

CUIMR-Q-98-001 C3



California
Sea Grant
Program Directory

1998-2000

Message from the director...

This year—1998—represents an important anniversary for our program.

Exactly 25 years ago, the U.S. Department of Commerce announced that the University of California had been designated the nation's seventh Sea Grant College, "for sustained excellence in research, education, and public service dedicated to wise use of America's marine resources." Since that time, California Sea Grant has grown to become the largest Sea Grant program in the nation.

Also, in 1973, the State of California enacted legislation providing matching funds to Sea Grant, a commitment which reflected State recognition of the importance of university research and other Sea Grant activities in addressing California's numerous marine issues.

As we mark our 25th anniversary as a Sea Grant College with the ambitious program of marine research, education, and advisory services outlined in these pages, we find it fortuitous and fitting that the United Nations has declared 1998 the "Year of the Ocean." The goal of the Year of the Ocean is to raise public awareness about the importance and relevance of the ocean in our lives—a goal to which we can all enthusiastically subscribe. It represents an opportunity for all of us—in academia, government, industry, or as private citizens—to rededicate ourselves to help sustain the marine environment and its essential resources.

**James J. Sullivan
Director**

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Sea Grant is a unique partnership of public and private sectors, combining research, education, and technology transfer for public service. It is a national network of universities meeting changing environmental and economic needs of people in our coastal, ocean, and Great Lakes regions.

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California's Sea Grant Institutions

Since 1968, Sea Grant in California has supported a unique combination of marine research, education, and advisory activities at a number of California universities and colleges. These institutions have included:

Bodega Marine Laboratory
California Institute of Technology
California Polytechnic University
California State University, Fresno
California State University, Fullerton
California State University, Hayward
California State University, Long Beach
California State University, Los Angeles
California State University, Monterey Bay
California State University, Northridge
Claremont College
Hopkins Marine Station
Humboldt State University
Moss Landing Marine Laboratories
Occidental College
San Diego State University
San Francisco State University
San Jose State University
Southern California Ocean Studies Consortium
Stanford University
University of California, Berkeley
University of California, Davis
University of California, Irvine
University of California, Los Angeles
University of California, Riverside
University of California, San Diego
University of California, San Francisco
University of California, Santa Barbara
University of California, Santa Cruz
University of San Diego
University of Southern California

Introduction

The National Sea Grant College Program is a nationally coordinated, university-based program with facilities and staff in every coastal and Great Lakes state. Activities are funded principally by the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce and by the individual states, with additional support from a number of private sources.

The California Sea Grant College System, the largest Sea Grant program in the nation, is a statewide, multiuniversity program of marine research, extension services, and education. Its mission is to maximize the contribution of universities and affiliated institutions to the wise use of the sea's resources and the meaningful defense from its hazards through research, education, and advisory services for the benefit of the state and nation. Through the research it sponsors, California Sea Grant contributes to the growing body of knowledge about our coastal and ocean resources and helps solve contemporary problems in the marine sphere. Through its Extension Program, California Sea Grant transfers information and technology developed in its research efforts to a wide community of users in California, the Pacific region, and the nation. California Sea Grant also supports a range of educational programs to promote the wise use of our coastal and oceanic resources by this and future generations.

California Sea Grant is administered by the University of California. Policy guidance comes from the California Sea Grant College System Advisory Council. The California Sea Grant Committee, composed of representatives of the University of California, the State University system, and private universities, provides administrative guidance to the director on matters pertaining to proposal review and the conduct of the program. A Living Marine Resources Advisory Committee and several other committees advise the Sea Grant Committee on program development.

This directory presents the 1998–2000 research projects and activities supported by the program.

Participating Institutions 1998–2000

BML	Bodega Marine Laboratory University of California, Davis Bodega Bay, California 94923	SU	Stanford University Palo Alto, California 94305
CDFG	California Department of Fish and Game	UCB	University of California, Berkeley Berkeley, California 94720
CIT	California Institute of Technology Pasadena, California 91125	UC-CE	University of California Cooperative Extension
CSLB	California State University Long Beach, California 90840	UCD	University of California, Davis Davis, California 95616
CSUF	California State University Fullerton, California 92634	UCSB	University of California, Santa Barbara Santa Barbara, California 93106
CSUMB	California State University, Monterey Bay Seaside, California 93933	UCLA	University of California, Los Angeles Los Angeles, California 90095
HMS	Hopkins Marine Station Stanford University Pacific Grove, California 93950	UCSC	University of California, Santa Cruz Santa Cruz, California 95064
HSU	Humboldt State University Arcata, California 95521	UCSD	University of California, San Diego La Jolla, California 92093
	Midwestern University Downer's Grove, Illinois 60515	UC-SG	University of California Sea Grant College La Jolla, California 92093-0232
MLML	Moss Landing Marine Laboratories Moss Landing, California 95039		University of Utah Salt Lake City, Utah 84112
NMFS	National Marine Fisheries Service		
SDSU	San Diego State University San Diego, California 92182		
SFSC	Southwest Fisheries Service Center		
SGEP	Sea Grant Extension Program		
SIO	Scripps Institution of Oceanography University of California, San Diego La Jolla, California 92093		
SJSU	San Jose State University San Jose, California 95192		



Coastal Ocean Research

- **The Effects of Coastal Fog on Planktonic Production and Food Web Structure**

R/CZ-137

N.A. Welschmeyer/SJSU, MLML

It has been suggested that changes in the prevailing winds responsible for upwelling, and thus coastal fog, are increasing as a result of global climate change, not only in California but also in Peru, Morocco, and the Iberian peninsula. This research seeks to analyze the effects of fog on the productivity and composition of coastal plankton in Monterey Bay and to determine what the likely effects of increased fog would be on the food web.

