California Sea Grant

Program Directory 2007–2008

Sea Grant
California

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Sea Grant is a unique partnership of public
and private sectors, combining
research, education,
and outreach 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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Message from the Director…

These are exciting times for those of us who are engaged in coastal issues in California. While federal efforts regarding ocean policy have made modest progress in 2006, the State of California has forged ahead to become the model and envy of much of the nation.

In September 2006, the governors of Washington and Oregon joined Gov. Schwarzenegger in announcing the West Coast Governors' Agreement on Ocean Health. This represents a significant effort to coordinate ocean research and management among the three states and will position the West Coast region to receive federal funds for regional ocean governance.The agreement builds upon the creation of the California Ocean Protection Council and the California Ocean Science Trust, which are two major advances for our state and have propelled California to the forefront of ocean governance and management.

And yet there remain many challenges facing the region and California. The stocks of many fishes remain depleted due to a variety of factors. California's coast continues to experience rapid development as people flock to the seaside environment. Marine habitats continue to suffer from numerous environmental insults. The threat of aquatic invasive species continues to worsen as new invaders are making their way along the length of the California coast. Finally, there are the long-term implications of global change. Clearly there is much to learn about the California coast, and the partnership between California Sea Grant and state agencies will be a key component of that discovery.

California Sea Grant works with both the Ocean Protection Council and the Ocean Science Trust in research and outreach and thus plays an important role in expanding the knowledge base regarding the coastal marine environment. That increased knowledge is in turn leading to better-informed decisions on how to restore, preserve and carefully manage our highly valued marine resources.

Russell A. Moll
Director

In this Program Directory you will find information about how California Sea Grant is fulfilling its mission. You will note a substantial increase in the level of State of California support and how California Sea Grant is contributing to the groundbreaking path for our state.

Many of you are partners with us in these and related ocean activities. We welcome your collaboration in our efforts to ensure that our ocean and coast are clean, safe and productive for future generations.

Contents

What is Sea Grant?

The National Sea Grant College Program, a network of 30 university-based programs, is dedicated to enhancing the understanding, conservation, and sustainable use of the nation's coastal and marine resources. It has facilities and staff in every coastal and Great Lakes state, with activities funded principally by the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce. Matching funds come from the individual states, and additional support from a variety of private sources.

The Sea Grant programs of today focus on making this country a world leader in marine research and the sustainable development of marine and coastal resources. To this end, they produce and make available a wealth of information on these topics, from school curriculum materials to the most advanced scientific research.

California Sea Grant College Program, the largest of these 30 programs, draws on the talents of scientists and engineers at public and private universities throughout the state. It is administered by the University of California and is based at Scripps Institution of Oceanography in La Jolla.

California Sea Grant contributes to the growing body of knowledge about coastal and marine resources and helps solve contemporary marine-related problems through its sponsored research. It supports graduate education by funding trainees who work with marine scientists and engineers on a diversity of subject areas. Through its outreach and communications components, developments in information and technology are transferred to stakeholders. Our Extension personnel, in partnership with UC Cooperative Extension (UCCE), play a major role in the link between university, industry, and the public.

The research funded is selected on the basis of competitive, peer-reviewed proposals and addresses a wide range of problems and opportunities. This Program Directory provides summaries of the projects being funded in 2007 by California Sea Grant. Further information on any of these projects is available by contacting our offices, or visiting the program Web site—http://www.csgc.ucsd.edu.

Other Web Resources:

National Sea Grant Office	www.nsgo.seagrant.org/
National Sea Grant Library	nsgl.gso.uri.edu/
UC Digital Library	http://repositories.cdlib.org/csgc/

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Father and son gaze out over large swells at Point Pinos on the Monterey Peninsula. Photo: Chad King, Monterey Bay National Marine Sanctuary

Participating Institutions 2007–2008

BML	Bodega Marine Laboratory Bodega Bay, California 94923
CASG	California Sea Grant College Program La Jolla, California 92093-0232
CDFG	California Department of Fish and Game
CICESE	Centro de Investigación Científica y de Educación Superior de Ensenada Ensenada, Mexico
CSGEP	California Sea Grant Extension Program
CSULB	California State University, Long Beach Long Beach, California 90840
HMS	Hopkins Marine Station Pacific Grove, California 93950
HSU	Humboldt State University Arcata, California 95521
H-SWRI	Hubbs-SeaWorld Research Institute San Diego, California 92109
MLML	Moss Landing Marine Laboratories Moss Landing, California 95039
NMFS	National Marine Fisheries Service La Jolla, California 92037
PRBOCS	PRBO Conservation Science Stinson Beach, California 94970
PU	Pepperdine University Malibu, California 90263
RCUH	Research Corp. of the University of Hawaii Honolulu, Hawaii 96822
SAMS	Scottish Association for Marine Science Oban, Scotland
SIO	Scripps Institution of Oceanography La Jolla, California 92093
SDSU	San Diego State University San Diego, California 92182
SERC	Smithsonian Environmental Research Center Edgewater, Maryland 21037

SFSU	San Francisco State University San Francisco, California 94132
SSU	Sonoma State University Rohnert Park, California 94928
SU	Stanford University Stanford, California 94305
UBC	University of British Columbia Vancouver, Canada
UCB	University of California, Berkeley Berkeley, California 94720
UCD	University of California, Davis Davis, California 95616
UCLA	University of California, Los Angeles Los Angeles, California 90095
UCSB	University of California, Santa Barbara Santa Barbara, California 93106
UCSC	University of California, Santa Cruz Santa Cruz, California 95064
UCSD	University of California, San Diego La Jolla, California 92093
URI	University of Rhode Island Kingston, Rhode Island 02881
USD	University of San Diego San Diego, California 92110
USGS	U.S. Geological Survey
UW	University of Washington Seattle, Washington 98195
WSU	Washington State University Vancouver, Washington 98686

Healthy Marine Ecosystems

- **Modeling Water and Sediment Quality in the Coastal Ocean**
  R/CZ-193 Mar. 05–Feb. 08
  Keith Stolzenbach, UCLA, 310.206.7624, stolzenb@ucla.edu, James McWilliams, UCLA, 310.206.2829, jcm@atmos.ucla.edu

Researchers are adapting a Regional Ocean Modeling System developed in an earlier project to resolve biological and physical processes at finer spatial and temporal scales. As a result, this model will be able to simulate–and eventually predict–three important water and sediment quality issues in Santa Monica Bay and over the San Pedro Shelf: 1) the fate of sewage discharged offshore; 2) the fate of storm water from rivers and storm drains; and 3) the transport of coastal sediments. Investigators are conducting and planning related research for the EPA, U.S. Army Corps of Engineers, State Water Resources Control Board and the sanitation districts of the City of Los Angeles, Los Angeles County and Orange County.

