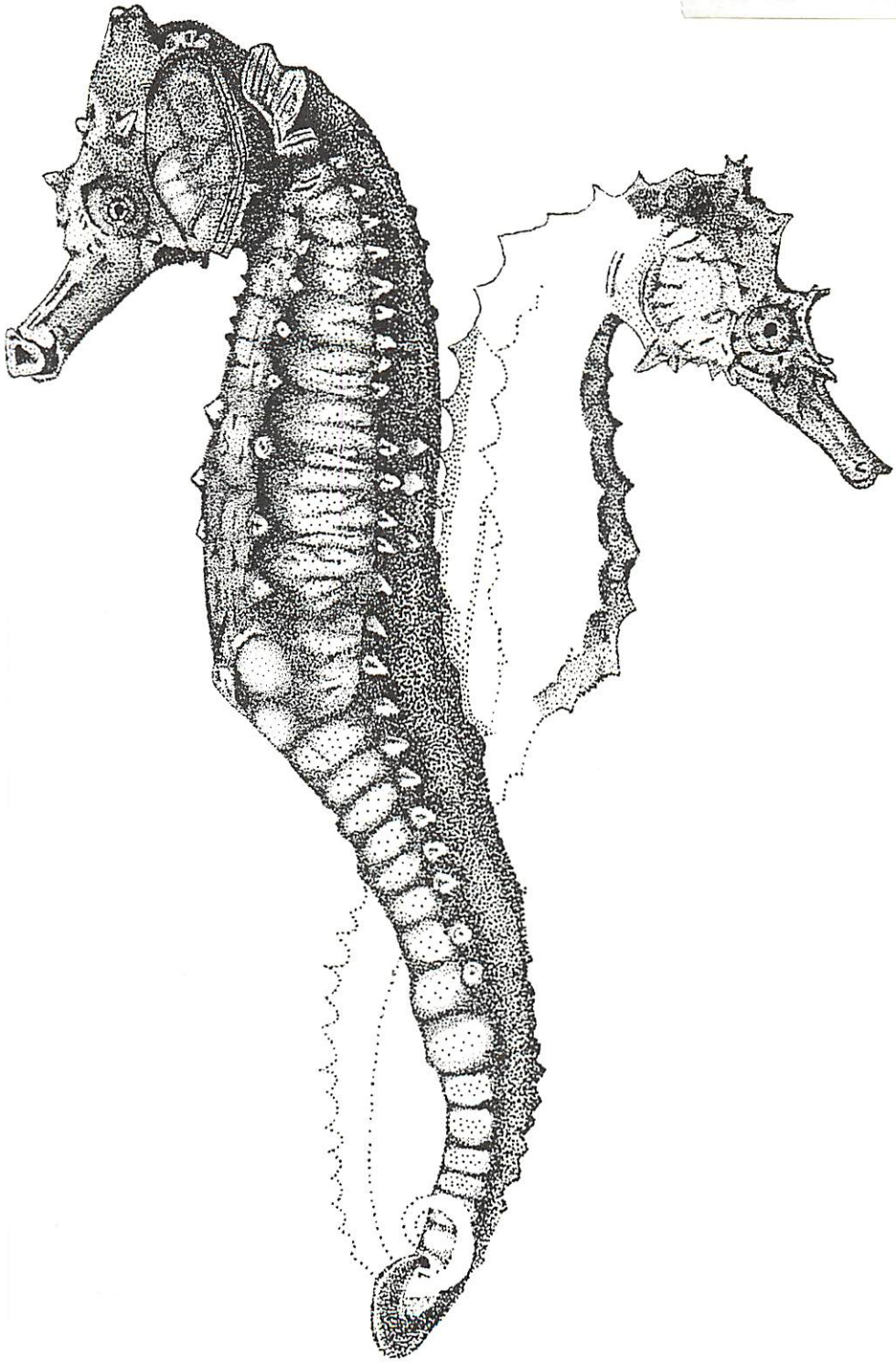
CALIFORNIA SEA GRANT COLLEGE PROGRAM

An Overview 1977-78



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INTRODUCTION TO SEA GRANT IN CALIFORNIA

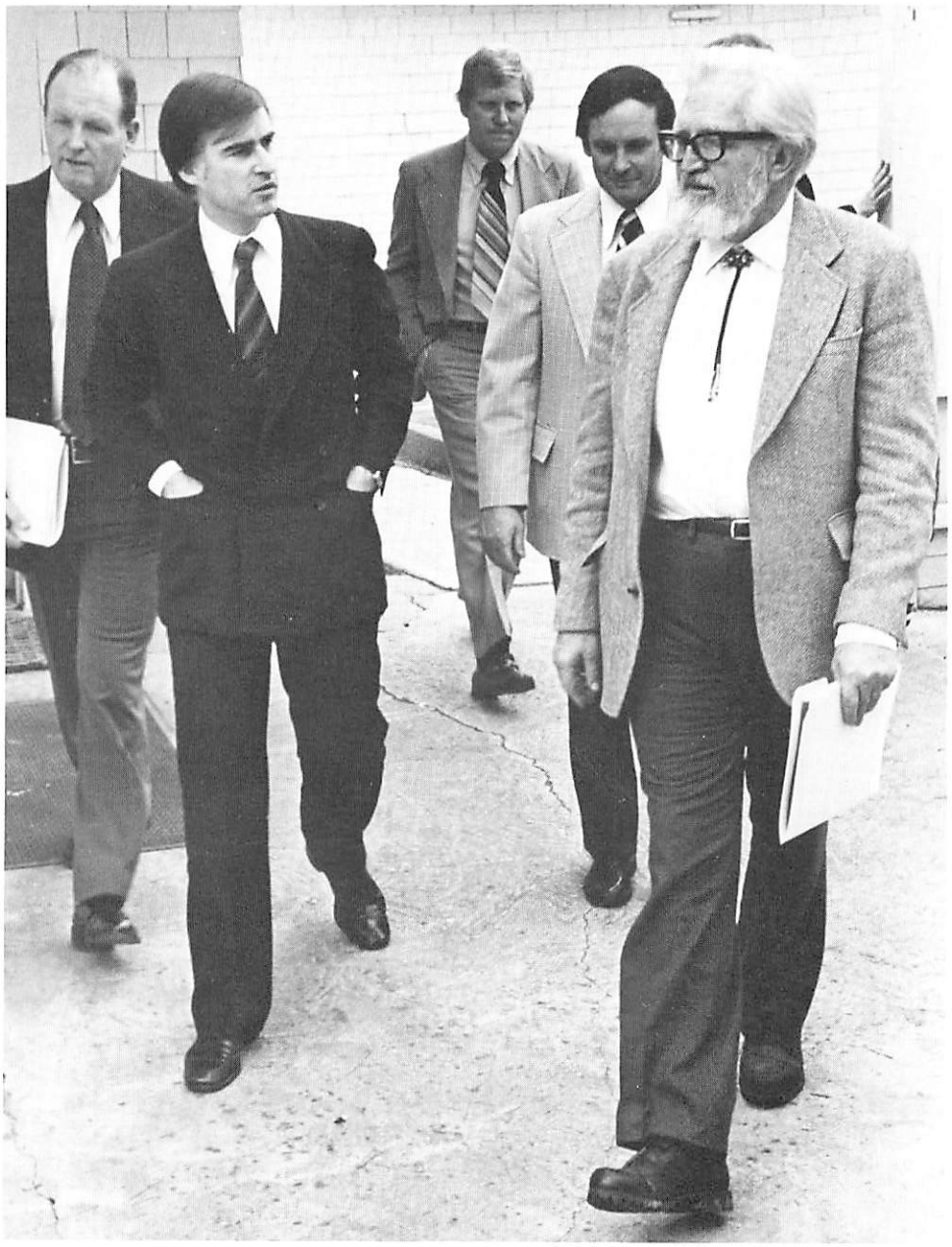
The Sea Grant Program was created in 1966 by Public Law 89-688, the National Sea Grant College and Program Act. The program is administered by the U.S. Department of Commerce through the National Oceanic and Atmospheric Administration. The purpose of the program is "to increase the understanding, assessment, 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."

This overview of the 1977-78 California Sea Grant Program addresses three themes that are among the foremost issues facing society today: ecology, technology, and cooperation. The scientific investigations reported range from the broadly fundamental to the sharply practical. The educational and advisory efforts described are critical to developing a common understanding of the potential of the ocean and the implications of developing that potential.

The policy of the California Sea Grant College Program is to seek out the most qualified research talent and the best applied research projects wherever they may exist within the State's institutions of higher education. In 1977-78, there were Sea Grant projects at six University of California campuses, two state universities, three state university laboratories, and two private universities.

In practice, Sea Grant is people working together to put good ideas into effect. On the surface this is a deceptively simple statement, one that belies the complexities of people working together, developing and refining good ideas, and putting something new into practice.

James J. Sullivan, Program Manager
California Sea Grant College Program
Institute of Marine Resources
University of California



John Isaacs, Director of the Institute of Marine Resources of the University of California, talks about marine affairs with Governor Edmund G. Brown, Jr. (Photo by Larry Ford)

Cordgrass (Spartina foliosa) is the most prominent vascular plant in California's coastal wetlands.

