintain the excellence and public utility of the institution's Sea Grant program.

By the award of Sea Grant College status, the Department of Commerce expresses its confidence in the demonstrated dedication and competence of the Sea Grant College by assigning priority of support to the College, within the limits of overall Federal priority and fiscal considerations, renewable as continued performance by the College may warrant.

The Sea Grant College accepts with such designation the responsibility for the continued pursuit of excellence in marine research, education, and public service through advisory programs, and the exercise of leadership in its region in assisting and supporting other institutions and agencies, both public and private, in the development of programs for the proper use and protection of the marine environment.

Designation as a Sea Grant College is not automatic after the prescribed period under Institutional Support, but is a matter of the most serious consideration by the Department of Commerce and its Sea Grant Advisory Panel after definitive review of the institution and its Sea Grant program by the Panel, the staff, and outside experts.

APPENDIX D

PROGRAMS (INCLUDES ORGANIZATIONAL CHARTS)

PROGRAMS

University of California

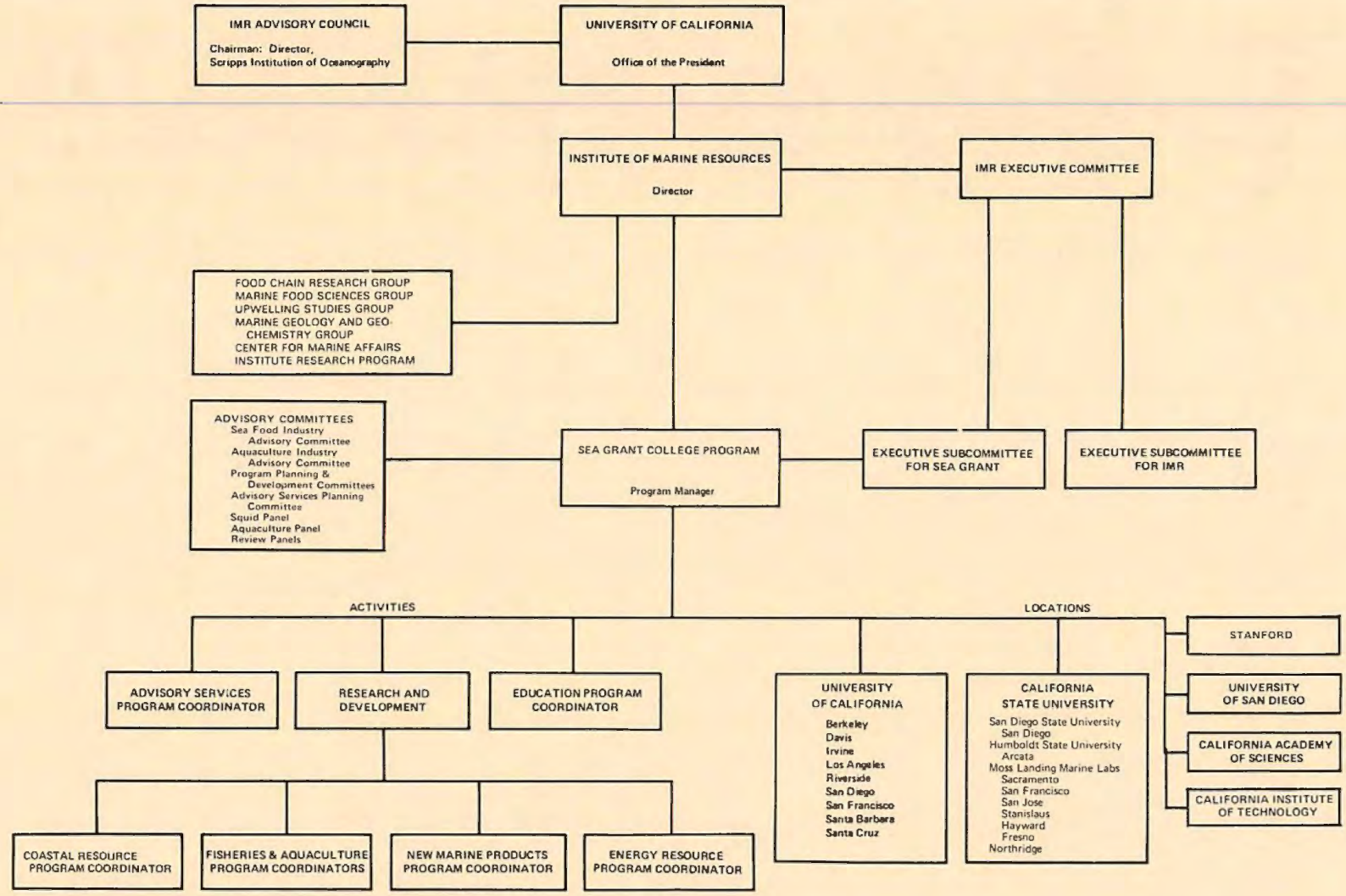
The University of California Sea Grant College Program began with a project awarded to Scripps Institution of Oceanography in 1968 to develop a new inter-departmental curriculum in Applied Ocean Science. Activities are now conducted on six of the nine campuses of the University of California, the Moss Landing Marine Laboratories (a consortium of six California State Universities and College campuses), the California State University at Northridge, San Diego State University, Humboldt State University, the University of San Diego, Stanford University, and California Institute of Technology.

In 1973 the University of California was "designated a Sea Grant College for sustained excellence in research, education, and public service dedicated to wise use of America's marine resources".* Thus, the University became the seventh institution of higher education so designated by the Department of Commerce.

Humboldt State University (HSU) began its participation in the National Sea Grant Program in 1969 and since then has sponsored both research and marine advisory programs. In 1976, HSU joined the UC Sea Grant Program. The strong natural resources program of the university--especially fisheries science, oceanography, marine biology, and wildlife management--will provide a pool of talent (both faculty and student) particularly suited for such a program.

Humboldt with its proximity to the important fishing ports of Fort Bragg, Eureka, Trinidad, and Crescent City, and the short distances to important salmonid spawning streams such as the Smith, Klamath, Trinity, Mad, Eel, and Mattole Rivers, gives additional relevance and value to the research, education and advisory work in northern California primarily in fisheries research and advisory services.

The University of California Sea Grant College Program is administratively housed in the statewide Institute of Marine Resources, which has its headquarters at the Scripps Institution of Oceanography, UC-San Diego. In view of the importance of the program to the University and the State, policy guidance is vested in the Institute of Marine Resources Advisory Council. The IMR Executive Subcommittee for Sea Grant (whose members are also on the Advisory Council) is charged with advising the Sea Grant Program Manager on administrative matters pertaining to the conduct of the Sea Grant Program and the pursuit of its objectives. Two members of the subcommittee are



ORGANIZATION OF UNIVERSITY OF CALIFORNIA SEA GRANT COLLEGE PROGRAM

APRIL 1, 1978

appointed from the State University and College System. The subcommittee will act as the review committee for the Sea Grant research program and appoints independent review panels to assist it in this task.

Under the direction of the Sea Grant Program Manager, who reports to the Director of IMR, a staff carries out the decisions of the Council, and provides day-to-day management and work on development of new programs. This small staff works through a decentralized administration to conform to the statewide multi-campus nature of the program. Local administrative offices, headed by Sea Grant Campus Coordinators, are located at Humboldt State University, San Diego State University, Moss Landing Marine Laboratory, UC-Santa Barbara, UC-Davis, and UC-Santa Cruz. The coordinators at the Davis, Santa Barbara, and Santa Cruz campuses also serve as Associate Directors of IMR.

To maintain liaison, improve inter-campus communications, and plan work on a UC subject area basis, a number of "program coordinators" have been appointed. These staff members have the primary responsibility for one or more annual, or more frequent, meetings of staff working in their field (usually without regard to whether they have support from Sea Grant or other sources). The subject areas are plant aquaculture, animal aquaculture, fisheries, coastal planning, and energy. These coordinators serve to catalyze joint work and new programs within their fields.

The University of California continues the style of educational support that has been used since the beginning of the UC-San Diego Sea Grant project in 1968: the establishment of Sea Grant Traineeships under which qualified graduate students in a variety of disciplines can obtain experience in marine research (and frequently carry out a thesis project) while advancing the research objectives of the Sea Grant Program in association with approved research projects. In 1976-1977, 72 graduate students associated with Sea Grant research projects, received financial assistance in the form of traineeships. This intermingling of application-oriented research and education is an excellent way for a university to train the people who will become the research and operating scientists for industry, government, and universities, and the teachers of future generations of marine scientists, ocean engineers, economists, lawyers, and others whose collective knowledge will be necessary to meet the challenges ahead.

The coordinator of statewide UC Sea Grant Advisory Programs is headquartered at UC-Davis and has been designated as the Program Leader of the UC Cooperative Extension Services' statewide Marine Advisory Program. The core of this major new commitment to the marine community by UC is the Sea Grant Program Advisory Staff.

University of Southern California

The University of Southern California has participated in the National Sea Grant Program since 1970. The institutional program, multi-disciplinary in nature, has increasingly concentrated on the needs of the California coastal regions, particularly those associated with the complex, urbanized Southern California area.

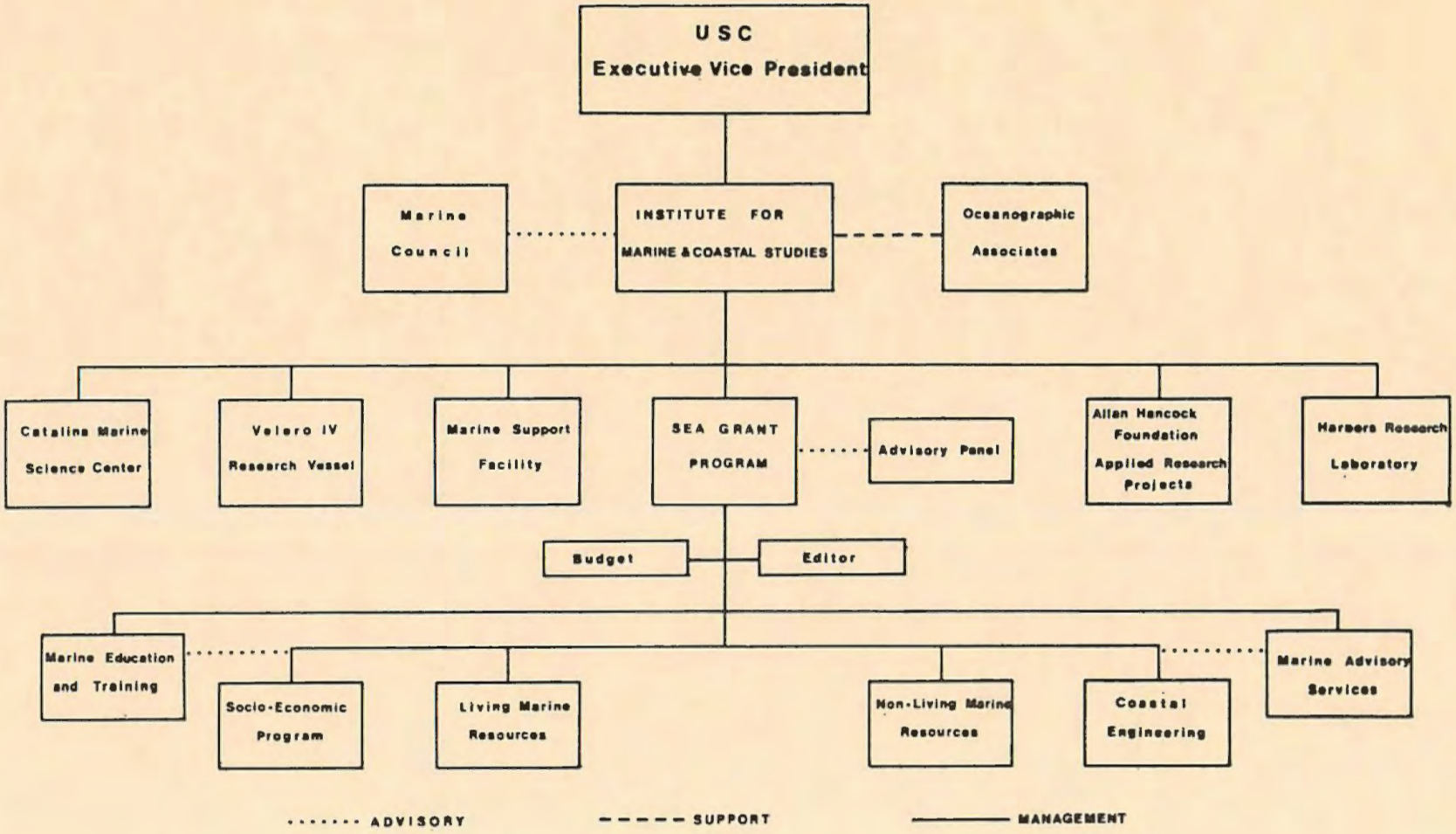
The research competence of USC's marine science and engineering schools have been combined with that of the Law Center, Center for Urban Affairs, Population Research Laboratory, Schools of Business, Administration, Public Administration and International Relations, and the Graduate School of Urban and Regional Planning, to solve marine research problems of State and local concern. Where significant marine research expertise exists in other colleges and universities, it has been integrated into the various projects. Thus, over the past six years, faculty and research staffs of Loyola, University of California, Occidental, California State University, Fullerton, Cerritos and Immaculate Heart have participated in Sea Grant Projects coordinated by USC. Also, a total of 20 institutions and 53 state and local agencies have been actively involved in their research projects.

The University of Southern California Sea Grant Program addresses itself to the theme, "The Planning and Management of California's Coastal Resources," identifying those marine resource needs of the greater Los Angeles metropolitan area, the southern California region, and the State of California which can be served through applied research, education, and marine advisory services.