- **Interdecadal Change in California Current Zooplankton—Retrospective Analyses by Optical Plankton Counter**

R/CZ-138

M.M. Mullin/UCSD, SIO

Recent research suggests that populations of zooplankton have declined in the California Current by about 70 percent over the past four decades, apparently because of ocean warming. In this project, researchers will use an optical plankton counter to analyze samples of zooplankton taken on CalCOFI cruises over the past 40 years. Since the size of these animals is important in determining whether or not they are acceptable food for larval or juvenile fish, this analysis will suggest how different groups of fishes might have been affected by the decline.

- **Ecosystem and Restoration Analysis of the Smith River Estuary, with Emphasis on Anadromous Salmonids**

R/CZ-155

T.J. Mulligan, et al./HSU

Efforts to restore salmon stocks have focused on protection and restoration of freshwater habitat, even though estuaries, which also provide critical habitats for salmonids, have been extensively degraded. One important estuary in northern California, the Smith River estuary, has been altered by diking and drainage to the point where only a small percentage of it offers typical habitat for anadromous fishes. Scientists will use GIS and ecological data to determine the historic and current juvenile salmonid-rearing habitats available in the Smith River estuary and will predict the juvenile-rearing potential of this system were it restored to a more natural state. Their results will provide critical information for the protection and restoration of other degraded estuaries along the Pacific Coast.

- **Processes of Tidal Channel Morphological Evolution and Application to Wetland Restoration and Conservation Efforts**

R/CZ-139

D.R. Stoddart, W.E. Dietrich/UCB

Restoration of tidal wetlands depends largely on successful creation of tidal channels like those found in natural marshes. But scientists have thus far been unable to quantify the relative importance of physical versus biological influences in determining the dimensions of tidal creeks. The objective of this project is to

understand how sediment transport controls the evolution of channels in newly established tidal wetlands and to apply this knowledge to the restoration, conservation, and management of tidal wetlands.

- **Faunal Recovery in Restored Wetlands**

R/CZ-140

L.A. Levin, P.K. Dayton/UCSD, SIO

Restoration of coastal wetland habitats requires that both animal and plant communities eventually take on the functional attributes of natural systems. To date, however, there have been no thorough investigations of succession of the animal portion of the system. The aim of this project is to better understand the factors controlling the recovery of invertebrates and fishes in wetland habitats in southern California.

- **Effect of Spore Abundance on Recruitment and Maintenance of Subtidal Kelp Populations**

R/CZ-141

P.K. Dayton/UCSD, SIO

Kelp not only serves important ecological and aesthetic purposes, but also is an important economic resource. Virtually nothing is known, however, about the factors affecting distribution of kelp spores in the water. This project will use state-of-the-art spectromicroscopy to determine whether subtidal kelp populations are regulated primarily by local spore production, or over what distances kelp populations are effective spore sources.

- **Characterizing Vegetation-Hydrology Interactions for Tidal Marsh Restorations**

R/CZ-154

T.C. Foin, et al./UCD

Despite efforts to restore tidal wetlands, the results have often been disappointing. This performance may be traced to our inadequate knowledge of the interactions between the physical state of the marsh and its biological community. Scientists participating in this project seek to determine the importance of the interactions between sediment, tidal volume, and vegetation. They will develop a quantitative model of marsh interactions that will be particularly relevant to scientists and managers involved in marsh restoration projects in North San Francisco Bay and the Sacramento-San Joaquin Delta.

- **A GIS-Based Monthly River Discharge Model for Coastal Watersheds in Southern California-Baja California**

R/CZ-136

R.D. Wright, A.S. Hope/SDSU

The river flows of many coastal chaparral basins are either ungauged or inadequately gauged, which is particularly unfortunate because these watersheds are frequently sites of rapid population growth and environmental degradation. This project seeks to develop a simple stream discharge model that will add to our knowledge of river flow of these basins, in particular the watershed of the Tijuana River. The project is linked to ongoing GIS database development in the San Diego-Tijuana region, funded by NOAA and EPA.

- **Domoic Acid Biosynthesis in Marine Diatoms: Biochemical Pathways and Environmental Regulation**

R/CZ-144

G.J. Smith/UCLA

The frequency of harmful algal blooms is increasing worldwide, with potential impacts on both wildlife populations and local fisheries. One common diatom along the California coast, *Pseudonitzschia* sp., is responsible for producing domoic acid, a compound that can be highly toxic to humans. Scientists will investigate the metabolic characteristics of domoic-acid producing species, seeking to increase our ability to predict the environmental conditions that promote production and accumulation of this toxin.

- **Assessing Environmental Control of Domoic Acid Production by the Planktonic Diatom *Pseudo-nitzschia australis* in California Coastal Waters**

R/CZ-145

D.L. Garrison et al./UCSC

As a result of the discovery of domoic acid in California waters, it has become necessary to monitor for toxic blooms. Unfortunately, current monitoring techniques may not be sufficiently reliable. This study will provide the first experimental data on nutrient conditions that promote domoic acid production on the West Coast, particularly limitations in silicon caused by excess nitrogen. If domoic acid production is brought about by nutrient inputs, then nitrogen-rich discharges may be significant in generating toxic blooms, and regions that experience these conditions, such as embayments and upwelling shadows in coastal regions, may be particularly prone to toxic events.

- **Speciation of Metal Inputs to Coastal Waters: Consequences for Metal Transport and Bioavailability**

R/CZ-146

J.G. Hering/CIT

Though it has become clear that the way in which metal pollutants are introduced to the marine environment (whether through sewage effluents, urban runoff, or other sources) profoundly affects their impacts, regulators have not incorporated into their standards the importance of metal speciation (i.e., the distribution of a metal among its various inorganic and organic forms). This project will use advanced analytical techniques to quantify and characterize ambient metal species in coastal waters and evaluate the consequences on environmental quality.

