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ANNUAL REPORT 2010 2011

Marine Science Institute
University of California , Santa Barbara

Table of Contents

Director's Statement

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It is a pleasure to provide the introduction for this annual report.

UC Santa Barbara's Marine Science Institute is a major focal point for research activity on the campus. During the period covered by this annual report the Institute employed over 600 researchers, staff and students with funding from over 100 agencies.

This year was notable in that the Institute received funding for several urgent and unique studies. One set was as a result of significant coastal fires in the Santa Barbara area which provided an opportunity to study their effects on immediate ecosystems in the Santa Barbara Channel. The second set were in response to the Deepwater Horizon Oil Spill in the Gulf of Mexico. It is especially gratifying to see our science community respond to issues of such importance to our region and nation.

Curiosity takes our researchers around the world. In South America, Professors Christopher Costello and Steven Gaines received funding to study the Peruvian Anchoveta Fishery. In Hawaii Volcanoes National Park, Professor Carla D'Antonio is studying the long term impact of grass invasions and fire community change and plant soil feedbacks. Dr. Gretchen Hofmann continues to expand her research activities on Ocean Acidification with annual field work in Antarctica.

And closer to home, several faculty led by Dr. Scott Hodges received a large award from the National Science Foundation to renovate several greenhouses on the UCSB campus.

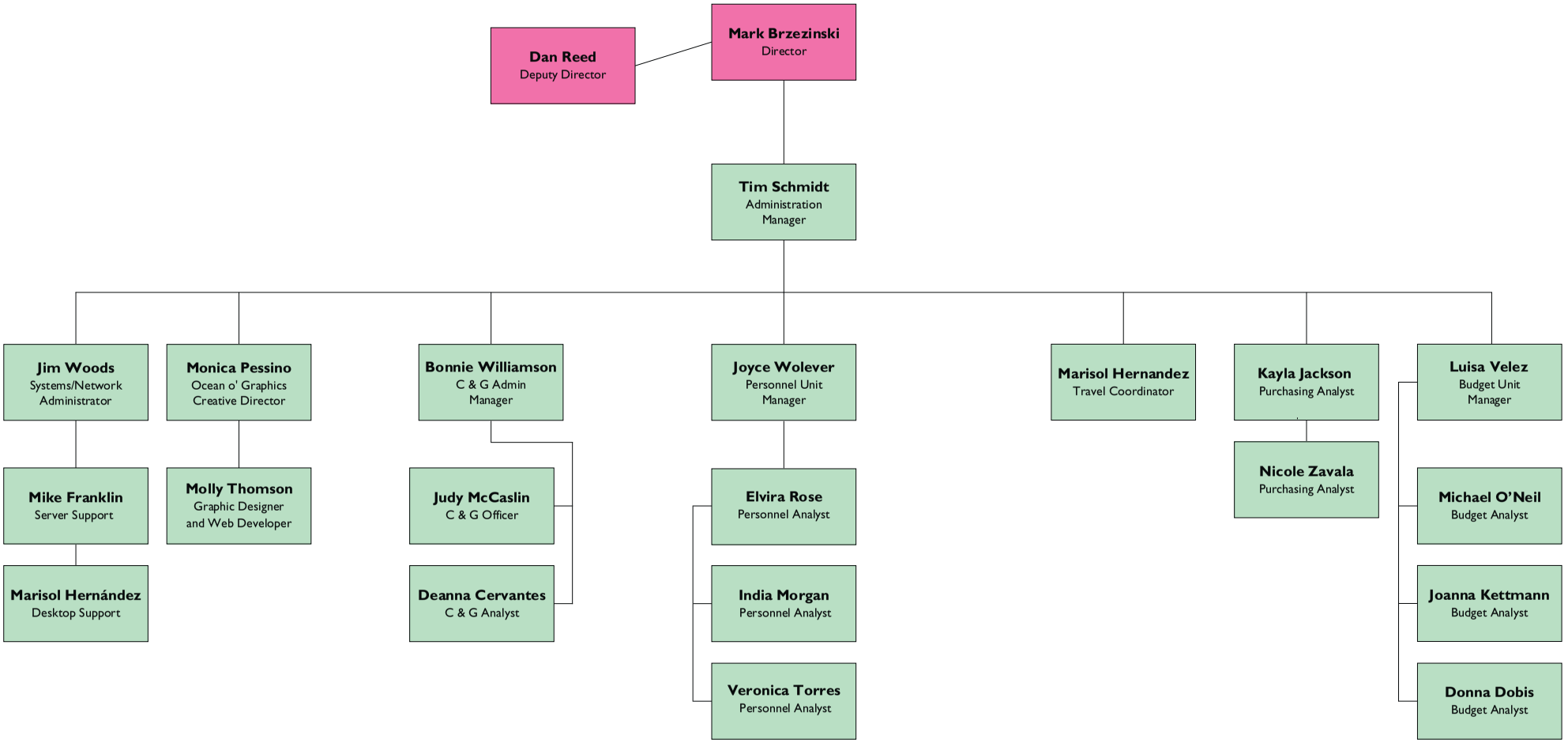
It is an honor to be part of these efforts and I hope you take the opportunity to read about the many other projects included in this report.

Mark Brzezinski
Director

Organizational Charts

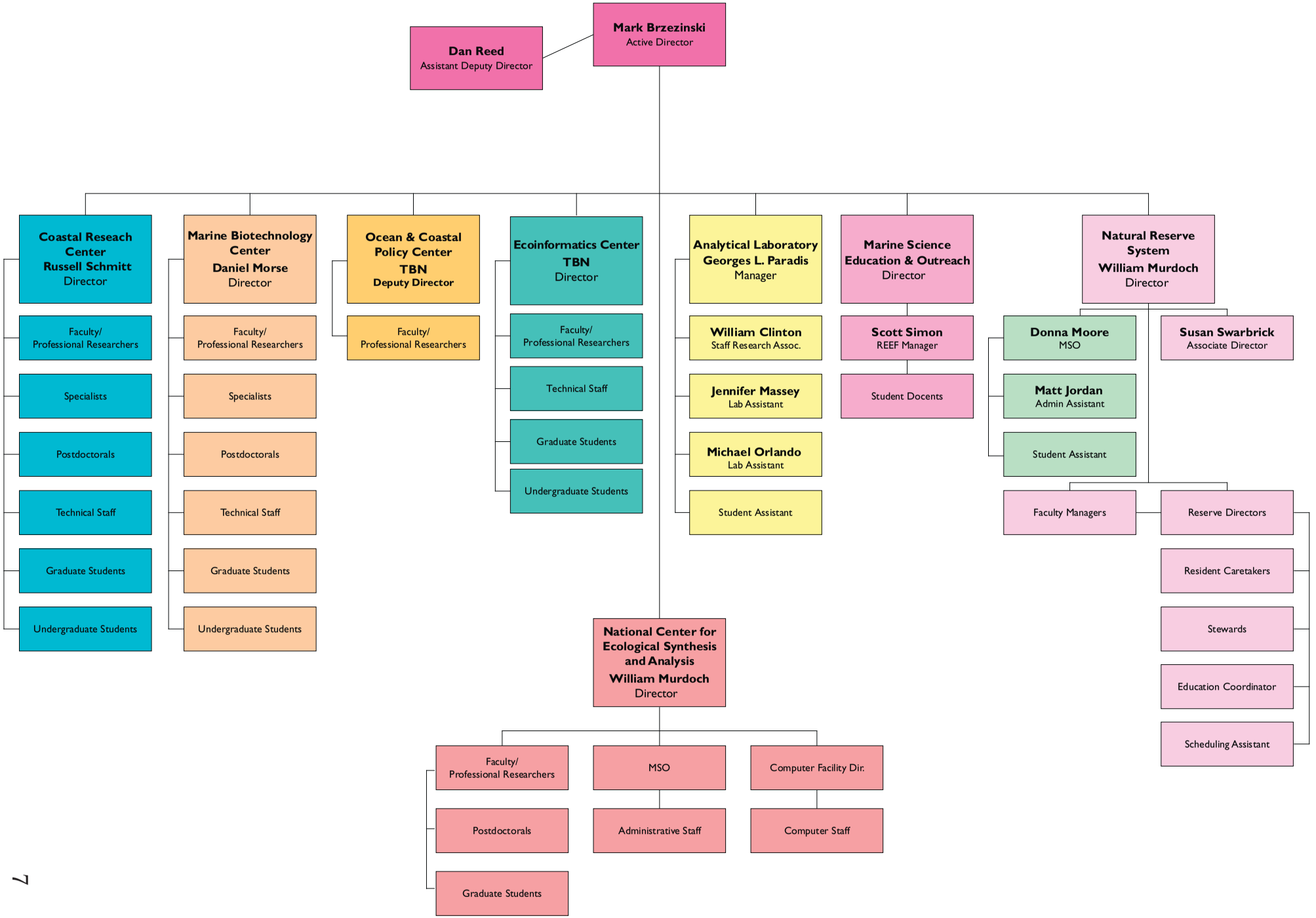
MARINE SCIENCE INSTITUTE

2010–2011 ORGANIZATIONAL CHART



MARINE SCIENCE INSTITUTE

2010–2011 ORGANIZATIONAL CHART



Other Projects & Activities

Seminars, Workshops, Conferences, and Meetings July 1, 2010–June 30, 2011

The Marine Science Institute continues to support various seminars, workshops, conferences and meetings. During the 2010-2011 fiscal year 158 events took place, in which a wide range of marine science topics were highlighted.

Dates	Coordinators	Topic
July 12–16, 2010	Kerry Britton	Plants of planting (Working Group)
July 12, 2009–April 13, 2011	Teresa Mourad, Wendy Gram, Bruce Grant	Engaging undergraduate students in ecological investigations using large, public datasets: Distributed Graduate Seminar (Distributed Graduate Seminar, Planning Meeting)
July 8, 2010	Scott Simon	Yuan-Lin Exchange Program, Center for Science and Engineering Partnerships
July 12–24, 2010	Ali Whitmer, Scott Simon & Dijanna Figueroa	Santa Barbara Channel LTER Professional Development Workshop for K-12 science teachers
July 19–20, 2010	Mark Schildhauer	INTEROP: A community-driven scientific observations network to achieve interoperability and ecological data (Working Group)
July 19–23, 2010	Michael Rosenberg, Bryan Epperson, & Andrew Storfer	An interdisciplinary approach to advancing landscape genetics (Working Group)
July 20–22, 2010	Christopher Konrad & Julian Olden	Evaluating responses of freshwater ecosystems to experimental water management (Working Group)
August 1, 2010	Teresa Mourad	Ecological Society of America 95th Annual Meeting Luncheon
August 2–5, 2010	Dijanna Figueroa, Ali Whitmer	STEM professional development wksh
August 9–13, 2010	Brad Cardinale, Dave Hooper, Emmett Duffy	Biodiversity and the functioning of ecosystems: Translating results from model experiments into functional reality (Working Group)

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August 10–13, 2010	M. Rebecca Shaw	Global climate change and adaptation of conservation priorities (Working Group)
August 27, 2010	Carol Blanchette	South Coast MLPA (Marine Life Protection Act) Research meeting
August 30–31, 2010	Jeannine Cavender-Bares & Stephen Polasky	Developing curricula and model systems for sustainability science: (Distributed Graduate Planning Meeting)
August 31, 2010	Daniel Reed & Mark Page	SONGS Research Committee Mtg
September 1–2, 2010	Taylor Ricketts	NCEAS Science Advisory Board 2010-2011 Meeting
September 3, 2010	Carol Blanchette	Soft Sediment MLPA workshop
September 4–5, 2010	Gretchen Hofmann & Pauline Yu	Evolution and Climate Change in the Oceans working group
September 5–10, 2010	Hugh Possingham & Carissa Klein	Supporting decision making in the Coral Triangle Initiative: Prioritizing socially and economically viable projects and places for biodiversity conservation EBM (Working Group)
September 9, 2010	Sadie Ryan, NCEAS	Satellites to parasites: assessing health in African park landscapes (Ecolunch Series)
September 9, 2010	Jennifer O'Leary, NCEAS	Using science for management: development of an Adaptive Management Program in Kenya's marine protected areas (Ecolunch Series)
September 13–17, 2010	Richard Norby, Yiqi Luo, I. Colin Prentice, Ram Oren, Paul Hanson	Benchmarking ecosystem response models with experimental data from long-term CO2 enrichment experiments (Working Group)
September 14, 2010	Scott Simon	South Coast Educators Roundtable
September 14–17, 2010	Sean Anderson, Charles (Pete) Peterson & Gary Cherr	Ecotoxicology of the gulf oil spill: A holistic framework for assessing impacts (Working Group)
September 15–18, 2010	Robert Costanza, Lisa Graumlich, Sander van der Leeuw	Integrated history and future of people on Earth (IHOPE): Building a community data base and testing the resilience - sustainability hypothesis across scales (Working Group)