The Sea Grant Program at USC is primarily concerned with marine and coastal resource development and management. It intends not only to expand the knowledge base of scientific and technical phases of marine science, but also to increase man's capability to utilize the resources effectively by developing sound planning and management strategies and the concomitant educational programs needed to prepare students to deal with marine and coastal resources.

The University of Southern California Sea Grant Program is a component of the newly-created Institute for Marine and Coastal Studies. This umbrella organization was created to better reflect the recognition of the marine sciences by the University and its Board of Trustees in their endeavor to confirm their commitment toward fulfilling the criteria for Sea Grant College designation. The Institute's Director has oversight responsibility for all USC's marine programs.

Administration and management of the USC Sea Grant Program is the responsibility of its Sea Grant Director and Assistant Director.


USC
Executive Vice President
Marine Council
INSTITUTE FOR MARINE & COASTAL STUDIES
Oceanographic Associates
Catalina Marine Science Center
Velero IV Research Vessel
Marine Support Facility
SEA GRANT PROGRAM
Advisory Panel
Allan Hancock Foundation Applied Research Projects
Harbors Research Laboratory
Budget
Editor
Marine Education and Training
Socio-Economic Program
Living Marine Resources
Non-Living Marine Resources
Coastal Engineering
Marine Advisory Services
ADVISORY
SUPPORT
MANAGEMENT

Although day-to-day administrative management is the Director's and Assistant Director's responsibility, they are assisted in the program's planning, coordination and evaluation by a management team whose functions are: (1) to facilitate project interaction, (2) monitor project progress, and (3) evaluate new project potential. This management team is comprised of 11 researchers representing the Program's six major areas of concentration: Living Marine Resources-Environmental Quality; Non-Living Marine Resources-Environmental Quality; Socio-Economics Program-Environmental Quality; Coastal Engineering; Marine Advisory Services; and Marine Education and Training Program.

To complement this team's inter-University coordination and review, the USC Sea Grant Program established an Advisory Panel consisting of representatives from industry, other Universities and local government. Through use of this two-tiered advisory process, potential and on-going projects are competently judged on their academic integrity and user-group applicability. Both groups are also charged with the task of using their creativity and expertise in helping develop and guide the Program's research thrust.

Philosophically, a coordinated and simultaneous approach was initially originated by the USC Sea Grant Program in its first year and is reflected today in what has been called "a programmed team approach" by some and what USC calls its multidisciplinary approach. In their approach, they have emphasized that scientists and engineers should be familiar with, and involved in, the process of planning and management of marine resources and that those responsible for the planning and management must be equally well-informed as to the scientific, technical characteristics of the marine environment and its concomitant resources. To this end, USC Sea Grant projects continue to reflect a multidisciplinary approach by prerequisite design.

EDUCATION

The Sea Grant College and Program Act of 1966 mandated the education and training of specialists for marine careers. Consequently, the California Sea Grant programs have developed educational activities which broaden public awareness of the coastal and marine environment. Educational projects cover a broad scope of activities, which include projects for developing: 1) undergraduate technician training projects; 2) independent scientific research projects; 3) graduate research projects; to preparing and presenting educational materials and classes to students from kindergarten through high school. Courses have also been conducted for the professionals' continuing education classes, and for college courses.

University of California

The Applied Ocean Science Curriculum of the University of California, developed from 1968 through 1974 with Sea Grant funding, has experienced a total enrollment of 173 graduate students to date. A total of 29 advanced degrees have been awarded: 18 masters of science and 11 PhD's.

The experimental undergraduate technician training program conducted by San Diego State University and Scripps Institution of Oceanography was concluded in 1975. Thirty-six students received training in the program during its several years of operation. Twelve currently are employed in technical or professional marine or related occupations, sixteen are continuing their educations, and two are employed elsewhere.

The trainee program continues to provide 72 qualified California graduate students with the opportunity to conduct practical marine research in association with approved Sea Grant projects each year with combined state-federal funding. This style of education has proved to be quite effective and flexible in providing well-trained manpower. As societal needs or problems change, research efforts are initiated in these new areas and the trainees who participate gain experience and knowledge in these new problem areas.

In addition, support is currently provided for 22 graduate students in the form of Research Assistantships. General assistance support provides financial aid for additional graduate students as well as 16 undergraduate students. A pilot project at UC Santa Cruz is developing a program where undergraduates may be involved in marine research as trainees.

University of Southern California

The active efforts under the University of Southern California's Sea Grant Program in education and training have been a full-time coordinator in cooperation with the College of Continuing Education.

Through the educational programs in Sea Grant, they are endeavoring to provide both materials to be used in the classroom and encouragement to the classroom teacher, in order to integrate these marine-oriented teaching materials into existing curricula. Furthermore, it is important that new generations have a better understanding and deeper appreciation of the role of the sea in maintaining our ecological balance.

During this past year the University has been able to develop important contacts with teachers interested in marine education. Workshops were held in which participants could share their ideas, needs and problem areas with each other. Sea Grant investigators have begun to provide curriculum materials to these educators which can be used immediately in the classroom, and a resource center is being established to disseminate additional materials.

The Journal of Marine Education has been created, each issue of which contains 16 tear-out pages of ready-to-use curriculum materials developed and contributed by teachers across the nation. This method of disseminating curriculum materials is proving to be most effective.

In conjunction with the above educational program for the public schools, extension programs have been organized to help fill the current vacuum in marine education for adults. New initiatives were the Harbor Management Conference, workshops for public school educators and administrators, the Bi-national Coastal Zone Planning Workshop, Sea Grant Intern Program, Law of the Sea Lecture Series, Conferences, teacher workshops, and the Underwater Natural History for the Recreational Diver, which proved to be one of the more popular programs which the University of Southern California Sea Grant Institutional Program sponsors.

The Harbor Management Conference, held February 19-21, 1975, was organized around the needs of modern harbor management and addressed such issues as relationships with public and private users of harbor facilities, financing harbor development, and servicing recreational users and others. These issues and their different facets were presented by specialists from Sea Grant Universities and from the professional fraternity of harbor managers. After a very successful two and one-half day conference, the Harbor Managers Association asked that the University of Southern California Sea Grant Institutional Program continue these conferences on a yearly basis.

Workshops for public school educators and administrators were held both on the University of Southern California campus and in the public schools. With lectures and slide presentations, the professionals were shown the "why" and "how" of teaching marine education in the classroom.

A "Career Opportunities Day" for about 450 students from 12 schools was organized and conducted. Individuals from universities, industries, and technical schools lectured on their respective disciplines, illustrating the wide range of possible careers in marine-related fields. For example, representatives from the Harbor Occupational Center in San Pedro revealed that their technical school offers training exclusively in marine-related fields, from clerical work to marine welding and ship building, and thus was an alternative to the academically oriented marine science training.

In August 1974, a five-day Bi-national Coastal Zone Planning and Management Workshop was held at the University of Baja California and Ensenada, Baja California. Experts from both the United States and Mexico in the fields of mariculture, environmental quality, fisheries, recreation and tourism, water resources, and geology were invited. These included academicians, industrialists, and representatives from state and federal agencies. During the workshop, the Mexican colleagues identified needs as they perceived them, and these issues were then discussed by professionals from both nations. Final recommendations and guidelines for the planning, management, and wise utilization of resources of Baja California were compiled and put into a written document which was presented to the President of Mexico.

The Ocean Environmental Workshop, held on the University of Southern California campus, combines classroom instruction and field experiences in a nine-week class for those desiring an introduction and overview of oceanography today, and who want to become more familiar with its current and projected happenings. The workshop was especially designed to point out the current developments concerning the Outer Continental Shelf on the western coast of the United States.

The Sea Grant Intern Program continues to attract highly qualified graduate students to the marine-related activities of the University of Southern California Sea Grant Institutional Program. The students are assigned to special Sea Grant projects which will fulfill their thesis requirements for a graduate degree and, at the same time, allow the Intern to develop his scientific and creative abilities in a combined research/education experience. Supported with a monthly stipend, the Intern is free to concentrate on his research program.

The Marine Education and Training Program offers several innovative classes to the public which have proven exceptionally rewarding as a

learning experience to both participants and instructors. The Underwater Natural History for the Recreational Diver Class, designed for the certified diver, is a good example of these innovative programs. This weekend class introduces the participants to the fundamentals of marine natural history as it pertains to the shallow waters of Santa Catalina Island.

MARINE ADVISORY PROGRAM

The Marine Advisory programs of the universities are located as far north as Crescent City, near the Oregon border, and as far south as San Diego, at the Mexican border. They are served by twenty-three advisors and specialists. The advisors are located in areas on the coast where they have direct contact with the public, agencies, and commerical and industrial sectors. These area where the advisors provide service are Del Norte-Humboldt-Mendocino counties, Marin-Sonoma-Mendocino counties, San Francisco-San Mateo counties, Monterey-Santa Cruz counties, Ventura-Santa Barbara-San Luis Obispo counties, Los Angeles-Orange counties, and San Diego county.

Specialists function in the areas of aquaculture, coastal resources, communications, legal advisory services, marine resources, marine recreation, seafood technology and marine transportation. These specialists are located in Davis and in Los Angeles.

University of California

The University of California marine advisors work through the Cooperative Extension offices located in all coastal counties and are the points of contact for the public on the coast. The Coordinator of the statewide Marine Advisory Program and marine specialists in marine resources, seafood technology, and aquaculture are located at UC-Davis. This program reflects the needs identified in the California Marine Advisory Service Plan currently under revision.

The Marine Advisory Program stresses the informational offerings and contacts with marine-resource-user audiences, emphasizing aquaculture, marine science education, extended jurisdiction, commercial fishing, consumer seafood-nutrition education, and coastal zone management. Workshops, coastal zone planning conferences, newsletters, publications, and field services are all part of the services provided by this program. Specialized workshops for fishermen, processors, retailers, and coastal zone management have been chaired by the UC Marine Advisory Program. A coastal zone advisor has been named to identify appropriate university staff to serve on advisory task forces on the Coastal Plan and the Legislative deliberations on the Coastal Act of 1976.

The advisory publications project ranging from newsletters and reports prepared by the program staff to scientific journal articles written by the project leaders and trainees, continues to provide services to all projects to assist in the preparation of materials for dissemination. In 1972-73, 74 different

publications were issued as advisory publications by the Marine Advisory Program; in 1973-74, 84 publications; and in 1976-77, more than 92 publications.

The public education advisory program of the Scripps Aquarium-Museum continues to provide instruction and a marine experience for 60,000 primary and secondary students a year. These students participate in the organized marine education activities developed and conducted by the Aquarium staff and Docents with Sea Grant funding. The outreach program, which takes slide-illustrated lectures to schools unable to visit the Aquarium, has been expanded.

University of Southern California

The Marine Advisory Services (MAS) of the University of Southern California efforts addressing the identified marine and coastal-related needs of the southern California region. With the establishment of the Coastal Commissions, the University of Southern California initiated a rapid response program to assist the local and State agencies in coastal zone planning and management data collection. This advisory service has been working on an almost daily basis with the Regional Coastal Conservation Commission and its staff, as well as with the State Coastal Conservation Commission staff, although on a less frequent basis.

In addition, MAS has worked closely with commerce and citizens' groups addressing a variety of information and educational needs including weather, news reports, and courses such as the marine recreation resources management course. Its accomplishments can be categorized in three major areas:

1. Observing and analyzing the planning process of the California Coastal Zone Conservation Commission has enabled MAS to educate both the public and private sectors as to their role in this process;

2. Providing the liaison and guidance between the state of knowledge and the public policy decisons regarding coastal resources, e.g., Los Angeles Mayor's Task Force on Outer Continental Shelf Development and the Los Angeles Chamber of Commerce; and

3. The development and implementation of the MAP feedback system such that local, regional, and State perspectives have been pursued by the University research effort.

Further, MAS is responsible for information transfer and has over the years contributed more than 35 information documents and conducted a number of conferences.

A most successful joint USC/UC Marine Advisory Services effort to date was the regional Pacific Area Sea Grant Advisory Panel (PASGAP) -- sponsored Coastal Zone Management Implementation Workshop. The idea was originated by the California Programs Marine Advisory Services, was supported by PASGAP, and was planned with assistance from staff at the University of Washington Sea Grant, as well as USC and UC. The workshop was conducted on the centrally-located UC Berkeley campus, and 35 participants came from Washington, Oregon, California, and Hawaii.

RESEARCH

The Sea Grant Advisory Panel, consisting of ten members appointed by the Secretary of the Resources Agency, was created by Chapter 1115, Statutes of 1973. This legislation provides $500,000 annually, through 1978-79, 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 goal of the Panel is to select only those projects for state support, under the provisions of Chapter 1115, which have a clearly defined benefit to the people of the State of California and which meet needs that can be clearly identified.

Priorities are transitory. What seems critical now may be much less important next year. Problems unthought of today may be paramount in the near future. Nevertheless, broad categories of RASGAP program elements have been identified as special concern to the people of California and most deserving of attention from the Panel. They are: Coastal Zone Resources Planning and Management, Coastal and Marine Recreation, Living Marine Resources, Energy Resources, Marine Mineral Resources, Waste Management, and Marine Data Acquisition and Dissemination (Advisory Services).

Coupled with RASGAP perceived research needs and review, potential research projects are reviewed internally by the executive subcommittees, by peer reviewers of the scientists and by the National Office of Sea Grant at the site visits.

This combination of reviews helps ensure vitality and integrity of the research proposals. The reviews coupled with the solicitation of proposals are devoted to research "aimed at acquiring new understanding of the marine environment which bears on the development and utilization of resources and the protection of the environment."* Particular emphasis is in the areas of aquaculture, living resources, marine biomedicinals and extracts, mineral resources, coastal zone management support, pollution studies, environmental models, socio-economics, ocean and coastal law, marine recreation, marine technological research and development, and sea food science and technology.