- **Tracer Dispersion in the Surf Zone: Water Quality and Ecology**
  R/CZ-196 Feb. 06–Jan. 09
  Falk Feddersen, UCSD/SIO, 858.534.4345, falk@coast.ucsd.edu; James Leichter, UCSD/SIO, 858.822.5330, jleichter@ucsd.edu; Robert Guza, UCSD/SIO, 858.534.0585, rguza@ucsd.edu

Building on previous Sea Grant research, oceanographers continue to study the effects of waves, bathymetry and cross-shore position on dispersion in the surf zone. In particular, they are studying the processes (e.g., shear waves and breaking waves) that dominate dispersion at

different length scales and cross-shore locations. Output from numerical simulations of tracer-release experiments will be used to develop dye-release strategies for real field experiments at Huntington Beach in Orange County, an urban beach plagued by (as yet) unexplained bacterial pollution. During field experiments, a jet ski will serve as a mobile sampling platform for measuring water temperatures, and concentrations of dye and phytoplankton in the surf zone. These field data will be combined with data from the Southern California Ocean Observing System to produce nearly synoptic maps of temperature, chlorophyll and dye concentration.

- **Understanding Submarine Groundwater Discharge and Its Influence on Coastal Water Quality Along the California Coast**
  R/CZ-197 Feb. 06–Jan. 09
  Alexandria Boehm, SU, 650.724.9128, aboehm@stanford.edu; Adina Paytan, SU, 650.724.4073, apaytan@stanford.edu

Researchers continue to explore the links between groundwater discharges and coastal water quality. They will soon measure fluxes of fresh and saline submarine groundwater, using a radium isotope, to understand how tides, rainfall and ocean waves modulate groundwater flows. Field experiments in Santa Cruz and Bolinas will examine the relation between land use and geology on groundwater nutrient levels, metal loads and fecal bacteria counts. They will also investigate whether sediments filter harmful microbes from groundwater. The scientists hypothesize that groundwater discharges may contribute as much to coastal pollution as surface runoff.

- **The Role of Symbiotic Bacterial Metabolites in the Development of Toxic Phytoplankton Blooms**
  R/CZ-198 Feb. 06–Jan. 08
  Carl Carrano, SDSU, 619.594.5929, carrano@sciences.sdsu.edu; Frithjof Kuepper, SAMS, 011.44.01631.559216, fck@sams.ac.uk; David Green, SAMS, 011.44.01631.559354, dgreen@sams.ac.uk

Certain toxic dinoflagellates cannot be cultured in a bacteria-free medium. Their growth depends on bacterial symbionts in some critical (yet unknown) way. The working hypothesis of this project is that these bacteria produce iron-binding compounds (siderophores) that help dinoflagellates acquire iron and grow, even in relatively iron-poor ocean water. In the first year, the scientists isolated a siderophore from a symbiont associated with the toxic dinoflagellate *Gymnodinium cantenatum* and identified it as the known siderophore vibrioferrin. They have subsequently discovered that vibrioferrin binds not only to iron as expected but also to boron. Boron has been shown to play a role in quorum sensing, in which microorganisms "sense" their populations. This is the first time anyone has documented a siderophore binding to boron. This year, biologists will continue to explore the potentially far-reaching implications of a tie between iron and boron regulation in toxic marine algae.

- **The Effects of Current Velocity and Creek Morphology on the Population Dynamics of Spionid Polychaetes in the Tijuana Estuary**
  R/CZ-199 Feb. 06–Jan. 09
  Brian Hentschel, SDSU, 619.594.0358, hentsche@sunstroke.sdsu.edu

The scientist will study changes in the abundance, growth and reproduction of small worms (polychaetes in the family Spionidae) in response to different flows through channels and creeks at the NOAA Tijuana River National Estuarine Research Reserve. Findings will help identify creek sizes, shapes and flow regimes that may benefit ecosystem health. This information might be useful in deciding how and where to build tidal channels and creeks as part of ongoing marsh restoration efforts.

- **California Beach Health: Evaluation of Grunion as an Indicator Species**
  R/CZ-195 Mar. 05–Feb. 08
  Karen Martin, PU, 310.506.4808,
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With the help of trained volunteers, the researcher is monitoring the spawning population of California grunion from San Diego to Monterey Bay and looking for links between grunion abundance and environmental stress like beach grooming, beach use, pollution and fishing. The monitoring involves counting adult grunion during "runs," collecting incubating eggs and examining embryos for developmental abnormalities. The findings may show that grunion, which spawn in wet sand, can be used as an indicator of beach health.

- **Flow Dynamics in Kelp Forests: Implications for Conditions and Survival**
  R/CZ-201 Feb. 06–Jan. 08
  Matthew Edwards, SDSU, 619.594.7049,
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The researcher is investigating whether ocean waves interact with giant kelp fronds to generate vertical flows along the plant's stem. These vertical flows, he theorizes, might bring cold, nutrient-rich water to the surface canopy and hence improve kelp health, particularly in summer and during El Niño. A variety of field experiments will be conducted in kelp beds in San Diego to test whether these vertical flows do exist and if they do, whether they have any biological implications. As part of the study, inorganic fertilizer will be placed at the bases of kelp plants to measure nutrient uptake rates. Besides adding to the basic understanding of kelp forest dynamics, this research will address the possibility of artificially fertilizing giant kelp beds to enhance their productivity or improve their survival during periods of environmental stress.