ECOLOGY

Ernst Haeckel in the 19th century proposed the term "ecology" to refer to the study of how living organisms and groups of organisms interact with one another and their environment. The word, ecology, is derived from the Greek words, **oikos** meaning "house" and **logos** meaning "study."

Ecology has come to mean different things to different people. To a biologist, it means describing and explaining the complex web of interrelationships between organisms and their environment in an attempt to form unifying models of how life functions. To politicians, ecology means a new political movement in which people seek to preserve undeveloped regions, to lead a lifestyle that uses less energy per capita and to advocate a "no growth" economic policy. To a land developer, ecology means the need to incorporate open space and preserve such valuable resources as trees, wildlife, and unobstructed views in his plans.

Sea Grant tries to integrate the differing views of different groups in a creative way to develop and use marine resources so that the natural and aesthetic values of the marine environment are preserved. This is a multidisciplinary process that seeks solutions to problems and rational explanations of modern myths through the concert of many voices from different academic specialities in harmony with lay common sense.

KELP ECOLOGY

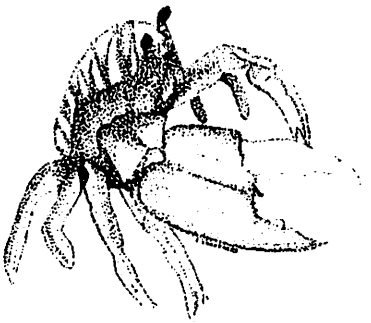
An example of the type of integrated, ecological research effort that Sea Grant undertakes is the array of projects relating to California's kelp community. Kelp, which grows in dense undersea forests along California's coast, has long been recognized as one of the state's important resources.

Kelp has been harvested for multiple industrial uses —primarily, as a thickening agent in cosmetics and food —but no extensive studies of kelp ecology were done before 1950. Around that time, however, the self-contained underwater breathing apparatus (SCUBA) became available to scientists and recreational divers, and investigation of kelp fish life in the early 1950s by scientists using SCUBA spurred interest in a broad-scale study of kelp bed resources. Interest in kelp beds as a major marine resource of California has continued, and over the past ten years of California Sea Grant's existence, kelp community research in its diverse dimensions has played a significant part in the overall program.

During 1977-78 John Pearse and Anson Hines of the University of California Santa Cruz studied the ecology of the kelp community. They are convinced that the giant kelp itself is the major primary producer (synthesizer of organic material from inorganic material) in the community. "We wanted to understand the factors regulating kelp growth and survival," says Pearse. "Availability of nutrients and light, storms that detach the kelp from the bottom and grazing organisms are the most important regulating factors. We have studied the major herbivores —snails, kelp crabs, sea urchins and abalones —and established that these organisms consume one quarter to one third of the kelp produced. The remainder of the kelp is torn loose during storms and exported to support other ecological communities. Offshore fisheries and marine life along the shore are beneficiaries of this process."

Pearse also has studied the predator-prey relationship of sea otters and abalone, documenting the impact of the otters on the abalone population. He estimates that the standing crop of abalone in his study area is about 300 animals. That number has not changed in the last six years. Nearly all of those are relatively small animals living in rock crevices. During 1977 and 1978, investigators collected more than 500 freshly abandoned abalone shells in the study area apparently resulting from sea otter predation. Their data suggest that the entire abalone population replaced itself once every six months to three years.

Mia Tegner of the Scripps Institution of Oceanography also has been studying abalone in the kelp community. She has investigated the various habitats in which juvenile abalone are found to find out where they survive best. During 1977-78, her project included planting 1000 juvenile abalones on a site near Santa Rosa Island in various natural and artificially



created habitats. She has confirmed that the juveniles survive best in rocky habitats laced with crevices in which they can hide from predators. An unexpected discovery, however, was that the young abalone often hide under mature sea urchins where, along with juvenile sea urchins, they graze together on the algae that grow on rocks. She has found as many as 30 young abalone under one sea urchin.

Michael Neushul and David Coon at the University of California Santa Barbara have been developing new propagation techniques for giant kelp, which will facilitate transplantation and cultivation of the plants. In addition, they have achieved successful hybridization of kelp from different genera. They hope this work will lead to the introduction of plants to new areas. This is an important link between scientific research and the establishment of a commercially viable mariculture industry.

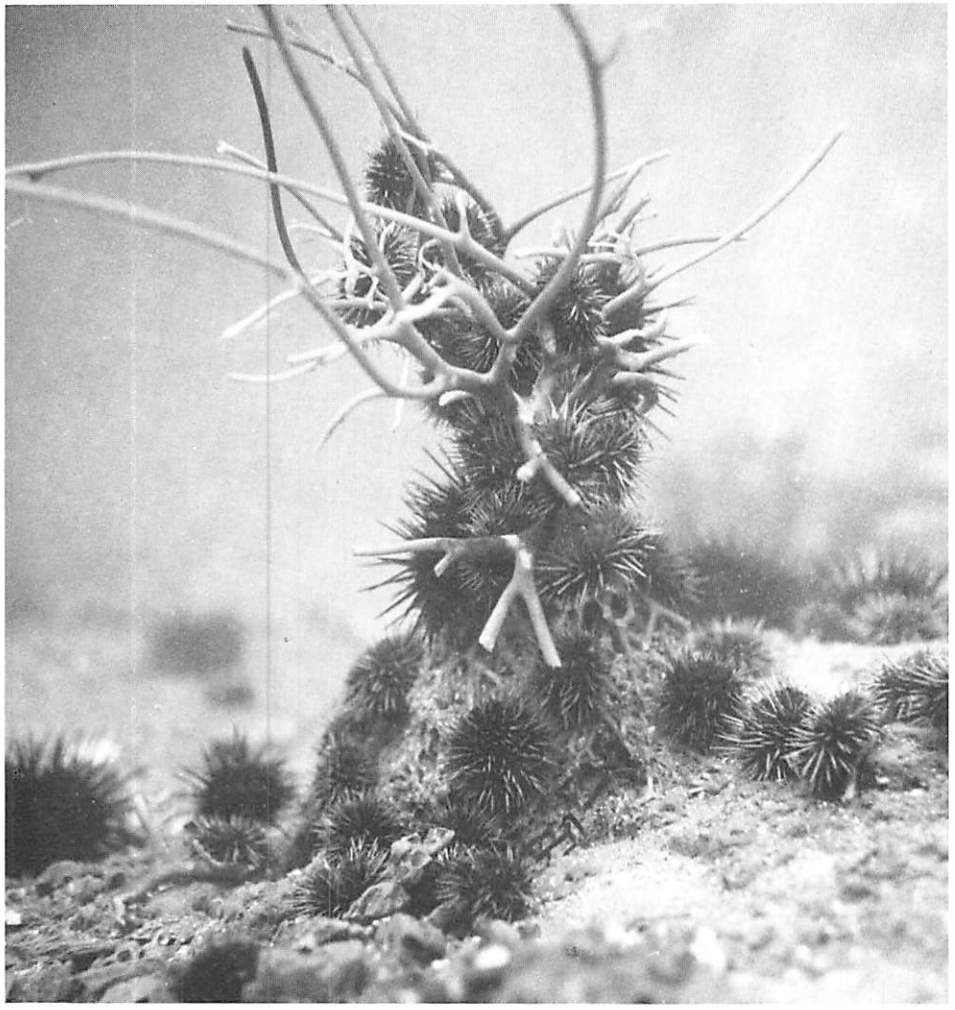
COASTAL WETLANDS ECOLOGY

The ecology of coastal wetlands is being studied by Joy Zedler and David Mauriello of San Diego State University. Coastal wetlands include saltwater and related freshwater marshes and mudflats commonly found at river mouths, coastal lagoons and sloughs.

Before the work of Zedler and Mauriello, most of what was known about coastal wetlands ecology was based on research done on the east coast of the United States and in Great Britain. Those wetlands were shown to be important spawning grounds for fishes and crabs and nesting grounds for birds. Productivity of vascular plants (those having roots, stems and leaves) is extraordinarily high in East Coast wetlands. Zedler and Mauriello have found, while the productivity of coastal wetlands in southern California is high, different types of plants are dominant. Instead of vascular plants, marine algae are the major producers. Like East Coast wetlands, West Coast wetlands export a large amount of organic nutrients to the ocean. This export is on a less regular basis, since many West Coast wetlands may be isolated from the sea for extended periods, releasing nutrients mainly during particularly high tides and storms.

