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CALIFORNIA'S SEA GRANT PROGRAM

SUMMARY OF THE REVIEW REPORT

FEBRUARY 1978

A Report To The Resources Agency Sea Grant Advisory Panel

PARTICIPATING CALIFORNIA SEA GRANT INSTITUTIONS

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State University, Hayward; Cali-
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San Francisco; San Jose State
University; California State
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SEA GRANT
PROGRAM

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

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SUMMARY

of

Review of California's Sea Grant Program, February 1978

A Report to the Secretary of the Resources Agency

The State of California enacted legislation in 1973 to provide \$500,000 annually, from 1974-75 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..."*

During the 4-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 totalling \$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 on the California Sea Grant Program increased, the high rate of inflation has reduced state support, in terms of 1973 dollars, by 24%.

The Sea Grant Matching Funds 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."

Review of California's Sea Grant Program, February, 1978: A Report to the Secretary of the Resources Agency is a university report prepared in response to the request of the Resources Agency

*California Senate Bill 755, Stull (Chapter 1115), (as amended by public law 94-461). Hereinafter referred to as the Sea Grant Matching Fund Act.

Sea Grant Panel (RASGAP). It is a review of accomplishments of state supported Sea Grant activities. Inasmuch as state funding was initiated in 1974, the review report concentrates on activities from 1974 to 1978; however, activities and projects prior to 1974 are also discussed for greater continuity and comprehension of the programmatic context of research, education, and advisory services.

The highlights, findings, and recommendations of the review report have been condensed into this summary.

The review report presents a statement of purpose; a summary and recommendations; an overview of the National Sea Grant program, the California Sea Grant Program, and the Resources Agency Sea Grant Panel; a statement of current funding and estimate of funds required for the immediate future; and a summary of accomplishments and benefits derived from the program. The comprehensive appendices include appropriate program data and information as well as a description of benefits to the state, arranged by geographical region.

The National and California Sea Grant Programs and RASGAP

Sea Grant is 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 of a great range of interests and fields working together, the development and refinements of good ideas, and the change inherent in putting something new into practice.

The National Sea Grant Program was created by an Act of Congress in 1966 (U.S. Public Law 89-688) and was amended in 1976. The Act authorizes grants and contracts to universities to conduct research, educational activities, and advisory services related to the use of ocean resources. For the fiscal year 1978, 31.8 million dollars were appropriated for grants to 54 institutions. Essentially, the Act has established a national network of Sea Grant Colleges patterned somewhat after the Land Grant Colleges. The goal of the program's activities is

to increase the understanding, assessment, development, utilization, and conservation of the Nation's ocean and coastal resources by providing assistance to promote a strong educational base, responsive research and training activities, and broad and prompt dissemination of knowledge and techniques.

Sea Grant requires that at least 1/3 of the program cost come from non-federal funding, thus ensuring the program's responsiveness to a broad range of specific practical problems. The provision of matching funds by the legislature meets the important criterion for

a state to continue its Sea Grant College status. Institutions that are Sea Grant Colleges have a federal funding priority within the total national budget. An important corollary to the requirement of non-federal participation is local determination of the nomination and selection of projects. 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. The result is a coherent, balanced approach to important needs, problems, and opportunities.

Sea Grant is committed essentially to application-oriented or problem-oriented research. To qualify as research, a project must have a clear possibility of application to an issue that is clearly relevant to Sea Grant goals and be scientifically sound. Within this conceptualization, research proposals are considered in any field, discipline, or specialty. It is understood that the program's purpose cannot always be achieved without innovative, sometimes high-risk research; Sea Grant funds are available to more speculative proposals when the potential application indicates very significant benefit.

The California Sea Grant Program has evolved from an original federal grant (\$186,000) awarded to Scripps Institution of Oceanography in 1968 for development of a new interdepartmental curriculum in Applied Ocean Science to the present statewide, multi-college/university program (\$5.1 million*) involving 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, California Academy of Sciences, and the Moss Landing Marine Laboratories Consortium (CSUS--Sacramento, San Francisco, San Jose, Stanislaus, Hayward, Fresno State Universities and Colleges).