- **Krill and Krill Predators: Ecosystem-Based Management in the Gulf of the Farallones-Cordell Bank Krill Production Domain**
  R/CZ-202 Feb. 06–Jan. 09
  William Sydeman, PRBOCS, 415.868.1221,
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In 2005 and again in 2006, the entire colony of Cassin's auklets on the Farallones Islands abandoned their nests, most likely because the birds could not find enough food.

A series of research cruises will help identify the physical processes that reduced krill populations apparently two years in a row. Scientists will test the hypothesis that coastward advection of cold, salty bottom water during intense upwelling pushes more oceanic species, such as *Euphausiid pacifica*, onto the continental shelf where they become an abundant, early-season food source. In conditions of relaxed upwelling, in contrast, the coastal *Thysanoessa spinifera* increases in relative abundance. Findings from this project can assist in ecosystem-based fisheries management, as krill is an important food for hake, Chinook and Coho salmon, rockfishes and whales.

- **Investigating the Limits of Native Oyster Recovery and Restoration**
  R/ENV-203 Feb. 07–Jan. 10
  Edwin Grosholz, UCD, 530.752.9151, tedgrosholz@ucdavis.edu; Chela Zabin, SERC, 415.435.7128, zabinc@si.edu

In an effort to explain the highly variable success of native oyster restoration in San Francisco and Tomales bays, scientists will examine spatial and temporal variability in oyster recruitment, measure predation by Atlantic oyster drills and European green crabs and quantify effects of fouling organisms and “space competitors” like tunicates and sponges. The long-term viability of native oysters will also be examined.

Sustainable Resource Use

- **Collecting Sea Palms: Planning for Sustainable Use in a Variable Environment**
  R/CZ-200 Feb. 06–Jan. 09
  Karina Nielsen, SSU, 707.664.2962, karina.nielsen@sonoma.edu; Carol Blanchette, UCSB, 805.893.5144, blanchet@lifesci.ucsb.edu

In collaboration with the California Department of Fish and Game, researchers are collecting basic biological data to evaluate whether current regulations are adequately protecting the California sea palm *(Postelsia palmaeformis*) from over-harvesting. As much as three tons of this easily accessible, suddenly popular, health food was harvested from coastal Mendocino County in 2001. Researchers are studying, among other things, the effects of different harvesting practices on sea palm reproduction, growth and abundance. Results will be communicated to undergraduates enrolled in a new course at Sonoma State University, "Communicating Ocean Sciences," and through UC Santa Barbara's Marine Science Institute via its Outreach Center for Teaching Ocean Science and the Research Experience and Education Facility.

- **Integrated Culture of Seaweeds and Red Abalone in Monterey Harbor**
  R/A-125 Feb. 06–Jan. 08
  Michael Graham, MLML, 831.771.4481, mgraham@mlml.calstate.edu

In collaboration with the Monterey Abalone Company, the scientist is experimenting with several techniques for growing red algae and kelp on ropes hung in Monterey Harbor. The company currently feeds its abalones kelp harvested from nearby wild beds. The goal of this project

is to figure out how to grow enough seaweed (quickly and in the smallest space possible) to sustain the farm's 36,000-abalones-per-year production level. The effect of diet on shell color and growth will also be investigated. The ability to culture abalone feed would benefit aquaculture and alleviate pressure on kelp forests. California Sea Grant Extension Program plans to adapt research findings into a user-friendly manual for industry.

- **Enhancement of Growth Rates and Swimming Performance in Juvenile Marine Finfish in Aquaculture**
  R/A-126 Feb. 06–Jan. 08
  Mary Sue Lowery, USD, 619.260.4078, slowery@sandiego.edu; Kevin Kelley, CSULB, 562.985.4294, kmkelley@csulb.edu; Mark Drawbridge, H-SWRI, 619.226.3943, mdrawbridge@hswri.org

Many of the benefits of exercise for people appear to translate to fish. In preliminary experiments with white seabass, researchers showed that exercise induced by water currents stimulates growth and reduces stress. This project will further quantify the effects of sustained exercise on stress and growth in white seabass, yellowtail (a fast-swimming species) and California sheephead (a slow one). They will measure levels of blood cortisol, insulin-like growth factor and a protein that regulates this growth factor. Findings will be used to build and test new raceways to optimize culture conditions for juvenile fish. As part of the project's outreach component, middle and high school girls participating in the BE WiSE (Better Education for Women in Science and Engineering) program in San Diego will participate in a series of educational lectures, tours and experiments related to this research.

- **Enhancement of Fertilization Success in Abalone: Increasing Effectiveness of Transplanting and Outplanting Recovery Strategies**
  R/F-197 Mar. 05–Feb. 08
  Richard Zimmer, UCLA, 310.206.4981, z@biology.ucla.edu; Cheryl Ann Zimmer, UCLA, 310.825.8561, cazimmer@obee.ucla.edu

As broadcast spawners, abalone reproduction would seem to hinge largely on random chance. As this research shows, this is only partly true. Biologists have found that red abalone eggs release an attractant molecule (the amino acid L-tryptophan) that "fundamentally and decisively" modulates the swimming speed and orientation of red abalone sperm. This chemical signal is stretched and dispersed by small-scale turbulence in shear flows. Sperm use gradients in tryptophan concentration to navigate toward an egg. Other factors influenc-

ing reproductive success are the properties of egg and sperm suspensions. This research has shown that egg viability decreases after 30 minutes, compared with three hours for sperm, and that egg suspensions sink while sperm suspensions float and thus are dispersed farther. A compilation of findings from this project could help in efforts to restore abalone populations.

- **Determination of Red and White Abalone Age and Growth Using Bomb Radiocarbon Signal and Lead Dating**
  R/F-202 Feb. 07–Jan. 09
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This project seeks to develop a technique for determining and validating age and growth rates of red and white abalones. To do this, researchers will use radiocarbon markers from atomic bomb detonations in the 1950s and 1960s, as well as Pb-210 dating, from a series of abalone shells, to estimate age, growth and longevity. These estimates will be compared to those computed using traditional methods to determine, among other things, if large abalones are as old, or older than, predictions from growth models. Accurate lifespan data are crucial for developing state and federal abalone fishery and recovery plans. As yet, nobody has been successful at aging abalones from their shells.