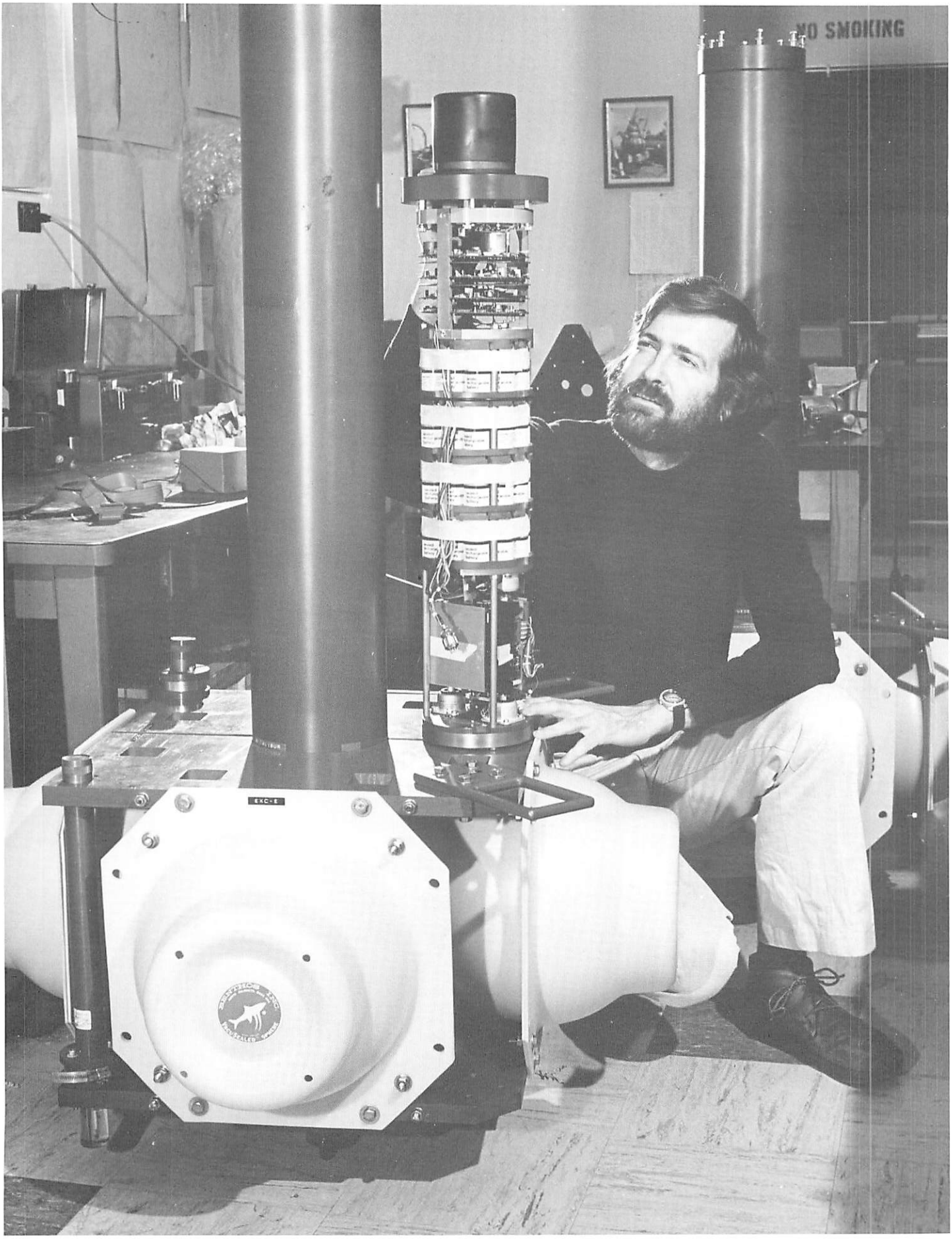
As part of a related study, Robert Holmes, Charles Peterson, and Christopher Onuf, biologists at the University of California Santa Barbara, have been studying the role of southern California coastal wetlands as fish nursery grounds. They have found that, contrary to East Coast evidence, wetlands in southern California are not important as nurseries for coastal commercial fish stocks. The wetlands are, however, important to a few "baitfish" such as topsmelt and slough anchovy. Onuf also says other researchers report wetlands to be crucial to the survival of migratory birds in the Pacific flyway as well as to several rare and endangered species of shorebirds, mice, and other creatures.

Kelp plants in various sizes showing an abundant population of sea urchins. (Photo by Wheeler North)



Sea Urchins cover a dead kelp holdfast. Grazing by the sea urchins has severed the plant from its holdfast. (Photo by Wheeler North)

A scientist in the kelp forest measures growth of a plant under natural conditions. (Photo by Ron Mc Peak)



William Prothero of the University of California Santa Barbara inspects the internal electronics component of an ocean-bottom seismometer capsule.

TECHNOLOGY

Universities are often criticized for conducting mainly esoteric research with no conceiveable benefit to people. Sea Grant encourages scientists at universities to select areas of research that may lead to new commercial products and technology, thus laying the groundwork for new industry, jobs, and the alleviation of some socio-economic problems.

NEW CHEMICAL PRODUCTS

In the marine environment, any surface offers a potential settling spot for the billions of floating or swimming larvae that attach themselves to filter feed at some stage in their life cycles. The surfaces of marine algae provide a tempting homesite for such organisms. Many barnacles, bryozoa, and worms can be found attached to the fronds of kelp. If they covered the whole plant, sunlight would be blocked, the plant could not photosynthesize organic material, and the plant would die. Consequently, kelp produces toxins to repel large numbers of settling larvae and some grazers, such as snails. In turn, some of the settling and grazing organisms also produce toxins to protect themselves from those produced by the kelp.

Could some of these naturally produced toxins be effective in protecting commercial agricultural crops from pests? Could some of these chemical compounds be useful in combating human diseases?

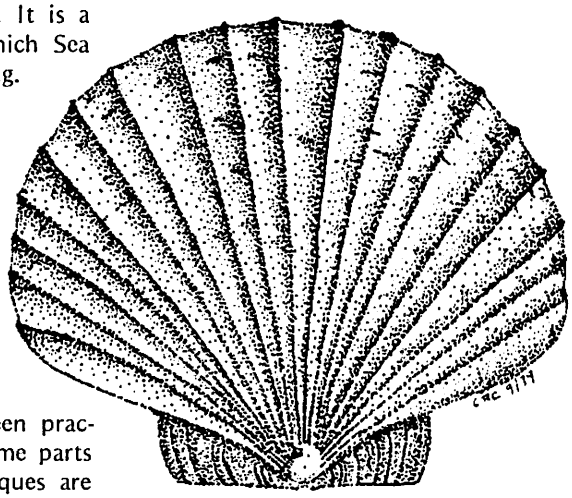
William Fenical and John Faulkner of Scripps Institution of Oceanography have been isolating and identifying compounds from marine algae and animals for pharmacological evaluation. "The long term objective of this project," says Fenical, "is the development of new drugs and environmentally safe herbicides and insecticides." "Since at least ten years of testing are required for each new product to ensure it does not have harmful side effects," Faulkner cautions, "our objective will not bear immediate fruit. We identify, purify, and describe the new chemical compounds and then send them to someone else for pharmacological screening."

Phillip Crews of the University of California Santa Cruz is involved in the same type of work. He has verified that certain seaweed extracts inhibit the growth of certain agricultural pests, even at low concentrations. Maximum effectiveness of these compounds has been against the housefly, the mosquito, the tobacco hornworm, and the tobacco budworm.

At the University of California Berkeley, Melvin Hatch, Frank Deig, and Neylan Vedros have isolated an extract from marine red algae that has been effective in helping mice resist infection with herpes simplex virus. Hatch reports that the mice given a single dose of the extract were from 100- to 1,000-fold more resistant to herpes simplex virus than were mice given no extract. This virus is notorious in causing a number of diseases including cold sores, encephalitis, a type of venereal disease, and possibly, a type of cervical cancer.

Mindful of the long testing process before these chemicals can be used generally, Sea Grant has funded a program coordinated by Robert Jacobs at the University of California Santa Barbara to select the most promising chemicals. Faulkner, Fenical, and Crews send chemicals to Jacobs. In the past year, Jacobs' laboratory initially screened 74 compounds, and 21 of these have proven active in initial testing.

The next step is to determine how these substances work. Then, a full testing program can begin, which could eventually lead to commercial production. It is a long road and a new field, which Sea Grant takes great pride in fostering.



RAISING LOBSTERS

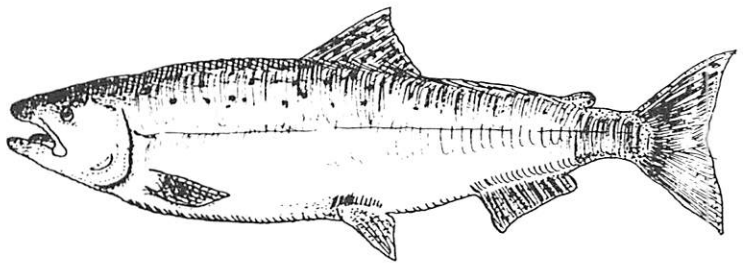
Although aquaculture has been practiced for many centuries in some parts of the world, successful techniques are known for only a limited number of organisms, such as oysters, mussels, catfish, carp, and prawns. California Sea

Grant sponsors research to foster commercial aquaculture of lobsters, abalone, salmon and rock scallops.