During the 9 years of federal funding to California institutions, the pressing needs and expansion of marine research have increasingly required greater coordination of Sea Grant Program activities (in the late 1960's and early 70's there were as many as 7 separate programs) to minimize unnecessary overlap and duplication of effort. This requisite became the impetus for creating a coordination network among programs and projects. Now, there are two separately administered programs, one administered by the University of California and the other by the University of Southern California. California Sea Grant institutions have coordinated their efforts in research, education, and advisory services to draw on the talents of all marine-oriented scientists in the state, regardless of affiliation, and to address the issues and problems in marine science.

*Total program costs including matching funds.

Through this network, the best qualified, most appropriate individuals or groups can be immediately identified for new situations or problems. The network has also served to transfer information in a timely manner among projects so that they can build on each other's results.

In 1973 the University of California was designated a Sea Grant College--one of 12 in the nation at the present time. In the same year, with the enactment of state matching funds legislation, the program's budget became the largest in the nation, and it remains in this leading position. In addition, 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.

Both at the state and national level, the Sea Grant Program comprises a mutually supportive set of three interacting activities--research, education, and advisory services--which are also fundamental university activities. These application-oriented efforts build on and extend the vast federal and state investments in basic research at our universities.

Research activities of the Sea Grant Program range through a wide variety of subjects including coastal zone studies, waste management, fisheries and aquaculture, natural marine products, and ocean engineering and energy development. Although the efforts focus on the wise utilization of marine resources, they cover a broad range of interests; for example, social, legal, and scientific studies relating to coastal resources and fisheries conservation management, productivity analysis of coastal wetlands, coastal bluff erosion control problems, investigations of aquaculture of various marine plants and animals as well as underdeveloped fisheries (such as squid) and research on salmon physiology and pathology.

Education is a basic function of the Sea Grant Program. 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. Recently a pilot program to involve undergraduate students in marine research and marine science writing has been initiated. Public education through displays, outreach programs, and consumer workshops have reached over half a million people annually.

The Marine Advisory Service is a source of independent information, advice, and assistance both to people who enjoy and those who earn a living from the coastal and marine resources. The research activities of Sea Grant investigators and others serve as the foundation on which marine advisory activities and information dissemination are built. In turn, the advisory service feeds back the new problems and needs of the California marine community to researchers.

The Sea Grant Matching Funds Act specifies that the Resources Agency Sea Grant Panel (RASGAP) be composed of representatives from: The Department of Navigation and Ocean Development (DNOD), the Department of Conservation, the California Department of Fish and Game, California Zone Conservation Commission (currently the California Coastal Commission), State Lands Commission, the fish industry, the ocean engineering industry, the University of California, the California State University and Colleges, and a private California institution of higher education which is participating in the National Sea Grant Program. The Resources Agency Sea Grant Panel serves to advise the Secretary of the Resources Agency with respect to the implementation of Senate Bill 755 amending Section 6217 of the Public Resources Code.

The panel (10 members) establishes research priorities and selects projects that have a "clearly defined benefit to the people of the state." There has been an increasing focus on state-related issues in Sea Grant activities since the formation of RASGAP in 1973.

RASGAP's perceived research needs and review of potential research projects are closely coordinated with internal evaluation by university committees, by peer review, and by the National Office of Sea Grant and its consultants at the on-site visits. This combined review system ensures vitality and integrity of research proposals.

Priorities are transitory; today's order of urgency may become entirely rearranged by tomorrow. Notwithstanding this obvious problem, RASGAP has identified 7 program elements as of special continuing concern to the people of California: Coastal Zone Resources Planning and Management; Coastal and Marine Recreation; Living Marine Resources; Energy Resources; Marine Mineral Resources; Waste Management; Marine Data Acquisition and Dissemination (Advisory Services). The Panel has adopted and disseminated a policy statement for each of these program elements and has identified specific state needs that can be met through Sea Grant research.