- **Integrated Modeling of the Southern California Coastal Ocean: Biogeochemistry and Particulate Dynamics**

R/CZ-156

K.D. Stolzenbach, J.C. McWilliams/UCLA

The coastal ocean is enormously complex in its circulation and distribution of natural and anthropogenic materials. In this project, researchers will seek to develop, test, and use for practical purposes an integrated computational model of the physical, chemical, and biological processes that affect the fate and transport of materials in the Southern California coastal ocean. The model will be of primary use to dischargers of treated sewage and to fisheries scientists.

- **Direct *In Vivo* Measurements of Enzyme Reaction Rates in Red Abalone as Indices of Sublethal Toxic Effects**

R/CZ-142

R. Tjeerdema/UCSC

One reason for the decline of many valuable marine species, such as abalone, may be sublethal exposure to toxic contaminants in seawater. Using noninvasive nuclear magnetic resonance (NMR) techniques, this study will establish biomarkers of sublethal chemical toxicity which are directly linked to important enzymatic processes. This information will be used to improve water-quality guidelines for protection of marine resources.

- **Molecular Biomarkers for Detecting Pollution and Its Remediation**

R/CZ-143

D. Epel/SU, HMS

Because some pollutants are hard to measure or have yet to be identified, it is often difficult to know whether toxins are responsible for observed declines in marine species. What is needed is a simple indicator that responds to different levels of toxins. In this study, researchers will investigate the multidrug transport protein, which they believe functions as a first line of defense against pollutants, to see whether it varies in response to pollution levels and whether it is a good biomarker in mussels. If so, it might be possible for agencies charged with maintaining water quality to use this assay for monitoring pollution.

- **The Introduction of Nonindigenous Ascidian Species into Southern California Harbors and Marinas**

R/CZ-135

C.C. Lambert, G. Lambert/CSUF

Worldwide shipping and the indiscriminate dumping of ballast water have contributed to the introduction into California waters of an alarming number of nonnative species. Because they do not naturally disperse very well, marine animals called ascidians (or sea-squirts) can serve as important indicators of such invasions. Project leaders will identify nonindigenous ascidian species present in harbors, determine their salinity and temperature tolerances, and collaborate with natural products chemists to determine whether abundant species produce pharmacologically important compounds.

Aquaculture Research and Development



- **Biotechnological Techniques to Improve Crustacean Aquaculture**

R/A-108

M.J. Snyder, E.S. Chang/UCD

The most promising prospect for the U.S. crustacean aquaculture industry may well be the development of intensive, high-technology culture systems that rely on a complete understanding of the basic biology of growth as a prerequisite for physiological manipulations. This project will address both basic and applied aspects of several proteins involved in molting and growth-related processes in crustaceans. The results will provide markers of growth processes and potential stress indicators for culture conditions, and may offer new tools for improving crustacean growth rates.

- **Genetic Engineering of Fish with Hemoglobins that Facilitate Survival under Oxygen Depleted Environments**

R/A-105

D.A. Powers/SU, HMS

Periodic oxygen depletion in the culture ponds and net pens of a variety of fish species results in the death of many thousands of fish each year, with an economic impact that reaches well into the multimillion dollar range. In an attempt to reduce losses due to low oxygen, fish farmers have made considerable efforts to increase dissolved oxygen and control pH, but these efforts have been far from successful. The goal of this research is to create genetically enhanced strains of fish such as striped bass that can better withstand environmental conditions that would normally prove lethal.

- **Enhancing Spawning Performance of White Sturgeon**

R/A-106

S.I. Doroshov, G.P. Moberg/UCD

Despite the progress recently made in domestic breeding of white sturgeon, the spawning performance of females could be improved; in addition, production of larvae and fingerlings is not fully reliable. The goals of this project are to enhance the reproductive performance of broodfish by optimizing spawning induction and vernalization (a technique in which female sturgeon are held in chilled water to increase spawning success).

- **Preservation of Genetic Variation Within Aquacultural Stocks of the White Sturgeon**

R/A-109

B.P. May/UCD

The commercial culture of white sturgeon in California is highly regarded worldwide, especially at a time when natural sturgeon populations are threatened in many countries. Unfortunately, artificially breeding white sturgeon is still an arduous process. The labor required and the need for only a few fish for the necessary gametes results in a small number of individuals being used to produce each year-class, with potential losses in genetic variability occurring over time. This research will assess levels of genetic variability, relationships among fish used as broodstock, and changes in gene pool variability from one generation to the next.

Fisheries Research and Development



- **Bioeconomic Management Model of a Metapopulation: The Red Sea Urchin**

R/F-169

L.W. Botsford et al./UCD

Though we now have a better understanding of the oceanographic basis of recruitment of urchins and other benthic invertebrates, we need a model that can integrate this information with a description of the economic factors that drive demand and the behavior of fishers. The objectives of this project are to develop a bioeconomic model of California's red sea urchin fishery and to use the model to evaluate proposed management strategies, including spatial management.

- **Recruitment Patterns in Red Sea Urchins: A Population Genetics Approach**

R/F-170

R.S. Burton/UCSD, SIO

This project will employ the tools of biochemical and molecular genetics to assess patterns of dispersal and recruitment among commercially harvestable populations of sea urchins along the California coast. By determining the genetic relationships among recruits to different geographic populations involved in the California red urchin fishery, this study will provide information of central importance to management.