* Non-UCSB personnel

September 15–18, 2010	John Callaway, Steve Crooks, Pat Megonigal, Abe Doherty	Tidal wetland carbon sequestration and greenhouse gas emissions model (Working Group)
September 16, 2010	Jim Morris, University of South Carolina & Steve Crooks, Philip Williams & Assoc. Ltd.	Bringing coastal wetlands to the carbon market (Ecolunch Series)
September 17, 2010	Will McClintock	MarineMap working group
September 22, 2010	Cheryl Briggs	Ecology, Evolution & Marine Biology Faculty Symposium
September 22–23, 2010	Erica Fleishman	Prediction of responses of wild Pacific salmon to climate change (Working Group)
September 23, 2010	Todd Oakley, UCSB	Biodiversity equals complexity... How do they originate? (Ecolunch Series)
September 23, 2010	Jennifer Thorsch	Kids in Nature Class
September 26–30, 2010	Erica Fleishman	Evaluation of declines of pelagic organisms in the upper San Francisco Estuary: Bay-Delta Science Conference
September 28–29, 2010	Margaret Connors	Education, Outreach and Communication Coordinators Annual Meeting
September 28–October 1, 2010	Robin Waples & Jeffrey Hutchings	Red flags and species endangerment: Meta-analytical development of criteria for assessing extinction risk (Working Group)
September 29, 2010	Jennifer Thorsch	CCBER Oversight Committee mtg
September 30, 2010	Robin Waples, NOAA Fisheries Service	Human-mediated evolution in an endangered species (Ecolunch Series)
October 1, 2010	Scott Simon	Docent training for REEF
October 1, 2010	Lisa Stratton	CCBER student intern presentations
October 3–5, 2010	Karen McLeod, Larry Crowder, Michael Fogarty, Andrew Rosenberg	A framework to assess ecosystem health in support of ecosystem-based management of coastal-marine systems (EBM) (Working Group)
October 5, 2010	Christy Henzler	Luce fellows research meeting

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October 6–7, 2010	Jennifer Williams	Structured population modeling workshop
October 7, 2010	Jennifer O'Leary, NCEAS	Indirect effects of fishing on reef building taxa (Ecolunch Series)
October 8, 2010	David Harris	California Conservation Corps and CCBER Restoration Services
October 12–16, 2010	Brian McGill, Walter Jetz, Robert Guralnick & Jana McPherson	Choosing (and making available) the right environmental layers for modeling how the environment controls the distribution and abundance of organisms (Working Group)
October 14, 2010	Anthony Richardson & Elvira Poloczanska, CSIRO Marine and Atmospheric Research	Marine climate change ecology (Ecolunch Series)
October 14–18, 2011	Anthony Richardson & Elvira Poloczanska	Towards understanding marine biological impacts of climate change (Working Group)
October 15, 2010	Scott Simon	Channel Islands National Marine Sanctuary, Aquaris Mission Project
October 18–22, 2010	Sonia Altizer, Karen Oberhauser & Leslie Ries	Monarch butterflies as a model for understanding the spatiotemporal dynamics of migratory species and their response to environmental change (Working Group)
October 19–21, 2010	Erica Fleishman	Ecological thresholds in the San Francisco Estuary (Working Group)
October 20, 2010	Dave Siegel	Spatial Ecology Group meeting
October 21, 2010	Karen Oberhauser, University of Minnesota	Using citizen science data to understand monarch butterfly migration and population dynamics (Ecolunch Series)
October 23, 2010	Scott Simon, Gretchen Hofmann	Ocean Acidification workshop
October 25–26, 2010	Robin Waples & Daniel Schindler	Evolutionary and plastic responses of Pacific salmon to climate change (Working Group)
October 26, 2010	Scott Simon	MSI K-12 outreach
October 26, 2010	Chad Burt	MarineMap working group

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October 28, 2010	Van Savage & Samraat Pawar, UCLA	The effects of body size and temperature on consumer-resource interactions and population dynamics (Ecolunch Series)
November 2–5, 2010	Larry Crowder & Martin Smith	Envisioning a sustainable global seafood market and restored marine ecosystems (Working Group)
November 3–5, 2010	Kay Gross	Predicting grassland community responses to fertilization: Exploring the role of clonality and other species traits
November 4, 2010	Susan Harrison, UC Davis	Partitioning diversity into alpha, beta and gamma: new insights from the original dataset (Whittaker 1960) (Ecolunch Series)
November 4–8, 2010	Jonathan Chase, Nathan Sanders, & Amy Freestone	A synthesis of patterns, analyses, and mechanisms of beta-diversity along ecological gradients (Working Group)
November 6, 2010	Eric Zimmerman, Jo Little	Freudenfest, A Symposium Highlighting the Research Inspired by Dr. William Freudenberg
November 8–9, 2010	Russell Schmitt, Sally Holbrook & Andrew Brooks	Moorea Coral Reef LTER All Investigators Annual Meeting
November 8–12, 2010	Andrew Liebhold & Deborah McCullough	Applying population ecology to strategies for eradicating invasive forest insects (Working Group)
November 9–13, 2010	Elizabeth Crone, Eric Menges & Martha Ellis	When are matrix models useful for management? An empirical test across plant populations (Working Group)
November 15–16, 2010	Jim Regetz	NCEAS servers, subversion, morpho and KNB training
November 17–20, 2010	Jeannine Cavender-Bares, David Ackerly, Richard Ree, Peter Reich Michelle Mack, & J. Gordon Burleigh	Linking phylogenetic history, plant traits, and ecological processes at multiple scales (Working Group)
November 17–22, 2010	Robert Condon, Carlos Duarte & William Graham	Global expansion of jellyfish blooms: Magnitude, causes and consequences (Working Group)

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November 18, 2010	Ruth Gates, NCEAS Sabbatical Fellow	Environmental thresholds in reef building corals: implications of diversity and flexibility in coral/dinoflagellate endosymbioses (Ecolunch Series)
November 23, 2010	Scott Simon	Experience Marine Research: La Cumbre Jr High students
November 29–December 3, 2010	Juliann Aukema, James Reichman & Stephanie Hampton	Economic impacts of non-native forest pests and pathogens in North America (TNC) (Working Group)
November 30–December 1, 2010	Peter Edmunds & Ruth Gates	Tropical coral reefs of the future: Modeling ecological outcomes from the analyses of current and historical trends (Working Group)
November 30–December 2, 2010	Chuck Cook & Steve Gaines	Sustainable Fisheries Working Group
December 2, 2010	Katie Longo, NCEAS	Size-structured effects of fishing on marine fish diversity (Ecolunch Series)
December 6–10, 2010	Brian Enquist, Robert Peet, Richard Condit, Brad Boyle & Steven Dolins	Developing an integrated botanical information network to investigate the ecological impacts of global climate change on plant biodiversity (Working Group)
December 7–8, 2010	Steven Gaines	Analytic Innovations in Limited Information Fisheries Management meetings
December 7–12, 2010	Benjamin Cook & Elizabeth Wolkovish	Forecasting phenology: Integrating ecology, climatology, and phylogeny to understand plant responses to climate change (Working Group)
December 9, 2010	Jim Bever, Indiana University	Microbial mediation of plant community structure (Ecolunch Series)
December 14–16, 2010	Sean Anderson, Charles (Pete) Peterson & Gary Cherr	Ecotoxicology of the gulf oil spill: A holistic framework for assessing impacts (Working Group)
December 16–17, 2010	Kay Gross	Predicting grassland community responses to fertilization: Exploring the role of clonality and other species traits

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January 5–6, 2011	Russell Schmitt, Sally Holbrook	MCR LTER Investigator Workshop
January 10, 2011	Myla Aronson, Kattie Madhusudan Paige Warren, Charles Nilon	Comparative ecology of cities: What makes an urban biota "urban"? (Working Group)
January 10–14, 2011	Mark Maunder, Benjamin Bolker, Beth Gardner	Evaluating and improving open source software for nonlinear statistical modeling in ecology (Working Group)
January 11, 2011	Michael Smith	California Gray Whale Count training
January 13, 2011	Ben Bolker, McMaster University	Estimating demographic parameters from samples of unmarked individuals (Ecolunch Series)
January 21–23, 2011	Jason Hoeksema & James Bever	A graduate seminar network to facilitate synthetic research on context-dependency in the mycorrhizal symbiosis: Grand synthesis Meeting for Distributed Graduate Seminar
January 24–28, 2011	Cascade Sorte, Joshua Lawler & Jeffrey Dukes	Climate change and invasive species: Are non-natives poised for greater success in future climatic conditions?
		(Working Group)
January 24–28, 2011	Kevin Lafferty, Andrew Dobson Mercedes Pascual	Parasites and food webs – the ultimate missing links (Working Group)
January 25–27, 2011	Erica Fleishman	Ecological thresholds in the San Francisco Estuary (Working Group)
January 27, 2011	Ines Ibañez, University of Michigan	Beyond their ranges, outside their niches: assessing the adaptation and migratory potential of temperate forests to global warming (Ecolunch Series)
January 27–29, 2010	Jack Engle	MARINe (Multi-Agency Rocky Intertidal Network) Annual Workshop
February 1, 2011	Carol Blanchette	Digital Ocean working group meeting
February 2–4, 2011	Erin Mordecai	The effects of global change on malaria transmission: A meta-analysis (Luce Fellows)

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February 2–3, 2011	Tal Ben-Horin & Kevin Lafferty	Difficulties in modeling Ro: functional forms to use for curve-fitting
February 3–4, 2011	Daniel Reed & Russell Schmitt	Southern California LTER Graduate Student Symposium
February 3, 2011	Gary Mittelbach, NCEAS Sabbatical Fellow & Kellogg Biological Station	Teaching ecology (Ecolunch Series)
February 3–5, 2011	Susan Swarbrick	UCSB Natural Reserve System Annual Managers Meeting
February 8–10, 2011	Anne Guerry & Kai Chan	Cultural ecosystem services from marine and coastal systems: Counting the intangibles EBM (Working Group)
February 10, 2011	Patricia Balvanera, UNAM, Mexico	Interdisciplinary Studies on ecosystem services: building a conceptual framework (Ecolunch Series)
February 11, 2011	Jenn Caselle	NOAA Channel Islands National Marine Sanctuary Research Activities Panel
February 11–12, 2011	Cheryl Briggs	Ecology, Evolution and Marine Biology Annual Graduate Student Symposium
February 16, 2011	Scott Simon	REEFinding Nemo - MCR-LTER seminar and training
February 17, 2011	Jim Regetz	Luce Graduate Fellows Informatics Seminar
February 17, 2011	Kay Gross, NCEAS Sabbatical Fellow & Michigan State University	What's so great about biological stations and KBS in particular? (Ecolunch Series)
February 19–22, 2011	Michael Rosenberg, Bryan Epperson, & Andrew Storfer	An interdisciplinary approach to advancing landscape genetics (Working Group)
February 21–26, 2011	Peter Edmunds & Ruth Gates	Tropical coral reefs of the future: Modeling ecological outcomes from the analyses of current and historical trends (Working Group)
February 22, 2011	Jenifer Dugan	UC Sea Grant Director Jim Eckman

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February 24, 2011	Tim McClanahan, Wildlife Conservation Society	Preparing for Climate Change: establishing priorities by integrating environmental, ecological and social variables (Ecolunch Series)
March 2, 2011	Steve Gaines	NOAA working group to Identify Critical New Directions in Marine and Coastal Ecosystem Science Research for NOAA Sea Grant
March 2, 2011	Sarah Lester	Novel Ecosystems within Bay and Estuarine Systems Workshop Group
March 3, 2011	Josh Tewksbury, NCEAS Sabbatical Fellow & University of Washington	Why are chilies hot? The evolution of a major spice (Ecolunch Series)
March 7–9, 2011	Ben Halpern	Ocean Health Index Weighting Workshop
March 10, 2011	Jonathan Levine, UCSB and ETH Zurich	The importance of niches for the maintenance of species diversity (Ecolunch Series)
March 12, 2011	Matt Jones	Ecoinformatics
March 15, 2011	Stephanie Hampton	Kids Do Ecology Poster Day
March 16–18, 2011	Nancy Baron & Ben Halpern	COMPASS Training Workshop
March 17, 2011	Kirsten Rowell, University of Washington	Turning off the Colorado tap - Establishing natural history baselines through geochemical logs of the Sea of Cortez (Ecolunch Series)
March 21–24, 2011	Robin Waples & Jeffrey Hutchings	Red flags and species endangerment: Meta-analytical development of criteria for assessing extinction risk (Working Group)
March 21–25, 2011	Brad Cardinale, Dave Hooper, Emmett Duffy	Biodiversity and the functioning of ecosystems: Translating results from model experiments into functional reality (Working Group)
March 24, 2011	Andrew Gonzalez, McGill University	Rescue, robots and ranges: experimental explorations of the eco-evolutionary response to environmental change (Ecolunch Series)

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March 28–April 1, 2011	Christopher Boone, Steward Pickett, J. Morgan Grove & Mary Cadenasso	Ecology of environmental justice in metropolitan areas (Working Group)
March 31, 2011	Christopher Boone, Arizona State University	An expanded view of environmental justice (Ecolunch Series)
April 2, 2011	Scott Simon	Training for REEF docents
April 4–8, 2011	Erin Peterson, Jay Ver Hoef, Daniel Isaak	Spatial statistical models for stream networks: Synthesis and new directions (Working Group)
April 6–8, 2011	Matt Jones & Stephanie Hampton	DataONE: Observation Network for Earth (Working Group)
April 7, 2011	Mike McGinnis, Victoria University of Wellington, New Zealand	Future ocean governance in [Aotearoa] New Zealand,; linking science to policymaking (Ecolunch Series)
April 9–10, 2011	David Marsh	Undergraduate Network for Invasive Plant Research Meeting
April 9–13, 2011	Elizabeth Crone, Eric Menges & Martha Ellis	When are matrix models useful for management? An empirical test across plant populations (Working Group)
April 11–12, 2011	Teresa Mourad, Wendy Gram & Bruce Grant	Engaging undergraduate students in ecological investigations using large, public datasets: Distributed Graduate Seminar Grand Synthesis Meeting
April 13, 2011	Egbert Leigh, Smithsonian Tropical Research Institute	Economies and Ecosystems: useful analogies and crucial differences (Ecolunch Series)
April 18–20, 2011	Mark Schildhauer	INTEROP: A community-driven scientific observations network to achieve interoperability and ecological data (Working Group)
April 19–21, 2011	Micah Brachman, Lindsay Vogt Idse Heemskerk	The science, media reporting and politics of California air-quality: Content, context, and voting patterns of Proposition 23 (Luce fellows, hosted by NCEAS)
April 21, 2011	Tom Miller, Rice University	Sex, dispersal and the spread of invasive species (Ecolunch Series)
April 22, 2011	Jennifer Caselle	California Sheephead Research Workshop with the California Department of Fish & Game

* Non-UCSB personnel

Coastal Research Center

The Coastal Research Center is an organizational unit within the Marine Science Institute at UCSB. The central theme of the Center is to develop scientific knowledge to gain a more complete understanding of coastal and island ecosystems, which is necessary for sound management of the natural resources within coastal and island regions. The Center links academic scientists from a wide variety of disciplines, enhancing the ability to address marine environmental issues.