- **Two Decades of Fishing the Santa Barbara Channel: An Examination of Effort and Catch with Regard to Serial and Localized Depletions of Reef Fishes**
  R/FISH-203 Feb. 07–Jan. 09
  Milton Love, UCSB, 805.893.2935, love@lifesci.ucsb.edu

Between 1979 and 2001, the owner of a commercial sport fishing boat regularly took groups of anglers fishing at nearby reefs and carefully recorded their catches, the weather and reef habitat. This project will examine whether these logbooks show a pattern of serial depletions of rockfishes and lingcod in the region. If such a pattern exists, it will be compared to peer-reviewed fisheries science data. Also to be examined is whether depletions are correlated with anglers' access to fishing areas.

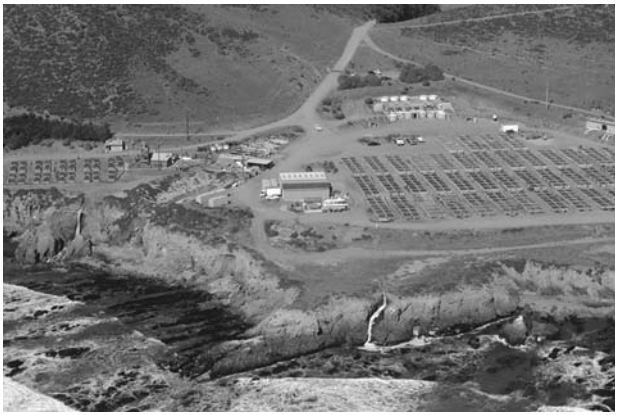
- **Understanding the Pathogenesis of *Streptococcus iniae* Infection in Fish and Development of an Effective Vaccine for Use in Aquaculture**
  R/A-124 Mar. 05–Feb. 08
  Victor Nizet, UCSD, 858.534.7408, vnizet@ucsd.edu

Streptococcus iniae (SI) causes a fatal meningoencephalitis in striped bass, tilapia and salmon. The investigator has identified several SI genes required for fish virulence and has developed a preliminary vaccine that uses live, attenuated mutants. In the second year of this project, the scientist will continue to develop the vaccine, working closely with a commercial seabass farm. Some specific aims: 1) to finish virulence gene characterization in the full panel of attenuated mutants; 2) to use directed mutagenesis to delete key virulence genes; and 3) to conduct large-scale vaccination trials with selected deletion mutants. The U.S. aquaculture industry stands to benefit greatly if a cost-effective vaccine can be developed.

- **Assessing Withering Syndrome Resistance in California Black Abalone: Implications for Conservation and Restoration**
  R/F-200 Feb. 06–Jan. 08
  Hunter Lenihan, UCSB, 805.893.8629, lenihan@bren.ucsb.edu; Carolyn Friedman, UW, 206.543.9519, carolynf@u.washington.edu; Glenn VanBlaricom, UW, 206.543.6475, glennvb@u.washington.edu; Kevin Lafferty, USGS, 805.893.8778, lafferty@lifesci.ucsb.edu

This project will gather basic biological information needed to restore black abalone populations. Scientists will examine whether offspring of surviving remnant black abalone populations are vulnerable to the lethal abalone wasting disease known as withering syndrome. If disease resistance is inherited, they will try to develop methods

for spawning disease-resistant specimens for captive rearing. Although the focus of this research is on abalone conservation, the findings will have immediate benefit for the state's abalone aquaculture industry, which also contends with the disease. The Abalone Farm, Inc. and Channel Islands Marine Resource Institute are collaborators on this project.



- **Initial Steps Towards Evaluating Potential Disease Impacts of Propagated Marine Fish on Wild Stocks: A New Herpesvirus from White Seabass**
  R/AQ-127 Feb. 07–Jan. 10
  Ron Hedrick, UCD, 530.752.3411, rphedrick@ucdavis.edu; Kristen Arkush, BML, 707.875.2062, kdarkush@ucdavis.edu; Mark Okihiro, CDFG, 760.726.8170, ms.okihiro@att.net

Fear of spreading disease is a major obstacle in developing marine aquaculture, particularly in California. In collaboration with the California Department of Fish and Game and the Hubbs-SeaWorld Research Institute, a doctor of veterinary medicine will study aspects of "pathogen amplification," using a herpes-like virus in white seabass as a case study. It is hoped this work will establish criteria and tools for systematically evaluating disease risks for a growing list of marine fish slated for artificial propagation.

New Technologies

- **Studies on the Rapid Self-Assembly of Elastic Tensile Fibers From a Natural Protein Polymer Found in Marine Snails**
  R/MP-97 Mar. 05–Feb. 08
  Herbert Waite, UCSB, 805.893.2817, waite@lifesci.ucsb.edu; Robert Shadwick, UBC, 604.827.3149, shadwick@zoology.ubc.ca

The egg capsules of marine whelk snails contain a protein polymer that can “self-assemble” and “self-heal.” Biologists will characterize the molecular basis for the protein’s novel elastic properties. They will also complete ongoing amino acid sequencing of the protein and cDNA, to begin the process of designing peptides with commercial potential. Fabrication of new tensile materials has broad industrial and biomedical applications in improving materials for artificial tendons and ligaments. Dow Corning Corporation, the world’s largest manufacturer of silicon-based materials, has provided matching support for this work.

- **Biomedical Development of New Marine Microbial Resources**
  R/NMP-98 Feb. 07–Jan. 10
  Paul Jensen, UCSD/SIO, 858.534.7322, pjensen@ucsd.edu; Bradley Moore, UCSD/SIO, 858.822.6650, bsmoore@ucsd.edu

In the search for new antibiotics and enzyme biocatalysts, chemists will assess actinomycete diversity in unexplored deep-sea sediments off California. (Soil actinomycetes have been the source of dozens of antibiotics, including streptomycin.) Their hypothesis: the deep-sea represents a potential reservoir of new actinomycete diversity. They will also investigate whether culture-independent methods and hydridization probes can improve the efficiency of natural product discovery. To this end, certain halogenating enzymes will be targeted for cloning and expression. Chlorine atoms will then be introduced into specific substrates using recombinant enzymes as biocatalysts. It is hoped that this process will enhance or trigger antibiotic activity.