- **Trace Elemental Fingerprinting of Otoliths Using ICP-MS to Determine the Population Structure of Marine Fishes**

R/F-171

G. Forrester/UCLA

Many coastal marine fishes occupy different habitats at different developmental stages, and their management would be enhanced if we knew more about their sites or habitats of origin. This project is designed to test the hypothesis that differences in trace element chemistry among nursery habitats are recorded as distinct "fingerprints" in the otoliths (ear bones) of juvenile fish like halibut. Quantifying the relative importance of estuaries and shallow open coast habitat as nursery areas for California halibut would aid managers in assigning values to these habitats for management and mitigation purposes and help fisheries scientists and managers identify sources of recruitment.

- **Real-Time Assessment of Pelagic Fish Eggs at Sea**

R/F-172

D.M. Checkley, M.M. Trivedi/UCSD, SIO

Many of the world's largest stocks of exploited fish are small, pelagic species like anchovies, sardines, and menhadens, whose populations undergo large fluctuations. In order to manage these populations wisely, accurate means for estimating egg abundance are needed. These scientists propose to develop an integrated shipboard system based on the Continuous Underway Fish Egg Sampler (CUFES) that will permit real-time assessment of pelagic fish eggs at sea.

New Marine Products Research and Development

- **Marine Inflammation Research Program 1. Pharmacological and Biochemical Studies of Inflammatory Processes**

R/MP-81

R.S. Jacobs/UCSB

Sea Grant research in recent years has resulted in the discovery of important new anti-inflammatory compounds of marine origin. It has also opened new avenues of study in the field of inflammation as it relates to serious debilitating symptoms in certain acute and chronic diseases, as well as discovered important new research probes. Now two new models will be used to identify marine natural products that can block the cascade of chemical reactions leading to inflammation.

- **Marine Natural Materials: Novel Biological Elastomers from Marine Organisms**

R/MP-77

R.E. Shadwick/UCSD/SIO

Proteins that function as elastomers are important constituents of the tissues of many organisms, serving specific mechanical functions requiring high resilience and extensibility. The primary goal of this project is to characterize elastomeric protein structures from marine invertebrates which have interesting and novel mechanical properties—specifically, the elastic egg capsules of a marine gastropod. The results could have potential application in medical prostheses, such as for skeletal or cardiovascular tissue repair, or for the construction of novel engineering materials.

- **New High-Performance Composite Materials from Marine Biomineralization**

R/MP-82

D. Morse/UCSB

An interdisciplinary group of Sea Grant scientists at the University of California, Santa Barbara is studying the high-performance "bio-ceramics" found in the shells and skeletons of marine organisms. These ceramic-like composites of proteins and crystals offer unique combinations of remarkable strength, precise structural

control, and biocompatibility that make them especially attractive starting points for the design of new construction materials and for new electronic, optical, and medical devices.

- **Marine Enzymes and Siderophores: A Biochemical and Bio-Organic Approach to Marine Pharmacology**

R/MP-76

A. Butler/UCSB

Compounds called siderophores are a newly discovered class of marine natural products with important biological and pharmacological activities. They are used by microorganisms to acquire iron and possibly other metal ions from seawater, and have potential applications as drugs for the treatment of iron-overload and other metal toxicity diseases, for the control of microbial infections, and for other applications. Researchers will also explore the potential of marine haloperoxidase enzymes in developing new routes for the production of drugs.

- **Marine Sponges and Their Associated Microorganisms as a Source of Anti-Infective Therapeutic Leads**

R/MP-78

P.O. Crews/UCSC

Modern medicine uses a variety of antibiotics to treat bacterial infections, but many of our current drugs are becoming drug-resistant and thus less effective. In addition, we have only a small drug arsenal available to treat viruses, fungi, and parasites. The overall goal of this project is the discovery of new marine natural products to serve as leads for therapeutics to combat infectious diseases. Focus will be on investigating marine natural products derived from sponges and their associated fungi.

Ocean Engineering and Instrumentation



- **The Feasibility of Large-Scale Floating Runways**

R/OE-35
W. Webster/UCB

The design of floating airport runways that do not rest on the bottom and that allow water flow beneath them might provide an environmentally acceptable solution to certain airport expansion needs, for example in San Francisco Bay. Several issues affect the feasibility of this option: structure, mooring, and dynamic response to such loads as waves, earthquakes, and the landing and taking off of aircraft. The primary goals of this project are to develop tools to analyze these issues, and to develop means to verify experimentally the dynamic behavior of such platforms.

- **Wave Climate Risk Analysis: Seasonal Triple Annual Maximum Frequency Analyses, with Intensity–Duration–Frequency Summaries**

R/OE-36
R.J. Sobey/UCB

Although predictions of “100-year” wave heights are the norm in risk analyses, wave measurement programs only became commonplace in the 1980s, and few sites have even 15 years of data. Further, present methods of extrapolation do not include either seasonal effects or duration of extreme sea state intensity. In this project, researchers will seek to extend and enhance present methods of analysis to develop methods for preparing and presenting intensity–duration–frequency data and applying these methods to historical wave height records from several sites. This work will be relevant to both coastal design and environmental impact assessment.

Marine Affairs

- **Socioeconomic Organization of the California Market Squid Fishery: Assessment for Optimal Resource Management**

R/MA-39
C. Pomeroy, M. FitzSimmons/UCSC

The fishery for California market squid is one of the last open access fisheries on the Pacific Coast. However, lack of information about both scientific and socioeconomic issues raises questions about the sustainability of this fishery. In this project, researchers will describe and explain the changing social and economic structure of the fishery in the larger context of West Coast fisheries. Results will contribute to evaluation of continued open access and be of use to policymakers, resource managers, and the industry.