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*"The National Sea Grant Program--A Review" by National Advisory Committee on Oceans and Atmosphere, November 3, 1976, p. 15.

Sea Grant is involved with "applied research" which is often not completely understood. "Application describes the end result and may not describe the research itself; it depends on the state of knowledge in a particular field, and what must be learned before an economic or social result can be obtained. For example, before economically viable aquaculture of many species is possible, it may be necessary to solve fundamental problems of the physiology of reproduction, the etiology of parasites, the chemistry of culture media, behavioral patterns, nutritional requirements, or genetic characteristics. 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. To qualify as Sea Grant research, the project must, however, be related to a clear possibility of culturing a commercially valuable organism, or it must contribute to the solution of a defined problem related to a Sea Grant purpose."

"Within this general principle, research proposals have been and continue to be considered in any field, discipline or specialty. Also, Sea Grant purposes cannot be achieved without innovation, and innovative research may fall in what is sometimes termed a high risk category. Such risks are acceptable when warranted by the potential of what may be achieved."*[2]

Furthermore, Sea Grant research is not simply a scientific research program; it may encompasses the disciplines of business, law, economics, political science, and management. The research proposals and results reflect this interdisciplinary approach to addressing local and state, as well as national needs.

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*[2] The National Sea Grant Program. Program Description and Suggestions for preparing Proposals, U.S. Department of Commerce, June 1972.

APPENDIX E

LIST OF BENEFICIARIES

BENEFICIARIES

Program Elements	Local Government	Regional Government	Federal Government	Industry	Public*	University**
Coastal Zone Resources Planning & Management	16	19	19	16	15	19
Coastal & Marine Recreation	1	1	1	23	10	
Living Marine Resources	4	2	37	121	18	53
Energy Resources	5	1	13	7	1	
Marine Mineral Resources	2	3	10	7	2	8
Waste Management	7	4	3	16	4	4
Marine Data Acquisition & Dissemination	16	6	4	18	111	2
Total	51	36	87	208	161	86

*includes: associations, commissions, union, leagues, clubs, societies, schools (kindergarten - 12th grade)

**multiplier effect only not including university where project is being conducted

Source: Volume II Revised Sea Grant Proposals, UC Sea Grant Annual Reports

BENEFICIARIES cont.

Program Elements	State Government: Total for all other agencies	Dept. of Fish & Game	California Coastal Commission	Dept. of Conservation	State Lands Commission	Dept. of Navigation & Ocean Devel.	Grand Total
Coastal Zone Resources Planning & Management	64	10	26	6	2	1	213
Coastal & Marine Recreation	11		4	5		2	58
Living Marine Resources	51	32	8		2		328
Energy Resources	4			1		4	36
Marine Mineral Resources	12			3	3	4	54
Waste Management	2						40
Marine Data Acquisition & Dissemination	10	1	1			1	170
Total	154	43	39	15	7	12	899

LIST OF BENEFICIARIES*

A beneficiary is a company, agency, university, organization, etc. who have applied or utilized project results, scientific or technical advice, advisory services, etc.

[Note: The out-of-California beneficiaries are the result of spin-offs from work done in California, applied to problems elsewhere.]

Regional and Local Government

Association Monterey Bay Area Governments (AMBAG)
Bay Area Council, San Francisco
Bay Conservation & Development Commission, San Francisco
Berkeley Bayfront Council
City of Arcata
City of Coronado
City of Huntington Beach, Department of Harbors & Beaches
City of Long Beach, Planning Department
City of Newport Beach
City of San Diego
City of Santa Barbara
City of South San Francisco
Contra Costa School District
County of Del Norte
County of Kern; Department of Parks & Recreation
County of Los Angeles
County of Orange
County of Marin
County of Mendocino
County of Monterey
County of San Diego & San Diego Planning Commission
County of San Luis Obispo
County of San Mateo, Planning Department
County of Santa Cruz
County of Santa Barbara
County of Sonoma
County of Ventura, Fish & Game Commission
Cresent City
Director Parks & Recreation, San Francisco

Sources-2nd Draft of State-Local Collaboration Planning: A Growing Trend in CZ Management Sept. 1, 1977; Sea Grant Annual Reports; State Report Information

Hopkins Marine Life Refuge
Laguna Beach
La Jolla Ecological Preserve
Long Beach Recreation Department
Los Angeles County:
- Department of Beaches
- Department of Sheriffs
- Flood Control District
- Parks & Recreation
- Sanitation District
- Small Craft Harbor Commission

Los Angeles County Lifeguards
Los Angeles Harbor Department
Mission Bay Citizens Advisory Committee
Regional Water Quality Control Board, Oakland, California
San Diego City & County Schools
San Diego Comprehensive Planning Organization
San Diego Unified Port District
San Mateo City Harbors
Santa Barbara County Department of Environmental Quality
Southern California Coastal Water Resources Project

State Government

Alaska Department of Fisheries Laboratory
Alaska Department of Fish and Game
Alaska Limited Entry Management Program
California Academy of Sciences
California Advisory Commission on Marine Coastal Resources
California Assembly Committee on Resources, Land Use & Energy
California Coastal Alliance
California Coastal Commission
California Coastal Zone Conservation Commission
California, State of, Department of Fish and Game
California, State of, Department of Health
California, State of, Department of Navigation & Ocean Development
California, State of, Department of Parks and Recreation
California, State of, Division of Mines and Geology
California, State of, Division of Oil & Gas
California, State of, Division of State Lands
California, State of, Highway Department
California, State of, Resources Agency
California, State of, Senate Committee on Natural Resources and Wildlife
California, State of, Senate Subcommittee on Land Use Planning Finance Committee
California, State of, Water Resources Control Board
Coastal Act Task Force

Hawaii, State of, Department of Planning & Economic Development
Maine State Planning Office
National Park Service, New York
New England Marine Advisory Service, New Hampshire
North Carolina Coastal Resources Commission
Office of Marine Affairs, State of North Carolina
Office of the Legislative Analyst, California Legislature
Oregon State Department of Marine Resources & Development
Southern California Coastal Water Research Project
State Parks Advisory
Texas Bureau of Economic Geology
Texas Parks and Wildlife Department
Washington Department of Ecology
Washington State Department of Fisheries
Washington State Department of Natural Resources
Wildlife Conservation Fund, California
Wisconsin Department of Natural Resources

Federal Government

Conservation Foundation, Washington, D.C.
Energy Research and Development Administration
Environmental Protection Agency
Federal Power Commission
Food and Drug Administration
Interior Department of Israel
Humboldt Sea Grant Program
Louisiana State University Sea Grant Program
Marine Mammal Commission
Maritime Administration
Michigan Sea Grant
Mississippi-Alabama Sea Grant Consortium
National Institute of Allergy & Infectious Diseases
National Marine Fisheries Service
National Parks and Recreation
National Oceanic and Atmospheric Administration
National Sea Grant Office/Program
Naval Coastal Systems Laboratory
Naval Medical Research Institute
New York Sea Grant Program
North Carolina State University Sea Grant Program
Nuclear Regulatory Commission
Office of Coastal Zone Management
Pacific Marine Fisheries Commission
Pacific Outer Continental Shelf Office
Point Reyes National Seashore
St. Andrews Biological Station of the Canadian
Fisheries & Marine Service

Smithsonian Institute
U.S. Antarctic Research Project
U.S. Bureau of Land Management
U.S. Bureau of Outdoor Recreation
U.S. Coast Guard
U.S. Corps of Engineers
U.S. Department of the Interior
U.S. Department of Transportation
U.S. Forestry Service
U.S. Geological Survey, Menlo Park
U.S. Navy, Department of
U.S. Navy, Naval Biosciences Laboratory,
Oakland, California
U.S. Parks Service
U.S. Public Health Service
University of Hawaii, Sea Grant

Private Industry

AAPHER
The Ab Lab, Port Hueneme, California
AIRCO
American Fishermen's Research Foundation - Pebble Beach
American Shellfish Enterprises, Monterey
American Tunaboat Association - San Diego
AMF Voit
Aquaculture Enterprises, Monterey
Aquaculture Industry
Aquaculture Systems, Inc., Old Saybrook, Connecticut
Atlantic Richfield Oil Company
Boating Industry Associations
Brookhaven National Laboratory
California Aquaculture Association
California Commercial Fishermen's Association, Inc. - Terminal Island
California Fisheries ASsociation - Los Angeles
California Marine Associates - Cayucos
California Seafood Institute
California Salmon Fishermen
Charter Boat Operators
Chevron Research Corporation
Chromally Corporporation
Commercial Abalone Fishermen
Commercial Fishermen's Organization of Morro Bay
Commercial Oysters & Clam Farmers, California
Construction Industry of California
Crab Boat Owners Association - San Francisco
Crop Improvement Research Center, Suweon, Korea
Crown Simpson Corporation
Dames & Moore
Del Monte Research Laboratory

Desert Development Corporation, New York, New York
Diving Equipment Manufacturers Association
Dungeness Crab Fishermen
E. & E.G. Corporation
Ecomar
EDAW, Inc.
Environmental Research Laboratory
Fishermen's Marketing Association, Inc. - Eureka
Fishermen's Marketing Association of Bodega Bay
Fort Bragg Salmon Trollers Marketing Association
Gallo Brothers
Garapota Trout Farms
Ghio Seafoods, San Diego
Global Marine Development
Golden Gate Sportfishers, Inc. - San Francisco
Grossmont Hospital
Half Moon Bay Fishermen's Marketing Association
Herring Fishery
Hokkaido Regional Research Lab., Hokkaido, Japan
Hubbs-Sea World Research Institute
Hueneme Fish Bait Processors
Humboldt Bay Fisheries Association
Humboldt Fishermen's Marketing Association - Eureka
Hydronautics, Inc., Goleta
International Irrigation Information Center, Volcani Center, Bet Dagan, Israel
International Rice Research Institute, Manila, Philippines
International Shellfish Enterprises - Moss Landing
Irvine Company
Jet Propulsion Laboratory
Jones & Stokes Assoc., Inc.
Kelco Company
KPFA Radio, Berkeley, California
KPIX Television, San Francisco, California
Kraft Pulp Mill
Lockheed Ocean Laboratory
Louisiana Pacific Corporation
Marine Colloids, Ltd.
Marine Ecological Consultants, Inc.
Marineland Aquarium Products
Metaframe, San Francisco Bay Brand
Mobil Research & Development Labs
Monterey Abalone Farms
Monterey Commercial Fishermen's Marketing Association
Morro Bay Commercial Fishermen's Association
Moss Landing Commercial Fishermen's Association
National Canners Association, California
National Research Council of Canada (Atlantic Regional Labs, Halifax, Nova Scotia)

National Association of Underwater Instructors (NAUI)
Nautilus Press
Noyo Salmon Trollers
Ocean Beauty, Sacramento
Ocean Laboratories, Inc.
Olympia Brewery
Outboard Marine Corporation
Pacific Biomarine Laboratories, Venice, California
Pacific Bio-Marine Supply Company
Pacific Environmental Laboratory, San Francisco, California
Pacific Fishery Management Council
Pacific Gas and Electric Company
Pacific Ocean Farms, Inc.
Pacific Lighting Service Company
Pacific Association of Diving Instructors (PADI)
Pidgeon Point Research Center
Port San Luis Commercial Fishing Boat Owners & Commercial Fishermen, Inc.
Roy Mann Associates, Inc.
Salmon Unlimited - Mendocino County
Sand & Gravel Industry of Southern California
Sanders Associates, Inc., Nashu, New Hampshire
San Diego Gas and Electric
San Diego Tuna Fishermen
Sandyland Nursery
San Francisco Bay & Fisheries Cooperative
Santa Barbara Mariculture Foundation
Santa Cruz Commercial Fishermen's Association
Sausalito Fishermen's Marketing Association
Science Applications, Inc.
Scuba Pro
Seafood Processors
SEA Magazine
Searle Laboratories
Sea World, San Diego
Shaklee Corporation
Shell Oil Company
Shellfish Wholesalers and Retailers
Sherwood-Selpac
Silliker Laboratories
Skin Diver Magazine
Solar Aquaculture Farms
Sonoma By-Products
Southern California Edison Company
Sportways, Inc.
Standard Oil of California
Starkist Foods, Inc.
Stauffer Chemical Company
Sub Aquatic Systems

Surfing Magazine
Syntex of Palo Alto
TECHNA
Tracor, Inc.
Transfresh Corporation
Trout Unlimited - Ventura County
TRW Systems, Inc.
Tuna Research Foundation
20th Century Fund, New York
Union Carbide Corporation
Union Research Corporation
Van Camp Seafoods
Westec
Western Fishboat Owners Association - San Diego
Western Fishermen's Association

University

Biological Institute, Slovene Academy of Sciences:
Ljubljana, Yugoslavia
Brigham Young University, Department of Biology
California Institute of Technology, Pasadena, California
California State College, Dominguez Hills
California State Polytechnic University, Pomona
California State University, Los Angeles
Centro de Investigacion Cientifica y de Educacion Superior,
Ensenada, Baja California
Claremont Mens College
Diablo Valley College, Pleasent Hills, California
Florida Atlantic University
Humboldt State University
Instituto de Botanica, Sao Paulo, Brazil
Instituto Nacional de Investigaciones Agricoles
Durango, DLO, Mexico
Louisiana State University
Moss Landing Marine Laboratory
Nihon University, Tokyo, Japan, Department of
Fisheries
Oregon State University
Pacific Marine Station, University of the Pacific,
Dillon Beach, California
Scripps Institute of Oceanography
Texas A & M University
University of British Columbia
University of California, Los Angeles
University of Miami
University of Texas, Port Arkansas, Marine laboratory
University of Washington
University of Waterloo, Ontario

University of Wisconsin
U.S. Naval Postgraduate School, Monterey, California
Virginia Institute of Marine Sciences, Wachapreague, Virginia
Washington University School of Medicine
Worchester State College, Worchester, Massachusetts