While CRC scientists work in marine environments throughout the world, much effort is focused on coastal reefs found in the Santa Barbara Channel region and the coral reefs surrounding the island of Moorea, French Polynesia. These two locations provide excellent model systems for the scientific exploration of a wide range of marine issues and scientists at UCSB have long valued these environments as natural laboratories for scientific study. Both areas are enjoyed by those seeking recreation, support important local fisheries and are faced with growing conflicts amongst different user groups as human population pressures increase, a trend that is common for many marine environments. The nearshore marine environments of California and the islands of French Polynesia are used increasingly as a disposal site for waste products. Renewed exploitation of oil and natural gas reserves has augmented the number of conflicting demands placed upon the Channel resources, while issues related to global climate change have increased concerns about the sustainability of coral reef ecosystems. Local issues related to the sustainability of commercial and sport fisheries in both regions mirror global concerns regarding management of exploited stocks. The cumulative effects of human activities on the natural resources of both of these regions are just beginning to be understood. It is imperative that we learn how to balance the multiple uses of nearshore ocean waters in an environmentally sound manner. Lessons learned by scientists in the Coastal Research Center have wide implications for understanding and resolving present and future problems, and will help local, regional and national regulators develop better management policies.

Development of sound management plans for areas such as the Santa Barbara Channel or the islands of French Polynesia is hampered by scientific uncertainty about the consequences of human activities. To understand and predict natural and anthropogenic disturbances, synthesis of new and existing knowledge of many scientific aspects of coastal marine systems - including biology, ecology, genetics, geology, chemistry and oceanography - will be necessary. Further, the development of new approaches and the use of emerging technologies are needed to resolve fundamental questions, some of which have remained unanswered for many years. Only with these advances will it be possible to make reliable predictions about the consequences of various activities, to develop the ability to restore degraded habitats and conserve valuable resources, and to foster development of environmentally sound policies for use of coastal or island regions in general.

The Center has four major objectives:

- To act as a center for production and integration of basic scientific information to more fully understand coastal and island ecosystems and their natural and exploited populations.
- To evaluate and predict effects of human activities on the marine environment, and to develop measures to ameliorate lost or degraded natural resources.
- To train students in basic research on marine environmental issues that may be applicable to decision-makers.
- To facilitate and promote interdisciplinary research initiatives.

Faculty/Professional Research Participants:

Russell J. Schmitt, Director and Professor of Biology

Alice Alldredge, Professor of Biological Oceanography

Giacomo Bernardi, Professor of Molecular Ecology (UCSC)

Andrew Brooks, Associate Project Scientist

Mark Brzezinski, Professor of Biology

Alison Butler, Professor of Chemistry

Bradley Cardinale, Assistant Professor of Biology

Craig Carlson, Associate Professor of Biology

Robert C. Carpenter, Professor of Biology (CSU-Northridge)

Joseph H. Connell, Research Professor of Zoology

Jenifer E. Dugan, Associate Research Biologist

Peter J. Edmunds, Professor of Biology (CSU-Northridge)

John M. Engle, Associate Research Biologist

A. Russell Flegal, Professor of Environmental Toxicology (UCSC)

Steven D. Gaines, Professor of Biology

Ruth D. Gates, Assistant Research Biologist (University of Hawaii)

Scott Hodges, Professor of Biology

Gretchen Hofmann, Associate Professor of Biology

Sally J. Holbrook, Professor of Biology

Evelyn Hu, Professor of Electrical and Computer Engineering

Ronald Iltis, Professor of Electrical and Computer Engineering

Robert Jacobs, Professor of Biology

Ryan Kastner, Assistant Professor of Electrical and Computer Engineering

Michael I. Latz, Research Biologist, (Scripps -UCSD)

David Lea, Professor of Geology

Hua Lee, Professor of Electrical and Computer Engineering

James J. Leichter, Associate Professor of Oceanography, (Scripps -UCSD)

Hunter Lenihan, Associate Professor of Environmental Science

Milton Love, Research Biologist

Sally MacIntyre, Professor of Limnology and Oceanography

Stéphane Maritorena, Associate Researcher

John Melack, Professor of Biology

Daniel Morse, Professor of Biology

Erik Muller, Assistant Research Biologist

Roger M. Nisbet, Professor of Biology

Henry M. Page, Associate Research Biologist

Daniel C. Reed, Research Biologist

Stephen C. Schroeter, Research Biologist

Hannah Stewart, Postdoctoral Researcher (Un. Washington)

Allan Stewart-Oaten, Professor of Biology

David Valentine, Assistant Professor of Geological Sciences

Libe Washburn, Professor of Geography

Allison Whitmer, Assistant Dean (Georgetown University)

Susan Williams, Professor of Environmental Science and Policy (UCD)

Leslie Wilson, Professor of Biology

EcoInformatics Center

Extensive research directed toward identifying and understanding the natural world has been conducted, leading to the acquisition of monumental amounts of data. Yet, due to the ways in which these data are managed, only a small amount of it is readily available to researchers, including those who gathered it, after a very short period of time. The lack of ready access to information is not surprising for data collected by past generations of scientists, but access is typically impossible even for information garnered within the lifetime of the youngest ecologist, or even within the last five years. In fact, it will be true tomorrow for data gathered today. The unfortunate circumstance is that despite many years and dollars spent in pursuit of useful information about the environment, preservation and reuse of that data has not been a priority. As a consequence, environmental data are distributed widely across institutions, are not standardized in content and format, and typically undocumented. As a result, ecologists are now limited not only by a lack of information, but also by an inability to access the vast amount of data that has been collected.

The EcoInformatics Center (EIC) was established in July 2003 to address this situation by making what is already known about the environment available to potential users, from students and scientists to resource managers, regional planners, and policy makers. The EIC involves both the technical and human aspects of data acquisition, sharing, preservation, and utilization.

The EIC resides under the Marine Science Institute and is a partner Center to the National Center for Ecological Analysis and Synthesis (NCEAS). Approaches developed at NCEAS are being used to identify, develop, and test emerging concepts, technologies, and software.

The Mission of the EIC is to:

- Develop and deploy cutting edge technology to generate an Ecological Information Access System to locate and utilize the dispersed and heterogeneous information that characterizes data pertinent to ecological and environmental issues.
- Extend core data-access capabilities by developing and distributing contemporary information tools for scientists, students, conservationists, resource managers, policy makers, and planners.

To accomplish this mission, the EIC is composed of the following elements:

1. Research and software development to promote data acquisition, distributed access, and long term storage and archiving.
2. Analyses of the cultural and sociological aspects of information sharing
3. Training of students and scientists in the use of data management tools

Information is the raw material of knowledge. The research enterprise is designed to generate information – data – and facilitate its incorporation into higher order understanding and true knowledge of the system under consideration. Information has accumulated in a somewhat haphazard way for centuries. In certain focused areas, such as medicine, basic information has been turned into operational outcomes (diagnoses, treatments, pharmaceuticals) that have benefited humans. However, the geometric increase in information, and its availability in machine form, have made the amount of accessible information overwhelming; unfortunately it has not led to a commensurate increase in knowledge in most fields.

This is particularly true for ecological information, which is important for advancing the basic understanding of natural systems and for making wise management and policy decisions about natural resources. Within the universe of information, ecological data may be as dispersed and heterogeneous as any of interest to scientists and other users. Decisions commonly depend on integrating data as diverse as climatological records, spatial distributions of organisms, changes in biodiversity over space and time, responses of species to experimental manipulations, genetic structure of populations, patterns

of human alterations of ecosystems, and much more. The scope of information needed to understand ecological systems is enormous.

Ecological information is inherently diverse, and it grows more diverse each day as new types of relevant information emerge. As a result, a database designed for today would be exceedingly complex, and it would be outdated long before it could ever be developed. Thus, the environment needs a different data management model that provides generic access to information in place of a uniform database structure. Rather than creating a single, fixed data schema, the solution lies in an approach analogous to the Internet that standardizes how information is characterized (through metadata, or information about the data itself). Information, once characterized with metadata, can be made accessible in context-dependent ways that are both comprehensive and efficient. The key tools are an efficient, flexible, and standardized way to describe ecological information, and a powerful information searching capability.

The primary faculty and research scientists associated with the Center include:

Dr. Richard Appelbaum, Department of Sociology and Director, Institute for Social, Behavioral, and Economic Research
Dr. Steven Gaines, Department of Ecology, Evolution, and Marine Biology and Director, Marine Science Institute
Mr. Matthew Jones, Director of Informatics Research and Development, National Center for Ecological Analysis and Synthesis
Mr. Chris Jones, Information Systems Coordinator, Marine Science Institute
Dr. Dan Reed, Research Biologist, Marine Science Institute
Dr. O. J. Reichman, Department of Ecology, Evolution, and Marine Biology and Director, National Center for Ecological Analysis and Synthesis
Dr. Mark Schildhauer, Director of Computing, National Center for Ecological Analysis and Synthesis
Dr. Robert Warner, Department of Ecology, Evolution, and Marine Biology

Marine Biotechnology Center

UCSB is recognized internationally for its leadership in Marine Biotechnology. This exciting field uses the latest breakthroughs in modern molecular biology, genetic engineering and cell science to solve basic problems in marine resource biology; to improve the production of medical, chemical, food, and energy resources from the ocean; and to develop new products and industries based on more efficient use of the ocean's resources.

The Marine Biotechnology Center is unique in the University of California system. It helps coordinate fifteen different research programs in this area at UCSB, and helps obtain funding for the vitally needed practical training of advanced students and professionals to help meet the future needs and changing requirements of the nation's marine and biotechnology industries. Close interactions with California's biotechnology, aquaculture and pharmaceutical industries provide new products and highly trained scientific personnel to the industrial sector, and provide support from industry for research and training in the University. The state-of-the-art Marine Biotechnology Laboratory Building - the first such facility of its kind in the United States - provides facilities needed to accommodate the rapid growth of research and teaching in Marine Biotechnology on the campus.

Research and training in Marine Biotechnology are focused at UCSB in three inter-related areas: (1) the development of new methods and approaches from molecular and cellular biology to investigate the basic mechanisms controlling life in the oceans and its responses to environmental change; (2) the development of new industries, resources and products from the oceans; and (3) the use of marine organisms as models for biomedical research. Recent progress in these areas is summarized below.

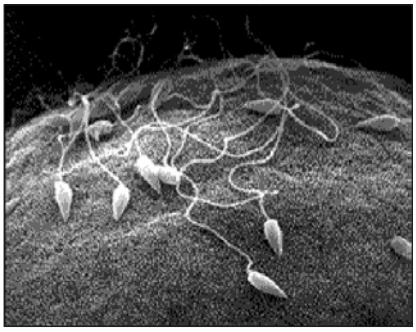
UCSB scientists are using the tools of biotechnology to unravel the ocean's mysteries in environments as diverse as the Antarctic, tropical seas and reefs, the great ocean depths, and California's resource-rich coastline. These investigations include pioneering studies of the molecular mechanisms of photosynthesis and carbon dioxide fixation by the ocean's phytoplankton, effects on these processes caused by the depletion of ozone in the Antarctic atmosphere, and effects of global warming, pollution and other environmental changes. UCSB scientists and students have discovered receptor molecules and chemical signals that control life in the ocean. The discovery of these signals, and of the receptors, transducing molecules and genes that respond to these signals, has shed new light on the underlying processes regulating the reproduction, development and growth of species ranging from tropical corals to valuable marine resources (urchins and abalones) in California waters and around the world.