- **The New Regionalization in International Fisheries Law and Management**

R/MA-40
H.N. Scheiber, UCB

Implementation of the United Nations Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks will set in motion a set of major changes in marine fisheries governance, with emphasis on regional international agreements. Researchers will monitor and analyze developments that concern management of Pacific Ocean and other fisheries to determine implications both for the Regional Fishery Management Councils and for the interrelationships of American and foreign distant water fishing fleets.

Rapid Response

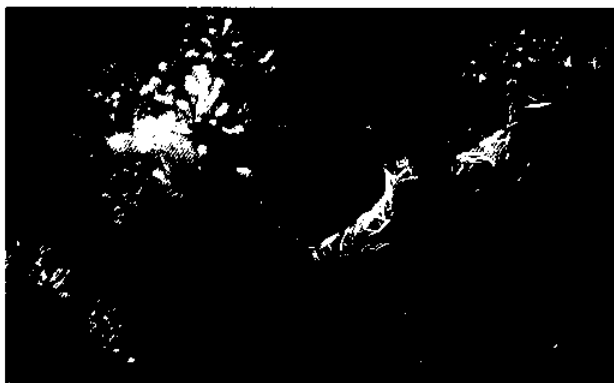
- **Rapid Response**

J.J. Sullivan/UC-SG

Because conditions in the marine sphere can change rapidly as a result of both human and natural causes, problems that need immediate attention can arise unexpectedly. The rapid response project allows prompt support for short-term marine-related research projects as needs arise.

Special Competitions

Marine Biotechnology



- **Polyunsaturated Fatty Acid Oxidases in Marine Algae**

R/MP-69

A. Butler/UCSB

The objective of this project is to discover, isolate, and characterize the enzymes in marine algae that transform polyunsaturated fatty acids into small molecules called eicosanoids. In mammals, the increased production of these small molecules is one of the key events in the onset of inflammation. However, it is also known that eicosanoids with slightly different structures, such as those from marine algae, can inhibit the development of inflammation. This research will advance the biological knowledge of eicosanoid metabolism in algae, and lead to new anti-inflammatory drug candidates.

- **The Oxidation and Metabolism of Polyunsaturated Fatty Acids (PUFAs) by Marine Organisms**

R/MP-71

R.S. Jacobs/UCSB

In companion work to that described above, scientists will focus on the precise nature of eicosanoid metabolism and biosynthesis in different species. The eicosanoids isolated from these species will be tested for their ability to inhibit mammalian eicosanoid synthesis in a variety of test systems and will illuminate the biochemistry and physiology of a number of marine species now recognized as important sources of new pharmaceuticals.

- **Neuroinflammation, Microglia, and Marine Natural Products**

R/MP-73

A.M. Mayer/Midwestern University

Inflammatory disease in the brain leads to loss of nerve cells and disruption of brain activity. It occurs in such disorders as HIV-induced dementia, Parkinson's disease, Alzheimer's, and multiple sclerosis. The brain damage that follows stroke is also often due to inflammation products. Unfortunately, present treatments for neuroinflammation are largely ineffective and are associated with a high incidence of toxicity. This project seeks to evaluate the marine anti-inflammatory agents now known to inhibit inflammation in the brain. It should generate valuable information for the design of novel therapeutic agents for the treatment of neuroinflammatory conditions, and point the way to a strategy for the discovery of still others.

- **Molecular Analysis of Tubulin-Binding Domains for Marine Natural Products**

R/MP-70

L. Wilson/UCSB

A number of effective anticancer drugs act to inhibit cell division by preventing the aggregation of molecules called tubulin into the slender fibers that pull divided chromosomes into the daughter cells. Researchers in this project will seek tubulin inhibitors from marine organisms that are exquisitely effective against the division of parasitic cells, including those causing malaria and sleeping sickness.

- **Addressing Cellular Processes Using Marine Natural Products**

R/MP-72

V. Malhotra, D. John Faulkner/UCSD, SIO

A marine molecule called ilimaquinone (IQ) interferes with formation of the Golgi apparatus, a cellular structure that exports antibodies, hormones, and other molecules from within their sites of manufacture. Cells that cannot produce a functional Golgi apparatus die. By breaking down the Golgi complex and preventing its reassembly, IQ provides an extraordinary tool for cell biologists interested in cell trafficking and export and has important pharmacological implications. This project is aimed at identifying the exact targets of the IQ molecule and thus the mechanism by which the compound prevents this vital cellular process.

- **Technology for Discovery of Anticancer Drugs from Marine Sources**

R/MP-68

L.R. Barrows, C.M. Ireland/University of Utah

This project seeks to expedite the discovery of new marine-derived anticancer agents by developing a rapid, sensitive, and inexpensive screening procedure that both detects marine extracts that affect the growth or viability of cancer cells, and provides information on precisely how this inhibition or killing is brought about. This procedure could become a powerful tool for detecting and characterizing specific types of anticancer agents not only from marine organisms but from plant and terrestrial organisms as well.

- **Saline Fermentation of New Drugs**

R/MP-74

W.H. Fenical/UCSD, SIO

Marine bacteria are beginning to be recognized as a significant resource for the fermentation production of industrial chemicals, including high-value pharmaceuticals and agrochemicals. In this project, researchers will seek to use saline fermentation conditions to produce new classes of anti-inflammatory compounds in larger scale in order to facilitate preclinical and early developmental evaluation.

- **Molecular Biology of Sea Urchin Skeletogenesis**

R/MP-75

E. Davidson, R.A. Cameron/CIT

The structural element of the sea urchin skeleton is one of the strongest biomaterials known. This composite, made up of magnesium-bearing calcite microcrystals embedded in a proteinaceous matrix, exhibits both extreme hardness and very high shear resistance. This project will seek to understand the processes of synthesis and assembly of the components of this biomaterial as a starting point for manipulating it for a variety of uses that its special physical qualities might warrant.