General Public

Advisory Committee of the San Diego-La Jolla Underwater Park
American Association of University Women
AFL Cannery Workers Union of the Pacific - Monterey
Association of Sport Fishermen of Southern California
Beach Users (Recreational)
Boaters, Pleasure
Brandon School
Brownies-Troop 68
Cabrillo Marine Museum
California Scuba Divers
Canalino School
Carpinteria High School
Child Care Center-UCSB
Coastal Residential Landowners
Consumers
Cub Scouts
Devereux School
Ecology Center of California
Elwood School
Environmental Groups
Ezra Tora Institute
Fairview School
Fishermen's Union AFL Seine & Line - Monterey
Fishermen's Union Local 73
4H Marine Science Club
Friends of the Sea Otter
Goleta Valley Jr. High
Hope School
International Game Fish Association
International Longshoremen's & Warehousemen's Union - San Pedro
Jonata School, Bulletin
La Reina High School
League of Women Voters
Marina del Rey Lessees Association
McKinley Elementary
Mission Bay Associates
Monroe School
Monterey County Federated Sportsmen
Montessori Center School
Morro Bay Tomorrow
Mountains Task Force, Sierra Club
Mountain View School

National Audubon Society
National Coalition for Marine Conservation
National Surf Lifesaving
North American Sailing Association
Notre Dame Grammer
Oaks Nursery School
Occasional Yacht Club
Ocean Fish Protective Association - Los Angeles
Petaluma Outdoorsmen
Project Hope
San Francisco Tyee Club - San Francisco
Santa Barbara High School
Save our Salmon - Mendocino County
Seine and Line Fishermen's Union of America, AFL-CIO - San Pedro
Sierra Club
Sportsfishing Association of California - Los Angeles
St. Michael's Nursery School
St. Raphael's School
St. Vincent's School
The Nature Conservancy
Undersea Medical Society
Underwater Society of America
Venice Legal Aid
Vieja Valley School
Western Surfing Association

APPENDIX F

COOPERATING ORGANIZATIONS

TABLE OF

COOPERATING ORGANIZATIONS*

Regional & Local Government	57
State Government	80
Federal Government	39
University	59
Foreign Government	6
Private Industry	135
Public**	20
Total	396

*A cooperating organization is an organization that provided financial, technical or other assistance to Sea Grant projects.

**includes: associations, unions, leagues, clubs, societies

Source: University of California Sea Grant College Proposals Volume III

LIST OF COOPERATING ORGANIZATIONS

Abbot Laboratories, Chicago, Illinois
AEGIR Corporation
Agromarina de Panama, S.A., Panama
Alaska Commercial Fisheries Entry Commission, Juneau, Alaska
A.L. Castle, Inc., Morgan Hill, California
Allan Hancock Foundation, University of Southern California, Los Angeles, California
American Agar & Chemical Company of San Diego
American Bureau of Shipping, New York, New York
American Institute for Merchant Shipping, Washington, D.C.
American Tunaboat Association, San Diego, California
Anthony's Sea Foods, San Diego, California
Aquaculture Enterprises, Monterey, California
Arizona State University
Associated Sport Fisherman of Southern California
Atlantic Richfield Corporation, Los Angeles & Bakersfield, California
Autonomous University of Baja California
Battele Columbus Laboratories
Bay Area Council, San Francisco, California
Bendix-Marine Incorporated
Bodega Marine Laboratory, Bodega Bay, California
Bodkin, Breslin and Luddy, Attorneys
Bolsa Aqua, Huntington Beach, California
Brigham Young University
Brookhaven National Laboratory
Bumblebee Seafoods
California, State of, Assembly Committee on Resources and Land Use, Sacramento, California
California Cooperative Fishery Research Unit
California Abalone Association, Santa Barbara, California
California Academy of Science, San Francisco, California
California, State of, Department of Finance
California, State of, Senate & Assembly Office of Research, Sacramento, California
California, State of, Department of Fish and Game, Granite Canyon Lab, Long Beach, Monterey, Sacramento, San Francisco
California Agricultural Experimental Station, Berkeley, California
California, State of, Department of Highways
California Marine Research Committee
California, State of, Board of Equalization
California, State of, Legislature Committees - Coastal Resources, Deep Water Ports, Environment & Land Use, and Natural Resources
California, State of, Department of Navigation and Ocean Development, Sacramento, California

California, State of, Department of Parks and Recreation, Sacramento, California
California Seafood Institute, Research Committee, Sacramento, California
California, State of, Department of Public Health
California, State of, Division of Mines & Geology
California, State of, Division of Oil & Gas
California, State of, Energy Resources Conservation & Development Commission
California Marine Parks and Harbor Association, Marina Del Rey, California
California, State of, Resources Agency
California, State of, Department of Conservation
California, State of, Employment Development Department
California State Lands Commission, Sacramento, California
California Council for Environmental Employment in the Economic Balance
California, State of, Park System
California Coastal Commissions, Eureka, San Francisco, San Rafael, Santa Cruz, Santa Barbara, Long Beach and San Diego, California
California, State of, State Department of Motor Vehicles
California State University, Long Beach
California State University, Northridge
California State Water Resources Control Board, Division of Planning and Research, Sacramento, California
California, University of, Berkeley, Hydraulic and Sanitary Engineering Department, Berkeley, California
California, University of, Berkeley, Zoology Department, Berkeley, California
California, University of, Davis, Extension Marine Resources, Extension Wildlife and Sea Grant, Davis, California
California, University of, Davis, Institute of Marine Resources, Department of Food, Science and Technology, Davis, California
California, University of, San Diego, Scripps Institution of Oceanography, Institute of Marine Resources, San Diego, California
California, University of, Santa Cruz, Board of Environmental Studies Santa Cruz, California
California, University of, Santa Cruz, Coastal Marine Laboratory, Santa Cruz, California
Campus-Industry Action Committee
Canada Department of the Environment, Vancouver, British Columbia
Center for Law and Social Policy, Washington, D.C.
Centro de Investigacion Cientifica y Educacion Superior, Ensanada, Baja California
CER, San Diego County Department of Education

Chancellor and Ogden
Chula Vista District (including Public Library), California
Citizens League (Twin Cities area), Minneapolis, Minnesota
City of Arcata
City of Avalon
City of Beverly Hills
City of Del Mar
City of Hermosa Beach
City of Huntington Beach
City of Imperial Beach
City of Laguna Beach
City of Long Beach
City of Los Angeles
City of Newport Beach
City of Oceanside
City of Riverside
City of San Diego
City of Santa Barbara
City of Santa Monica
Clean Seas, Inc.
Colorado Environmental Affairs and Planning, Denver, Colorado
Colorado Land Use Commission, Denver, Colorado
Colorado Municipal League, Wheat Ridge, Colorado
Colorado, University of, Bureau of Governmental Research and Service, Boulder, Colorado
Columbia Broadcasting System-KNX Radio
Commercial Diving Center, Wilmington, California
Commercial oyster and clam cultivators
Commercial processors for abalone, tuna and salmon
Comprehensive Planning Organization for the San Diego Region, San Diego, California
Concerned Mayor's Task Force
Conservation Foundation, The, Washington, D.C.
Cooperative Extension Laboratory, UC-Davis, California
Coordinating Council of Higher Education, HEW
County of Del Norte
County of Humboldt
County of Los Angeles
County of Mendocino
County of Monterey
County of Orange
County of San Diego
County of San Francisco
County of San Luis Obispo
County of San Mateo
County of Santa Barbara
County of Sonoma
County of Ventura

Covington and Burley, Washington, D.C.
Crown Simpson
Cyprus Mines
Dames and Moore, Incorporated
Datatronics Systems Corporation
Davey's Locker, Incorporated
Delaware Department of Natural Resources and Environmental Control, Dover, Delaware
Delaware Planning Office, Dover, Delaware
Delaware, University of, Coastal Zone Resource Planning, Newark, Delaware
Del Monte Properties Beach and Tennis Club, Pebble Beach, California
Department of Agronomy and Range Sciences, UC-Davis, California
Department of Engineering Research, San Ramon, California, UC-Davis
Department of Land, Air, and Water Resources, UC-Davis, California
Department of Navigation and Ocean Development, State of California, Sacramento, California
Department of Sanitation and Flood Control, San Diego County
Department of Soils and Plant Nutrition, UC-Davis, California
Department of Tourism, Baja California, Tijuana and La Paz
Department of Vegetable Crops, UC-Davis, California
D.H. McKee Inc., (Flavor-Tex), Tampa, Florida
Diablo Valley College, Pleasant Hill, California
Diving equipment manufacturers:
- Aqua Craft, San Diego, California
- Dacor Corporation, Chicago, Illinois
- Farallon Industries, Belmont, California
- Healthways, Los Angeles, California
- O'Neil, Inc., Santa Cruz, California
- Parkway-Poseidon, Perth Amboy, New Jersey
- Scuba Pro, Paramount, California
- Sherwood-Selpac, Santa Ana, California
- Sportsways, Inc., Paramount, California
- Sub Aquatic Systems, Redondo Beach, California
- Techna, Menlo Park, California
- U.S. Divers, Santa Ana, California
- Voit, Santa Ana, California
- White Stag, Incorporated, Marina del Rey, California

Diving Equipment Manufacturers Association, Long Beach, California
Domingues-Carson Chamber of Commerce
Dravco Corporation, Pittsburgh, Pennsylvania
Dungeness crab fishermen
East Carolina University
Effects Technology, Inc., Santa Barbara, California
EG&G, Inc.
Environmental Canada, Nanaimo, British Columbia, Canada

Environmental Groups
Environmental Protection Agency
Environmental Research Laboratories, Puerto Penasco, Sonora, Mexico
Environmental Research Laboratory, Tucson, Arizona
Escuela Superior de Ciencias Marinas, Ensenada, Baja California
Eureka Fisheries, Eureka, California
Exploratory Career Experience Program, San Diego City Schools
Exxon-Environmental Engineering Department
Fisherman's Association, Bodega Bay, California
Fisheries Research Board of Canada, Nanaimo, British Columbia, Canada
Fisherman's Unions
Fishermen and Allied Workers Union, Local 33, I.L.U., Terminal Island, California
Flavor-Tex
Florida Atlanic University, Joint Center for Environmental and Urban Problems, Fort Lauderdale, Florida
Florida Coastal Coordinating Council, Tallahassee, Florida
Florida Department of Administration, Bureau of Land and Water Management, Tallahassee, Florida
Florida Division of State Planning, Tallahassee, Florida
Food Technology Research and Development Center, Division of Food Technology, Ministry of Agriculture and Land, Sungei Besi, Selangor, Malaysia
Foremost Research Center, Division of Foremost Foods, Dublin, California
Foundation for Ocean Research, San Diego, California
Fullerton Junior College
G.D. Searle & Company, Chicago, Illinois
Global Marine
Glosten Associates, Seattle, Washington
Governor's Office of Planning and Research, Sacramento, California
H&M Wholesale Lobster Company, Petaluma, California
Hawaii Department of Planning and Economic Development, Honolulu, Hawaii
Hawaii Land Use Commission, Honolulu, Hawaii
Hoffman-La Roc.
Hopkins Marine Station of Stanford University, Pacific Grove, California
Hueneme Fish and Bait Processors, Port Hueneme,
Humboldt State University, Arcata, California
Hydrolab
Immaculate Heart College
Institute of Geophysics and Planetary Physics, La Jolla, California
Institute of Marine Resources, University of California
Inter-American Tropical Tuna Commission, La Jolla, California
International Biological Consultants
International Shellfish Enterprises, Inc., Moss Landing, California
Johns Hopkins School of Advanced International Studies, Washington, D.C.
Jones & Stokes, Environmental Consultants, Sacramento, California
Kelco Company, San Diego, California

Kelp Habitat Improvement Project, California Institute of Technology, Pasadena, California
Kennecott Explorations, Inc., Ocean Operations Division, San Diego, California
Kinnetics Laboratory Inc., Santa Cruz, California
KNX Radio Station
Korean Institute of Science and Technology, Seoul, Korea
Lawrence Radiation Laboratory, Berkeley, California
Lazio Fish Company, Eureka, California
Leonard Greenstone Company, Los Angeles, California
Leslie Salt Company, Newark, California
LFE Environmental Analysis Laboratories, Richmond, California
Local and Regional Water Quality Control Boards
Local Fishermen, San Diego, California
Lockheed Missiles and Space Company
Long Beach Chamber of Commerce
Long Beach Harbor Department
Los Angeles Chamber of Commerce
Los Angeles City Planning Department
Los Angeles County Department of Beaches
Los Angeles County Department of Parks and Recreation
Los Angeles County Museum of Natural History, Los Angeles, California
Los Angeles County Regional Planning Commission
Los Angeles County Sanitation District
Los Angeles County Small Craft Harbor Commission
Los Angeles Flood Control District
Los Angeles Yacht Club
Louisiana Pacific
Louisiana State Planning Office, Baton Rouge, Louisiana
Lowie Museum
Loyola University of Los Angeles
Maccaferri Gabions, Incorporated, Flushing, New York
Maine Department of Environmental Protection, Augusta, Maine
Maine Natural Resources Council, Augusta, Maine
Maine State Planning Office, Coastal Planning Group, Augusta, Maine
Maine State Planning Office, Land Use Regulation Commission, Augusta, Maine
Maine State Planning Office, Resource Planning Division, Augusta, Maine
Marconsult, Inc.
Marina Del Rey Chamber of Commerce, MDR Lessee's Association
Marina Del Rey, Sea Grant Project, Marina Del Rey, California
Marine Collids, Rockland, Maine
Marine Commodities International, Inc., Brownsville, Texas
Marineland of the Pacific
Maritime Administration, Washington, D.C.
Maryland Department of Natural Resources, Annapolis, Maryland