- **Sizing Fish with an Acoustic System**
  R/OE-40 Feb. 06–Jan. 09
  Jules Jaffe, UCSD/SIO, 858.534.6101, jjaffe@ucsd.edu

In this project, the researcher is investigating the feasibility of measuring fish size and swimming orientation with a multi-static sonar system and whether reflected sound patterns can be used to speciate fish. The prototype system will include a single acoustic transmitter with multiple receivers located at different angles. With this system, scattering experiments on live fish will be performed. Inferences on fish size and morphology and swim bladder size and shape will then be compared to 3D surface topography maps made using a computed tomography (CT) system at the UCSD School of Medicine. The CT scans will allow the researcher to check the accuracy of sound-based estimates of fish size and orientation. Success of this project would significantly advance efforts to use sonar for stock assessment.

Coastal Community Development

- **Relationship Between Bluff Erosion and Beach Sand Supply for the Oceanside Littoral Cell**
  R/OE-39 Feb. 06–Jan. 08
  Scott Ashford, UCSD, 805.822.0431, sashford@ucsd.edu; Neal Driscoll, UCSD/SIO 858.822.5026, ndriscoll@ucsd.edu

In previous California Sea Grant research, the lead investigator showed that bluff erosion is a major source of beach sand in parts of San Diego County. Scientists will continue to use a ground-based laser-imaging technology to make detailed maps of coastal bluffs before and after failure. From these, the volume of material lost to beaches will be estimated. The co-investigator will conduct an experiment to quantify the amount and fate of sand flowing through the Santa Margarita River, the only completely undammed, free-flowing river in the region. The experiment will test the hypothesis that highly episodic rivers do not contribute a large amount of sand to the nearshore system—and thus to beaches. If this hypothesis proves true, it would further substantiate the importance of bluff erosion to replenishing beaches with sand.

- **Exposure of Santa Cruz Wharf Anglers to Domoic Acid**
  R/MA-45 Feb. 06–Jan. 08
  Mary Silver, UCSC, 831.459.2908, msilver@ucsc.edu; Caroline Pomeroy, CSGEP, 831.763.8002, cmpomeroy@ucdavis.edu

The lead investigator documented the presence of domoic acid in sport fish caught from the Santa Cruz Wharf. This project is designed to characterize seafood catch and consumption patterns of wharf anglers, and identify subpopulations that may be at particular risk of exposure because of those patterns. Certain culinary practices increase a person's risk of poisoning. Although commercial fish and shellfish are tested for domoic acid, the cause of amnesic shellfish poisoning, the same public health safeguards are not required for recreationally caught fish. Very little is known about anglers' exposure to marine toxins or how this varies across socioeconomic and cultural lines.

Rapid Response

- **Rapid Response**
  M/NP-1
  R.A. Moll/CASG

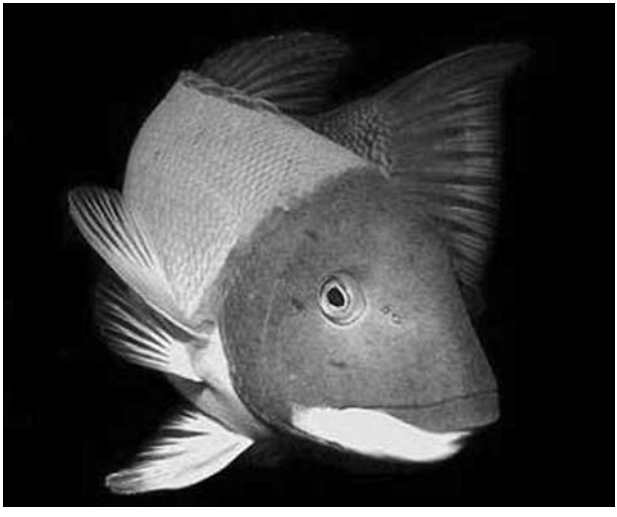
Conditions in the marine sphere can change rapidly because of both human and natural causes, and problems that need immediate attention can arise unexpectedly. The rapid response project allows prompt support for short-term, marine-related research, outreach, and education projects.

Marine Life Protection Act

The 1999 Marine Life Protection Act calls for the creation of a network of marine protected areas to, among other things, protect marine life and habitats, marine ecosystems and marine natural heritage. The act also set aside funds to support research of relevance to the act. California Sea Grant and USC Sea Grant administer these projects on behalf of the California Department of Fish and Game.

- **The Effects of Habitat Composition, Quality, and Breaks on Home Ranges of Exploited Nearshore Reef Fishes**
  R/MLPA-02 Jan. 05–Dec. 07
  Christopher Lowe, CSULB, 562.985.4918, clowe@csulb.edu; Jennifer Caselle, UCSB, 805.893.5144, caselle@lifesci.ucsb.edu

By overlaying fish tracks (collected acoustically) on maps of bottom topography, biologists are identifying home ranges and fine-scale habitat preferences of adult ocean whitefish and barred sand bass in the Catalina Marine Science Center Marine Life Refuge. Fish are being moved to adjacent areas to test their home-range fidelity. The researchers are also documenting the degree to which different species (e.g., kelp bass, sand bass, whitefish and sheephead) are willing to cross expanses of sandy-bottomed areas to return to the place they were originally tagged. Findings have application in designing marine reserves that would be large enough and of sufficient habitat quality to protect reproductive adults. The research will also assist in identifying essential fish habitats for nearshore reef fishes.



CALFED Science Fellows Program

The California Bay-Delta (CALFED) Program is a collaborative effort of more than 20 state and federal agencies with management or regulatory responsibilities for the San Francisco Bay-Delta system. Its four objectives are to improve ecosystem quality, water supply reliability, water quality and levee system integrity. The CALFED Science Fellows Program has been established toward those ends and is administered by California Sea Grant.