Researchers in the Marine Biotechnology Center are developing the tools and techniques of molecular and cellular biology to better understand the biodiversity of marine organisms, and how they affect, and are affected by, physical, chemical and geochemical oceanic processes. Marine biota, particularly the microscopic plankton, are dominant mediators of geochemical change on Earth, yet the genetic diversity, abundance and function of these microorganisms in complex communities is still not completely understood. Researchers at the Marine Biotechnology Center are developing new ways to monitor these microscopic communities, and are discovering previously unsuspected diversity and population structure in globally distributed marine microbial populations.

Research at UCSB in the development of new products and industries from marine resources has led to the discovery of promising new diagnostic and therapeutic agents for diseases including cancer, arthritis, epilepsy and Alzheimer's disease, and the development of powerful new enzyme catalysts, novel bioadhesives, and marine microorganisms capable of degrading and detoxifying chlorinated

hydrocarbons and other pollutants. Members of the Marine Biotechnology Center are working with researchers in Chemistry, Physics and Engineering through UCSB's new Army-supported Institute for Collaborative Biotechnologies, and through the NSF-sponsored National Materials Research Laboratory, the California NanoSystems Institute, NIH's Bioengineering Consortium Program, and NASA's Biomolecular Materials program to develop valuable new materials based on the structures made by marine organisms which exhibit exceptional strength, resiliency, hardness and enhanced electrical and optical performance. With the help of the marine biotechnologists' skills in genetic and protein analysis and engineering, and close collaborations with colleagues in Chemistry, Physics and Engineering, the fundamental molecular structures and mechanisms underlying the enhanced performance of these natural materials made by marine organisms are being revealed, and translated into practical engineering solutions for the development of novel advanced materials. Teams are working with experts in the Department of Electrical and Computer Engineering to harness the mechanisms of low-temperature catalysis and molecular recognition of proteins that direct biomineralization in marine organisms to help direct the nanoscale fabrication of ultra-small crystals used for magnetic information storage and semiconductors, to help reduce the size and defect-density of electronic components, and to make new photovoltaic materials with improved efficiency to harness the sun's energy. A new generation of tough, water resistant adhesives and coatings has been inspired by sessile intertidal invertebrates, and the fangs and beaks of marine polychaetes and squids are the pointing the way to new lightweight polymeric materials with the hardness and wear resistance usually associated with ceramics. Research aimed at practical applications with economic value also has led to improvements in the economic efficiency and yield of cultivation of valuable marine fish, shellfish and plants grown for food and pharmaceuticals. These findings have led directly to the growth of new and "environmentally friendly" industries in Santa Barbara that now are producing abalones, urchins and marine algae using innovations in aquaculture technology developed at UCSB.

Research using marine organisms as model systems for biomedical research has led to a host of new and far-reaching discoveries at UCSB. Many marine invertebrates, because of their relatively simple design, and the ease of their maintenance and analysis in the laboratory, have provided a rich source of new information and serve as desirable, non-mammalian models for research. A major area of emphasis is in regard to the genetic control of normal development and of tumor formation. Professor Kathleen Foltz and her students make use of marine model systems to investigate fundamental questions of reproductive biology, cell cycle control, and early development. They discovered that the molecular recognition processes controlling oocyte maturation and fertilization are highly conserved across species; information gained from studying the eggs and embryos of many marine invertebrates (such as sea urchins, sea stars and sea squirts) can be applied to other animals, including mammals. This research group has been actively involved in the Genome Sequencing Project for the California Purple Sea Urchin, *Strongylocentrotus purpuratus*. Their team is part of an international consortium that completed the first echinoderm genome sequence. The information gained from this genome project is being used to identify and understand the gene networks that regulate early development, and to investigate the evolutionary underpinnings of animal development. The Foltz research team is using the genomic information to describe the egg "proteome" – the identification of all of the proteins present in the egg – and to study their regulation in the first few minutes of fertilization and during the egg to embryo transition. Using a functional proteomics approach, over 250 sea urchin egg proteins that undergo modifications at fertilization have been identified. Most of these proteins are conserved in mammals and thus may provide insight into fertility and contraception.



High-magnification electron micrograph of sea urchin sperm fertilizing an egg

Another important area of research is water resistant adhesion. Water is the nemesis of practical adhesive bonding, yet the rocky intertidal seashore is home to a host of organisms that spend their lives attached to solid surfaces surrounded and assaulted by water and waves. Professor Waite and his students discovered that the amino acid known as Dopa is a key to the remarkable underwater

adhesion in mussels and sandcastle worms. In related studies, discoveries first made at UCSB on the biological mechanisms controlling the nanofabrication and toughness of the abalone shell have now been extended by Professor Paul Hansma and his students to human bone, with profound implications for diseases such as osteoporosis and arthritis.

National Center for Ecological Analysis and Synthesis
July 1, 2010 – June 30, 2011

The National Center for Ecological Analysis and Synthesis (NCEAS) was created in May 1995 with funding from NSF, the State of California, and UCSB. The Center focuses on the use of collaborative and synthetic approaches to solve fundamental ecological and environmental problems, and emphasizes application of up-to-date analytical and informatics tools to existing data sets and the development of new modeling approaches. NCEAS (http://www.nceas.ucsb.edu/) is associated with the Marine Science Institute and is located in downtown Santa Barbara. Edward McCauley is NCEAS' Director, Stephanie Hampton is the Deputy Director, and Mark Schildhauer is the Director of Computing.

The Science Advisory Board (SAB) of 18 eminent ecologists met September 1 - 2, 2010 to review proposals and provide guidance on the Center's mission and research directions.

Research activities focus on working groups, sabbatical fellows, postdoctoral associates, distributed graduate seminars and graduate student internships. During the 2009-2010 fiscal year, NCEAS hosted 13 meetings, 41working group projects, and 6 training workshops. In addition, the Center hosted 7 Sabbatical Fellows, 23 Postdoctoral Associates, 8 Center Associates, 13 graduate student interns, and 4 undergraduate interns.

NCEAS activities involve important topics in ecology and allied disciplines such as analysis of large scale processes, complex population dynamics, ecological community dynamics, analysis of broad biogeographical patterns, development of new analytical and statistical methods, projects related to resource management, and ecological informatics. Several projects have involved areas outside the core of ecology, such as human cultural diversity, sociology of scientific collaboration, and urban ecology.

The Gordon and Betty Moore Foundation has supported a diversity of NCEAS projects. A Moore-funded project has supported two postdoctoral researchers and multiple Working Groups convened to examine the effects of climate change on wild Pacific salmon. The Moore Foundation funded a distributed graduate seminar in complement to a NSF-funded working group that was assembled to reconcile the viewpoints of Fisheries science and Ecology in issues of fisheries management. Finally, the Moore Foundation is supporting a project at NCEAS in which we purchased a proprietary software package (AD Model Builder) common in Fisheries management, moved it into the public domain and have provided free training sessions to extend its usefulness to other fields.

The David and Lucille Packard Foundation continue to fund working groups and postdoctoral fellows focused on a critical review of ecosystem-based management (EBM) efforts relevant to coastal-marine ecosystems and to design a longer-term program of activities to develop the scientific foundations for EBM in coastal marine systems. Packard EBM awards include a project which emphasizes making scientific results more available and useful for policymakers.

The Nature Conservancy supports Working Groups assembled to examine the economic impacts of non-native forest pests and pathogens in North America; previous phases of the project included support for postdoctoral researchers, distributed graduate seminar, and a graduate student.

The Paul G. Allen Family Foundation has supported a project that focuses on the design of sustainable fisheries that meet socioeconomic needs and conservation goals for society. This project also involves Environmental Defense, a non-governmental organization that is active in marine conservation.

The U.S. Fish and Wildlife Service has funded a project designed to synthesize information related to the decline of endangered fishes in the San Francisco Bay Estuary.

An ongoing NOAA Fisheries project has supported two working groups to address the need for generalizable approaches to detecting species-level responses to large-scale environment management actions. NOAA is also a co-supporter of a CAMEO (NSF-NOAA) collaboration to examine natural and human influences on coral reef community structure, diversity, and resilience, a project involving technicians who collaborate with a postdoctoral researcher.

The Henry Luce Foundation founded graduate fellowships at UCSB as part of a program called Environmental Science to Solutions, in which graduate students received training in leadership, communication and ecoinformatics. NCEAS provided ecoinformatics training, gave students experience in existing Working Group collaborations, and continues to host Working Groups that the students themselves have convened. Student projects include "The effects of global change on malaria transmission: a meta-analysis", "Can eco-labeling drive conservation & sustainable harvesting of marine fisheries" and "The science, media reporting, and politics of CA air quality: Content, context, and voting patterns of Prop 23."

An award from Conservation International convenes experts to develop rigorous and transparent indices of "ocean health" to guide and influence science and policy at national and international levels. Professional, postdoctoral, graduate student and high school researchers have been supported on this award.

One postdoctoral researcher is supported by the Schmidt Foundation to study shark interactions on coral reefs.

NCEAS has become a leader in developing collaborations and technical solutions to overcome obstacles related to the dispersed and heterogeneous nature of ecological data. The Center has been involved with many collaborators to develop generic data access tools for more efficient and powerful analysis of ecological data by a broad user community, from student and resource managers to scientists. These ecoinformatics tools are reaching maturity and are being deployed in a number of settings; information about these tools can be found online at http://www.nceas.ucsb.edu/ecoinformatics.

NCEAS encourages wide dissemination of Center-related findings by providing press releases and interviews to popular media outlets, by maintaining a news feature and archive on our website, and using other web-based media, and by providing communications training for our scientists. NCEAS promotes interest in ecology and technology professions, particularly among underrepresented groups, provides outreach experiences to resident scientists, and fosters the inclusion of synthesis in ecology education.

NCEAS provides training opportunities for K-12, graduate school, and professionals. These include a successful Kids do Ecology program and bilingual website, Distributed Graduate Seminars, as well as scientific computing and ecoinformatics workshops. The Center also hosted 32 Ecolunch seminars this past year. These seminars are presented by resident and visiting scientists, and are open to the scientific community.

NCEAS relies almost exclusively on the Internet to disseminate Center-related information and findings, in addition to the usual peer-reviewed publications. The Center receives e-mail at nceas@nceas.ucsb.edu, and our website is http://www.nceas.ucsb.edu. The NCEAS home page provides interactive access to a large array of information, including summaries of current and pending research, descriptions of computing resources at NCEAS and elsewhere, funding and employment opportunities at NCEAS, ecological data archives, and NCEAS reports and publications.

NCEAS Working Groups, Meetings, Conferences, And Training Workshops July 1, 2010 – June 30, 2011

Working Groups

Leader(s): Altizer, Sonia; Oberhauser, Karen; Ries, Leslie
Title: Monarch butterflies as a model for understanding the spatiotemporal dynamics of migratory species and their response to environmental change
18OCT2010 - 22OCT2010 and 17MAY2011 - 22MAY2011

Leader(s): Anderson, Sean; Peterson, Charles; Cherr, Gary
Title: Ecotoxicology of the gulf oil spill: A holistic framework for assessing impacts
14SEP2010 - 17SEP2010 and 14DEC2010 - 16DEC2010

Leader(s): Aronson, Myla; Katti, Madhusudan; Warren, Paige; Nilon, Charles
Title: Comparative ecology of cities: What makes an urban biota "urban"?
10JAN2011 - 14JAN2011

Leader(s): Aukema, Juliann; Reichman, O.; Hampton, Stephanie
Title: Economic impacts of non-native forest pests and pathogens in North America (TNC)
29NOV2010 - 03DEC2010

Leader(s): Boone, Christopher; Pickett, Steward; Grove, J. Morgan; Cadenasso, Mary
Title: Ecology of environmental justice in metropolitan areas
28MAR2011 - 01APR2011

Leader(s): Britton, Kerry
Title: Plants for planting
12JUL2010 - 16JUL2010

Leader(s): Buckley, Lauren; Holt, Robert; Angilletta, Michael; Tewksbury, Joshua
Title: Mechanistic distribution models: Energetics, fitness, and population dynamics
23MAY2011 - 26MAY2011

Leader(s): Callaway, John; Crooks, Steve; Megonigal, Pat; Doherty, Abe
Title: Tidal wetland carbon sequestration and greenhouse gas emissions model
15SEP2010 - 18SEP2010

Leader(s): Cardinale, Bradley; Hooper, Dave; Duffy, Emmett
Title: Biodiversity and the functioning of ecosystems: Translating results from model experiments into functional reality
09AUG2010 - 13AUG2010 and 21MAR2011 - 25MAR2011

Leader(s): Cavender-Bares, Jeannine; Ackerly, David; Ree, Richard; Reich, Peter; Mack, Michelle; Burleigh, J. Gordon;
Title: Linking phylogenetic history, plant traits, and ecological processes at multiple scales
17NOV2010 - 20NOV2010

Leader(s): Chase, Jonathan; Sanders, Nathan; Freestone, Amy
Title: A synthesis of patterns, analyses, and mechanisms of beta-diversity along ecological gradients
04NOV2010 - 08NOV2010