Maryland Department of Natural Resources, Coastal Zone Management Program, Annapolis, Maryland
Maryland State Land Use Planning Program, Baltimore, Maryland
Massachusetts, Commonwealth of, Division of Water Resources, Department of Environmental Management, Boston, Massachusetts
Massachusetts, Commonwealth of, Executive Office of Environmental Affairs, Boston, Massachusetts
Masachusetts, Department of Natural Resources, Wetlands Division, Boston, Massachusetts
Massachusetts Institute of Technology
Massachusetts Lobster Hatchery, Martha's Vineyard, Massachusetts
Massachusetts, University of, Institute for Man and Environment, Amherst, Massachusetts
Matson Navigation Company, San Francisco, California
Mayor's Task Force of Southern California Governments Concerned with OCS Oil and Gas Development
McCutcheon, et al., Attorneys at Law, Los Angeles
Merck, Sharp & Dohme Labs, Rahway, New Jersey
Meredith Fish Company, Sacramento, California
Minnesota Coastal Zone Program, State Planning Agency, St. Paul, Minnesota
Minnesota Department of Natural Resources, St. Paul, Minnesota
Minnesota Land Use Planning, State Planning Agency, St. Paul, Minnesota
Mission Bay Associates, San Diego, California
Mobil Oil Company
Monsanto Company
Moss Landing Marine Laboratories, California
Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts
Nacional Hotelera, Ensenada, Baja California, Mexico
National Association of Underwater Instructors, Colton, California
National Cancer Institute, National Institutes of Health, Bethesda, Maryland
National Canner's Association, Washington, D.C.
National Canner's League, Sacramento, California
National Environmental Data Service
National Institutes of Health, Bethesda, Maryland
National Marine Fisheries Service, San Francisco, Tiburon, La Jolla, Terminal Island, California; Auke, Alaska; and Seattle, Washington.
National Museum of Natural History, Smithsonian Institution
National Oceanographic & Atmospheric Administration
National Scuba Training Council: NASDS, NAUI, PADI, SSI and YMCA
National Weather Service, Redwood City, California; San Diego, California; and Phoenix, Arizona
Naval Medical Research Institute, Behavior Sciences Department, Bethesda, Maryland
Naval Oceanographic Office

Naval Weather Service, San Diego, California
New Jersey Department of Environmental Protection, Coastal Area Planning, Trenton, New Jersey
New Jersey Department of Environmental Protection, Office of Coastal Zone Management, Trenton, New Jersey
New Jersey State and Regional Planning, Department of Community Affairs, Trenton, New Jersey
Newport Beach Chamber of Commerce
New York Department of Environmental Conservation, Albany, New York
New York Department of State Planning, Albany, New York
New York Division of Planning Services, Albany, New York
New York State University, Albany, New York
New York State University, Department of Public Administration, Albany, New York
Nossaman, Waters, Krueger, Marsh & Riodan, Los Angeles, California
Oakland, Port of, Oakland, California
Oakland World Trade Club, Oakland, California
Occidental College
Ocean Labs Inc., Irvine, California
Office of Coastal Zone Management, National Oceanographic & Atmospheric Administration
Office of Sea Grant, National Oceanographic & Atmospheric Administration
Oregon Department of Land Conservation and Development, Salem, Oregon
Oregon Executive Department, Local Government Relations Division, Salem, Oregon
Oregon League of Women Voters, North Bend, Oregon
Oregon State University
Pacific Alaska LNG Company
Pacific Coast Fisherman's Organization, Sausalito, California
Pacific Gas & Electric Company
Pacific Lighting Services Company
Pacific Marine Exchange, San Francisco, California
Pacific Marine Fisheries Commission, Portland, California
Pacific Merchant Shipping Association, San Francisco, California
Palos Verdes Estates
Peterson Publications, Incorporated
Plessey Corporation, San Diego
Point St. George Fisheries, Santa Rosa, California
Ralston Purina, St. Louis, Missouri
Regional Water Quality Control Board, Oakland, California
Resources for the Future, Washington, D.C.
Rhode Island Statewide Planning Program, Providence, Rhode Island
Rhode Island, University of, Coastal Resources Center, Kingston, Rhode Island
Rhode Island, University of, Marine Advisory Service, Kingston, Rhode Island
Royal Norwegian Council for Scientific & Industrial Research, Oslo, Norway

Salk Institute, La Jolla, California
Sanders Associates, New Hampshire
San Diego, City of, Planning Department, San Diego, California
San Diego City School District, volunteer office
San Diego County Department of Education, Community Education Resources
San Diego Gas & Electric Company, San Diego, California
San Diego Museum of Man
San Diego State University
San Francisco Bay Brand Brine Shrimp Company, San Francisco, California
San Francisco Bay Chapter, Oceanic Society, San Francisco, California
San Francisco Bay Conservation and Development Commission, San Francisco, California
San Francisco State University, San Francisco, California
San Mateo County Assessor, Finance Department, Redwood City, California
Santa Barbara City College
Save Our Seas, Washington, D.C.
San Pedro Chamber of Commerce
Scripps Institution of Oceanography, University of California, San Diego
Sea Landing Sportfishing, Santa Barbara, California
Searle Laboratories, Chicago, Illinois
Sea World, San Diego, California
Seven Seas Dive Shop, Monterey, California
Shell Oil Company
Sierra Club, Minneapolis, Minnesota
Signal Oil Company, Long Beach
Silliker Laboratories, Vernon, California
Soil Control Lab, Watsonville, California
Southern California Coastal Waters Research Project
Southern California Edison Company
Southern California Gas Company
Southwest Regional Calibration Center, San Diego, California
Sport and Commercial Fishermen's Associations
Sport diving clubs
Standard Oil - California
Marine Engineering Department
Transportation Department
Standard Oil - Ohio
Environmental Department
Transportation Department
St. Andrews Biological Station, Fisheries Research Board of Canada, New Brunswick
Stanford University
Star-Kist Foods, Incorporated
Stauffer Agricultural & Chemical Company, Mountain View, California
Stauffer Chemical, Port Hueneme, California
Steinhart Aquarium, California Academy of Sciences, San Francisco
Syntex Corporation, Palo Alto, California
1000 Friends of Oregon, Portland, Oregon

Maryland Department of Natural Resources, Coastal Zone Management Program, Annapolis, Maryland
Maryland State Land Use Planning Program, Baltimore, Maryland
Massachusetts, Commonwealth of, Division of Water Resources, Department of Environmental Management, Boston, Massachusetts
Massachusetts, Commonwealth of, Executive Office of Environmental Affairs, Boston, Massachusetts
Masachusetts, Department of Natural Resources, Wetlands Division, Boston, Massachusetts
Massachusetts Institute of Technology
Massachusetts Lobster Hatchery, Martha's Vineyard, Massachusetts
Massachusetts, University of, Institute for Man and Environment, Amherst, Massachusetts
Matson Navigation Company, San Francisco, California
Mayor's Task Force of Southern California Governments Concerned with OCS Oil and Gas Development
McCutcheon, et al., Attorneys at Law, Los Angeles
Merck, Sharp & Dohme Labs, Rahway, New Jersey
Meredith Fish Company, Sacramento, California
Minnesota Coastal Zone Program, State Planning Agency, St. Paul, Minnesota
Minnesota Department of Natural Resources, St. Paul, Minnesota
Minnesota Land Use Planning, State Planning Agency, St. Paul, Minnesota
Mission Bay Associates, San Diego, California
Mobil Oil Company
Monsanto Company
Moss Landing Marine Laboratories, California
Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts
Nacional Hotelera, Ensenada, Baja California, Mexico
National Association of Underwater Instructors, Colton, California
National Cancer Institute, National Institutes of Health, Bethesda, Maryland
National Canner's Association, Washington, D.C.
National Canner's League, Sacramento, California
National Environmental Data Service
National Institutes of Health, Bethesda, Maryland
National Marine Fisheries Service, San Francisco, Tiburon, La Jolla, Terminal Island, California; Auke, Alaska; and Seattle, Washington.
National Museum of Natural History, Smithsonian Institution
National Oceanographic & Atmospheric Administration
National Scuba Training Council: NASDS, NAUI, PADI, SSI and YMCA
National Weather Service, Redwood City, California; San Diego, California; and Phoenix, Arizona
Naval Medical Research Institute, Behavior Sciences Department, Bethesda, Maryland
Naval Oceanographic Office

University of Southern California, Political Science Department, Los Angeles, California
University of the Pacific Marine Laboratory
University of Washington
Van Camp Company
Vermont Environmental Board, Agency of Environmental Conservation, Montpelier, Vermont
Vermont State Planning Office, Montpelier, Vermont
Washington D.C. Naval Undersea Center, San Diego & Civil Engineering Lab., Port Hueneme, California
Washington Department of Ecology, Office of Land Programs, Olympia, Washington
Western Coast Travelers Association
Washington University, St. Louis, Missouri
Western Coast Trawlers Association
Western Oil and Gas Association
Wilmington Chamber of Commerce
Zoecon Corporation, Palo Alto, California

APPENDIX G

CALIFORNIA SEA GRANT PROGRAM FACT SHEET

CALIFORNIA'S
SEA GRANT PROGRAM
FACT SHEET*

Table G-1

Grant Year	
1975-76	104 industrial firms participated
1975-76	47 educational institutions participated
1975-76	108 state and local government agencies participated
1975-76	139 publications with Sea Grant support (journal articles, newsletters, etc.)
1976-77	465 individuals involved 181.37 Total FTE
1976-77	45 Advisory Service staff 25.54 FTE
1976-77	210 faculty and professional staff 71.1 FTE
1976-77	87 graduate trainees 17 undergraduate students 32 graduate research assistants

Grant Year 1976-77	Office of Sea Grant Funding	Percent of Total
Research	$1,408,830	54.0%
Education	384,703	15.0%
Advisory	494,306	19.0%
GRAND TOTAL	$2,605,000**	100.0%

*Includes University of California, Humboldt State University, University of Southern California, and Stanford University

**Includes management and rapid response

Table G-2

PARTIAL CALIFORNIA SEA GRANT FUNDING HISTORY, 1970-1978

Grant Year	Federal Funding	State Matching Funds
1970-1971	$1,265,000	--
1971-1972	$2,051,400	--
1972-1973	$2,334,600	--
1973-1974	$1,740,400	--
1974-1975	$2,295,400	$500,000
1975-1976	$2,398,474	$500,000
1976-1977	$2,605,000	$500,000
1977-1978	$2,930,000	$500,000

Source - California Sea Grant Proposals, California Sea Grant, form 1-90's

APPENDIX H

MATCHING FUNDS & SOURCES

Table H-1

CALIFORNIA SEA GRANT PROGRAMS
MATCHING FUNDS AND SOURCES

	Grant Yr 71-2	Grant Yr 72-3	Grant Yr 73-4	Grant Yr 74-5	Grant Yr 75-6	Grant Yr 76-7	Grant Yr 77-8*	TOTALS*
Universities and Colleges	$ 649,784	$951,507	$684,100	$977,238	$ 746,960	$ 1,304,003	$ 1,417,823	$ 6,731,415
State Government Departments and Agencies	-0-	91,719	192,668	172,897	310,691	132,783	101,786	1,002,544
State (Stull) Matching Funds	---	---	---	500,000	500,000	500,000	500,000	2,000,000
Private Industries	143,533	153,260	84,610	143,202	122,438	53,435	162,218	862,696
Public Organizations, Foundations, et cetera	207,366	151,100	66,081	53,303	90,562	133,454	71,208	733,074
TOTAL	$1,000,683	$1,347,586	$1,027,459	$1,846,640	$1,770,651	$ 2,123,675	$ 2,253,035	$11,369,729**

* estimated; incomplete list

**Humboldt State University's matching funds for 1971 through 1975-76 are not included in the above; funds were not identified by year. Overall total of matching funds of HSU is $279,000.