- **Antiviral Drugs from Deep-Sea Marine Microorganisms**

R/MP-80

W.H. Fenical/UCSD, SIO

Studies have shown that marine bacteria and fungi are prolific sources of unique bioactive compounds with significant potential for drug discovery. This project

seeks to identify new antiviral drug leads produced by deep-sea marine bacteria and fungi, a virtually unexplored group of organisms. The wide-scale exploration of natural products produced by deep-sea microbes represents a new step in drug discovery.

- **Molecular and Biochemical Characterization of Microbial Symbionts and Their Bioactivities in Sepioid and Loliginid Squids**

R/MP-79

D. Epel, M.R. Kaufman/SU, HMS

During the month after they have been deposited in shallow coastal waters, developing squid eggs show remarkably little microbial, fungal, or animal predation. Project scientists believe protection is provided by symbiotic bacteria transmitted by the adult female and associated with the egg capsule sheath. They plan to identify bioactive compounds produced by these bacteria, particularly potential antifungal compounds, thus providing important new pharmacologicals for the medical, veterinarian, agricultural, and aquacultural areas.

- **Identification of Natural and Synthetic Peptides for Controlling Marine Larval Set**

R/CZ-152

R.K. Zimmer-Faust, K.A. Browne/UCLA

Chemical cues, or inducers, in the marine environment are known to trigger settlement and metamorphosis of marine molluscs, including the larvae of abalones and oysters. These scientists seek to develop new methods for designing inducer compounds. Specifically, they will identify natural compounds that control these processes and develop mathematical models for predicting the structure of synthetic compounds. Laboratory and field tests will then be used to identify the most potent natural or synthetic analogs for enhancing animal production. They will also seek to identify the inducers for barnacle larvae, as a critical step towards control.

- **Quantitative PCR Assay for Marine Bacteria**

R/CZ-153

C.F. Brunk/UCLA

Monitoring the bacteria present in coastal waters by conventional techniques has been difficult. But existing molecular techniques (PCR amplification) may produce a more rapid and specific test. This project, an extension of earlier work, will compare the PCR assay with conventional culture plate techniques to establish its accuracy and efficiency. Emphasis will be placed on

developing a protocol that can be performed inexpensively in a normal monitoring laboratory to yield rapid and accurate data on the amount of indicator species—for example, coliform and enteric bacteria.

Nonindigenous Species



- **Eradicating *Arundo donax* from California Ecosystems: Establishing the Most Effective Timing for Mechanical and Chemical Procedures**

R/CZ-151

A. Wijte/CSLB

Arundo donax is a tall perennial grass, first introduced in California in the early nineteenth century. Because of the many problems associated with its dramatic expansion in Southern California, much effort is presently directed at eradicating this pest and controlling its spread. The objectives of this project are aimed at optimizing the timing of control efforts based on the physiology of the plant during its growing season. The researcher will also develop a computer model that will describe and quantify the physiology of carbohydrate production, translocation, and storage in plant tissues.

- **Contrasting Effects of Ecosystem Alteration by Two Exotic Wetland Invertebrates**

R/CZ-150

L.A. Levin/UCSD, SIO

One of the means by which nonindigenous species can alter ecosystems is by changing the physical architecture of the environment. This research will examine modification of the physical environment in California bays by two exotic "ecosystem engineers," and quantify their effects on the physical properties of invaded environments. The isopod *Sphaeroma quoyanum* destroys sensitive salt marsh habitat through its extensive burrowing activities in banks. The Asian mussel, *Musculista senhousia*, creates habitat by the construction of dense byssal mats which stabilize and

trap sediments and by the deposition of biological products.

- **Containment of Sabellid Pests of California Abalone: Assessment of Habitats and Hosts at Risk of Infestation**

R/CZ-147

A.M. Kuris/UCSB

For the past several years, the California abalone aquaculture industry has suffered from a previously undescribed sabellid polychaete pest that appears to have been introduced from South Africa. Some sabellids have been released and are now locally established in the wild. Evaluating their potential for establishment in other molluscan species will require an understanding of host specificity, size preference, habitat use, and behavioral aspects of susceptibility. The objective of this research is to determine which habitats are most at risk for establishment of the sabellid and which native California species could be potential hosts.

- **Safety and Efficacy of Green Crab Biological Control**

R/CZ-148

K.D. Lafferty/UCSB

One nonindigenous species that might be appropriately treated using biological control is the European green crab, *Carcinus maenas*, which became established in San Francisco Bay in 1990 and now encompasses a range in California as far north as Humboldt Bay and as far south as Elkhorn Slough. The crab has the potential to cause direct losses to the oyster, mussel, and clam mariculture industries, as well as to the Dungeness fishery. It may also cause erosion and destabilization of marsh channel banks, levees, and dikes. In this research, scientists will test a parasitic barnacle, *Sacculina carcini*, for its safety as a possible control agent and develop mathematical models for assessing how parasites like *Sacculina*, which block the reproductive capability of the host, might be used as biological controls.

- **Settlement, Survival, Growth, and Reproduction of the Nonindigenous Mussel (*Musculista senhousia*): Effects of Eelgrass**

R/CZ-149

S.L. Williams, T.A. Ebert/SDSU

The nonindigenous mussel *Musculista senhousia* impedes the establishment and growth of native eelgrass where the mussel is very abundant and eelgrass is

not—for example, in transplanted or fragmented beds. In dense eelgrass beds, however, the mussel is suppressed. This project will quantify the settlement, survival, growth, and reproduction of *Musculista* populations in shallow subtidal areas suitable for eelgrass. Scientists will test the hypothesis that eelgrass controls the mussel by indirectly limiting its food supply. Regulatory and advisory agencies and private environmental practitioners will use the results to determine effective eelgrass planting strategies and set permit requirements.