In addition to the seven RASGAP program elements, state funding is also provided for rapid, short-term research response to unanticipated marine and coastal problems or opportunities and for new and innovative projects without the long lead time required for inclusion in an annual proposal.

Funding

There are two aspects to consider regarding the 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 4 more years, by 1983-84, \$913,000 will be needed to equal the 1974 state dollars, as depicted by Figure 2 in the *Review Report*.

In 1977-78, the total non-federal funding was \$2,253,035 and the federal grant was \$2,930,000: a ratio of 43/57% of non-federal to federal monies. Since the National Sea Grant Act stipulates that at least one-third of the total cost of the program be matched by non-federal funds, California's support overmatches the minimum legal requirements. Nevertheless, as the federal guidelines on Sea Grant point out, there is no upper limitation on the percentage of non-federal matching funds. According to the guidelines, "The Office of Sea Grant often receives proposals in which the non-federal matching funds are substantially more than the required one-third." In fact, on a nationwide basis, in all states with Sea Grant programs the average ratio of non-federal to federal funds is 40% to 60%.

Thirty-seven institutions are competing on a nationwide basis for Sea Grant funding. This competition will increase as additional coastal states initiate programs and the existing programs improve and attempt to expand. In light of the intensifying competition for federal funds, the National Sea Grant Office will be giving greater consideration in determining increases in the annual grant to evidence of a state's commitment to its Sea Grant program and its ability to conduct high-quality application-oriented work.

While it is true that the National Sea Grant Program continues to receive recognition and greater annual funding, this increase must be spread over many institutional programs according to National guidelines and priorities. It is only through state matching fund programs, like California's, that the specific state's needs and requirements can be effectively programmed into the Sea Grant network.

Benefits

State funded Sea Grant research and advisory activities provide the people of California with economic, environmental, social, and institutional coordination benefits. Sea Grant projects have achieved these benefits by working with other institutions, usually government agencies, public interest organizations, or private industry.

The principal economic benefits from state-funded Sea Grant research and advisory activities have been the development of new pro-

ducts and the improvement of effectiveness and efficiency of existing industrial and public operations.

New products developed or being developed by state supported research activities include the tethered float breakwater, new strains of hybrid kelp for commercial harvesting, a new domestic market for Pacific hake, a sand fluidizer system to open estuary inlets and maintain tidal exchange, a low-cost system for monitoring wave conditions, antioxidants for fish preservation, marine algal derivatives for pesticide and herbicide agents, and salt-tolerant strains of barley and tomato that can be cultivated with seawater. In most cases, the realized or potential dollar benefits of these new products (as described in the *Review Report*) is far greater than the cost of research.

Applicable processes, assays, and techniques evolved by Sea Grant researchers include prerefrigeration exposure of commercial fish to carbon dioxide and carbon monoxide for reduced spoilage and improved color; a quick, accurate assay for histamine, an indicator of spoilage (and toxicity) in tuna and mackerel; a precise, rapid technique for determining trimethylamine, the major component of spoiled-fish smell; an inexpensive, highly sensitive 30-minute assay for saxitoxin, a plankton-occurring (red-tide) poison that accumulates in shell fish and has a paralyzing effect on humans; and a machine that will clean and skin squid. Researchers have experimented with squid, sea urchins, California spiny lobster, New England lobster, Dungeness and other crabs, abalone, rock scallop, surf perch, and salmon in aquaculture projects involving water quality, reproduction cycles and larval stages, suitable diets, pathogen control, and cost analysis of system components.

Environmental benefits have been derived from a number of Sea Grant projects designed to develop or improve governmental management of coastal and ocean resources. Many projects are designed to enhance or protect the qualities of ocean and coastal environments, such as determination of species' parameters for sustained yield management; assessment of land-use effects of development in an estuarine watershed; determination of the effect of effluents on biological conditions; and an analysis of the political and economic implications of limited-entry policy in the state's abalone fisheries.