APPENDIX I

EMPLOYMENT OF PREVIOUS CALIFORNIA SEA GRANT-FUNDED STUDENTS

Table I-1
Employment of Previous
California Sea Grant-Funded Students

Employment	Bachelors	Masters	Ph.D.	Total
Regional & Local Government	1	10	1	12
State Government	0	12	6	18
Federal Government	7	8	8	23
Private Industry	8	24	17	49
University	2	21	13	36
Place of Employment Unknown	43	32	40	115
Total	61	107	85	253

Table I-2
[Status of students who were continuing education one year after finishing a degree on Sea Grant funding]

Educational Program	Bachelors	Masters	Ph.D.	Total
Ph.D. Programs	0	29	0	29
Professional Schools	3	10	0	13
Masters Programs	5	0	0	5
Undergrad Programs	3	0	0	3
Total	11	39	0	50

Table I-2

STUDENTS

List of Student Employment

GOVERNMENT

Regional & Local

Contra Costa School District
San Joaquin County
San Diego County
San Diego City
City of Long Beach Planning Department
City of Santa Clara
County of Los Angeles
Santa Cruz Regional Commission
Yuba County Health Department
Placerville High School

State

California Department of Fish and Game
California Department of Parks and Recreation
California Department of Navigation and Ocean Development
Alaska Limited Entry Management Program
Alaska Fish and Game
Texas Bureau of Economic Geology
Alaska Department of Fisheries Laboratory
California State Water Quality Control Board
New York Legislature, Albany
California Coastal Commission, San Francisco

Federal

United States Department of the Navy
Nuclear Regulatory Commission
United States Antarctic Research Project
United States Geological Survey
United States Forestry Service
Smithsonian Institute
National Marine Fisheries Service
National Oceanographic & Atmospheric Administration

Source: graduate student offices of university campuses

PRIVATE INDUSTRY

Annheuser-Busch
Santa Fe International Company
Ramsey Engineering Company
Paul, Hastings & Janofsky
Tetra Tech, Inc.
Donald Wolbrink and Associates
Environmental Protection Division, Atlantic Richfield Company
Atlantic Richfield Oil Company
Community and Land Use Consultants, Capitola, California
Del Monte Research Laboratory
Gallo Brothers
Landscape Architecture
Lockheed Ocean Laboratory
Oceanographic Services
Olympia Brewery
Scripps Clinic
Shaklee Corporation
Solar Aquaculture Farms
Southern California Edison
San Diego Gas and Electric Company
Sea World, San Diego
Grossmont Hospital
Petroleum Industry
Aerotherm Acurex Corporation
Commercial Diving Center
Morrow Law Firm

UNIVERSITY

University of Southern California
Cut Cove Marine Laboratory
City College of New York
Atomic Energy Institute, Brazil
Pahlavi University
San Diego State University
Scripps Institution of Oceanography
University of California, Berkeley
University of California, San Diego
University of California, Santa Barbara
University of Hawaii
University of Idaho
Arizona State
University of Delhousie
University of Maine
University of California, Davis
California Technical Institute
University of Texas at Arlington

NON-PROFIT FOUNDATION

Brookings Institute

Student Status

Ph.D. Programs

California Polytechnic Institute, San Luis Obispo
Michigan State University
Oregon State University
Stanford University
Stonybrook State University
Texas Women's University
University of California, Berkeley
University of California, Davis
University of California, San Diego
University of California, Santa Barbara
University of California, Santa Cruz
University of Hawaii
University of Idaho

Professional Schools

University of California, Davis
University of California, Irvine

Masters Programs

San Diego State University

Undergraduate Programs

San Diego State University

APPENDIX J

COMMITTEES AND PANELS

RESOURCES AGENCY
SEA GRANT ADVISORY PANEL
(RASGAP)

Name	Representation
Mr. E.C. Fullerton, Director Department of Fish and Game 12th Floor, Resources Building Sacramento, California 95814	Chairman, representing the Department of Fish and Game (916) 445-3535
Mr. Joseph E. Bodovitz, Executive Director California Coastal Zone Conservation Commission 1540 Market Street, 2nd Floor San Francisco, California 94102	Member, representing the California Coastal Zone Conservation Commission (415) 557-1001
Mr. Jeffery D. Frautschy, Assistant Director Scripps Institution of Oceanography Mail Code A-032 University of California La Jolla, California 92093	Member, representing the University of California (714) 452-4446
Mr. Thomas E. Gay, Jr., Chief Deputy State Geologist Division of Mines and Geology Department of Conservation 1416 Ninth Street, Room 1341 Sacramento, California 95814	Member, representing the Department of Conservation (916) 445-1923
Mr. Dennis Grotting, Secretary-Manager Fishermen's Marketing Assoc., Inc. #2 Commercial Street Wharf Eureka, California 95501	Member, representing the fish industry (707) 442-3789
Mr. Wilbur M. Thompson, Manager Long Beach Operations State Lands Commission 100 Oceangate St., Room 300 Long Beach, California 90802	Member, representing the State Lands Commission (213) 590-5201

Resources Agency-Sea Grant Advisory Panel, Con't.

Name	Representation
Mr. Donald Walsh, Director USC Institute for Marine and Coastal Studies University of Southern California University Park Los Angeles, California 90007	Member, representing the private institutions participating in the National Sea Grant Program (213) 741-6104
Mr. Richard Ridenhour Humboldt State University Arcata, California 95521	Member, representing the California State Universities and Colleges (707) 826-3632
Ms. Marty Mercado, Director Department of Navigation and Ocean Development Resources Building, Room 1336 Sacramento, California 95814	Member, representing the Department of Navigation and Ocean Development (916) 445-6281
Mr. Elmer P. Wheaton 127 Solana Road Portola Valley, California 94025	Member, representing the ocean engineering industry

UNIVERSITY OF CALIFORNIA
SEA GRANT COLLEGE PROGRAM

IMR EXECUTIVE SUBCOMMITTEE FOR SEA GRANT

James J. Sullivan, Chairman
Program Manager
Sea Grant College Program
A-032
University of California
La Jolla, California 92093

Victor C. Anderson
Deputy Director
Marine Physical Laboratory
P-001
University of California
La Jolla, California 92093

William Doyle
Associate Director, Institute
of Marine Resources and Director
of Coastal Marine Laboratory
University of California
Santa Cruz, California 95064

Richard F. Ford, Director
Center for Marine Studies
San Diego State University
San Diego, California 92182

Jeffery D. Frautschy
Associate Director
Institute of Marine Resources
Coastal Resources and Sea Grant
A-032
University of California
La Jolla, California 92093

Cadet Hand, Director
Bodega Marine Laboratory
P.O. Box 247
Bodega Bay, California 94923

Robert W. Holmes
Associate Director
Institute of Marine Resources
University of California
Santa Barbara, California 93106

Theodore Kerstetter, Director
Marine Laboratory
Humboldt State University
Trinidad, California 95570

Anthony Orme, Chairman
UCLA Marine Studies Council
and Geography Department
1255 Bunche Hall
University of California
Los Angeles, California 90024

Bernard Schweigert
Associate Director
Institute of Marine Resources, and
Chairman, Department of Food
Science and Technology
University of California
Davis, California 95616

Gerald Wick
Assistant Director
Institute of Marine Resources
A-027
University of California
La Jolla, California 92093

UNIVERSITY OF CALIFORNIA
INSTITUTE OF MARINE RESOURCES ADVISORY COUNCIL

MEMBERS

Mr. Willard Bascom
Director, Southern California
Coastal Water Research Project
1500 East Imperial Highway
El Segundo, California 90245

Dr. Claire T. Dedrick
Public Utilities Commission
350 McCalister
San Francisco, California 94102

The Honorable Hugo Fisher
San Diego Superior Court
Department 29
220 West Broadway
San Diego, California 92101

Mr. C.M. (Tod) Ghio
Ghio Seafood Products
5232 Lovelock
San Diego, California 92110

Dr. Arthur W. Hansen
Director, Consumer and
Environmental Protection
Del Monte Corporation
P.O. Box 3575
San Francisco, California 94119

Mr. Francis J. (Frank) Hortig
Consulting Engineer,
Energy Resources
2216 Westboro
Alhambra, California 91803

Dr. James Joseph
Director of Investigations
Inter-American Tropical
Tuna Commission (IATTC)
Southwest Fisheries Center
La Jolla, California 92037

Mr. John W. Landis, Vice President
Stone & Webster Engineering Corp.
P.O. Box 2325
Boston, Massachusetts 02107

Mr. James G. Wenzel
Vice President
Lockheed Missiles & Space Co., Inc.
1111 Lockheed Way
Sunnyville, California 94080

Dr. Allen E. Puckett
Executive Vice President
Assistant General Manager
Hughes Aircraft Company
Centinella Avenue & Teale
Culver City, California 90230

Mr. J.T. (Jack) Riley
President, Kelco Company
8355 Aero Drive
San Diego, California 92123

Dr. Brian Rothschild, Director
Office of Policy Development and
Long Range Planning (Code FXI)
National Marine Fisheries Service
U.S. Department of Commerce,
NOAA
Washington, D.C. 20235

Mr. John J. Royal
Secretary-Treasurer
Fishermen's Union ILWU Local 33
806 South Palos Verdes Street
San Pedro, California 90731

Mr. Phillip N. Storrs
Senior Vice President
Engineering-Science Inc.
150 North Santa Anita Avenue
Arcadia, California 91006

Mr. Elmer P. Wheaton
(Retired Vice President,
Lockheed Missiles and
Space Company)
127 Solana Road
Portola Valley, California 94025

UNIVERSITY OF CALIFORNIA
INSTITUTE OF MARINE RESOURCES ADVISORY COUNCIL (CONTINUED)

EX-OFFICIO MEMBERS*

William A. Nierenberg
Chairman, IMR Advisory Council
and Director, Scripps
Institution of Oceanography
A-010
University of California
La Jolla, California 92093

John D. Isaacs, Director
Institute of Marine Resources
A-027
University of California
La Jolla, California 92093

Richard W. Eppley
Associate Director
Institute of Marine Resources--
Marine Productivity
A-018
University of California
La Jolla, California 92093

Joseph L. Reid
Associate Director
Institute of Marine Resources--
Pelagic Resources, and Director,
Marine Life Research Group
A-030
University of California
La Jolla, California 92093

---

* Includes members of the IMR Executive Subcommittee for Sea Grant

UNIVERSITY OF SOUTHERN CALIFORNIA
SEA GRANT ADVISORY PANEL

Victor Adorian, Director
Department of Small Craft Harbors

Gary L. Bane, Manager
Ocean Engineering Department
Rockwell International

Richard A. Geyer, Chairman
Department of Oceanography
Texas A and M University

Col. Ted Gillenwaters
Ocean Research Institute

George Hatchett
Executive Vice President
Tetra Tech, Inc.

Robert Kleist
Director of Trade Development
Port of Los Angeles

Robert Krueger, Esquire
Nossaman, Krueger and Marsh

Capt. William C. Lynch
Naval Legal Service Office
Naval Station, San Diego

Wheeler J. North
Department of Environmental
Science
California Institute for Technology

Richard J. Seymour
Department of Navigation and
Ocean Development
University of California,
San Diego

Howard Talkington, Head of
Ocean Technology Department
Naval Undersea Center

Richard C. Timme
General Manager
Environmental Engineering Division
Interstate Electronics Corporation

Capt. T.K. Treadwell
Department of Oceanography
Texas A and M University

O.D. Waters, Jr.
Rear Admiral, USN (Retired)

Elmer Wheaton
Vice President (Retired)
Lockheed

Oscar P. Zabarsky, President
Martek Instruments Inc.

EX OFFICIO MEMBER

Don Walsh, Director
USC Institute for Marine and
Coastal Studies
University of Southern California

APPENDIX K

LIST OF MARINE ADVISORY WORKSHOPS

APPENDIX K

List of Marine Advisory Workshops

Audience Type*	Number of Workshops	Number of Attendees
Commercial and Recreational Fishermen	73	3,265
Marine Businesspeople	6	240
Homemakers	13	1,540
General Public	7	728
Members of University Government	2	80
TOTAL	101	5,853

*These are grouped according to predominant number of each group present at workshops on Marine Financial Assistance, Marine Insurance, Business Management, Seafood Consumer Education, National Fisheries Plan, Marine Weather, Tuna Boat Acoustics, Nutrition Expo and Leadership Training. This table does not list all the workshops presented by the Marine Advisory Program.

Source-USC Annual reports, UC Marine Advisory Program Workshop Statistics.

APPENDIX L

NUMBER OF LETTERS OF SUPPORT

Table L-1

NUMBER OF
LETTERS OF SUPPORT*

RASGAP Program Elements	Regional & Local Government	State Government	Federal Government	Private Industry	Public**	University	Total
Coastal Zone Resources Planning & Management	4	8	2	1	4	0	19
Coastal & Marine Recreation	4	3	1	1	1	1	11
Living Marine Resources	1	16	8	34	2	8	69
Energy Resources	1	2	2	2	0	0	7
Marine Mineral Resources	0	3	1	0	0	0	4
Waste Management	0	0	0	5	0	0	5
Marine Data Acquisition & Dissemination	1	5	5	2	3	1	17
Total	11	37	19	45	10	10	132

*Source: California Revised Sea Grant Proposals, Volume III; 1974/75 - 1977/78

**includes:
associations
commissions
unions
leagues
clubs
societies

APPENDIX M

NUMBER OF PUBLICATIONS RELEASED

Table M-1

NUMBERS OF PUBLICATIONS RELEASED
BY SPECIFIC TYPE AND SUBJECT CATEGORIES*

RASGAP PROGRAM ELEMENTS	Sea Grant/IMR Publications	Sea Grant Technical Pub. (Reprints)	Conference Proceedings	Sea Grant Reports**	Sea Grant Working Papers	Dissertations & Theses	Brochures	Abstracts	Books	Misc***	Total
Costal Zone Resources Planning & Management	18	44	30	10	22	5		3	2	6	140
Coastal & Marine Recreation		15	11	1	3		1			32	63
Living Marine Resources	50	223	92	15	6	39		12	2	39	444
Energy Resources	5	16	2	4	2	3		6		4	42
Marine Mineral Resources	2	5	9	4		7		5			32
Waste Management	1	7	2	1		1					12
Marine Data Acquisition & Dissemination	35	16	7	2	1				1	3	65
TOTAL	111	326	153	37	34	55	1	26	5	84	832

* Source: California Sea Grant Annual Reports,
1977 Sea Grant Project Information Forms
** publications with Sea Grant funding printed through other University departments
*** includes presentations in newsletters

APPENDIX N

DISTRIBUTION OF PUBLICATIONS

Distribution of Publications
in 1977
Audiences*

Table N-1

RASGAP PROGRAM ELEMENTS	Fishermen & Sea Food Processors	Students	Libraries	General Public	Professionals	Federal & State Agencies	Universities	Schools	Sea Grant	Industry	Total
Coastal Zone Planning & Management			19	8	14	16	7		2	17	84
Coastal & Marine Recreation											
Living Marine Resources	4	1	31	68	36	42	50	5	10	44	291
Energy Resources			4	4	7	2	9	1	2	13	42
Marine Mineral Resources			7	2			2			3	14
Waste Management			2								2
Marine Data Dissemination	306	289	71	3791	867	901	765	5	1434	56	8485*
Total	310	291	134	3873	924	961	833	11	1448	133	8918

* Key to audiences:

Fishermen & Seafood processors - includes all Seafood processors and fishermen identified as such either in the letter or by the name of the company (letterhead).

Students - all levels from kindergarten through Ph.D.'s.

Libraries - all State, County, City or miscellaneous libraries, does not include University or industrial libraries.