Leader(s): Cleveland, Cory; Townsend, Alan
Title: Revisiting nutrient limitation in tropical forests
17MAY2011 - 20MAY2011

Leader(s): Condon, Robert; Duarte, Carlos; Graham, William
Title: Global expansion of jellyfish blooms: Magnitude, causes and consequences
17NOV2010 - 22NOV2010

Leader(s): Cook, Benjamin; Wolkovich, Elizabeth
Title: Forecasting phenology: Integrating ecology, climatology, and phylogeny to understand plant responses to climate change
07DEC2010 - 12DEC2010 and 02MAY2011 - 06MAY2011

Leader(s): Costanza, Robert; Graumlich, Lisa; van der Leeuw, Sander
Title: Integrated history and future of people on Earth (IHOPE): Building a community data base and testing the resilience - sustainability hypothesis across scales
15SEP2010 - 18SEP2010

Leader(s): Crone, Elizabeth; Menges, Eric; Ellis, Martha
Title: When are matrix models useful for management? An empirical test across plant populations
09NOV2010 - 13NOV2010 and 09APR2011 - 13APR2011

Leader(s): Crowder, Larry; Smith, Martin
Title: Envisioning a sustainable global seafood market and restored marine ecosystems
02NOV2010 - 05NOV2010

Leader(s): Edmunds, Peter; Gates, Ruth
Title: Tropical coral reefs of the future: Modeling ecological outcomes from the analyses of current and historical trends
30NOV2010 - 01DEC2010 and 21FEB2011 - 26FEB2011

Leader(s): Enquist, Brian; Peet, Robert; Condit, Richard; Boyle, Brad; Dolins, Steven
Title: Developing an integrated botanical information network to investigate the ecological impacts of global climate change on plant biodiversity
06DEC2010 - 10DEC2010

Leader(s): Fleishman, Erica
Title: Prediction of responses of wild Pacific salmon to climate change

22SEP2010 - 23SEP2010

Leader(s): Fleishman, Erica
Title: Ecological thresholds in the San Francisco Estuary
19OCT2010 - 21OCT2010 and 25JAN2011 - 27JAN2011

Leader(s): Guerry, Anne; Chan, Kai
Title: Cultural ecosystem services from marine and coastal systems: Counting the intangibles EBM
08FEB2011 - 10FEB2011

Leader(s): Jones, Matthew; Hampton, Stephanie
Title: DataONE: Observation Network for Earth
06APR2011 - 08APR2011

Leader(s): Konrad, Christopher; Olden, Julian
Title: Evaluating responses of freshwater ecosystems to experimental water management
20JUL2010 - 22JUL2010

Leader(s): Lafferty, Kevin; Dobson, Andrew; Pascual, Mercedes
Title: Parasites and food webs - the ultimate missing links
24JAN2011 - 28JAN2011

Leader(s): Liebhold, Andrew; McCullough, Deborah
Title: Applying population ecology to strategies for eradicating invasive forest insects
08NOV2010 - 12NOV2010

Leader(s): Maunder, Mark; Bolker, Benjamin; Gardner, Beth
Title: Evaluating and improving open source software for nonlinear statistical modeling in ecology
10JAN2011 - 14JAN2011

Leader(s): McGill, Brian; Jetz, Walter; Guralnick, Robert; McPherson, Jana
Title: Choosing (and making available) the right environmental layers for modeling how the environment controls the distribution and abundance of organisms
12OCT2010 - 16OCT2010

Leader(s): McLeod, Karen; Crowder, Larry; Fogarty, Michael; Rosenberg, Andrew
Title: A framework to assess ecosystem health in support of ecosystem-based management of coastal-marine systems (EBM)
03OCT2010 - 05OCT2010 and 14JUN2011 - 16JUN2011

Leader(s): Norby, Richard; Luo, Yiqi; Prentice, I. Colin; Oren, Ram; Hanson, Paul
Title: Benchmarking ecosystem response models with experimental data from long-term CO2 enrichment experiments
13SEP2010 - 17SEP2010

Leader(s): Peterson, Erin; Ver Hoef, Jay; Isaak, Daniel
Title: Spatial statistical models for stream networks: Synthesis and new directions

04APR2011 - 08APR2011

Leader(s): Possingham, Hugh; Klein, Carissa
Title: Supporting decision making in the Coral Triangle Initiative: Prioritizing socially and economically viable projects and places for biodiversity conservation EBM
05SEP2010 - 10SEP2010 and 10MAY2011 - 13MAY2011

Leader(s): Richardson, Anthony; Poloczanska, Elvira
Title: Towards understanding marine biological impacts of climate change
14OCT2010 - 18OCT2010 and 10MAY2011 - 14MAY2011

Leader(s): Rosenberg, Michael; Epperson, Bryan; Storfer, Andrew
Title: An interdisciplinary approach to advancing landscape genetics
19JUL2010 - 23JUL2010 and 19FEB2011 - 22FEB2011

Leader(s): Sabo, John; Bowling, Laura; Schoups, Gerrit
Title: Human impacts of water infrastructure on watershed ecosystems and the sustainability of irrigated agriculture in the coterminous US
27JUN2011 - 29JUN2011

Leader(s): Schildhauer, Mark
Title: INTEROP: A Community-driven scientific observations network to achieve interoperability of environmental and ecological data
19JUL2010 - 20JUL2010 and 18APR2011 - 20APR2011

Leader(s): Shaw, M. Rebecca
Title: Global climate change and adaptation of conservation priorities
10AUG2010 - 13AUG2010 and 15MAY2011 - 16MAY2011

Leader(s): Sibert, John; Maunder, Mark
Title: Public domain ADMB project
20JUN2011 - 23JUN2011

Leader(s): Sorte, Cascade; Lawler, Joshua; Dukes, Jeffrey
Title: Climate change and invasive species: Are non-natives poised for greater success in future climatic conditions?
24JAN2011 - 28JAN2011 and 21MAY2011 - 25MAY2011

Leader(s): Waples, Robin; Hutchings, Jeffrey
Title: Red flags and species endangerment: Meta-analytical development of criteria for assessing extinction risk
28SEP2010 - 01OCT2010 and 21MAR2011 - 24MAR2011

Leader(s): Waples, Robin; Schindler, Daniel
Title: Evolutionary and plastic responses of Pacific salmon to climate change
25OCT2010 - 26OCT2010

Meetings Hosted By NCEAS

Leader(s): Brachman, Micah; Vogt, Lindsay; Heemskerk, Idse
Title: The science, media reporting, and politics of California air quality: Content, context, and voting patterns of Proposition 23 (Luce Fellows) (Hosted by NCEAS)
19APR2011 - 21APR2011

Leader(s): Cavender-Bares, Jeannine; Polasky, Stephen
Title: Developing curricula and model systems for sustainability science: Subtitle: Distributed Graduate Seminar Planning Meeting
30AUG2010 - 31AUG2010

Leader(s): Connors, Margaret
Title: Education, Outreach and Communication Coordinators Annual Meeting
28SEP2010 - 29SEP2010

Leader(s): Davis, Frank
Title: The Joint TNC-NCEAS Visioning Meeting
02MAY2011 - 03MAY2011

Leader(s): Fleishman, Erica
Title: Evaluation of declines of pelagic organisms in the upper San Francisco Estuary: Bay-Delta Science Conference
26SEP2010 - 30SEP2010

Leader(s): Gross, Katherine
Title: Predicting grassland community responses to fertilization: Exploring the role of clonality and other species traits
03NOV2010 - 05NOV2010 and 16DEC2010 - 17DEC2010

Leader(s): Hampton, Stephanie
Title: Kids Do Ecology Poster Day
15MAR2011 - 15MAR2011

Leader(s): Hoeksema, Jason; Bever, James
Title: A graduate seminar network to facilitate synthetic research on context-dependency in the mycorrhizal symbiosis: Grand synthesis Meeting for Distributed Graduate Seminar
21JAN2011 - 23JAN2011

Leader(s): Marsh, David
Undergraduate Network for Invasive Plant Research Meeting (Hosted by NCEAS)
09APR2011 - 10APR2011

Leader(s): Mordecai, Erin
Title: The effects of global change on malaria transmission: A meta-analysis (Luce Fellows)
02FEB2011 - 04FEB2011

Leader(s): Mourad, Teresa; Gram, Wendy; Grant, Bruce
Title: Engaging undergraduate students in ecological investigations using large, public datasets: Distributed Graduate Seminar Grand Synthesis Meeting
11APR2011 - 12APR2011

Leader(s): Ricketts, Taylor
Title: Science Advisory Board 2010-2011 Meeting
01SEP2010 - 02SEP2010

Leader(s): Teck, Sarah
Title: Can eco-labeling drive conservation and sustainable harvesting of marine fisheries? (Luce Fellows) (Hosted by NCEAS)
14JUN2011 - 17JUN2011

Training Workshops

Instructor(s): Baron, Nancy and Ben Halpern
Title: COMPASS Training Workshop
16MAR2011 - 18MAR2011

Instructor(s): Halpern, Benjamin
Title: Ocean Health Index Weighting Workshop (Hosted by NCEAS)
07MAR2011 - 09MAR2011

Instructor(s): Byrnes, Jarrett
Title: Structural Equation Modeling
06JUN2011 - 08JUN2011

Instructor(s): Regetz, Jim
Title: NCEAS servers, Subversion, Morpho and KNB Training
15NOV2010 - 16NOV2010

Instructor(s): Regetz, Jim
Title: Luce Graduate Fellow Informatics Seminar
17FEB2011 - 17FEB2011

Instructor(s): Williams, Jennifer
Title: Structured population modeling workshop
06OCT2010 - 07OCT2010

Ocean and Coastal Policy Center

Ocean and coastal policy issues are becoming increasingly important in California, nationally, and internationally. The University of California, Santa Barbara is in a key position to make significant contributions in research and policy analyses of local, state, national, and international ocean management issues.

The need for programmatic attention on ocean and coastal policy in California has never been greater. California has one of the longest and most valuable coastlines in the nation. Offshore California, significant development of offshore resources takes place and the ocean and coastal zone are used, with increasing frequency, by a wide range of users - including offshore oil and gas extraction, recreation, marine transportation, fishing, and marine research. Offshore oil development and the attendant multiple-use controversies, in particular, have dramatized the need for better methods of ocean policy planning.

The Ocean and Coastal Policy Center (OCPC) is oriented toward problem-solving of significant coastal and ocean policy issues. Work at the center is interdisciplinary, involving perspectives from the different social science disciplines (broadly defined as political science, economics, law, history, anthropology, sociology, geography and aspects of environmental studies) and from the natural and physical sciences. In addition to interdisciplinary research, the Center engages in applied projects which directly relate research to specific marine policy problems. The OCPC is one of the few centers in California focusing on these issues.

Major themes of the center include:

- Coastal watershed management and ecosystem planning
- California marine and coastal policy
- Aquatic and marine biodiversity conservation policymaking
- Studies in ecological restoration

The OCPC has received support from the National Science Foundation, U.S. Department of the Interior, and other governmental agencies. The Center has also produced a “White Paper Series” that includes several essays devoted to ecological and policy-related activities of the Southern California Bight and associated coastal watersheds and wetlands. The special series is available on the center’s webpage.

UC Natural Reserve System

The mission of the UC Natural Reserve System is to contribute to the understanding and wise management of the Earth and its natural systems by supporting university-level teaching, research, and public service at protected natural areas throughout California.

The University of California administers 35 natural reserves throughout the state which serve as outdoor classrooms and research laboratories for faculty, researchers, and college students in the field sciences and humanities. Community groups and K-12 classes also benefit from the reserve system through field trips and outreach programs. The reserves are natural areas that represent the ecological diversity of California. Most of the major habitats of California are included in the NRS. Each reserve is managed by a UC campus. UC Santa Barbara oversees seven of these reserve sites with habitats as diverse as coastal wetlands, coastal dunes, rocky intertidal, oak woodlands, grasslands, Monterey pine forest, island marine and terrestrial environments, and the mountain and Great Basin environments of the eastern Sierra. Unlike wilderness areas that are available for public recreation, the University reserves are devoted entirely to teaching and research. The reserves serve as "living laboratories," where researchers, teachers, and students can pose questions of the natural world that can only be answered by studying the natural environment. Access to the reserves is restricted to preserve their natural resources and provide security for long-term research and education projects.

- **Carpinteria Salt Marsh Reserve** is a significant coastal wetland reserve located 20 miles east of UCSB. It consists of 120 acres of south coast estuary, mudflats, beach and intertidal habitats, providing areas for studies on wildlife and fisheries biology, botany, and ornithology (site of several endangered species). The reserve is a part of the 230-acre Carpinteria Salt Marsh, one of the largest remaining coastal wetland habitats in southern California.

Reserve Staff
Andrew J. Brooks. Reserve Director
William Rice, Faculty Advisor

- **Coal Oil Point Natural Reserve** is located on the West Campus of UCSB and is composed of 158 acres of vulnerable and valuable coastal dunes, coastal terrace, south coastal estuarine lagoon, vernal pools, mudflats, beach and rocky intertidal habitats. It provides critical habitat for a number of endangered species including the Western Snowy Plover. This reserve is an ideal location for studies of migratory shorebirds and waterfowl, estuarine plants and animals, water quality and the impacts of human activities on coastal environments. Because of its close proximity to the main campus, the Coal Oil Point Natural Reserve provides a unique and accessible research and teaching resource.