- **Development of a Simulation Model of Juvenile Salmon Movement in the Sacramento-San Joaquin Delta**
  R/SF-7 Sept. 05–Aug. 08
  Annjanette Dodd, HSU, 707.733.9462,
  amd2@humboldt.edu

The CALFED Fellow will combine a hydrodynamic model of particle transport with a biological model of fish behavior to simulate the effects of water operations (e.g., reservoir release rates, pumping rates and other operations of the Delta Cross Channel gates) on juvenile salmon migration patterns. To validate the computer model, output from multiple simulations will be compared to real field observations. Through these comparisons, the researcher will be able to identify model hypotheses that best replicate observed patterns of fish movement.

- **Modeling Nutrient and Organic Carbon Loads and Sources in Central Valley Watersheds: Taking Existing Monitoring Data to the Next Stage**
  R/SF-8 Sept. 05–Aug. 08
  John Harrison, UCD, 530.752.1450,
  jharrison@ucdavis.edu

High nutrient levels reduce the amount of oxygen available to fish and, in water destined for public consumption, pose public health issues. This research uses existing data and computer models to quantify the fluxes, sources and

controls of nitrate, phosphate and organic carbon throughout the Sacramento and San Joaquin river system. The first stage of the project is to identify the relative amounts of these nutrients from various land-based sources such as farming. Later, the researcher will describe the effects of climate change and population growth on water quality.

- **The Application of Otolith Geochemistry to Determine Stock Structure, Survival and the Relative Impact of Water Exports on the "Threatened" Delta Smelt**
  R/SF-9 Sept. 05–Aug. 08
  James Hobbs, BML, 707.875.1973, jahobbs@ucdavis.edu

The delta smelt is a small fish found in only one ecosystem in the world: the brackish waters of the San Francisco estuary. Unfortunately for its survival, about two-thirds of the state's fresh water is pumped from this same habitat. As a result, untold numbers of smelt larvae are sent through the extensive pumping systems of state and federal water projects. In this project, a scientist is analyzing otolith geochemical signatures in adult fish (otoliths are bony structures in a fish's ear) to identify important larval nursery habitats. He will also examine (1) whether there is a connection between growth and survival rates, and (2) the role of water temperature on the abundance and distribution of juvenile smelt.

- **Determining the Factors Controlling Site Invasibility to *Lepidium latifolium***
  R/SF-10 Sept. 05–Aug. 08
  Margaret Andrew, UCD, 530.752.5092,
  meandrew@ucdavis.edu

Perennial pepperweed (*Lepidium latifolium*) is a noxious exotic weed in the San Francisco Bay-Delta area. To prevent its spread and otherwise improve the management of this potentially destructive plant, the CALFED Fellow is mapping the plant's distribution and identifying environmental factors (e.g., temperature, precipitation, wind, stream flow and soil salinity) that may influence its growth and reproduction. In the latter stages of the project, she will use these data to identify areas vulnerable to infestation. This information can serve as an early detection system for subsequent eradication programs and assist in protecting native habitats from encroaching, invasive plants.

- **Effects of Water Temperature, Stream Flow and Flood Availability on the Growth, Survival and Movement of Central Valley Juvenile Steelhead (*Oncorhynchus mykiss*) with Implications for Water Management**
  R/SF-11 Sept. 05–Aug. 08
  Walter Heady, UCSC, 831.459.5783, heady@biology.ucsc.edu

Through field studies, laboratory experiments and computer modeling, researchers are investigating factors affecting the growth, survival and movement of federally protected juvenile steelhead in parts of the Central Valley. This project focuses on links between water operations and biological resources. The government has set the goal of doubling populations of naturally produced salmonids and of providing water flows to protect their early life-stages. Findings will clarify questions regarding the impacts of water diversions and the Delta Cross Channel on juvenile steelhead trout.

- **Addressing Stakeholder Concerns: Pests and Pest Control in the Sacramento River Conservation Area**
  R/SF-12 Sept. 05–Aug. 08
  Suzanne Langridge, UCSC, 831.459.3902, sml@ucsc.edu

Could habitat restoration in the Sacramento River valley increase agricultural pests and hence create problems for nearby farms? This project examines the scientific validity of this concern by studying the movement of serious agricultural pests—weeds, insects and mammals—from restored riparian habitats to farm lands. Because healthier native habitats could elevate abundances of pest enemies or serve as refuges for them, biologists will also measure the abundance and movement patterns of pest enemies. The scientist will share findings with farmers and other stakeholders.

- **Long-term Geomorphic Effects of Dams on Rivers, Comprehensive and Comparative Approach**
  R/SF-13 Sept. 05–Aug. 08
  Toby Minear, UCB, 510.847.4454, tminear@berkeley.edu

Not all dams equally impact water flows and sediment transport. The goal of this project is to compare the effects of 16 different dams on major tributaries in the Central Valley on water flows and sediment transport. Of particular interest is the influence of dam design and operation on geomorphic processes such as river channel shape and sediment composition. Findings have the potential to identify areas that would be geomorphically suitable for restoration.

- **Restoring Non-equilibrium Riparian Communities in Disturbance-Altered Ecosystems: Implications for River Management and Climate Change**
  R/SF-14 Jan. 06–Dec. 08
  John Stella, UCB, 510.643.2450,
  stella@nature.berkeley.edu

The Fremont cottonwood is an abundant and important part of Central Valley riparian forests, as it stabilizes riverbanks, fixes carbon, produces woody debris and creates complex floodplain habitat for fish and wildlife. This project examines ecological factors influencing cottonwood forest health, growth and sustainability. Some hypotheses being tested: 1) Fremont cottonwood populations are declining throughout the Central Valley because of habitat loss and inappropriate hydrology; 2) Tree growth and stand condition are largely determined by sufficient water, the availability of which varies with climate, location and severity of hydrologic alteration; and 3) Cottonwood physiological function varies with water availability. Findings will assist in restoring forests in an ecosystem that is constantly being stressed by human activity.