General Public - includes those requests from individuals that cannot be placed in any of the other categories. Includes letters from general public when no affiliation is given either in the letter, or no letterhead.

Professionals - includes professional people other that those in industry or at the University.

Federal & State Agencies - from federal & state agencies.

Universities - includes requests from professors, university research units, etc. (Includes all higher level educational institutions.)

Schools - includes requests from kindergarten, elementary, junior high & high school administrative offices.

Sea Grant - includes requests from any Sea Grant program, or any Sea Grant personnel.

Industry - includes all requests from industry identified as such either by letterhead or in letter. Also includes industry libraries.

*Source: University of California Sea Grant Publications Project Record includes only publications distributed from University of California Sea Grant T-N - does not include University of Southern California publications.

APPENDIX O

STATE-RELATED PROJECTS

Table 0-1

TOTAL OFFICE OF CALIFORNIA SEA GRANT AND MATCHING FUNDS SPENT ON STATE RELATED PROJECTS FOR THE PERIOD 1970-1978*

Grant Year	Dollars in State*** Related Projects	Dollars in All Projects	Dollars In State Related Projects as percentage of Total	Average
1970-71	$1,096,016	$1,859,860	58%	
1971-72	$2,083,861	$3,060,283	68%	59%
1972-73**	$1,827,084	$3,597,076	50%	
1973-74	$2,040,385	$2,736,559	74%	
1974-75	$3,075,533	$3,989,362	77%	78%
1975-76	$3,214,313	$4,160,244	77%	
1976-77	$3,696,739	$4,838,751	76%	
1977-78	$4,369,150	$5,115,078	85%	

*includes Humboldt State University, University of California, and University of Southern California.

**$139,342 match funded for management, research, education, and advisory projects at HSU 1971-72 - 1973-74 that is not included in chart.

***State related projects are all projects that have a direct and identified benefit to the State of California - it's state, regional or local governments, industry, public, etc. including all projects supported by state matching funds.

APPENDIX P

PROJECTS OF CALIFORNIA SEA GRANT PROGRAM

CALIFORNIA SEA GRANT PROGRAM CUMULATIVE PROJECTS LIST 1968-1977

I. COASTAL ZONE RESOURCES PLANNING & MANAGEMENT

- Predictive Methods and Information Systems in Coastal Zone Management (Twiss)
- Physical Criteria for Coastal Planning (Inman)
- Development and Assessment of Legally Permissible Methods for Coastal Management (Heyman)
- Determination of Physical Changes of Southern California Coastal Lagoons (Phillips)
- Subtidal Ecology of Carmel Bay (Thompson)
- Management of Beach and Dune Vegetation (Barbour)
- Management of Cumulative Impacts of Coastal Development (Dickert)
- Issues of Coastal Governance (Lee, Scott)
- San Francisco Bay Project: Reference Collection, Bibliography, Identification Keys and Specimen Depository (Lee)
- Coastal Wetlands Management: Biological Criteria (Holmes *et al*)
- Coastal Wetlands Management: Effects of Disturbance on Estuarine Function (Zedler, Mauriello)
- Coastal Wetlands Management: Opening of Coastal Lagoons by Sand Fluidization (Inman, Nordstrom)
- Participatory Planning for Coastal Decision-Makers (McCoy)
- Geological and Historical Analysis of Coastal Zone Environment Hazards and Liability for Losses Caused by Them (Shepard, Hildreth)
- Experimental Study of the Tomales Bay "Sneaker Wave" (Fischer)
- Legal Techniques for Marine Resources Management (Bowden)
- Organizational Arrangements for Coastal Management (Lee, Scott)
- Coastal Environmental Monitoring Data Base Inventory (Olsen, Hubay)
- Onshore Impacts of the Development of Ocean Resources (Richardson, Gordon)
- Planning Methods for Coastal Communities (Kreditor, Banerjee)
- Coastal Engineering Data Network (Isaacs)
- Economics of Marine Resources Decision Modeling (Sullivan)
- Ecology of Santa Cruz and San Mateo County Coasts (Doyle)
- Sea Coast Planning Project (Hetrick)
- Economic Impacts of Channel Islands Development (Sullivan)
- Public Policy and the California South Coast's Tourist and Retirement Industries (Brownlee, Douglas, Morgan)
- Monitoring of Pollution Parameters in San Francisco Bay (Wilde)
- Physical Factors Controlling Coastal Planning (van Atta)
- Management of Coastal Zones in Metropolitan Regions (Warren, Weschler)
- Coastal Population Study (Friedman, Van Arsdol)
- Coastal Resources Data File (Warren)
- Storm Drainage and Environmental Quality of Semi-enclosed Coastal Waters (Bowerman)
- The City of Avalon Sewer Outfall as an Isolated Case Study (Given)
- Oceanographic Observatinns in Monterey Bay, California (Broenkow, Benz)
- Coastal Governance 1977-1978: First Steps in Implementing (Lee, Scott)
- Coastal Zone Law (Lane)
- Development and Assessment of Legally Permissible Methods for Coastal Management (Heyman)
- A Framework for Identification and Control of Resnurce Degradation and Conflict in the Multiple Use of the Coastal Zone (Twiss)
- Design of a Computer Automated Map Intersection Methodology for Project Review, Plan Development, and Policy Testing in the Coastal Zone (Pepper)
- The Impact Upon California World Ocean Decisions (Friedheim)
- Transactional Planning for Coastal Decision-Making (McCoy)
- Thermal Variability in Coastal Waters in the Southern California Bight (Winant)
- Coastal Zone Management: Methods for Plan Development, Evaluation, and Monitoring of Local Programs (Dickert)
- Development of a California Coastal Wetlands Information Directory for Resources Management (Dickert, Pepper)
- Impact of Public Policy on the Pacific Basin and its Ocean Environment (Schmidhauser, Totten)
- Handbook of Methods and Techniques for Assessing Visual Resources and Related Community Priorities for Coastal Zone Planning and Management (Banerjee)
- Interdisciplinary Study for a Semi-Protected Hand Launched Boat Facility (Stone, McCoy)
- Aesthetic Indicators for Land Use Planning: Application to the Coastal Zone (Banerjee)
- Appearance of Design Planning in the Coastal Zone (McCoy, Banerjee)
- Laboratory-Workshops in Coastal Zone Planning (McCoy)
- National Coastal Population Study (Friedman)
- Southern California Regional Population Study (Van Arsdol)
- Coastal Zone Environment Management Institute (Lutz)
- Marina del Rey Project (Warren, Schultz)
- Coastal Commission Scorecard (Washom)
- Development of Environmental Maintenance Systems in Los Angeles-Long Beach Harbor (Soule, Oguri)
- Model Coastal Ordinance Project (Motley)
- Marine Resource Evaluation of Humboldt and Del Norte Counties, California: Preliminary Investigations (Isaacs)
- Rapid Response: Coastal Plan Preparation (Sullivan)
- Model Course in Marine Planning (Burton)
- Half Moon Bay Private Sector Impact Study (Goldman)
- Geology, Faulting, and Related Sea-Cliff Erosion, San Dieguito River to Carlsbad, San Diego County, California (Shepard)
- Transportation Analysis in the Coastal Zone: Subregional Considerations for Local Coastal Plans (Dickert)

San Diego Law Review--Law of the Seas Symposium (Bratton)

Environmental Conflict Identification (Twiss)

Acoustic Holographic System for Underwater Search (Wade)

Tidal Oscillations at the Head of Monterey Submarine Canyon (Broenkow)

Seaward Dipping Internal Structures in Ripple Marks at Whaler's Cove (Leopold)

Improvement of Methods of Predicting Sea-Surface Temperatures (Gibson)

Elkhorn Slough and Moss Landing Harbor, California: Seasonal and Tidal Processes Effecting the Hydrography and Water Chemistry (Smith, Broenkow)

Drift Card Observations in Monterey Bay, California. September 1971 to March 1973. (Broenkow, Blaskovich, Phillips)

Hydrographic Observations in Elkhorn Slough (Broenkow)

Marine Air Penetration of Monterey Coastal Strip (Read)

II. COASTAL & MARINE RECREATION

Recreational Resources of Los Angeles County Coast (Egstrom)

Diving Safety Research Project (Egstrom)

Effects of People and Pollution on Beaches in Southern California (Straughan)

Marine Recreation (Anderson)

Development of Interpretive Methods and Materials for Marine Parks in Northern California (DeMartini)

Interdisciplinary Study for a Semi-Protected, Hand-Launched Boat Facility (Stone)

Fiscal Impact of Park Acquisition in Laguna Beach (Dickert)

Recreational Beach Use Survey (Sonquist, Gold)

III. LIVING MARINE RESOURCES

Design and Development of a Squid Processing Machine (Singh)

Bioconversion of Chitin Wastes (Carroad)

Coordinated Management of the Pacific Coast Salmon Fisheries and the Implications of Extended Jurisdiction (Moore *et al*)

Optimal Leasing Agreements for Marine Resource Development (Quirk/Lewis)

Pharmacological Evaluation Program (Jacobs)

New Agricultural Chemicals from Marine Organisms (Fenical)

Antileukemia Compounds from the Brown Seaweed *Dictyota* (Fenical)

The Surf Grass Habitat as a Nursery for Juvenile Spiny Lobsters (Fauchald)

Food Resource Dynamics and Utilization in Channel Island *Macrocystis* Habitat (Brusca)

The Energetic Role of Amino Acid and Protein Metabolism in the Kelp Bass *(Paralabrax clathratus)* (Dunn, Bever)

Phytoplankton and Red Tide as a Food Source for Inshore Communities (Abbott)

Kelp Forest Ecology of the Central California Coast (Pearse)

Economics of Marine Resources Decision Modeling (Sullivan)

Feasibility of a Black Cod Trap Fishery in Monterey Bay (Cailliet)

Aquaculture of the Purple-Hinge Rock Scallop (Phleger, Leighton)

Carrageenophyte Cultivation, Genetics, Population Dynamics, and Development of Agar Substitutes (Doyle, West, Abbott)

Toward Seawater Based Crop Production (Epstein)

California Aquaculture Law (Bowden)

Protective Immunization of Anadromous Salmonids Against *Aeromonas salmonicida* and *Vibrio anguillarum* (Kerstetter)

Endocrinology of Salmon Smoltification and Adaptation to Seawater (Bern)

Development of Multispecies Management for Kelp Bed Resources with an Emphasis on Sea Urchins (Tegner)

Surfperch Mariculture (Norris)

Studies on the Ecology of the Red Abalone, *Haliotus rufescens*, in Northern California (DeMartini, Burge)

Studies on the Biology of northern Anchovy *Engraulis mordax*, and Pacific herring, *Clupea harengus pallasi*, in Humboldt Bay (Barnhart)

Sewage Fertilization of Brackish and Salt Water Ponds for Rearing Trout (Allen)

Sources, Types, and Seasonal Fluctuations of Microbial Pollutants and Aquatic Zoonoses in Humboldt Bay, California (Busch)

Osmoregulatory Status of Juvenile Steelhead and Chinook Salmon in the Trinity River (Kerstetter)

Development of a Marine Bioassay Utilizing *Urechis caupo* Larval Development (Lester)

Hake Fishery Development (Ridenhour)

Development of a Self-destructing Escape Mechanism for Dungeness Crab Pots (Jolly)

Benzo(a) pyrene Induction of Tumors in Flatfish (Puffer, Brewer, Wellings)

Effects of Water and Sediment Contaminants on Invertebrate Reproduction and Development in Los Angeles Harbor (Emerson)

Aspects of the Biology of the Anchovy, *Engraulis mordax* in San Pedro Harbor (Brewer)

Studies of Fish Muscle Proteins and Fresh and Frozen Seafood Technology (Brown)

Naturally Occurring Halogenated Compounds: Their Interference in Pesticide Pollution Analysis (Fenical)

Economics of Aquaculture (Johnston)

Protective Measures for Lobster Aquaculture (Schapiro, Steenbergen)

Use of Thermal Effluent in Aquaculture (Ford, Van Olst)

Seaweed Resource Management (Neushul, Coon)

Salt-Tolerant Plants (Epstein)

Toxins from Marine Dinoflagellates (Rapoport)

Mass Culture of Toxic Dinoflagellates (Haxo)

Determination of Appropriate Levels of Fees for Vessels Fishing for Yellowfin Tuna in the Eastern Tropical Pacific (Flagg)