Reserve Staff
Cristina Sandoval, Resident Reserve Director
Carla D'Antonio, Faculty Advisor

- **Kenneth S. Norris Rancho Marino Reserve** lies along the coast just south of Cambria. This 500 acre reserve offers access to offshore giant kelp forests, as well as a very diverse rocky shore. Important terrestrial natural resources include coastal terrace grassland and soft chaparral plant communities. The reserve contains the southern-most remnant of indigenous Monterey pine forest. Overnight facilities are available for research groups and university classes.

Reserve Staff
Don Canestro, Resident Reserve Director
Steven Gaines, Faculty Advisor

- **Santa Cruz Island Reserve,** located 24 miles offshore from Santa Barbara, comprises 46,020 acres

of the largest and most topographically diverse of Southern California's offshore islands. Two thirds of the island is owned by The Nature Conservancy and remainder is part of the National Park Service. The island is used by the Natural Reserve System for research and environmental education under a long-term license agreement. The reserve field station is located in the center of the island and provides housing, laboratories, collections, information, a GIS database, and transportation to support research and teaching on and around Santa Cruz Island and neighboring islands in the Channel Island chain.

Reserve Staff
Lyndal Laughrin, Resident Reserve Director
Sally J. Holbrook, Faculty Advisor

- **Sedgwick Reserve** is located less than one hour from the UCSB campus and is an excellent natural study area for classes in biology, botany, zoology, geography, geology, anthropology, agroecology, and environmental studies. Situated in the Santa Ynez Valley, the 5,860 acre reserve includes coast live oak forest, blue oak woodland, valley oak savannah, Ceanothus chaparral, coastal sage scrub, grassland, and willow riparian forest, plus a variety of wetland types, including vernal pools. The reserve's large size and environmental heterogeneity provide an exceptional opportunity for teaching and research on biodiversity and landscape ecology. The extensive repetition of small drainages, distinct geologic and soil regimes (including large areas of unique serpentines), and complete drainage systems make the site uniquely suitable for replicated experimental studies. At least one significant Chumash archeological site is located on the property. The reserve has active K-12 science education and public outreach programs in addition to supporting research and university instruction.

Reserve Staff
Katherine McCurdy, Resident Reserve Director
Joshua Schimel, Faculty Advisor

- **The Valentine Eastern Sierra Reserve** is composed of two reserve sites in the Mammoth Lakes area, SNARL and Valentine Camp.

The Sierra Nevada Aquatic Research Laboratory (SNARL) is located on 51 acres of the eastern slope of the Sierra Nevada and is an ideal base for field research throughout the ecologically and geologically diverse eastern Sierra and Owens Valley. The reserve offers modern housing, including dormitory accommodations for short and long-term use by researchers and classes. Office space and laboratory facilities, including wet labs, controlled-environment rooms, chemistry and radio-isotope labs, and experimental stream channels, as well as meeting and classroom facilities, are offered on a year-around basis. An extensive GIS database, a library, and a computer/communications center are also available. The reserve supports a well-attended public lecture series in the spring and early summer.

Valentine Camp encompasses 152 acres and contains one of the region's few pristine montane meadows. It provides varied habitats, including coniferous forest, chaparral, and sagebrush plains in which to conduct observational and experimental studies. The considerable ecological diversity within the reserve makes it an excellent teaching resource. The facilities include housing and laboratories which are open in the summer and early fall and, on a limited basis, in the winter. A system of foot trails provides access to all of the site's major habitats. The reserve has a very active K-12 outreach program during the summer.

Reserve Staff
Daniel R. Dawson, Resident Reserve Director
John M. Melack, Faculty Advisor
Leslie Dawson, K-12 Education Coordinator

UCSB Natural Reserve System Administration
William W. Murdoch, Director
Susan L. Swarbrick, Associate Director
Donna Moore, MSO

Analytical Laboratory

The MSI Analytical Lab is a professionally managed chemical analysis facility, with the objectives of improving the quality and efficiency of marine-related research efforts, and of providing advanced capabilities for new and expanded research programs. Originally established in 1977 to serve the needs of UCSB marine researchers, the facility is now recognized campus wide as well as nationally as a resource for high-quality analytical services, with a regular user base of over 50 faculty and professional researchers. The major capabilities of the Lab include metals analysis by Inductively Coupled Plasma Mass Spectroscopy, Flame Atomic Absorption Spectroscopy (AAS), and Furnace AAS; bulk elemental analysis of carbon, hydrogen and nitrogen (CHN) by combustion; stable isotope ratio determination of light isotopes (C, N, O, H, S) in biological and geological materials using both continuous-flow and dual inlet Isotope Ratio Mass Spectrometry; and automated determination of nutrients in natural waters using a 5-channel Flow Injection Analyzer. Most of the Lab's current instrumentation was obtained with extramural funding from grants acquired by the Lab manager in conjunction with interested faculty and researchers. The Lab operation is supported largely through user fees. There are currently five full time and three part time staff employed by the Analytical Laboratory. Please visit our Web site at analab.msi.ucsb.edu for more information.

MSI Education and Outreach

2010 was another year of growth for the REEF and MSI Ed/Outreach. It was also a year of shifting program focus and rebranding to Oceans-To-Classrooms and our partnership with the Channel Island National Marine Sanctuary continues to grow and develop with the construction of the Outreach Center for Teaching Ocean Science (OCTOS). Our total outreach efforts have provided marine science and ocean awareness to almost 16,000 (See Figure 1) people on the Central Coast. On-Campus efforts have seen visits to the REEF increase to almost 10,000! Our Mobile Efforts alone reached almost 1500 children. None of this would have been possible without our continued growth and collaborations with such groups both on- and off-campus. These groups include the Cheadle Center for Biodiversity and Ecological Restoration (CCBER), The Office of Early Academic Outreach and Preparation (EAOP) and many others.

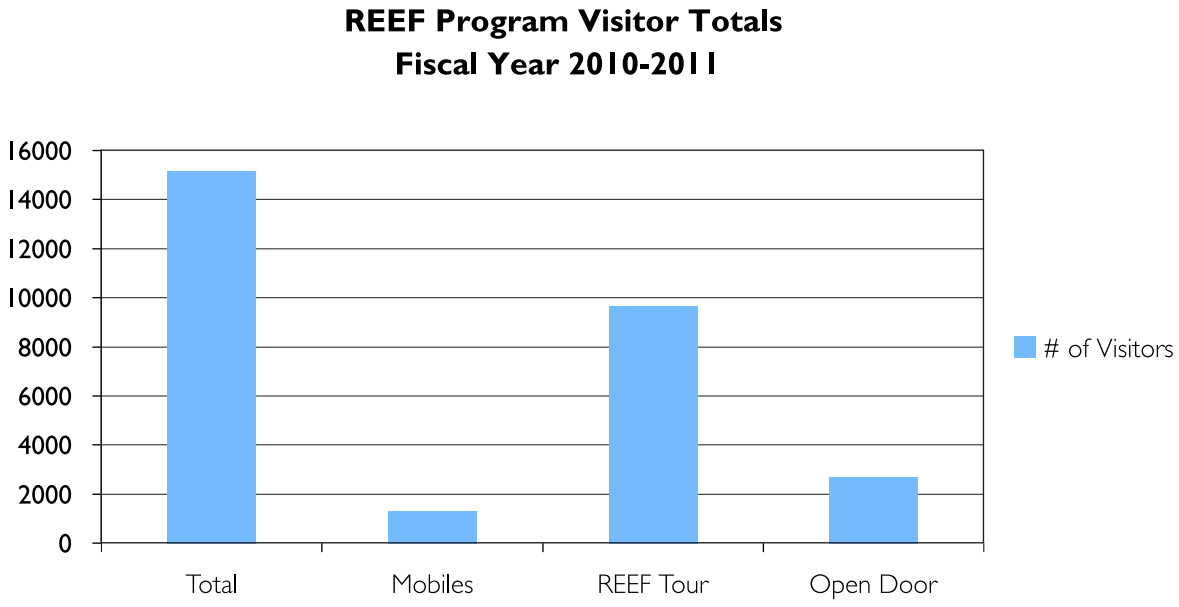


Figure 1. Figure 1. Graph of total number of participants served through MSI Ed/Outreach Efforts and the REEF.

Awards Administered

Awards Administered

California Coastal Conservancy

W. Murdoch, S. Swarbrick	8/26/2010-12/31/2012	$960,000
Sedgwick Reserve Infrastructure and Facilities Project: Phase 2		
	California Coastal Conservancy Subtotal	**$960,000**

California Dept. of Boating and Waterways

J. Dugan	4/1/2011-12/31/2012	$34,988
The Ecological Services of Open Coast Sandy Beaches		
	California Dept. of Boating and Waterways Subtotal	**$34,988**

California Dept. of Parks and Recreation

J. Dugan H.M. Page	4/20/2010-2/28/2012	$49,511
		$49,566
Evaluating Approaches to Enhancing Prey Resources for Nesting Shorebirds on Sandy Beaches		
	California Dept. of Parks and Recreation Subtotal	**$99,077**

California Sea Urchin Commission

S. Schroeter	7/1/2009-4/30/2012	$8,000
		$2,000
Studies of Sea Urchins Settlement in Southern and Northern California		
	California Sea Urchin Commission Subtotal	**$10,000**

Clark County, Nevada

T. Dudley	12/16/2008-7/1/2011	$46,430
For Effectiveness Monitoring of Spring-fed Wetlands and Riparian Restoration Treatments		
	Clark County, Nevada Subtotal	**$46,430**

CODAR Ocean Sensors

L. Washburn	9/1/2010-1/15/2011	$31,659
HF Radar Calibration with Automatic Identification System Ships of Opportunity		
	CODAR Ocean Sensors Subtotal	**$31,659**

Colorado State University

A. Whitmer	10/1/2008-9/30/2012	$1,049,469
MSP: Culturally Relevant Ecology, Learning Progressions, and Environmental Literacy		
	Colorado State University Subtotal	**$1,049,469**

Consolidated Safety Services

D. Valentine Pisces Cruise to Study the Effects of the Deepwater Horizon	8/1/2010-7/1/2011	$18,000
	Consolidated Safety Services Subtotal	**$18,000**

Ecotrust

M. Jones, M. Schildhauer Semantic Representation of Juvenile Salmon Outmigrant Data	11/17/2010-9/30/2011	$45,931
	Ecotrust Subtotal	**$45,931**

Gordon and Betty Moore Foundation

J. Caselle, S. Gaines Partnership for Interdisciplinary Studies of Coastal Oceans: Science to Policy, the Marine Life Protection Act	8/1/2010-12/31/2012	$846,492
	Gordon and Betty Moore Foundation Subtotal	**$846,492**

Human Frontier Science Program Organization (Intl)

H. Waite The Calcified Byssus of Anomia: A Unique Solution to Underwater Adhesion	5/1/2010-4/30/2013	$125,000
	Human Frontier Science Program Organization (Intl) Subtotal	**$125,000**

Japan Aerospace Exploration Agency (JAXA)

I. Leifer GOSAT Synergies for Ground-Reference of CH4-Emissions from Geologic and Biologic Mid-Latitude and Arctic Sources	1/1/2011-12/31/2012	$-0-
	Japan Aerospace Exploration Agency Subtotal	**$-0-**

Lockheed Martin Corporation

I. Leifer Multibeam Sonar Application to At-Sea Fish Aquaculture	4/1/2011-3/31/2012	$45,500
	Lockheed Martin Corporation Subtotal	**$45,500**

Marisla Foundation (frmly Homeland Foundation)

J. Caselle, S. Gaines Coral Reef Research in a Rare, Undisturbed Ecosystem: UCSB and Palmyra Atoll	6/26/2008-1/31/2012	$200,000
	Marisla Foundation Subtotal	**$200,000**

National Aeronautics and Space Administration

M. Fewings Satellite and Land-Based Remote Sensing of Atmospheric Wind Relaxations and the Oceanic Response in the California Current Large Marine Ecosystem	7/22/2010-7/21/2014	$145,059
	National Aeronautics and Space Administration Subtotal	**$145,059**