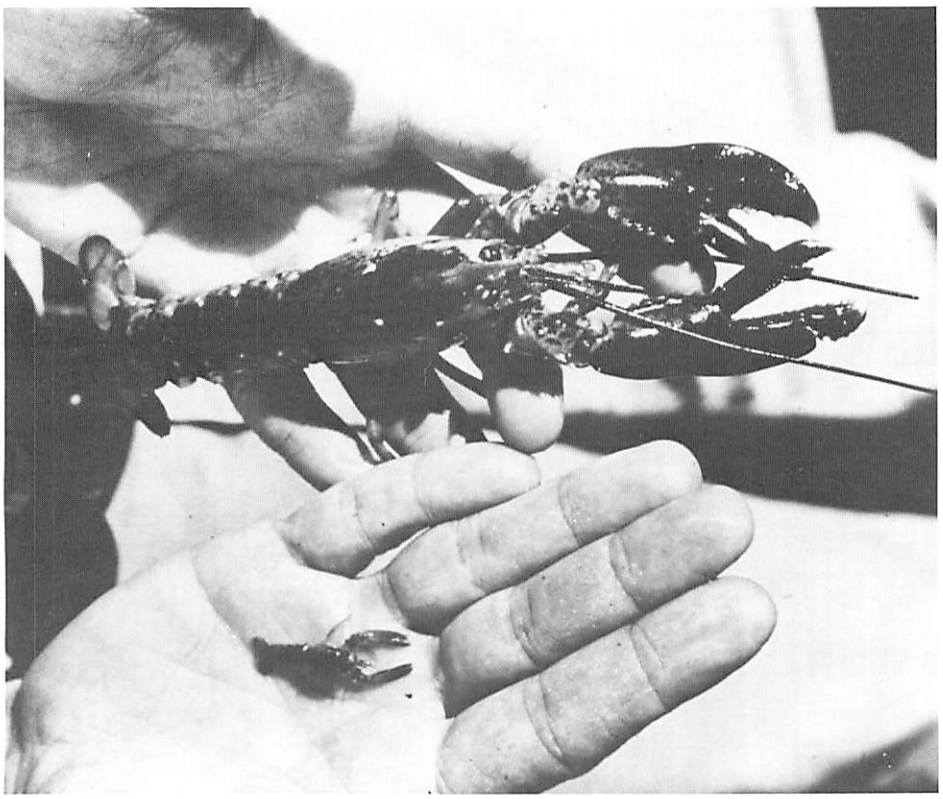
The Bodega Marine Laboratory of the University of California Berkeley has been progressing toward the development of a viable lobster aquaculture system since 1971. The research recently has centered on species of the American and European lobster, because the larval stages are relatively short, the developing organisms are hardy, and the potential economic value is high.

The Bodega lab has developed a systems approach to this research. The lab includes specialists working on water quality requirements, lobster diseases, genetic development of hybrids, development of proper feed, and economics of the system. The principle problem blocking commercial viability appears to be control of lobster reproduction to ensure a steady supply of larval lobsters from a broodstock colony.

In a closely coordinated effort, a team of researchers from San Diego State University has investigated the potential of raising lobsters in the warm water effluent of a non-nuclear power plant. The warm water is a byproduct of the plant, so no extra cost is involved in raising the water temperature. In water at 20° C (68°F), lobsters have been reared from the egg to a marketable, 1-pound size in an average of three and one-half years, which is twice the normal growth rate of lobsters in the natural environment.



The coho salmon (Oncorhyncus kisutch), found from the Bering Sea to California, migrates to freshwater to spawn. (Drawing by Henri Albert)



Sibling seven month old lobsters raised in a communal tank show the effect of dominance on growth. (Photo by Jon Van Olst)

FISH FARMING

The oldest form of agriculture used along the Pacific coast of the United States is the hatching of salmon and trout, which dates from the latter part of the 19th century. The industry has been continuous, owing to the progressive depletion of natural spawning grounds.

In spite of this long history of successful aquaculture, the solution of some related problems would be of economic benefit to the industry.

Howard Bern of the University of California Berkeley has been trying to solve the problem of why 50% of coho salmon raised in hatcheries become stunted when transferred from freshwater pens to seawater pens. He has discovered that the growth hormone cells of the pituitary gland in stunts are almost as active as in normal fish. This surprising result led Bern to hypothesize that something may prevent the tissues of the stunts from using the growth hormone. He is focusing his study on the kidney, since it is the principle organ that regulates salt concentration of the body liquids.

Another problem of hatchery conditions is disease control. Two common bacterial diseases, vibriosis and furunculosis, have been responsible for high losses of fish in culturing facilities. Theodore Kerstetter of Humboldt State University innoculated 44,000 coho salmon and 34,000 steelhead trout, constituting 56% of the total in the hatchery. He tagged and released tham along with non-innoculated fish at the time of their downstream migration. A tally of mature steelhead trout that returned to the Mad River

Hatchery in the winter of 1979 revealed that 60% of the returning fish were from among those that had been innoculated. Reports from commercial and sport fishermen catch have yet to be analyzed.

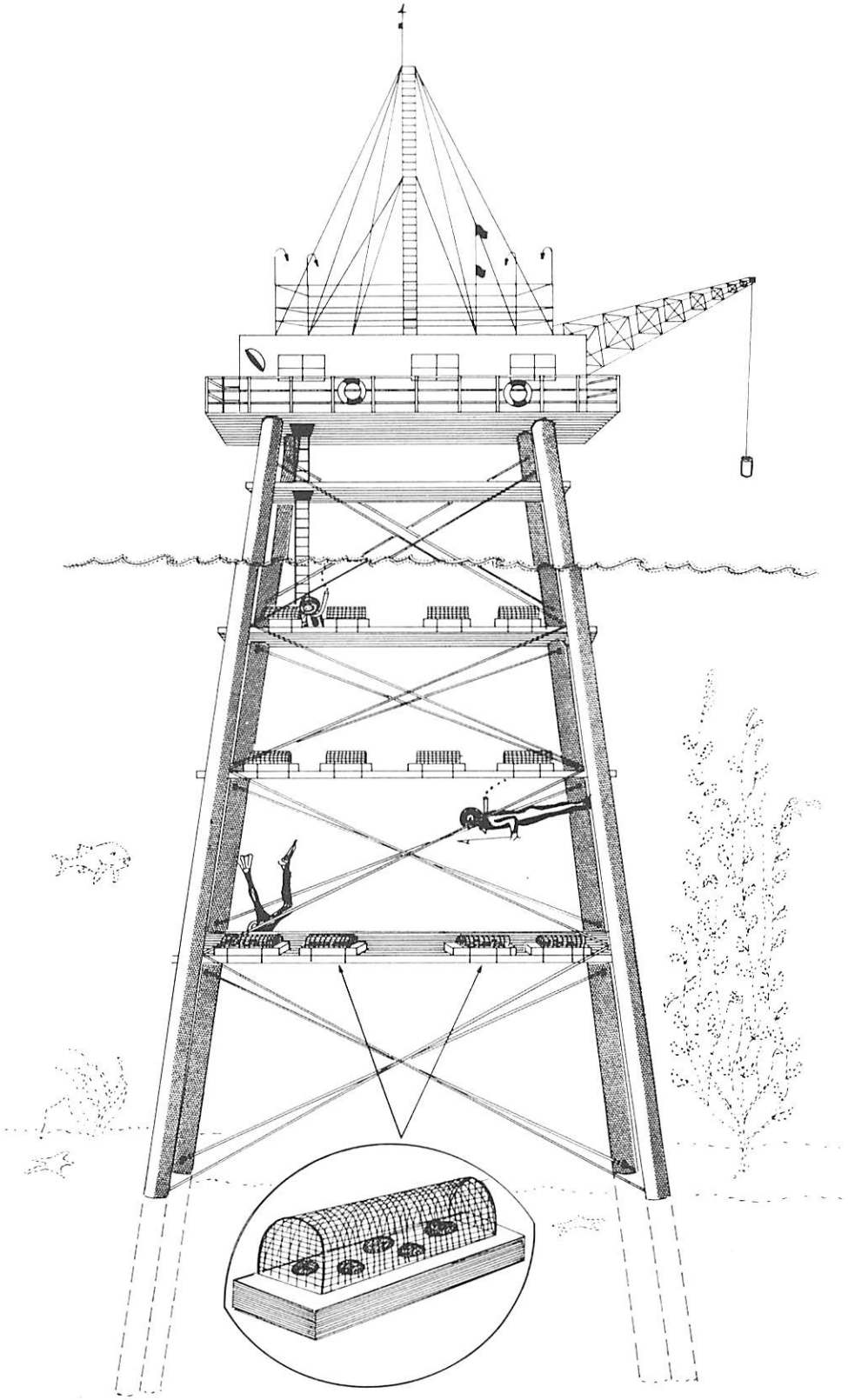
Another Sea Grant researcher, Michael Lewis of the University of California Davis, has studied the problem of the lack of natural pigment in salmon and trout raised in hatcheries. The Bodega Bay researchers added paprika to the diet of lobsters to solve this problem. Lewis has experienced success by adding red yeast to the diet of the fish.