- **Prey Selection of Larval and Juvenile Planktivorous Fish in the San Francisco Estuary**
  R/SF-15 Jan. 07–Dec. 08
  Lindsay Sullivan, URI—SFSU, 401.874.6129,
  lsullivan@gso.uri.edu

Laboratory feeding experiments will be conducted to study prey selection in larval and juvenile delta smelt, striped bass and longfin smelt and its relation to light and turbidity levels. Results will be compared to analyses of gut contents of respective fishes—the traditional method for

inferring prey selection. The findings, it is hoped, will shed light on the causes of declines in the abundances of plankton-eating fishes in the San Francisco Estuary.

- **Temperature and Salinity Effects on the Physiology of White Sturgeon**
  R/SF-16 Jan. 07–Jan. 09
  Brian Sardella, UBC—UCD, 604.822.3378, sardella@zoology.ubc.ca

This project investigates the physiological response of white sturgeon to rising water temperatures. The primary objective is to predict how the species, at the population level, might be affected by climate change. As part of this, experiments will be conducted to determine the upper end of the sturgeon's thermal tolerance and to identify the relation to salinity. The CALFED Fellow will also seek to sequence proteins activated under temperature-induced stress.

- **Role of Exotics as Ecosystem Engineers Affecting Estuarine Food Webs in Suisan Marsh**
  R/SF-17 Feb. 07–Feb. 09
  Christine Whitcraft, UCSD–SFSU, 858.534.3579, cwhitcra@ucsd.edu

The CALFED Fellow will test the hypothesis that invasive estuarine plants, by affecting the biodiversity of microalgae and invertebrate communities, change local food web dynamics. In particular, the project will document key functional differences in areas of Suisun Marsh invaded by *Arundo donax* (giant reed), *Lepidium latifolium* (perennial pepperweed) and *Phragmites australis* (common reed). What is learned will be used to develop eradication strategies in highly disturbed wetland habitats, where there may be several rare species or other factors complicating restoration options.

- **The Impacts of Global Climate Change on Delta Fishes: Predicting Fish Abundance, Distribution and Community Changes**
  R/SF-18 Jun. 07–May 10
  Christa Woodley, UCD, 530.400.5871, cmwoodley@ucdavis.edu

Global warming is predicted to reduce rainfall, raise sea level and enhance evaporation in the San Francisco Bay-Delta region. This project looks at what this may mean for native and invasive species in the region, in terms of their distribution, foraging opportunities, growth and reproduction. Select species of fish will be studied under various scenarios of future climate patterns to address these questions.

- **Temporal and Spatial Patterns in Abundance and Production in Pelagic Organisms in the Low Salinity Zone (Suisan Marsh, Bay and Delta) of the San Francisco Estuary with Insight into Trophic Position and Impacts of Alien Invasive Species**
  R/SF-19 Dec. 06–Nov. 09
  Robert Schroeter, UCD, 530.219.9693, reschroeter@ucdavis.edu

The aquatic community in Suisun Marsh will be compared to that in habitats in adjacent waterways to determine why there has been such a decline in marsh aquatic life. A first step in the research will be to compile existing data on aquatic life and use the larger dataset to begin to look for patterns linking fish and invertebrate abundances with environmental conditions. The CALFED Fellow will also examine potential consequences of invasive gelatinous zooplankton on native zooplankton and how this might influence primary productivity.

- **Estimating Route-specific Survival and Distribution of Juvenile Salmonids Migrating Through the Sacramento-San Joaquin River Delta**
  R/SF-20 Nov. 06–Oct. 09
  Russell Perry, UW, 541.380.1564, rperry@usgs.gov

A model developed for studying salmon on the Columbia River will be adapted to compute survival statistics for juvenile salmon migrating through the various river networks flowing into the Sacramento-San Joaquin Delta. The probability of a fish surviving passage through a specific dam or channel and more significantly, the proportion of a population subject to each route-specific survival rate, will be estimated. This information will allow the researcher to quantitatively assess the impact of water exports on juvenile salmon and the proportion of a population subject to lower survival rates for a given management decision.

- **Heterotrophic Bacteria and the Food Web of the Low Salinity Zone and Salt Marsh Habitats of the San Francisco Estuary**
  R/SF-21 Nov. 06–Oct. 08
  Alexander Parker, SFSU, 415.338.3746, aeparker@sfsu.edu

There has been a sharp decline in phytoplankton abundance in the low-salinity zone of the San Francisco Estuary, and this has likely increased the relative importance of bacterial carbon as a food source for higher trophic levels. This project will compare phytoplankton and bacteria production and their respective roles in supporting the local food web. In the project's first year, the CALFED Fellow will map the spatial and temporal patterns in phytoplankton and bacteria activity and abundance, and investigate factors influencing these patterns in restored vs. natural salt marshes.

- **Mercury Interactions with Algae: Effects on Mercury Bioavailability in the San Francisco Bay Delta**
  R/SF-22 Jan. 07–Dec. 09
  Allison Luengen, UCSC, 831.459.2088, luengen@etox.ucsc.edu

Several fish species in the San Francisco Bay-Delta contain potentially unsafe (for human consumption) levels of mercury. This project seeks to identify the chemical parameters controlling mercury uptake in phytoplankton—the pathway by which mercury enters the aquatic food chain. Some researchers speculate that phytoplankton accumulate more methyl mercury when there is considerable dissolved organic matter in the water column. The CALFED Fellow will investigate the hypothesis that phytoplankton are accidentally acquiring methyl mercury as they feed. The findings may help regulators identify ways to reduce the entry of mercury into the food chain.

- **Measuring and Predicting the Success of Riparian Restoration for Wildlife Populations**
  R/SF-23 Nov. 06–Oct. 09
  Nathaniel Seavy, USGS—RCUH, 808.967.7396, nseavy@yahoo.com

Restoring riparian habitats has the potential to benefit songbirds. This project will determine the level of restoration needed to ensure songbird habitats. Models of riparian bird population dynamics will be used to predict whether or not a given restoration project will provide functional bird habitat. This information will be used to identify factors essential for re-creating bird habitats.This will hopefully

lead to restoration strategies that will protect songbirds today and in the face of future climatic change.