National Science Foundation

C. Briggs, R. Knapp	6/17/2007-8/31/2010	$466,082 $7,500
Collaborative Research: After the Crash: Factors Allowing Host Persistence Following Outbreaks of a Highly Virulent Disease		
B. Cardinale, L. Albertson	10/1/2006-6/30/2010	$15,000
Dissertation Research: Impacts of Biological Diversity on Sediment Transport Conditions in Streams		
J. Caselle	7/15/2010-6/30/2013	$122,482
CAMEO: Comparative Approach to Predicting the Consequences of an Impending Reinvasion: Top-Predator Effects on Californian Nearshore Fisheries		
J. Damuth	6/1/2010-5/31/2012	$60,000
Collaborative Research: Were There "Too Many" Browser Species Worldwide in Local Faunas of the Early Miocene? Testing a Global Hypothesis using the Australian Fossil Mammal Record		
C. D'Antonio	9/1/2010-8/31/2011	$214,284 $7,500
Long Term Impacts of Grass Invasions and Fire on Community Change and Plant Soil Feedbacks		
C. D'Antonio, K. Stahlheber	7/1/2011-6/30/2012	$13,163
DISSERTATION RESEARCH: Islands of Invasion: Savanna Oak Trees and Plant Community Structure in California Grasslands		
F. Davis	10/1/2006-9/30/2012	$3,703,738
NCEAS: National Center for Ecological Analysis and Synthesis		
A. De Tomaso	11/1/2009-10/31/2011	$226,882
Evolution of Allorecognition in a Basal Chordate		
S. Hampton	8/1/2010-7/31/2013	$41,559
Collaborative Research: CAMEO: Comparative Analyses of Natural and Human Influences on Coral Reef		
S. Hampton, D. Marsh	11/1/2009-10/31/2011	$23,668
An Undergraduate Network for Analyzing Plant Invasion in U.S. National Wildlife Refuges - A Workshop Proposal		
S. Hodges, S. Mazer, R. Finkelstein	10/1/2010-9/30/2013	$283,656
Renovation of Research Greenhouses at UC Santa Barbara for Ecological, Evolutionary and Developmental Studies		
G. Hofmann	8/1/2010-7/31/2013	$563,446
Effect of Ocean Acidification on Early Life Stages of Antarctic Sea Urchins (Sterechinus neumayeri)		
G. Hofmann	9/1/2010-8/31/2013	$599,034
Synergistic Effects of Climate-Related Variables on Larval Sea Urchins: Performance to Gene Expression		
G. Hofmann, P. Matson	8/1/2010-7/31/2012	$8,394
International: Biochemical Consequences of Ocean Acidification on Larval Development in a Temperate Sea Urchin		
G. Hofmann, C. Blanchette, L. Washburn	10/1/20109/30/2013	$473,354
OCEAN ACIDIFICATION - Category 1: COLLABORATIVE RESEARCH: Acclimation and Adaptation to Ocean Acidification of Key Ecosystem Components in the California Current System		
J. Kennett	9/15/2008-8/31/2012	$175,625
Collaborative Research: Co-Evolution of Submillennial and Orbital Scale Climate and Ocean Behavior During the Last 700 kyrs: The Unique Santa Barbara Basin Record		

I. Leifer	9/1/2010-8/31/2013	$224,088
COLLABORATIVE RESEARCH: The East Siberian Arctic Shelf as a Source of Atmospheric Methane: First Approach to Quantitative Assessment		
I. Leifer	8/1/2010-7/31/2012	$110,711
RAPID: Fossil-Fuel Extraction Industry Methane Emission Ground Reference Measurements during the AVIRIS Response to the Gulf Oil Spill		
L. Lisiecki	10/1/2010-9/30/2013	$157,017
CMG Collaborative Research: Probabilistic Stratigraphic Alignment and Dating of Paleoclimate Data		
S. Mazer	8/15/2007-1/31/2013	$228,858 $25,000 $6,000
Collaborative Research: The Evolution of Life History, Physiological, and Floral Traits in Clarkia: do Genetic Correlations Affect Mating System Evolution?		
T. Oakley	9/1/2010-8/31/12	$200,000
Collaborative Research: Developing Genomic Tools for Integrative Biology Research		
T. Oakley	4/1/2007-3/31/2010	$15,000
CAREER: Exploring Congruence of Fossil and Molecular Estimates of MacroevolutionaryDivergence Times in Ostracoda (Crustacea)		
T. Oakley	10/1/2010-9/30/2012	$515,722
Dimensions: Collaborative Research: Can Evolutionary History Predict How Changes in Biodiversity Impact the Productivity of Ecosystems?		
H. M. Page	4/1/2010-3/31/2012	$264,564
Sources of Particulate Organic Matter and Their use by Benthic Suspension-Feeders in the Coastal California Ecosystem		
U. Passow, M. Brzezinski, C. Carlson	10/1/2010-9/30/2013	$971,524
Will High CO2 Conditions Affect Production, Partitioning and Fate in Organic Matter?		
U. Passow	7/1/2010-6/30/2012	$12,878
RAPID Deepwater Horizon Oil Spill: Collaborative Research: Marine Snow and Sedimentation		
Q. Langdon, R. Ross	4/1/2011-3/31/2012	$192,144
Palmer LTER Zooplankton 1993-2008: Synthesis and Integration of Time-Series Data, Zooplankton Aggregation Structure and Secondary Production of Antarctic Krill		
D. Reed, S. Gaines, J. Melack, D. Siegel, S. Holbrook	12/1/2006-11/30/2010	$820,000 $103,910 $25,000 $61,518
LTER: Land/Ocean Interactions and the Dynamics of Kelp Forest Communities		
M. Schildhauer	9/1/2009-8/31/2011	$265,000
INTEROP: A Community-Driven Scientific Observations Network to Achieve Interoperability of Environmental and Ecological Data (SONet)		
R. Schmitt, S. Holbrook	9/1/2004-8/31/2012	$78,910 $20,000 $25,000 $54,233
LTER: Long-Term Dynamics of a Coral Reef Ecosystem		
R. Schmitt, S. Holbrook	8/1/20100-7/31/2012	$48,105
OISE IRE: Planning Visit and Workshop Involving Two Marine LTER Sites and Two Chinese CERN Sites		
R. Schmitt, S. Holbrook	9/1/2010-8/31/2013	$940,000 $940,000
LTER: Long-Term Dynamics of a Coral Reef Ecosystem		

D. Valentine Collaborative Research: Experimental Determination of Petroleum Biodegradation Patterns from Genomically-Informed Analytical Vista	6/1/2010-5/31/2012	$140,531
D. Valentine Collaborative Research: Chemical Changes Accompanying Petroleum Weathering in the Coastal Ocean	4/15/2010-3/31/2013	$14,700
D. Valentine MIP: Interactions Between Archaea, Bacteria and Their Viruses in the Anoxic Sediments of a Modern Evaporative Basin: Salton Sea, CA	9/1/2006-8/31/2010	$12,250
D. Valentine Dimensions: The Role of Viruses in Structuring Biodiversity in Methanotrophic Marine Ecosystems	1/1/2011-12/31/2014	$915,552 $8,775
D. Valentine MRI RAPID: Acquisition of Two Cavity Ringdown Spectrometers to Quantify Hydrocarbon Conversion in Deep Waters of the Gulf of Mexico	8/15/2010-7/31/2012	$124,313
L. Wshburn Dimensions: The Role of Viruses in Structuring Biodiversity in Methanotrophic Marine Ecosystems	9/15/2010-8/31/2011	$212,420
P. Yu Postdoctoral Fellowship in Polar Regions Research: Effects of Ocean Acidification on Developmental Physiology of an Antarctic Sea Urchin, Sterechinus neumayeri	8/15/2010-7/31/2012	$10,000
	National Science Foundation Subtotal	**$14,748,890**

National Institute of Health

J.H. Waite, J. Israelachvili	8/4/2008-6/30/2010	$451,046
Translating Mussel Adhesion	**National Academy of Sciences Subtotal**	**$451,046**

The Nature Conservancy

A. Lambert The Economic Impact of Non-Native Forest Pests and Pathogens in North America	1/24/2011-3/31/2011	$19,042
S. Hampton A Workshop on Global Climate Change and Adaptation of Conservation Priorities	6/25/2009-12/31/2011	$20,000
	The Nature Conservancy Subtotal	**$39,042**

Oregon State University

S. Airame Effectively Communicating the Science of Marine Reserved to European Audiences	1/24/2011-5/1/2011	$22,519
G. Hofmann S. Gaines, R. Warner, L. Washburn, Understanding the California Current Large Marine Ecosystem under Climate Change: Delivering Sound Science for Policy	3/18/2010-12/31/2010	$56,701 $34,804
	Oregon State University Subtotal	**$114,024**

PHS Centers for Disease Control

S. Sokolow, A. Kuris, K. Lafferty Emergence and Biological Control of Schistosomiasis	9/1/2010-8/31/2011	$116,041
	PHS Centers for Disease Control Subtotal	**$116,041**

Resources Legacy Fund Foundation

W. McClintock, S. Gaines MarineMap Decision Support System, 2008-0046M	10/1/2008-6/30/2011	$7,000
W. McClintock, S. Gaines MarineMap Decision Support System, 2008-0045M	9/1/2008-12/31/2010	$45,001
	Resources Legacy Fund Foundation Subtotal	**$783,166**

Schmidt Oceanographic Institute

S. Hampton, J. Baum Sharks on Coral Reefs - Ecosystem Consequences of Eliminating the Ocean's Apex Predators	1/4/2011-8/15/2011	$84,320
	Schmidt Oceanographic Institute Subtotal	**$84,320**

Third Sector New England

B. Halpern TSNE Human Impacts Mapping	1/1/2011-12/31/2011	$66,774
	Third Sector New England Subtotal	**$66,774**

Tides Foundationm, The

W. McClintock Extending MarineMap for Nationwide Coastal and Marine Spatial Planning	1/1/2011-12/31/2011	$150,000
	Tides Foundation Subtotal	**$150,000**

Truckee River Watershed Council

D. Herbst Use of Biological Indicators in Evaluating Sediment Deposition Impairment on the Middle Truckee River, California	9/28/2010-6/30/2012	$21,800
	Truckee River Watershed Council Subtotal	**$21,800**

UC San Diego

S. Holbrook Southern California Regional Coastal Ocean Observing System: Surface Current Mapping, Harmful Algal Bloom, and Sub-Surface Water Sections	1/1/2011-12/31/2011	$30,000
L. Washburn, M. Brzezinski Southern California Regional Coastal Ocean Observing System: Surface Current Mapping, Harmful Algal Bloom, and Sub-Surface Water Sections	6/1/2010-5/31/2012	$146,822
L. Washburn The UCSB Component of the Coastal Ocean Current Mapping Program (COCMP) Southern California Coastal Ocean Observing System (SCCOOS)	7/15/2009-12/31/2010	$30,060
	UC San Diego Subtotal	**$206,882**

UC Santa Cruz

J. Engle Shoreline Assessment of changes in Southern California Rocky Intertidal Communities	5/1/2010-4/30/2015	$45,198
M. Love Investigations in Fisheries Ecology	10/1/2010-6/30/2012	$100,372

R. Ross, L. Quetin	8/21/2009-9/30/2011	$59,319 $11,863
Improving Current Assessments and Future Predictions of Carbon Fluxes in the Southern Ocean as Mediated by the Dynamical Response of Ice-Ocean- Ecosystem Interactions to Climate Change		
	UC Santa Cruz Subtotal	**$216,752**

UC Sea Grant

T. Dudley	2/1/2010-1/31/2011	$2,000
Development of Biological Control for the New Zealand Mud Snail (State funds)		
J. Dugan, A. Wenner	2/1/2010-1/31/2011	$2,000
Beaches as Threatened Ecosystems: An Evaluation of Status and Trends in the Ecology of California's Sandy Beaches (State funds)		
J. Goddard	12/1/2009-11/30/2010	$500
Long-Term Faunal Changes in California Nudibranchs: Climate Change and Local Ocean Health		
S. Hamilton, R. Warner	7/1/2010-5/31/2012	$14,999 $4,950
Effects of Marine Reserves on Behaviorally-Mediated Changes in Spawning Success of California Sheephead		
R. Hechinger, A. Kuris, K. Lafferty	2/1/2007-2/28/2012	$24,870 $30,000
Parasites as Indicators of Coastal Wetland Health		
G. Hofmann	12/1/2010-11/30/2011	$16,000
Ocean Acidification Exacerbated by Coastal Upwelling: Monitoring of CO_2 and O_2 on the California Shelf and Effects on Red Sea Urchins, Abalone, and Oysters		
	UC Sea Grant Subtotal	**$95,319**

University of Arizona

M. Schildhauer	3/1/2011-2/29/2012	$169,971
iPlant/NCEAS Collaboration to Build the BIEN and Environment & Organisms Working Groups' Informatics Frameworks		
	University of Arizona Subtotal	**$169,971**

University of Miami

C. Carlson	2/1/2009-1/31/2012	$119,091
Collaborative Research: Global Ocean Repeat Hydrography, Carbon, and Tracer Measurements, 2009-2014		
	University of Miami Subtotal	**$119,091**

University of Mississippi

I. Leifer	8/1/2008-7/31/2012	$127,743
Spatio-Temporal Measurement of Seep Emissions by Multibeam Sonar		
	University of Mississippi Subtotal	**$127,743**

University of Nebraska

D. Wilson	11/1/2010-3/1/2012	$41,103
DataNetONE: Observation Network for Earth		
	University of Nebraska Subtotal	**$41,103**

University of New Mexico

M.B. Jones, S. Hampton	8/1/2009-10/31/2011	$662,688 $305,434
DataNetONE: Observation Network for Earth		
	University of New Mexico Subtotal	**$968,122**

University of Southern California, Southern California Earthquake Center

C. Nicholson	2/1/2007-1/31/2012	$35,000 $40,000
Evaluating Active 3D Fault Structure Through San Gorgonio Pass -- A Focused Natural Laboratory for Complex Fault Behavior		
	University of Southern California Subtotal	**$75,000**