Ecological Studies of the Nearshore Zone (Dayton)	Restoration, Propagation, and Management of Marine Algae (North)	Marine Ecology of the Central California Coast (Doyle)
Ecology of Santa Cruz and San Mateo County Coasts (Doyle)	Uses of Waste in Aquaculture (Cooper, Holmes)	Agarweed Resource Management (Barilotti)
Development of a Commercial Aquaculture System for the Crab *Scylla serrata* (Harrison)	Aquaculture of the American Lobster (Shleser)	Antioxidants for Marine Lipids (Olcott)
The California Market Squid Fishery (Thompson, Frey)	Aspects of the Biology of the Anchovy, Engraulis mordax, in San Pedro-Long Beach Harbor (Nafpaktitis)	Subtidal Ecology of Carmel Bay (Thompson)
Optimal Mangement of Sea Urchin Fisheres (Dayton)	California Spiny Lobster Growth (Dexter)	Management of Beach and Dune Vegetation (Barbour)
Effect of Fishing Sea Urchins on the Marine Ecosystem (Connell)	Protective Measures for Lobster Aquaculture (Mathewson)	Development of Aquaculture Systems (Shleser)
Protective Measures for Shellfish Aquaculture (Schapiro, Steenbergen)	Plankton, Productivity and Red Tide Cycles (Abbott)	Seaweed Products: Application In Algae Control, Mariculture and Agriculture (Fenical)
Kelp Bed Mariculture Resource Management (Neushul, *et al*)	Population Changes in Benthic Communities Following Pollution Abatement (Reish)	Naturally Occurring Halogenated Compounds: An Assessment of their Interference in Pesticide Pollution Analysis (Fenical)
Effects of Public Regulations on the California Aquaculture Industry (Bowden)	The Effects of Pollution on Fish Populations in Los Angeles-Long Beach Harbor (Stephens, Chamberlain)	An American Lobster Fishery in California (Ford)
New Antioxidants for Marine Lipids (Olcott)	The Uptake of Oxygen by Los Angeles Harbor and San Francisco Bay Sediments (Hammond)	Abalone Culture (Leighton)
Natural Fermentation of Marine Products (Crisan, Miller)	The Environmental and Living Resource Potential of Marina del Rey Harbor, California (Soule, Oguri, Soule)	Biological Stimulus for Spawning Abalone (Wilson)
Histamine Toxicity from Fish Products (Olcott, Bjeldanes)	Inshore Marine Environmental Research (Soule, Oguri)	Beneficial Uses of Sewage Sludge, Sewage Waste, and Kelp Drift--An Aquaculture Experiment (Holmes, Cooper)
Limited Entry Assessment of California Fisheries (Wyner, Harding)	The Roles of Microbiological Activity in Harbor Ecosystems (Juge)	The Effects of Food Availability on the Growth and Survival of California Jack Mackerel Larvae (Mullin, Lasker)
Pharmaceuticals from Marine Organisms (Faulkner)	A Radiometric Study of the Amino Acid and Lipid Nutritional Requirements of Three Commercially Important Shellfish, Crassostrea gigas, Haliotis rufescens, and Mytilus edulis (Allen)	Support of Albacore Advisory Service Radio Broadcasts (Shor)
Seaweed Products: Application in Algae Control, Mariculture and Agriculture (Fenical)	Biological Investigation of Chinook Salmon, Oncorhynchus tshawytscha, and the Coho Salmon, O. kisutch, in the Ocean off Northern California (Van Kirk)	A Checklist of the Fishes of the Monterey Bay Area (Kukowski)
Antiviral Compounds from Algae as a Potential Marine Resource (Vedros)	Biochemical Analysis of Fish Processing Offal in the North Coast Region of California, and the Development of an Artifical Bait for the Dungeness Crab Fishery (Allen)	Fishes of the Santa Barbara Kelp Forest (Ebeling)
Marine Natural Products Chemistry of Fouling Organisms (Faulkner)	Benthic Biological Studies (Nybakken)	Food Uses of Marine Lipids (Olcott)
The Development of the Science and Technology nf Aquaculture (Hand)	Natural Compounds From Marine Organisms (Sims)	Gelidium Resource Management (Barilotti)
Use of Thermal Effluent in the Culture of Crustacea and Fishes (Van Olst, Ford)	Continued Studies of Seaweed Resource Management (Neushul)	Protective Measures for Lobster Aquaculture (Mathewson)
Protective Measures for Shellfish Aquaculture (Steenbergen)		Rearing of Larval Fishes (Lasker)
Biochemical and Genetic Control Applied to the Critical Stages in Culturing Abalone (Morse)		Carrageenophyte Cultivation, Genetics, Population Dynamics, and Development of Agar Substitutes (Doyle, West, Abbott)
Improved Marine Food Products and Marine Food Technology (Brown)		Improved Marine Food Products and Marine Food Technology (Brown)
		Optimization of an Artificial Diet for Lobster Culture (Holtz)

Studies Toward the Optimal Management and Environmental Effects of Sea Urchin Fisheries (Dayton, Connell)

Methods for Quality Assessment in Fishery Products (Chang)

Socio-Economic Aspects of Expansion of the California Swordfish Fishery (Holt)

Astaxanthin from Yeast for Fish Diets (Lewis)

Santa Barbara Inshore Party Boat Fishery: Emphasis on the Olive Rockfish (Ebeling)

Re-establishment of Anadromous Fishes in Southern California (Olst, Ford)

Toxins and Other Biologically Active Compounds from Marine Dinoflagellates (Rapoport)

Amine Toxicity of Fish Products (Bjeldanes)

Comparative Analysis of the Social and Political Systems of the Tuna Fleets of San Diego and Ensenada (D'Andrade)

A Multispecies Bioeconomic Fisheries Model Under Uncertainty (Just)

An Economic Study of the United States Pacific Albacore Jig Boat Fishery (Holt)

An Ethnography of the San Pedro Wetfish Fishing Fleet (Velez-I)

Marine Natural Products for Pharmacological Evaluation (Faulkner)

Marine Plants as a Source of Insect Growth Inhibitors (Crews)

Assessment of the Quantitative Distribution and Therapeutic Potential of an Anti-herpesvirus Polysaccharide in Marine Algae from Northern California (Vedros)

Some Aspects of the Temperature, Oxygen and Nutrient Distributions in Monterey Bay, California (Smethie, Broenkow)

Biological and Ecological Studies of Normal Populations, Natural Variability and Effects of Environmental Changes in the Nearshore Zone (Newman)

Studies of Vertical Migration of Zooplankton (Enright, Isaacs)

Historical Levels, Areas, and Routes of Pesticides in the Plankton and Fish of the California Current (Longhurst, Lasker)

The Juvenilizing Factor in Crustacean Eyestalks (Faulkner, O'Connor)

Culture, Behavior and Physiology of the California Spiny Lobster Panulirus interruptus (Case, Childress)

Ecology of Benthic Herbivores in the Sea (Connell, Murdoch)

Ecosystem Studies and Maricultural Potentialities of a Coastal Lagoon (Holmes)

Seasonal Changes in the Body Component Indices and Biochemical Composition of the Dungeness Crab, Cancer magister (Allen)

Mariculture of the Crab, Cancer magister, Utilizing Fish Wastes as Food (Welsh)

Studies of the Ecology of the Gaper Clam, Tresus capax, in Northern California (DeMartini)

Program Management (Seaweed Symposium) (Neushul)

Development of Trapping Methods for Migratory Salmonid Smolts in Hatcheries (Kerstetter)

Plant Pathogens of Aquaculture Systems (Goff)

Investigation of Data for an Economic Study nf the U.S. Pacific Albacore Jig Boat Fishery (Holt)

Bioeconomic Modeling of the Freshwater Prawn Macrobrachium spp. (Johnston)

Food Conversion Efficiencies of Instar Dungeness Crabs (Tulles)

Histamine Toxicity from Fish Products (Brown)

Astaxanthin From Yeast (Phaff)

The Role of Diseases in Aquaculture. Preliminary Survey (Paggi)

Causes of the Decline in Dungeness Crabs in the San Francisco Bay Area (Horne)

Conference on the Standardization of Taxonomic Reporting of Marine Invertebrates (Bascom)

Development of an Anticancer Substance from the Brown Seaweed Dictyota (Fenical)

Rapid Response - Dptimization of an Artificial Diet for Lobster Culture (Holtz)

Biochemical Composition of Crab Tissues (HSU)

Bacterial Pollution of Humboldt Bay (Busch)

Biology of Northern Anchovy and Pacific Herring in Humboldt Bay (Barnhart)

Utilization of Fish Wastes for Rearing of Crabs (Allen)

Stress-Induced Fish Parasitism: Effects of Waste-Heat Effluents From the Diablo Cove Plant (Noble)

A Genetic Program for Improvement of Carrageenan Production in the Red Algae Gigartina (West)

IV. ENERGY RESOURCES

Wave Climate Modification in Harbors by Dynamic Breakwater (Isaacs)

New Applied Developments (Isaacs)

Biological Effects of Waste Heat Effluents of Coastal Power Plants (Smith, Hand)

Earthquake Loading on Large Offshore Structures in Deep Water: A Study for the Correlation of Analytic and Physical Models (Wiegel)

Seismic Hazards to the Development of Offshore Oil Resources (Prothero)

Side-Scan Sonar Mapping and Computer-Aided Interpretation of the Geology of the Santa Barbara Channel (Luyendyk, Simonett)

Nearshore Wave Power Source (Seymour)

Power Generator Inertially coupled to Seawaves (Lee, Manalis)

Studies on Thermophilic Microorganisms Located from Undersea Hot Springs, Electric Power Plant Condensers, and Ships' Heat Exchangers (Isaacs)

Power from Salinity Gradients (Isaacs, Wick)

Tilting Spar Directional Wave Sensor (Inman, Guza)

Geophysical and Geological Data Center for Information on Petroleum Resources (Chase)

Microwave Radiometric Measurement of Oil Slicks and Sea Temperature (Sanders)

Trace Metal Analysis of Oily Beach Pollutants in the Santa Barbara Channel (Mikolaj)

- An Investigation of the Seismicity and Earthquake Hazards of the Santa Barbara Channel Area (Sylvester)
- Enhancement of Natural Marine Productivity by Artificial Upwelling (Isaacs, Schmitt)
- Synthesis of Forces Marine Structures (Paulling)
- Placement of Underwater Mass Concrete by the Tremie Method (Gerwick)
- Natural Seepage in the Santa Barbara Channel: Physiochemical Aspects (Mikolaj)
- An Analysis of the Impact of Beach Pollution on the Development of the Channel Island Coastline with Reference to Natural Oil Seeps (Hetrick)
- The Economic Impact of Oil Production in the Santa Barbara Channel (Deacon)
- The Economic Impact of Oil Production in the Santa Barbara Channel (Mead)
- Wave Power
  a) Wave Attenuation Studies
  b) Wave-Powered Generator
  (Isaacs)
- Unmanned Sea Floor Work Systems (Anderson)
- Underwater Cable Dynamics (Webster)
- Composite Materials for Ocean Construction (Tetelman)
- Breakwater Permeability (Lee)
- New Projects (Shor)
- Tide-Induced Currents in Harbors of Arbitrary Shape (Lee)
- A Study of Natural Oil Seeps in Southern California (Fischer, Berry)
- Oil and Tar Seeps on the Shelf off Southern California (Henyey, Teng)
- Wave Energy Permeation of Breakwaters (Lee)
- Internal Waves Over Shelf and Canyon (Cox)
- Stray Electrical Current Hazards to Prestressed Concrete Construction in Seawater (Cornet)
- Marine Vehicle Safety Analysis (Webster)

V. MARINE MINERAL RESOURCES

- Offshore Sand and Gravel Resources in California (Henyey, Osborne)
- Replenishment of Shoreline Sands and Organics (Henyey)
- Uptake of Oxygen by Los Angeles and San Francisco Bay Sediments (Hammond)
- Offshore Sand and Gravel Resources, San Pedro and Santa Monica Bays, California (Osborne, Henyey)
- Coastal Resources Program - Marine Geology (Kolpack)
- Sand Transport Studies Along the Central California Coast (Arnal)
- Oceanographic Inventory of the Southern California Shelf (Fischer, Berry)
- Offshore Sand and Gravel Resources, Southern California (Henyey, Osborne)
- Assessment of the Offshore Commercial Sand and Gravel Potential on the Central California Continental Shelf (Berry, Wilde)
- Economic Evaluation of Ocean Mineral Resource Development and Related Public Policy Issues (Mead, Sorensen)
- Marine Geology (Kolpack)
- Longshore Sand Transport Studies (Inman)
- Engineering Properties of Sea Floor Sediments (Norrany)

VI. WASTE MANAGEMENT

- Uses of Waste in Aquaculture (Cooper, Holmes)
- Environmental Impact of Storm Drain on a Semi-Enclosed Coastal Water (Chen, Bowerman, Petridis)
- Computer Simulation of Pollutant Transport (Lee)
- Development of Environmental Maintenance Systems in Los Angeles-Long Beach Harbors (Soule, Abbott, Oguri)
- The City of Avalon Sewer Outfall as an Isolated Case Study (Given)
- Storm Water Quality and Land Use Characteristics (Bowerman, Chen)
- Biodegradation of Kraft Pulp Mill Effluent (Lester)
- Impact of a New Secondary Treated Sewage Effluent on an Area of Previous Raw Sewage Seawater Disposal (Given)
- The Potential of Cannery Wastes to Enhance Receiving Water Nutrient Quality (Soule, Oguri, Soule)
- Kaiser Refractories Environmental Studies (Harville)
- Air Flow Land Sea Air Interface Monterey Bay (Read)
- A Short Survey of Environment at Dumping Site for Santa Cruz Harbor Dredging (Arnal)
- Development of Humboldt Bay Maricultural Potential Emphasizing a Use of Waste Materials As A Resource (Allen)
- Biological Effects of Waste-Heat Effluents From Coastal Power Plants (Smith, Hand)
- Monitoring of Pollution in San Francisco Bay, Interaction of Industrial Waste (Wilde)
- Some Aspects of the Temperature, Oxygen and Nutrient Distributions in Monterey Bay, California (Smethie, Broenkow)
- Storm Drainage on Environmental Quality of Semi-Enclosed Coastal Waters (Bowerman, Chen)

VII. MARINE DATA ACQUISITION & DISSEMINATION

- Marine Extension Services (Cummings)
- Publications and Public Advisory Services (Wick)
- Ocean Engineering Data Center (Johnson)
- Advisory Services (Thompson)
- Maintenance of Sea Grant Research Collection (Lane)
- Marine Advisory Services (Leopold)
- Marine Advisory Program (Washom)
- Marine Advisory Services (Mallon)
- Information Retrieval and Transfer (Leopold)
- Information and Dissemination Program (Hudgins)
- Publications and Public Advisory Services (Frautschy)
- Oceanographic Observations in Monterey Bay, California (Broenkow, Benz)
- Marine Advisory Services (Cummings)
- Publications and Public Advisory Services (Sullivan)
- Marine Advisory Program (Leopold)
- Marine Advisory Extension Service (Ludwig)
- Ocean Education for the Public (Wilkie)
- Monterey Bay Bibliography (Baron)
- Harbors, Beaches, Ocean Instrumentation, Lab, Coastal Aquifer (Bowerman)