- **Validation of a New Method for Population Assessment of Pacific Salmonids Using Genetic Markers**
  R/SF-24 Nov. 06–Oct. 09
  Anthony Clemento, UCSC, 831.420.3906,
  anthony.clemento@noaa.gov

The CALFED Fellow seeks to identify genetic markers in the DNA of Central Valley chinook to trace the parentage of these fish. Further studies will evaluate whether these genetic markers can be used to cost-effectively tag and track salmon. If successful, this virtual tagging method would yield a powerful tool—one significantly better than current coded wire tags—for monitoring the effects of hatchery practices, water policy, climate change and fisheries management on salmonid populations.

California Ocean Protection Act

California's Ocean Protection Council (OPC), which was created in accordance with the 2004 California Ocean Protection Act, has awarded funds to California Sea Grant to administer peer-reviewed, scientific research to address OPC research priorities (see www.csgc.ucsd.edu/PROPOSAL/PROP_PDFs/OPCdocFinal.pdf). The projects below were selected for 2007 funding.

- **Parasites as Indicators of Coastal Wetland Health**
  R/OPCENV-01 Feb. 07–Jan. 10
  Kevin Lafferty, USGS, 805.893.8778, lafferty@lifesci.ucsb.edu; Armand Kuris, UCSB, 805.893.8083, kuris@lifesci.ucsb.edu

How healthy is that salt marsh? If biologists leading this study are correct, the number and diversity of trematode parasites in common snails are a big clue. The trematodes they are studying require specific intermediate, nonsnail hosts. The presence or absence of a trematode species, they believe, is thus an indicator of the species of fish, animals and birds that must be living in the area for that parasite to complete its lifecycle. It is hoped that a snail-trematode "index" could provide a simple, rapid method for monitoring wetland biodiversity.

- **Evaluating Current Ocean Management Systems to Facilitate the Development of Ecosystem-based Management**
  R/OPCENV-02 Feb. 07–Jan. 10
  Oran Young, UCSB, 805.893.8747, young@bren.ucsb.edu

In recent years, both federal and state officials have emphasized the need to coordinate ocean policies as a first step toward improving the health of our nation's coast. That emphasis recognizes the inefficiencies and redundancies present in the current morass of regulations that govern economically valuable industries such as shipping, coastal tourism and coastal development. In an effort to streamline and coordinate ocean governance in California, the investigator of this project will 1) identify marine-related laws that overlap in function and space, 2) identify inconsistencies in ocean management, and 3) identify areas where agency and/or legal coordination can be improved. One by-product of this work will be the creation of a public database of coastal and marine laws.

- **Spiny Lobster Movement, Habitat Use and Abundance in Southern California: Bottom-up and Top-down Interactions in Kelp and Seagrass Habitats**
  R/OPCFISH-03 Feb. 07–Jan. 10
  Kevin Hovel, SDSU, 619.594.6322, hovel@sciences.sdsu.edu; Christopher Lowe, CSULB, 562.985.4918, clowe@csulb.edu

Researchers continue to tag and acoustically track California spiny lobsters to better understand the animal's movement patterns and benthic habitats (e.g., kelp forests, surf grass and eelgrass beds). These data are being used, among other things, to identify the animals' home ranges and the influence of geological and biological features on their activity. In the first year of the project, biologists will tag 12 lobsters in San Diego and begin SCUBA surveys to estimate lobster densities and community structures in different habitats.

- **Binational Studies Leading to Ecosystems-based Management Strategy for the Common Thresher Shark and Other Fishery Resources in the Southern California Bight**
  R/OPCFISH-04 Feb. 07–Jan. 09
  Jeffrey Graham, UCSD/SIO, 858.534.8044, jgraham@ucsd.edu; Oscar Sosa-Nishizaki, CICESE, 646.175.0500, ososa@cicese.mx; Suzanne Kohin, NMFS, 858.546.7104, suzanne.kohin@noaa.gov

In collaboration with researchers from Baja California, biologists will describe artisanal and commercial thresher shark fisheries in northwestern Baja California to better assess the impact of fishing on thresher shark populations. They will also identify essential habitat areas for juvenile threshers in Baja, work that is similar to what has already been done in California. The emphasis on gathering basic fisheries data in Baja represents a vital step forward in the ability to establish bi-national ecosystem-based thresher shark management that will truly protect this species.

- **Assessing Changes in Life History Traits and Reproductive Function of California Sheephead Across its Range: Historical Comparisons and the Effects of Fishing**
  R/OPCFISH-05 Feb. 07–Jan. 09
  Jennifer Caselle, UCSB, 805.893.5144, caselle@lifesci.ucsb.edu; Christopher Lowe, CSULB, 562.985.4918, clowe@csulb.edu; Kelly Young, CSULB, 562.985.4859, kyoung@csulb.edu

According to results of a preliminary study, fishing in the last 30 years has shrunk the average size of California sheephead. Females are reaching sexual maturity earlier and they are transforming into males younger and at odd times in the year. (Sheephead are sequentially hermaphroditic.) In this project, researchers will investigate possible explanations for changes in their size and reproductive structure. The leading theory is that selective pressure from fishing and/or pollutants, especially estrogenic compounds, is altering the life history characteristics (and also social structure) of this species.

Education, Training & Public Information

- **Sea Grant Trainees**
  R/G-2
  R.A. Moll/CASG

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 the academic community, government, and industry.

- **California Sea Grant State Fellowship Program**
  E/G-9
  R.A. Moll/CASG

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

- **John D. Isaacs Marine Undergraduate Research Assistant Program**
  E/UG-4
  R.A. Moll/CASG

This new grants program provides undergraduate students with the opportunity to work closely with established marine scientists, develop their research skills, and better define their career goals in marine science. The program honors the memory of John D. Isaacs, a world-renowned figure in marine science.

California Sea Grant Committees

Sea Grant Advisory Board

This board represents the marine community of California and advises the president of the University of California, and the director of the California Sea Grant College Program on research, education, and outreach activities of the program.

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The state of California interacts with California Sea Grant through the Resources Agency Sea Grant Advisory Panel. The panel prioritizes California Sea Grant research in terms of the needs of the agency.

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