ROCK SCALLOPS: A NEW COMMERCIAL SHELLFISH

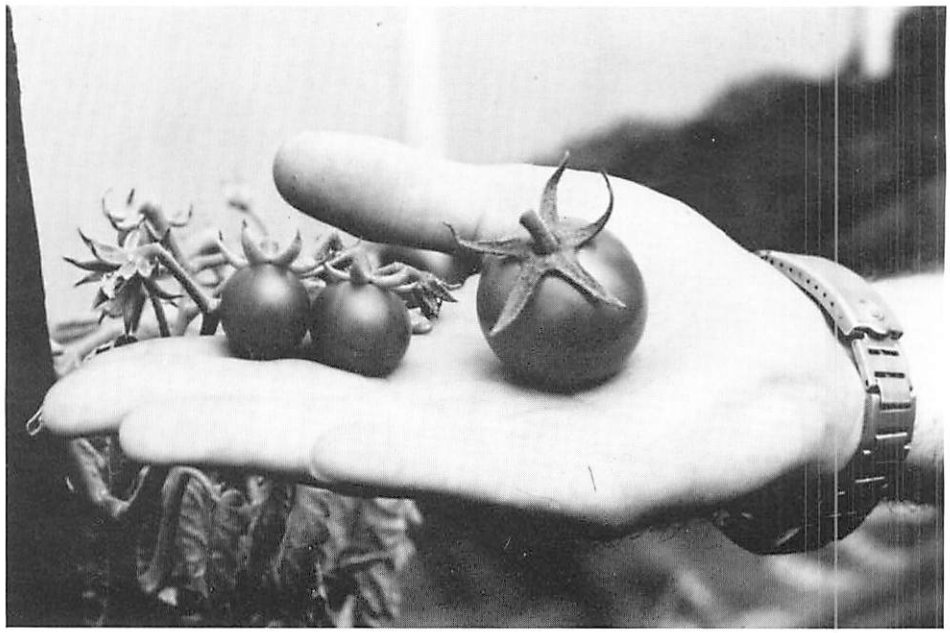
The technology of raising rock scallops can be closely modeled after successful oyster and mussel cultivation techniques already established. Rock scallops, in natural conditions, attach themselves to hard surfaces and then filter feed. This offers the economic advantage of culturing on artificial surfaces in bays or other coastal areas with adequate nutrients and water quality. Even the laborious process of producing juvenile scallops in a hatchery to seed the coastal area can be bypassed. Charles Phleger and David Leighton of San Diego State University have been raising rock scallops in Mission Bay and on an offshore U.S. Navy research platform. They have discovered that juvenile scallops are remarkably attracted to the shells of adult scallops. This discovery opens the possibility of developing artificial collectors to attract wild juveniles. Once the juveniles attach to the artificial collectors, they grow with minimum care until they are ready for market in about two years. In fact, offshore oil platforms may prove to be a suitable location for rock scallop culture.

SEAWATER IRRIGATION OF CROPS

Seawater encroachment into coastal groundwater supplies and lack of adequate



Naval Ocean System Center Tower, located off Mission Beach, San Diego, California, which is being used for open ocean growth studies of the purple-hinge rock scallop.



Hybrid tomatoes from a wild salt-tolerant and a high-yield commercial variety are shown. Those on the left were watered with 70% seawater.

freshwater for irrigation are widespread world problems from Peru to California and from Oceania to Israel. Emanuel Epstein of the University of California Davis is raising tomatoes, wheat, and barley and is watering the plants with seawater. This project involves genetic screening and hybridization to identify salt-tolerant varieties. Epstein has had extraordinary success with both tomatoes and barley and has just begun working with wheat. This effort promises to open sandy coasts, coastal deserts, and freshwater-poor islands to agriculture.

CLEANING SQUID

A major block to large-scale commercial use of squid in U.S. markets has been the reluctance of the American consumer to purchase and clean what is believed to be an unattractive product, combined with the expense of removing the head and tentacles before sale. Yet, consumers like the taste of squid. Paul Singh of the University of California Davis has designed and built an automatic squid-cleaning machine, and he may have found the missing link in development of a major new U.S. fishery. Food industry leaders on the West Coast are watching this development closely because natural populations are immense, as revealed by studies led by Conrad Recksiek of Moss Landing Marine Laboratories and Herbert Fry of the California Department of Fish and Game.

ENERGY

The energy crisis. Mention it and it brings to mind power blackouts, long lines at gas stations, and high prices. Dealing with the crisis requires vision, innovation, wise decision-making, and perseverance. Since there are so many facets of the crisis and it is so pervasive, solving the problems seems overwhelming. The philosophy of Sea Grant is to identify small problems within the crisis that are related to the marine environment and to exert a concentrated effort leading toward rapid solution.

Power plants often use seawater as a coolant in the steam generation of power. Bacteria form a slime layer on the pipes, which significantly reduces the efficiency

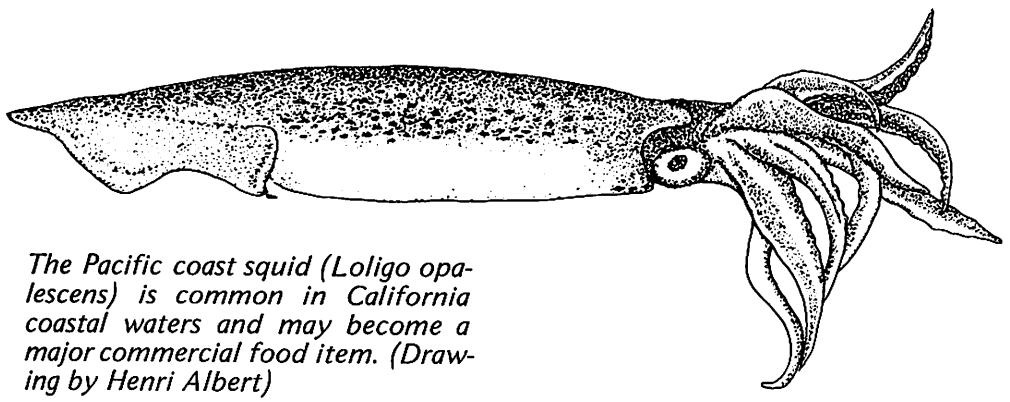
of heat exchange and which initiates scaling and heavier fouling by other organisms. Ken Nealson and Francisco Vidal of Scripps Institution of Oceanography and John Isaacs, Director of the University of California's Institute of Marine Resources, have identified the principle fouling bacteria as the same types found in deep-sea hot springs. They are now working on methods to control the growth and prevent fouling. Penicillin and other antibiotics have inhibited growth of these bacteria.

STRUCTURES BUILDING OFFSHORE

In building offshore structures such as oil platforms, abundant hazards must be taken into account. Acquiring basic information about the geology of the ocean bottom and identification of the precise location of active faults are essential to a precise location of such structures. This is especially important for seismically active regions such as California, Alaska, Indonesia, and the Persian Gulf.

William Prothero, Bruce Luyendyk, and David Simonett of the University of California Santa Barbara, in coordinated projects, have been working on these problems. Prothero has designed, built, and tested new ocean-bottom seismometer capsules that are launched from small vessels and are capable of aiding in the location of active faults. After the Santa Barbara earthquake of August 13, 1978, Prothero was able to coordinate two of his seismometers with five portable land seismometers to study the aftershocks and locate the movement with precision.

Luyendyk and Simonett are using sonar pulses obliquely bounced off the ocean floor from dual sonar transducers towed by a ship. The data are recorded and new computer image-processing techniques are used to give a level of refinement never before achieved. Faults and submarine slumps in the Santa Barbara Channel have now been located. This research, it is hoped, will reduce the potential danger of drilling from and operating offshore facilities.



The Pacific coast squid (Loligo opalescens) is common in California coastal waters and may become a major commercial food item. (Drawing by Henri Albert)

San Diego area Marine Advisor Art Flechsig examines a navigational chart with a local commercial fisherman. (Photo by Joanne Silberner)

COOPERATION: MANAGING AND ADVISING

Most of what happens in our complex, modern society requires the cooperation of people. People accomplish things through many different institutions, including government, industry, citizen groups, and universities. Sea Grant is only a small part of the vast web of society, but has set for itself as a prime goal the advocacy of cooperation between research scientists, research technologists, government policy decision-makers, industry, and the public in marine affairs.

The California Coastal Zone Conservation Act of 1972 committed California to "preserve, protect, and where possible, to restore the resources of the coastal zone for the enjoyment of current and succeeding generations." Then, with the California Coastal Act of 1976, the State legislature established a State commission and six regional commissions. The State commission interprets and enforces central coastal zone management policies. The regional commissions are charged with permit authority over development in each respective region and with adopting long-range coastal protection plans in cooperation with the cities and counties in their jurisdiction. These plans are required to be completed by 1981, at which time the regional commissions will disband and responsibility for coastal zone management will be shared by the State commission and local governmental units.

Within this mandate, Sea Grant has attempted to identify areas where research is needed to manage coastal resources wisely and to provide support for research in identified problem areas.

COASTAL EROSION AND BUILDINGS

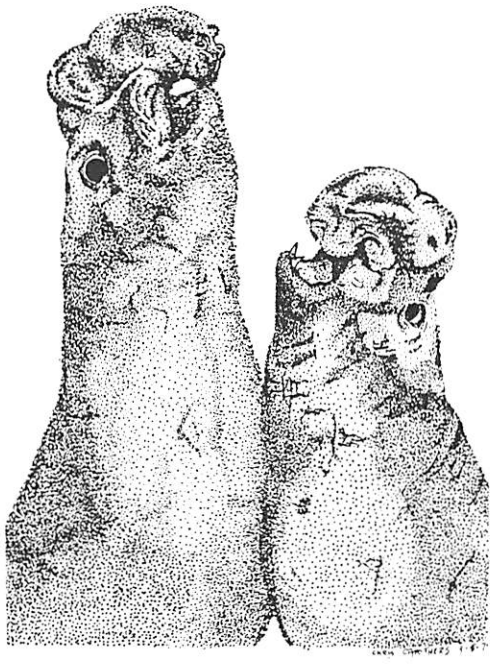
Most geologists have perpetuated the belief that erosion is a slow, continuous, and almost imperceptible process. This has resulted in widespread recommendations that building twenty-five feet back from the edge of a sea cliff is safe because it will take many years to erode the cliff.