Oyster Disease

- **Genetic Engineering to Create a Transformed Oyster Cell Line**

R/A-107
J.C. Burns/UCSD

Aquaculture of marine bivalves is an important commercial enterprise, but intensive production has resulted in increased prevalence of many infectious diseases. One impediment to research on these pathogens, particularly viral agents, is the lack of a mollusc cell line. Similarly, development of diagnostic tests and therapeutic strategies has been hampered by the lack of cell lines in which to propagate the agents in the laboratory. The goal of this project is to assist the aquaculture industry by using retroviral vectors to produce a genetically transformed oyster cell line that will facilitate studies of oyster molecular genetics and pathogens.

National Outreach

- **West Coast Ballast Water Initiative: An Outreach Program to Improve Ballast Management**

A/EA-2
J. Cassell, et al./SGEP

Ballast water in transoceanic ships is the leading vector for the introduction of aquatic nuisance species to estuaries throughout the world. However, widespread awareness of ballast management issues must be increased in the West Coast maritime industry. In collaboration with the San Francisco Estuary Project, California Sea Grant's Extension Program will launch an education and outreach effort that will, among other objectives, open lines of communication and promote cooperation between private industry, regulators, and researchers concerned with ballast water management, and set the stage for industry participation in future West Coast ballast technology participation projects.

Marine Ecological Reserves Research Program

As a result of the Marine Resources Protection Act of 1990, the California Department of Fish and Game established the Marine Ecological Reserves Research Program. California Sea Grant was selected to administer the program. All research funded under the Act must focus on marine resource enhancement and management within one or more of four designated research reserves. The following projects are being funded under this program.

- **Quantitative Inventory of Habitat and Species of Management Concern at Punta Gorda Reserve**

R/PG-1
K. Karpov, et al./CDFG, HSU

The objective of this project is to produce a habitat map of the Punta Gorda Reserve and an inventory of the main fish, invertebrate, and algal species by habitat type. Researchers will provide population inventories created with side-scan sonar to produce depth-substrate habitat maps and ground-truth data with a remotely operated vehicle; survey and quantify reef-based species of special interest to managers; and identify genetic markers specific to the red abalone population within the reserve to determine whether this population serves as a source to adjacent areas.

- **Marine Reserves as a Resource Management Tool: An Evaluative Study of Cooperative Data Collection at Big Creek**

R/BC-2
C. Pomeroy/UCSC

Local fishermen in cooperation with the Big Creek Reserve manager have collected data on more than 5,000 rockfish since 1991. However, scarcity of resources has prevented analysis of this information. This project seeks to analyze the data and combine them with fieldwork, archival research, interviews, and other sources in order to provide information that will contribute to the management of rockfish fishery.

- **The Potential of Marine Reserves to Enhance Nearshore Fisheries: Assessing Fish Populations in the Recently Established Big Creek Ecological Reserve**

R/BC-3

D. A. VenTresca, et al./CDFG, CSUMB

The collection of baseline information on population densities and size frequencies of rockfish populations in Big Creek Ecological Reserve is essential to determine population changes in the reserve and in adjacent fished areas. Researchers will collect data on selected populations inside and outside of the reserve; produce a bathymetric/habitat map and incorporate this information into a GIS system; and document population characteristics and catch-per-unit-effort for the commercial fishery outside the reserve.

- **Deepwater Habitat and Fish Resources Associated with a Marine Ecological Reserve: Implications for Fisheries Management**

R/BC-1

M. M. Yoklavich, et al./NMFS, MLML, CDFG

Using a manned submersible and video cameras, researchers will estimate the abundance and distribution of bottomfish populations and habitats within and outside the Big Creek Reserve relative to habitat types, and generate maps of bottom types to establish species-habitat relationships. They will also produce estimates of fish density, size structure, and species composition relative to depth and habitat for areas within and outside the reserve.

- **Recruitment and Resistance to Withering Syndrome in a Population of Black Abalone, *Haliotis cracherodii*, at the Vandenberg Ecological Reserve**

R/V-1

C. Friedman, et al./UCD, BML, CDFG

Adult and newly recruited black abalone that appear to be resistant to withering foot syndrome (WS) are present in the Vandenberg Reserve and adjacent areas. The investigators will inventory reserve populations of black abalone and other invertebrates and algae and assess the incidence of WS within and outside the reserve. Resistance and heritability of the disease in new recruits will be tested to determine long-term survival of the population. This information will assist managers in determining how to rebuild populations severely impacted by the disease and will aid in the assessment of protected areas as a management tool for abalone populations.

- **Egg and Larval Production from Marine Ecological Reserves**

R/M-2

R. Vetter, et al./SFSC

This study will assess the effectiveness of the Vandenberg and Big Sycamore Canyon reserves as sources of fish eggs and larvae that will disperse to adjacent areas. Researchers will map habitat types and measure general and fine-scale current flows that influence egg and larval dispersal. Surveys of resident adult and juvenile fish will also be conducted.

- **Genetic Structure of Marine Invertebrate Stocks in California State Marine Ecological Reserves**

R/M-1

R. S. Burton/UCSD, SIO

This study will measure the genetic diversity of populations of red and purple urchins and red and black abalone within and between the Vandenberg, Big Creek, and Punta Gorda reserves. It will provide baseline data to help measure trends in invertebrate populations and to evaluate future resource management strategies for these species. A genetic analysis of temporally and spatially sample invertebrates will shed light on stock structure, dispersal, and recruitment success within and outside the reserves.