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. Projects that have addressed these problems are the evaluation of hazards of coastal erosion by data from a wave monitoring system in the ocean, the geological assessment of sea-cliff stability and faulting and its legal liabilities, and the examination of potential hazards of seismic-induced oil pollution from both offshore fields and failures of commercial structures.

Social benefits may be measured in terms of public education, manpower development, and recreation opportunities.

The Sea Grant Program contributes to public education through its Marine Advisory services by demonstrations, workshops, conferences, brochures, newsletters, exhibits, and response to inquiry. More than 2,500 people/year participate directly in the workshops, conferences, and short courses: commercial and sport fishermen, recreational boaters, harbor operators, fish processors, local government officials, and divers. Advisory services' newsletters regularly inform over 3,000 sport and commercial fishermen of recent industrial developments. Through exhibits, newsletters, radio, and newspaper articles, the Sea Grant Program reaches nearly 3 million people/year in the state.

The Sea Grant Program recognizes the value in manpower opportunities of students educated or trained in marine research, education, and advisory activities. In the past 10 years, over 250 graduate students and post-graduate specialists have worked on various projects. Most of these students have been supported with state funds. Over 100 students received masters degrees, and another 85 received doctoral degrees. Disciplines and specializations include fisheries biology; zoology; marine biology; oceanography; city and regional planning; law; economics; public policy; landscape architecture; transportation, hydraulic, and structural engineering; library science; agricultural economics; botany; home economics; physical education; food science; and business administration. Most of these highly trained graduates have remained in California and serve to transfer expertise and technology from the university projects to a wide array of organizations within the state.

A number of projects have provided social benefits by making the public aware of existing recreational opportunities as well as increasing the recreational potential of coastal and ocean environments. For example, the advisory service program has issued a guide to beaches, a diving safety guide, and a recreational map of Humboldt Bay.

Recreational supply and demand analyses, such as those conducted in Monterey Bay and Los Angeles Harbor, are other means of increasing social opportunities. A topographical and ecological inventory in Los Angeles County assisted formulation of the underwater parks plan which will accommodate the increasing number of SCUBA recreationists. This inventory method has been used by the State in other underwater areas.

From participation in California Sea Grant-sponsored national conference on Marine Recreation, advisory agents and researchers were able to identify potential diverse interests and to develop a series of marine recreational guidelines for state and local Government.

Less tangible than economic, environmental, and social benefits, institutional coordination through the California Sea Grant Program has benefited all participants.

State benefits of the program's coordinative efforts can be measured by a reduction in the amount of unnecessary overlapping or duplicative efforts, the number of projects involving two or more institutions, and the economies realized by cooperative and complementary arrangements. The California Sea Grant Program is the only one in the state that links marine and coastal research of the 9 University of California campuses, 19 state universities, California Institute of Technology, Stanford University, and the University of Southern California. To facilitate research applicability, the universities and industry have formed scientific and technical advisory panels. To date, advisory panels have been formed to help guide activities in marine aquaculture, marine geology, fisheries, seafood processing and marketing, and marine recreation.

Consequent to the initiation of state matching funds in 1973, interaction among members of RASGAP has established new communication channels between the university community and state agencies. This intensified working relationship is helping to develop an ocean and coastal research agenda for California's future, an example of which is the integrated series of university research projects that will serve as the scientific component for the California Department of Fish and Game's abalone enhancement program.

One goal of the Sea Grant's coordination efforts is the establishment of appropriate procedures to determine baseline environmental conditions and to follow this up with evaluation of the various agencies' standards, thus developing agreement among regulatory agencies. Pertinent project examples are thermal effluent from power plants and discharges from fish canneries and pulp mills.

The marine advisors often serve as institutional coordinators by facilitating contact and information exchanges among governmental agencies and the private sector. For example, marine advisors are the bridge between NOAA's production of weather satellite maps and the utilization of the maps by commercial fishermen. The National Environmental Satellite Service, salmon and albacore fishermen, and the marine advisory program are involved in a cooperative project to use satellite maps of ocean surface temperatures as a daily means of locating fishing grounds.