Gerald Kuhn and Francis Shepard of Scripps Institution of Oceanography have brought into question this long-held belief. Using old photo files, old maps, county records, and newspaper accounts, they have compiled a vast body of information about the history of coastal erosion in San Diego County. They have supplemented this historical information with extensive photo documentation during the past few years, including the unusual stormy winter of 1977-78. Kuhn and Shepard have discovered that coastal erosion in southern California is rapid in relatively short episodes but essentially negligible, or gradual, in the intervening periods, which may be as long as many years. The pattern they have uncovered indicates that each site has its own special erosional characteristics and that as much as 20 to 60 feet of a sea cliff may be eroded in one season. This new preception of coastal erosion is obviously crucial to decisions about development policy.

COASTAL ZONE MANAGEMENT

Thomas Dickert of the University of California Berkeley's Institute of Urban and Regional Development is studying the effects of development on Elkhorn Slough in Monterey County. "We are trying to relate the intensity and type of land use in an estuarine watershed to impacts within the estuary," he explains. This involves integrating data on vegetation, geology, agriculture, weather, soils, and records from the County Assessor in addition to other historical material of the kind being used by Kuhn and Shepard. The coastal commissions are using this comprehensive approach to planning in developing land-use plans and recommendations for legislative action.

The federal Fishery Conservation and Management Act of 1976 set up eight regional councils, charged with the responsibility of devising management plans for nearly all commercial marine species within their respective jurisdictions. The goal was to prevent overfishing, to achieve optimum yield from each species, to make consistent overall plans for migratory species, and to promote efficient and wise use and development of fishery resources. John Moore, Alan Wyner, and Biliana Cicin-Sain of the University of California Santa Barbara are studying the effectiveness of the implementation of these management plans.



Winter storms in 1977-78 battered this sea cliff in San Diego County causing the collapse of a deck and beach access stairs. (Photo by Gerry Kuhn)

In a related study, Suzanne Holt of the University of California Santa Cruz undertook one survey of the economics of the U.S. Pacific coast albacore jigboat fishery and another evaluating the non-monetary benefits fishermen derive from their work. These socio-economic aspects of the fishing industry have never been quantified or evaluated in a comprehensive way. Yet, they play an important role in development of policy for managing the industry. The Fishery Conservation and Management Act, in fact, requires that such information be included and considered in the development of plans for managing any fish species that is affected by the Act.

PUBLIC ADVISORY SERVICE

The Ocean Education for the Public Project in 1977-78 reached more than 60,000 school age children who toured the Scripps Institution of Oceanography Aquarium/Museum, the University of California Santa Barbara Marine Science Institute, and the Moss Landing Marine Laboratories. Other special activities included teacher workshops, mini-courses, a special Spanish language program, and marine biology classes designed to reach mentally gifted students.

Historically, a major gap has existed between the development of scientific information and the practical application of that information for public benefit. Sea Grant's Marine Advisory Program and the Ocean Education for the Public project are designed to bridge this gap.

The Marine Advisory Program consists of eight marine advisors and three specialists who work under the guidance of Maynard Cummings of the University of California Cooperative Extension Service at Davis. Two of the advisors serve as specialists in addition to their advisory roles. The advisors are located at coastal ports from San Diego to southern Oregon. Their work is many-faceted. It includes advising port authorities, fishermen, seafood industries, citizen groups, 4-H Club youth, and governmental agencies and providing them with information on a variety of marine topics and issues. This is accomplished, in part, by establishing person-to-person contact in the arenas of action. The marine specialists fulfill a state-wide leadership role in educating groups by holding workshops —such as the Commercial Aquaculture Workshop in 1978 for 87 of the State's leading aquaculture producers —or by writing and producing educational pamphlets for wide distribution.

Los Angeles area Marine Advisor Barbara Katz works with Newport Beach dory fishermen. (Photo by Gary Beall)

Through public education programs, youngsters have a chance to learn about California marine life.

EPILOGUE

Sea Grant represents a unique approach to marine resource development. By encouraging broad interdisciplinary cooperation among researchers at diverse institutions, Sea Grant elicits the participation of not only oceanographers and engineers but also economists, lawyers, educators, sociologists, and others to help solve regional and national problems.

Can the development of offshore oil and gas resources be done safely and unobstrusively?

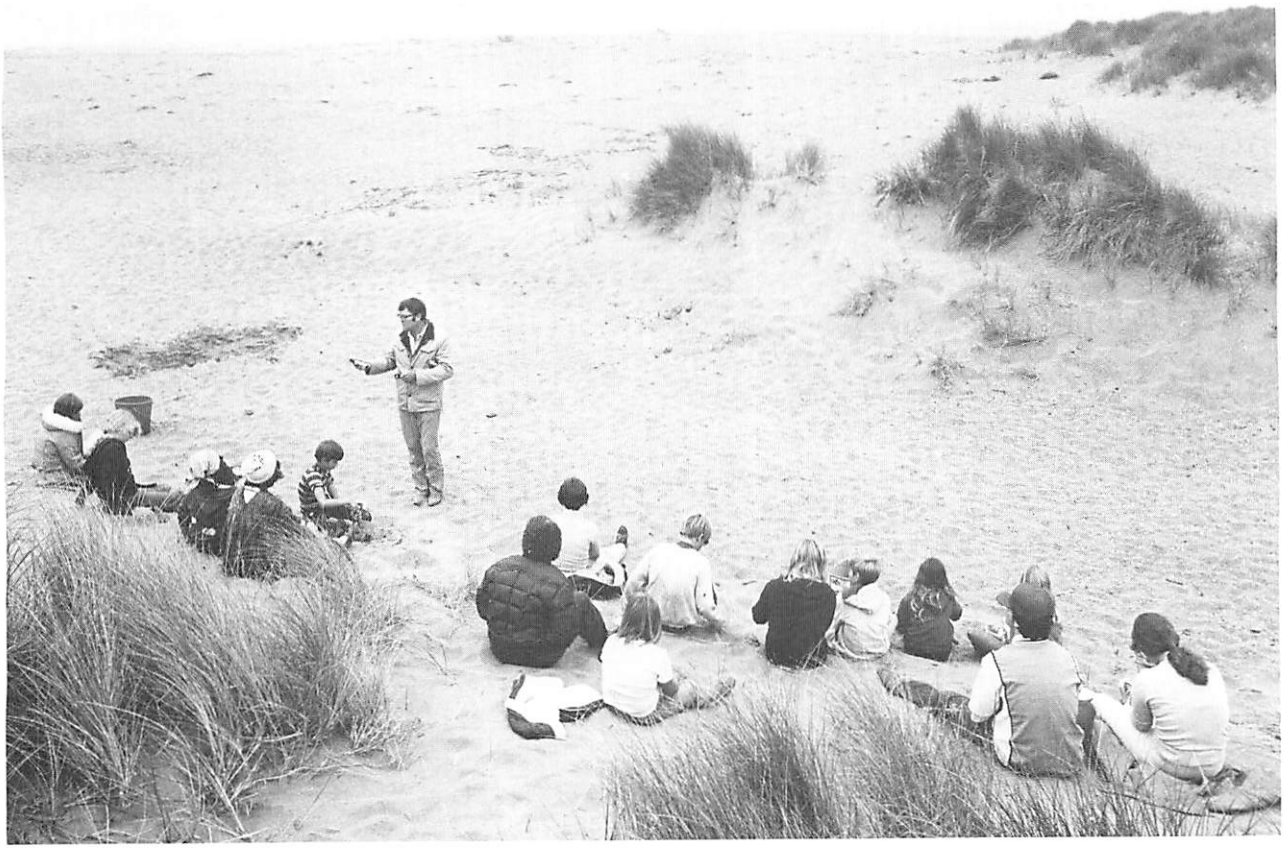
How can we build dams for flood control and agricultural use of water without increasing coastal erosion?

Are sea otters really responsible for the reduced shellfish populations in some areas? If so, what should be done?

How much waste can safely be dumped into coastal waters?

Is such a renewable resource as the temperature difference between surface and deep ocean waters practical for electrical power generation? What would be the environmental impact of developing this resource?

These are some of the questions with which Sea Grant is concerned. Sea Grant embodies the belief that coastal and ocean resources can be used in such a way that conflicting values and interests can be reconciled. Achievement of this goal presents a vast challenge to the scientists, engineers, educators, and the public body whose concern is the ocean. Through our knowledge of coastal ecology, the development of compatible, safe technology, and the cooperation of people and institutions, ocean and coastal resources can be used and developed for the benefit of all.