Education

- **Sea Grant Trainees**

E/G-2

J.J. Sullivan/UC-SG

Sea Grant's commitment to furthering marine-oriented education is met by the Sea Grant trainee project. Graduate students participate in research and work on problems relating to marine resources while fulfilling thesis requirements. This experience prepares them to enter positions in academia, government, and industry.

- **John D. Isaacs Memorial Sea Grant Scholarship**

E/UG-4

J.J. Sullivan, R. Amidei/UC-SG

The John D. Isaacs Memorial Sea Grant Scholarship was established in 1981 to recognize excellence in research by high school seniors, to encourage interest in marine science at the high school level, and to encourage pursuit of scholastic excellence in higher education. Each year a California high school senior who presents an outstanding marine science project at the California State Science Fair receives a scholarship to study at a college or university in California.

- **California Sea Grant State Fellowship Program**

E/G-9

J.J. Sullivan/UC-SG

The State Fellowship Program, modeled after the Dean John A. Knauss Marine Policy Fellowship, provides graduate students with training in the development and implementation of policy. Interns are assigned to a state agency, legislative committee, or office concerned with marine resource issues.

- **Wetlands Restoration by Public School Teachers and Students**

R/CZ-131

D. Ingmanson, J. Callaway/SDSU

This new education project will address the need for better public understanding of the purpose, approach, and problems of wetland restoration, by involving secondary school teachers and students in hands-on, real-world projects.

Management

- **Management**

M/A-1

J.J. Sullivan/UC-SG

The California Sea Grant management project develops and coordinates research, education, and advisory activities. Effective management allows continued development of the California Sea Grant College System, ensures fiscal control and efficient program administration, encourages the development of cooperative activities and scientific workshops, and permits liaison with local, state, and national agencies, industries, and the National Sea Grant College Program.

- **Planning and Development**

M/P-1

J.J. Sullivan, D. Wesson/UC-SG

California Sea Grant sponsors marine science projects that have local, national, and international impact. Through these projects, Sea Grant is able to meet the changing needs of user groups through responsive planning and development. The planning and development project provides staff support for advisory committees, supports educational programs, promotes the wise use and conservation of coastal and marine resources, and assists government regulatory agencies and industry in applying research results.

Advisory Services

- **Communications Program**

A/P-1

J.J. Sullivan, R. Amidei/UC-SG

Disseminating research results and information on marine resources is the task of Sea Grant's communications and publications program. Audiences include scientists, technical researchers, academicians, legislators, user groups, industry, and the general public. An education component of this project works to build a strong community of marine educators in California.

- **Sea Grant Extension Program**

A/EA-1

C. Dewees/UC-CE

One of Sea Grant's major objectives is to provide marine-related information to the people of California, particularly those who depend on oceanic and coastal resources for their livelihoods and those who use the ocean for recreational purposes. Through the Sea Grant Extension Program, citizens learn the latest scientific information on the management, utilization, and conservation of the state's marine resources.

Sea Grant Specialists

Marine Fisheries

Christopher M. Dewees
Sea Grant Extension Program
Wildlife, Fish, and Conservation Biology
University of California
1 Shields Avenue
Davis, California 95616-8751
(530) 752-1497
cmdewees@ucdavis.edu

Seafood Technology

Robert J. Price
Sea Grant Extension Program
Food Science and Technology
University of California
1 Shields Avenue
Davis, California 95616-8598
(530) 752-2194
rjprice@ucdavis.edu

Sea Grant Marine Advisors

Curry (OR) & Del Norte (CA) Counties

James B. Waldvogel
Sea Grant Extension Program
981 H Street, Room 2
Crescent City, California 95531
(707) 464-4711
cedelnorte@ucdavis.edu

Humboldt & Mendocino Counties

Susan McBride
Sea Grant Extension Program
2 Commercial Street, Suite 4
Eureka, California 95501
(707) 443-8369
scmcbride@ucdavis.edu

Sonoma & Marin Counties

Paul Olin
Sea Grant Extension Program
2604 Ventura Avenue, Room 100
Santa Rosa, California 95403
(707) 527-2621
pgolin@ucdavis.edu

San Francisco Bay Counties

Jodi Cassell
Sea Grant Extension Program
300 Piedmont Avenue
Bldg. C, Room 305A
San Bruno, California 94066
(415) 871-7559
jlcassell@ucdavis.edu

Santa Cruz & Monterey Counties

Richard M. Starr
Sea Grant Extension Program
P.O. Box 440
Moss Landing, California 95039
(408) 633-7266
starr@miml.calstate.edu

San Luis Obispo, Santa Barbara, & Ventura Counties

Deborah McArdle
Sea Grant Extension Program
105 E Anapamu Street, Room 5
Santa Barbara, California 93101-2000
(805) 568-3330
damcardle@ucdavis.edu

Los Angeles, Orange, & San Diego Counties

Leigh Taylor Johnson
Sea Grant Extension Program
5555 Overland Avenue, Bldg. 4
San Diego, California 92123
(619) 694-2852
ltjohnson@ucdavis.edu

Technology Transfer

- **International Technology and Information Transfer Program**

A/S-3

J.J. Sullivan, D. Wesson/UC-SG

The objective of this program is to establish a formal mechanism for transferring information from international experts to California scientists and entrepreneurs. The formats for such information transfer include, for example, visiting scientists and seminar series.



For more information, contact

California Sea Grant College System

University of California
9500 Gilman Drive Dept. 0232
La Jolla, California 92093-0232
(619) 534-4440

Dr. James J. Sullivan, Director
Dolores M. Wesson, Associate Director
Rosemary E. Amidei, Assistant Director for External
Relations