Conclusions

There has been an increasing focus on state-related issues in Sea Grant research activities since the initiation of state matching

funds and formation of RASGAP in 1973. During the 3-year period preceding this, the average amount of Sea Grant funds spent on state-related activities was 59% of the total; the average for the past 5 years, since the addition of matching funds, is 78% (in grant year 1977-78, 85% of the total was spent on projects directly relevant to state interests). The projects constituting the remaining percentage were still relevant to the state interests and were directed to a national or international audience.

There has been a reciprocal benefit from continuing State and University personnel liaison whereby an appreciation of bureaucratic constraints has been gained by University researchers, and University expertise is easily available to the State.

Sea Grant coordination of institutions engaged in ocean resources research and management constitutes an achievement of process. Other benefits can be measured in terms of outcome, such as employment, new or improved products, consumer price, education, price of pollution control, or reduction of damage from natural hazards.

Environmental management as well as institutional coordination and cooperation have benefited from Sea Grant projects such as independent advice and assistance with the development of the California Coastal Plan and the Coastal Act, management of coastal bluff erosion, investigations into underutilized fisheries such as squid, and studies of harbor-pollution control and waste-discharge impacts.

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 the employers are located within the state.

Marine advisory service activities have contributed to the education of the public and have enhanced public opportunities to use marine resources.

The marine needs of the State are many, and in the report we have covered only one area of effort to meet these needs--Sea Grant. Clearly, the program has been very beneficial and should continue to be even more so in the future.

Yet, more remains to be done in all areas to provide the necessary understanding and assessment of California's ocean and coastal resources, which require a solid scientific and technical foundation for sound public policy development and resource utilization and conservation.

Problems already defined for the immediate future include the need to:

1. Increase food supplies from traditional and new fisheries and from the development of science and technology of aquaculture.
2. Improve existing technology and develop new technology to increase the contribution of marine resources to the production, transportation, distribution, and safety of energy supplies at minimal social and environmental cost.
3. Improve existing technology and develop new technology to protect ports, harbors, and beaches from the hazards of the sea.
4. Increase the supply of marine resources for medicinal, agricultural, and industrial use.
5. Assist public bodies to develop ocean-related public policies
6. Inform the public about the opportunities and issues that derive from potential marine-resource utilization and conservation.

A new and unique process is now operating in the State, one whose capabilities have been only slightly tapped. As we move into the future, this process called Sea Grant should be used as a basis to step up our collective efforts to address important ocean and coastal matters of the State.

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

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

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 (Carrodd)	Surfperch Mariculture (Morris)	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, <i>Haliotis rufescens</i> , 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 <i>Engraulis mordax</i> , and Pacific herring, <i>Clupea harengus pallasii</i> , 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 <i>Dictyota</i> (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 <i>Urechis caupo</i> Larval Development (Lester)	Tilting Spar Directional Wave Sensor (Inman, Guza)
Food Resource Dynamics and Utilization in Channel Island <i>Macrocystis</i> Habitat (Brusca)	■ Hake Fishery Development (Ridenhour)	V MARINE MINERAL RESOURCES
The Energetic Role of Amino Acid and Protein Metabolism in the Kelp Bass (<i>Paralabrax calthratus</i>) (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 (Heney, 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, <i>Engraulis mordax</i> 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 Against <i>Aeromonas salmonicida</i> and <i>Vibrio anguillarum</i> (Kerstetter)	Earthquake Loading on Large Offshore Structures in Deep Water: A Study for the Correlation of Analytic and Physical Models (Wiegel)	Marine Advisory Program (Leopold)
Endocrinology of Salmon Smoltification and Adaptation to Seawater (Bern)		Marine Advisory Extension Service (Ludwig)
		Ocean Education for the Public (Wilkie)