APPENDIX A
PROGRAM SUMMARY
1976-1978

Project Title (Project Number, Project Leader)	FY76	FY77	FY78
PROGRAM MANAGEMENT			
Program Management (M/A-1, Sullivan)	O	O	O
Program Planning and Development (M/P-1, Sullivan)	O	O	O
EDUCATION/TRAINING			
Sea Grant Trainees (E/G-2, Sullivan)	O	O	O
Model Course in Marine Planning (R/R-14, Burton)	N/C	–	–
Marine Education: Undergraduate Independent Research (E/UG-1, Doyle)	–	N	O
ADVISORY			
Ocean Education for the Public (A/PE-1, Wilkie *et al.*)	O	O	O
Marine Advisory Program (A/EA-1, Cummings)	O	O	O
Publications and Public Advisory Services (A/P-1, Frautschy)	O	O	O
COASTAL RESOURCES RESEARCH			
Physical Criteria for Coastal Planning (R/CZ-3, Inman/Winant)	C	–	–
Oceanographic Inventory of the Southern California Shelf (R/CZ-23, Fischer/Berry)	C	–	–
Management of Beach and Dune Vegetation (R/CZ-22, Barbour)	O	C	–
Diving Safety Research Project (R/CZ-25, Egstrom)	O	C	–
Management of Cumulative Impacts of Coastal Development (R/CZ-26, Dickert)	N/C	–	–
Issues of Coastal Governance (R/CZ-27, Lee/Scott)	N/C	–	–
San Francisco Bay Project: Reference Collection, Bibliography, Identification Keys and Specimen Depository (R/CZ-28, Lee)	N	C	–
Coastal Engineering Data Network (R/CZ-30, Isaacs)	–	N/C	–
Tilting Spar Directional Wave Sensor (R/CZ-40, Inman/Guza)	–	N/C	–
Coastal Wetlands Management: Biological Criteria (R/CZ-33A, Holmes *et al.*)	N	O	O
Coastal Wetlands Management: Effects of Disturbance on Estuarine Function (R/CZ-33C, Zedler/Mauriello)	–	N	O
Coastal Wetlands Management: Opening of Coastal Lagoons by Sand Fluidization (R/CZ-33D, Inman /Nordstrom)	–	N	C
Longshore Sand Transport Studies (R/NP-10, Inman)	–	N/C	–
Model Coastal Ordinance Project (R/NP-1V, Motley)	–	N/C	–
Development of a California Coastal Wetlands Information Directory for Resources Management (R/NP-1W, Dickert/Pepper)	–	N/C	–
Marine Resource Evaluation of Humboldt and Del Norte Counties, California: Preliminary Investigations (R/NP-1X, Isaacs/Kerstetter)	–	N/C	–
Geology, Faulting, and Related Seacliff Erosion, San Dieguito River to Carlsbad, San Diego County, California (R/NP-1H, Shepard)	N/C	–	–
Fiscal Impact of Park Acquisition in Laguna Beach (R/NP-1L, Dickert)	–	N/C	–
Transportation Analysis in the Coastal Zone: Subregional Considerations for Local Coastal Plans (R/NP-1M, Dickert)	–	N/C	–
Thermal Variability in Coastal Waters in the Southern California Bight (R/CZ-31, Winant)	N	O	O
Internal Waves Over Shelf and Canyon (R/CZ-32, Cox)	N	O	C
Assessment of the Offshore Commercial Sand and Gravel Potential on the Central California Continental Shelf (R/CZ-37, Berry/Wilde)	N	C	–

Project Title (Project Number, Project Leader)	FY76	FY77	FY78
COASTAL RESOURCES RESEARCH (continued)			
Methods for the Management of the Cumulative Impacts of Coastal Development (R/CZ-26, Dickert/Twiss)	N	C	–
Coastal Governance in California (R/CZ-38, Lee/Scott)	–	N/C	–
Half Moon Bay Private Sector Impact Study (R/NP-1C, Goldman)	N/C	–	–
Development of Interpretive Methods and Materials for Marine Parks in Northern California (R/MR-1, DeMartini)	–	N	C
The potential Environmental Impact of the Japanese Alga, *Sargassum muticum* (R/R-4, Dayton)	N/C	–	–
Geological and Historical Analysis of Coastal Zone Environmental Hazards and Liability for Losses Caused by Them (R/CZ-43, Shepard/Hildreth)	–	–	N
Kelp Bed Mariculture and Resource Management (R/A-16, Neushul *et al.*)	N	R	C
Coastal Governance 1977-1978: First Steps in Implementing California's 1976 Legislation (R/CZ-41, Lee/Scott)	–	–	N/C
Coastal Zone Management: Methods for Plan Development, Evaluation and Monitoring of Local Programs (R/CZ-42, Dickert)	–	–	N/C
AQUACULTURE RESEARCH AND DEVELOPMENT			
Economics of Aquaculture (R/ME-1, Johnston)	C	–	–
Development of Aquaculture Systems (R/FA-4, Shleser)	C	–	–
Use of Thermal Effluent in Aquaculture (R/FA-17, Ford/Van Olst)	C	–	–
Salt-Tolerant Plants (R/FA-13, Epstein)	C	–	–
Development of a Commercial Aquaculture System for the Crab *Scylla serrata* (R/A-8, Harrison)	C	–	–
Protective Measures for Shellfish Aquaculture (R/A-15, Steenbergen)	N	O	C
A Genetic Program for Improvement of Carrageenan in Red Algae *Gigartina* (R/A-17, West)	N	R	–
California Aquaculture Law (R/A-13, Bowden)	N	O	C
The Development of the Science and Technology of Aquaculture (R/A-19, Hand)	–	N	C
Optimization of an Artificial Diet for Lobsters (R/NP-1D, Holtz)	N	C	–
Use of Thermal Effluent in the Culture of Crustacea and Fishes (R/A-21, Van Olst/Ford)	–	N	C
Biochemical and Genetic Control Applied to the Critical Stages in Culturing Abalone (R/NP-1A, R/A-25, Morse)	N	O	C
Surfperch Mariculture (R/R-9, R/A-23, Norris)	N	C	–
Aquaculture of the Purple-Hinge Rock Scallop (R/R-7, R/A-24, Phleger/ Leighton)	N	O	C
Carrageenophyte Cultivation, Genetics, Population Dynamics, and Development of Agar Substitutes (R/A-17, Doyle *et al.*)	–	R	C
Toward Seawater-Based Crop Production (R/A-22, Epstein)	–	N	O
Astaxanthin from Yeast for Fish Diets (R/R-11, R/A-27, Lewis)	N	O	C
The Role of Diseases in Aquaculture: Preliminary Survey (R/NP-1E, Raggi)	N/C	–	–
Plant Pathogens of Aquaculture Systems (R/NP-1R, Goff)	–	N/C	–
Bioeconomic Modeling of the Freshwater Prawn *Macrobrachium* spp. (R/NP-1T, Johnston)	–	N/C	–
Food Conversion Efficiencies of Instar Dungeness Crab (E/G-2, Tullis)	–	N/C	–

Project Title (Project Number, Project Leader)	FY76	FY77	FY78
AQUACULTURE RESEARCH AND DEVELOPMENT (continued)			
Control of Reproduction in the Lobster (R/NP-1-7B, Talbot)	–	–	N/C
FISHERIES RESEARCH AND DEVELOPMENT			
The California Market Squid Fishery (R/F-15, Recksiek/Frey)	O	O	C
Optimal Management of Sea Urchin Fisheries (R/F-18, Dayton)	O	R	–
Effects of Fishing Sea Urchins on the Marine Ecosystem (R/F-18, Connell)	O	R	–
Studies Toward the Optimal Management and Environmental Effects of Sea Urchin Fisheries (R/F-18, Dayton, Connell)	–	R/C	–
Studies of Fish Muscle Proteins and Fresh and Frozen Seafood Technology (R/ST-2, Brown)	O	C	–
Histamine Toxicity from Fish Products (R/F-22, Olcott *et al.*)	O	C	–
Methods of Quality Assessment in Fishery Products (R/F-23, Chang)	N	C	–
Limited Entry: An assessment for California Fisheries (R/F-24, Wyner/Harding)	N/C	–	–
Cause of the Decline in Dungeness Crabs in the San Francisco Bay Area (R/NP-1F, Horne)	N/C	–	–
Sand Bottom Community Structure and Artificial Reefs (R/R-5, Dayton)	N/C	–	–
A Study of the Santa Barbara Inshore Party Boat Fishery and Aspects of the Life History of the Olive Rockfish *Sebastes serranoides* (R/NP-1I, Ebeling)	N	C	–
Development of Trapping Methods for Migratory Salmonid Smolts In Hatcheries (R/NP-1N, Kerstetter)	–	N/C	–
Optimal Leasing Agreements for Marine Resource Development (R/F-35, Quirk, Lewis)	–	N	C
The Effects of Food Availability on the Growth and Survival of California Jack Mackerel Larvae (R/F-44, Mullin/Lasker)	–	N	O
Investigation of Data for an Economic Study of the U.S. Pacific Albacore Jig Boat Fishery (R/NP-1S, Holt)	–	N/C	–
An Ethnography of the San Pedro Wetfish Fishing Fleet (R/NP-1U, Velez)	–	N	C
Socio-Economic Aspects of Expansion of the California Swordfish Fishery (R/F-26, Holt)	–	N/C	–
Coordinated Management of the Pacific Coast Salmon Fisheries and the Implications of Extended Jurisdiction (R/F-24, R/F-31, Moore *et al.*)	–	N	C
Protective Immunization of Anadromous Salmonids Against *Aeromonas salmonicida* and *Vibrio anguillarum* (R/F-29, Kerstetter)	–	N	C
Development of a Mechanism to Allow Release of Dungeness Crabs from Lost or Abandoned Pots (R/F-27, Jolly)	–	N	C
Endocrinology of Salmon Smoltification and Adaptation to Seawater (R/F-25, Bern)	–	N	C
Comparative Analysis of the Social and Political Systems of the Tuna Fleets of San Diego and Ensenada (R/F-30, D'Andrade/Bailey)	–	N	C
Development of Multispecies Management for Kelp Bed Resources with an Emphasis on Sea Urchins (R/F-36, Tegner)	–	–	N
Improved Marine Food Products and Marine Food Technology (R/F-32, Brown)	–	–	N
Amine Toxicity of Fish Products (R/F-43, Bjeldanes)	–	–	N
Design and Development of a Squid Processing Machine (R/NP-1J, R/F-33, Singh)	–	–	N

Project Title (Project Number, Project Leader)	FY76	FY77	FY78
FISHERIES RESEARCH AND DEVELOPMENT (continued)			
Bioconversion of Chitin Wastes (R/F-34, Carroad)	–	–	N
An Economic Study of the U.S. Pacific Albacore Jig Boat Fishery (R/F-38, Holt)	–	–	N/C
Santa Barbara Inshore Party Boat Fishery: Emphasis on the Olive Rockfish (R/F-39, Ebeling)	–	–	N/C
Re-establishment of Anadromous Fishes in Southern California (R/F-42, Van Olst/Ford)	–	–	N/C
A Multispecies Bioeconomic Fisheries Model Under Uncertainty (R/F-37, Just)	–	–	N/C
Experimental Abalone Enhancement Program (R/NP-1-7A, Tegner)	–	–	N
Limited Entry in the California Abalone Fishery: A Longitudinal Analysis (R/NP-1-7C, Cicin-Sain/Moore)	–	–	N/C
NEW MARINE PRODUCTS			
Seaweed Products: Application in Algae Control, Mariculture and Agriculture (R/MP-7, Fenical)	O	C	–
Antiviral Compounds from Algae (R/MP-12, Vedros)	N	O	C
Marine Natural Products Chemistry of Fouling Organisms (R/MP-10, Faulkner)	N	C	–
Development of Anticancer Substances from the Brown Seaweed *Dictyota* (R/NP-1G, Fenical)	N/C	–	–
Tissue Culture of *Macrocystis* and Related Seaweeds of Economic Importance (R/MP-13, Lewin/Fenical)	–	N/C	–
Marine Plants as a Source of Insect Growth Inhibitors (R/MP-14, Crews)	–	N	O
Pharmacological Evaluation Program (R/MP-15, Jacobs)	–	–	N
Marine Natural Products for Pharmacological Evaluation (R/MP-16, Faulkner)	–	–	N
New Agricultural Chemicals from Marine Organisms (R/MP-18, Fenical)	–	–	N
Antileukemia Compounds from the Brown Seaweed *Dictyota* (R/MP-17, Fenical)	–	–	N/C
ENERGY			
Wave Climate Modification in Harbors by Dynamic Breakwater (R/E-1A, Isaacs)	C	–	–
Biological Effects of Waste Heat Effluents of Coastal Power Plants (R/E-10, Smith/Hand)	C	–	–
Stray Electrical Current Hazards to Prestressed Concrete Construction in Seawater (R/E-12, Cornet)	N	O	C
Earthquake Loading on Large Offshore Structures in Deep Water: A Study for the Correlation of Analytic and Physical Models (R/E-14, Wiegel)	–	N	O
Seismic Hazards to the Development of Offshore Oil Resources (R/E-15, Prothero)	–	N	O
Power from Salinity Gradients (R/NP-1B, R/E-16, Isaacs)	N	O	C
Studies on Thermophilic Microorganisms Located from Undersea Hot Springs, Electric Power Plant Condensers and Ships' Heat Exchangers (R/NP-1P, R/E-21, Isaacs)	–	N	O
Placement of Underwater Mass Concrete by the Tremie Method (R/NP-1Q, Gerwick)	–	N	C
Identification of Sources of Oil Spills in the Santa Barbara Channel (R/R-8, Profio)	N/C	–	–
Marine Vehicle Safety Analysis (R/E-17, Webster)	–	N	C

Project Title (Project Number, Project Leader)	FY76	FY77	FY78
ENERGY (continued)			
Side-Scan Sonar Mapping and Computer-Aided Interpretation of the Geology of the Santa Barbara Channel (R/E-18, Luyendyk/Simonett)	–	–	N
Nearshore Wave Power Source (R/E-19, Seymour)	–	–	N/C
Power Generator Inertially Coupled to Seawaves (R/E-20, Lee/Manalis)	–	–	N/C
RAPID RESPONSE			
Rapid Response Capability (R/NP-1, Sullivan)	O	O	O

N = New Project
O = Ongoing Project
R = Restructured Project
C = Completed Project
T = Terminated Project

NOTE: For further information about specific projects, contact the California Sea Grant College Program, Institute of Marine Resources, University of California, A-032, La Jolla, California 92093 (714) 452-4440.

APPENDIX B

LOCATION OF SEA GRANT MARINE ADVISORY STAFF

Name and Position	Location
Maynard Cummings Coordinator	554 Hutchison Hall University of California Davis, CA 95616 916/752-3342
Fred Conte Aquaculture Specialist	554 Hutchison Hall University of California Davis, CA 95616 916/752-7490
Christopher Dewees Marine Resources Specialist	554 Hutchison Hall University of California Davis, CA 95616 916/752-1497
Robert Price Seafood Technology Specialist	101 A Cruess Hall University of California Davis, CA 95616 916/752-2193
Fred Jurick Marine Extension Agent	Humboldt State University Arcata, CA 95521 707/ 443-8369
Barbara Katz Area Marine Advisor Ports and Transportation Specialist	100 West Water Street Wilmington, CA 90744 213/830-6328
Andrew Manus Area Marine Advisor Coastal Resources Specialist	P.O. Box 34066 Cow Palace, South Hall San Francisco, CA 94134 415/586-4115
John Richards Area Marine Advisor	260 N. San Antonio Road Santa Barbara, CA 93111 805/964-9869
Art Flechsig Area Marine Advisor	1140 N. Harbor Drive Room 11 San Diego, CA 92101 714/234-4033
James Waldvogel Area Marine Advisor	Del Norte County Courthouse Annex 981 H Street Crescent City, CA 95531 707/464-4711
Bruce Wyatt Area Marine Advisor	2555 Mendocino Avenue Room 100-P Santa Rosa, CA 95401 707/527-2621

Note: Additional advisors, to be located in Monterey and Ventura, will be named in 1980.

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA
1979

Edmund G. Brown, Jr.
Governor of California and
President of the Regents
Mike Curb
Lieutenant Governor of California
Leo T. McCarthy
Speaker of the Assembly
Wilson Riles
State Superintendent of Public Instruction
Lee Wenzel (1980)
President of the Alumni Association of
the University of California
George David Kieffer (1980)
Vice President of the Alumni
Association of the University
of California
David S. Saxon
President of the University

Appointed Regents*

Edward W. Carter (1982)
William K. Coblentz (1980)
DeWitt A. Higgs (1982)
Glenn Campbell (1984)
William French Smith (1986)
Robert O. Reynolds (1986)
Chairman of the Board
Dean A Watkins (1984)
Joseph A. Moore (1990)
Vice Chairman of the Board
John H. Lawrence, M.D. (1988)
William A. Wilson (1988)
Gregory Bateson (1988)
Wilma S. Martinez (1990)
Verne Orr (1988)
John F. Henning (1989)
Stanley K. Sheinbaum (1989)
Yori Wada (1980)
Yvonne Brathwaite Burke (1990)
Hector Cruz Lozano (1980)

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Donald L. Reidhaar
General Counsel
Herbert M. Gordon
Treasurer
Miss Marjorie J. Woolman
Secretary

Faculty Representatives to the Board of Regents

William R. Frazer
(September 1, 1977 to August 31, 1979)
Karl S. Pister
(September 1, 1978 to August 31, 1980)
Benjamin Aaron
(September 1, 1979 to August 31, 1981)

University of California Administration

David S. Saxon
President of the University
William B. Fretter
Vice President of the University
Donald C. Swain
Academic Vice President
Archie Kleingartner
Vice President-Academic and Staff
Personnel Relations
James B. Kendrick, Jr.
Vice President-Agriculture and
University Services
Dorothy E. Everett
Assistant President-Coordination
and Review
Thomas E. Jenkins
Associate Vice President
David A. Wilson
Executive Assistant to the President
Lowell J. Paige
Special Assistant to the President
for Governmental Relations

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*Terms of Regents appointed by the Governor expire March 1 of the year named in parentheses, with names arranged in order of original accession to the Board. The student Regent (**Hector Cruz Lozano**) and alumni Regents serve one-year terms beginning July 1 and ending June 30 of the year listed.

California Sea Grant College Program
Institute of Marine Resources
University of California, A-032
La Jolla, California 92093