University of Washington

W. Rice	4/1/2008-5/31/2011	$136,350
Drosophila Seminal Fluid: Proteomic Discovery and Functional Variation Analyses		
	University of Washington Subtotal	**$136,350**

US Department of Commerce, NOAA

J. Caselle	8/23/2009-8/31/2011	$32,200 $14,597
Maintenance of PISCO-CINMS Moorings in the Channel Islands National Marine Sanctuary		
S. Gaines	10/1/2010-9/30/2011	$49,997
Working Group to Identify Critical New Directions in Marine and Coastal Ecosystem Science Research for NOAA Sea Grant		
	US Department of Commerce, NOAA Subtotal	**$96,794**

US Department of Commerce, Marine Fisheries Service

S. Cooper, P. Alagona	8/5/2010-7/1/2011	$18,000
Documenting the Historic Distribution of Steelhead and Rainbow Trout (Oncorhynchus mykiss) in the Santa Ynez River, Santa Barbara County, California		
	US Department of Commerce, Marine Fisheries Service Subtotal	**$18,000**

US Department of Energy

D. Valentine	10/1/2008-9/30/2012	$323,641
Assessing the Efficacy of the Aerobic Methanotrophic Biofilter in Methane Hydrate Environments		
	US Department of Energy Subtotal	**$323,641**

USDI — Bureau of Land Management

D. Herbst	9/1/2010-9/30/2012	$20,000
		$14,000
Quantitative Survey of Invertebrate Populations, Physical Habitat Characteristics and Water		
Chemistry in Rough Creek, Bodie Creek and Tributaries, Bodie Hills, Mono County, CA		
	USDI – Bureau of Land Management Subtotal	**$34,000**

USDI — Bureau of Ocean Energy Management (Formerly Minerals Management Service)

M. Love	4/22/2010-5/31/2012	$375,000
Completion of Fish Assemblage Surveys around Manmade Structures and Natural Reefs off California		
	USDI – Bureau of Ocean Energy Management Subtotal	**$375,000**

USDI Fish & Wildlife Service

T. Dudley, A. Lambert	11/29/2010-10/20/2015	$125,000
Research and Restoration Through the Santa Clara River Reserve: A Proposal to Develop a University of California Research and Education Station		
D. Herbst	8/25/2008-9/30/2013	$35,090
Monitoring Aquatic Ecosystem Indicators of Spring Restoration on the Sheldon National Wildlife Refuge: Feral Horse Grazing Exclosures		
	USDI Fish & Wildlife Service Subtotal	**$160,090**

USDI Geological Survey

S. Mazer	9/13/2010-8/31/2011	$49,900
Phenology Literacy: Understanding through Science and Stewardship (PLUSS)		
	USDI - Geological Survey Subtotal	**$49,900**

USDI National Park Service

J. Caselle	8/15/2010-2/29/2012	$15,820
Analysis and Publication of Long-Term Kelp Forest Monitoring Data Inside and Adjacent to the Channel Islands Marine Protected Areas		
S. Mazer	8/30/2010-5/30/2013	$286,000
Facilitation of a Phenology Network to Assess Climate Change Response in California National Parks		
	USDI – National Park Service Subtotal	**$301,821**

Woods Hole Oceanographic Institution

C. Carlson	10/1/2009-8/31/2010	$7,192
14C Dissolved Inorganic Carbon Collection on the P6 CLIVAR Repeat Hydrography Cruise		
	Woods Hole Oceanographic Institution Subtotal	**$7,192**

Research Summaries
(Contracts/Grants Administered)
July 2010 – June 2011

Satie Airame **9/15/05-2/28/11** **119,967**
Resources Legacy Fund Foundation, 2009-90038

California Marine Life Protection Act Initiative

The "South Coast Science and Planning Advisor" will work closely with the Senior Advisor and Principal Planner to support the work of the South Coast MLPA Initiative planning team, will serve as the MLPA Initiative liaison to the Science Advisory Team (SAT), and will facilitate the incorporation of key information relevant to marine protected area (MPA) planning within the South Coast Study Region. The South Coast Science and Planning Advisor will play a critical role in facilitating the communication of science among the SAT, Blue Ribbon Task Force (BRTF), and Regional Stakeholder Group (RSG). With the California Department of Fish and Game (DFG), the South Coast Science and Planning Advisor will assist in communicating the results of the Channel Islands MPA monitoring program.

Satie Airame **1/24/11-5/1/11** **22,519**
Steven Gaines
Oregon State University

Effectively Communicating the Science of Marine Reserved to European Audiences

Natural England will sponsor PISCO's production of a European version of the educations booklet The Science of Marine Reserves tailored to policy leaders, non-governmental organizations, scientists, marine resource managers, fishing groups, and the general public in the European Union. The main purpose of the booklet is to present the latest scientific evidence about the effects of marine reserves in order to help inform current management dialogues. In particular, the booklet seeks to meet the requests for scientific information to inform the discussions surrounding the increasing legislative frameworks and political initiatives to implement networks of marine protected areas (MPAs) in the U.K. and across the E.U.

Sandy Andelman **9/1/05-8/31/11** **100,000**
National Science Foundation, EF-0443453

RCN: Biodiversity Conservation in Dynamic Landscapes (BCDL) Network

Developing the conceptual foundations for conserving biological diversity in a rapidly changing and uncertain world requires understanding of the linkages among the drivers of species distributions, ecological systems, economic activities, and land-use change. Despite common objectives and recognition of the need for this integration, research in each of these areas commonly proceeds independently. Support for the Biodiversity Conservation in Dynamic Landscapes (BCDL) Research Coordination Network will enable a 5-year interdisciplinary program of collaboration directed towards coordinating research in ecology, economics, policy, land-use, and operations research needed to catalyze the development of an interdisciplinary conceptual framework for biodiversity conservation. The BCDL Network will: (1) identify important gaps in theory and data that limit our ability to plan for new biological reserves and anticipate future patterns of habitat distribution in human-dominated landscapes; (2) coordinate the development of new tools and methods that link ecological, economic and land-use change dynamics, and incorporate key uncertainties into conservation decisions; (3) develop a successful clearing house for tools and other resources needed to advance the scientific basis for biodiversity conservation; and (4) train a cadre of graduate students and early career scientists in quantitative interdisciplinary methods relevant to understanding and conserving complex ecological systems within a dynamic framework. The BCDL Network addresses a fundamental limitation of current conservation and development approaches and will bridge the gap between conservation and land use change theory and practice. The Network will provide

interdisciplinary training opportunities for graduate students and early career scientists and is committed to increasing participation in the Network by under-represented communities.

Julia Baum **3/1/10-9/30/10** **11,945**
UC San Diego

Sharks on Coral Reefs: Estimating Baseline Abundances & Ecosystem Consequences of their Elimination

The remainder of my David H. Smith Conservation Research Fellowship (grant # MBR41JB), will be used to support the field work component of my research on Kiritimati (northern Line Islands, Republic of Kiribati).

The primary scientific objectives for this trip are as follows:

a) to complete fish, algae, and plankton collections, which will later be used for stable isotope analysis and food web reconstruction

b) to conduct underwater surveys for urchins and urchin predators at as many of our 40 established sample sites as possible, and to complement these with measures of rugosity and water samples (for chlorophyll a analysis)

c) to take photos using small benthic photoquads at as many of our 40 established sites as possible and to rephotograph the 10 permanent mega-photoquadrats that we established in summer 2009. These photos will capture changes in the benthos including the predicting bleaching event due to the current El Niño

d) to conduct an urchin predation experiment at 9 sites (3 low fishing pressure, 3 medium fishing pressure, 3 high fishing pressure), including 4 replicates of 10 urchins at each site. These 24 hour assays will be complemented with underwater video and direct observations of the urchins

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Charlotte Beucher **6/1/08-5/31/12** **204,479**
Mark Brzezinski
National Science Foundation, OCE-0752264

Collaborative Research: N and Si Dynamics in the Glacial Southern Ocean

For the past twenty years, evaluating the role of the Southern Ocean in regulating glacial-interglacial atmospheric CO2 cycles has been a major focus of marine paleoclimate research. Efforts to gauge the strength of the biological pump in the glacial Southern Ocean have been largely inconclusive due to discrepancies among different proxy records. The PIs seek to use two new isotopic techniques to generate multiple downcore records of silicon and diatom-bound nitrogen isotopes in cores from the Subantarctic and Antarctic Zones of the Atlantic and Pacific sectors of the Southern Ocean. The objectives of this research are (1) to evaluate latitudinal trends in N and Si use across the Southern Ocean; (2) to distinguish between supply- (i.e. stratification) versus demand- (Fe availability) driven variations in relative consumption; and (3) to determine the potential for greater Si export from the Southern Ocean, relative to that of nitrate, to the low latitudes during the last glacial period. These nutrient status records will be the first-of-their kind, aiding efforts to evaluate if Southern Ocean biology could have contributed to changes in atmospheric CO2, either through enhanced nutrient consumption within the Southern Ocean proper or through silicic acid leakage and its influence on whole ocean alkalinity.

Cheryl Briggs **6/17/07-8/31/11** **401,019**
Roland Knapp **579,957**
National Science Foundation, EF-0723563

Collaborative Research: After the Crash: Factors Allowing Host Persistence Following Outbreaks of a Highly Virulent Disease

Emerging infectious diseases can have dramatic effects on their host populations. In wildlife species, there are many recent examples of novel pathogens invading native populations, with different

pathogens resulting in very different outcomes on their hosts. In some systems, the pathogen sweeps through the local population causing a single outbreak ("episodic"), after which the pathogen goes locally extinct as the pool of susceptible hosts is depleted (e.g., morbillivirus in marine mammals and Ebola in gorillas). Pathogens can also cause regional host extinction in some cases. In other systems, following arrival of the pathogen and subsequent host population crash, the host-pathogen system reaches a new "enzootic" state in which pathogen and host persist, potentially with reduced host population density (e.g., myxomatosis). In the Sierra Nevada Mountains of California, both types of outcomes in a single host-pathogen system have been documented. The pathogen is the amphibian chytrid fungus, Batrachochytrium dendrobatidis (Bd), which causes the disease, chytridiomycosis, and is implicated as one of the major causes of amphibian declines worldwide. In this region, the primary amphibian host is the mountain yellow-legged frog, Rana muscosa, once a common amphibian that has declined precipitously in recent decades. Based on prior research, invasion of Bd into the remaining uninfected R. muscosa populations appears inevitable within the next few years. Therefore, it is critical to understand the factors allowing for host persistence in the enzootic state.

Mark Brzezinski **7/1/07-6/30/12** **672,641**
National Science Foundation, 0648130

Silica cycling and the role of diatoms in the North Pacific Subtropical Gyre

This study examines the unique silicon cycle of the North Pacific Subtropical Gyre (NPSG). Most marine silicon cycle studies have focused on the more productive coastal waters or the Southern Ocean where diatoms typically dominate the phytoplankton. Although diatom biomass is much lower in subtropical gyres, silica production is significant in global terms. Silicon cycle studies of the Sargasso Sea in the 1990's implied that subtropical gyres account for 13% of global marine silica production. More recent data from the NPSG show much higher rates of silica production that would increase the contribution of subtropical gyres to as much as 40%. The new estimate is uncertain and based on few data, but suggests that the contribution of subtropical gyres has been underestimated. Differences in the silicon cycle between the NPSG and the Sargasso Sea go beyond differences in average production rates. The two systems are several months out of phase with each other in terms of their seasonal silica production cycles. Unlike the Sargasso Sea, where diatoms bloom regularly in spring in response to winter convective overturn, permanent stratification prevents spring diatom blooms events in the NPSG, where annual diatom blooms occur in summer, when stratification is strongest and nutrient concentrations are at a seasonal minimum. These enigmatic summer blooms contribute significantly to carbon and nitrogen export in the NPSG and likely dominate the annual silicon cycle. This project will expand understanding of the mechanisms controlling the contribution of diatoms to elemental cycling in open ocean ecosystems.

Bradley Cardinale **03/1/09-2/28/13** **389,496**
National Science Foundation, DEB-0842009

Collaborative Research: Does Productivity Drive Diversity or Vice Versa? Empirical and Theoretical Investigations of the Multivariate Productivity-Diversity Hypothesis in Streams

This research will test and refine a new conceptual model that outlines how the historical perspective that productivity-drives-diversity might be fused with the more recent perspective that diversity-drives-production. The collaborators suggest that these two perspectives can be unified with a multivariate model that distinguishes how three causal pathways operate concurrently to influence the production of biomass by a community: 1) a direct effect of nutrient supply on productivity 2) a direct effect of species richness on productivity, and 3) an indirect effect of nutrient supply on production that is mediated through its control over species richness. The investigators argue that these pathways are fundamentally connected such that the same biological mechanisms by which nutrient supply influences species richness also determine how species richness influences the utilization of resources and their conversion to biomass. They detail a set of laboratory, field, and modeling studies that are designed to test and refine this multivariate model in freshwater ecosystems, which are experiencing rapid changes in productivity and diversity. They further propose to extend this model to incorporate interactions between producers and consumers, which is important because the majority of diversity-productivity studies have focused only on simplified systems composed of just one trophic level (usually plants).

Bradley Cardinale **6/1/11-5/31/13** **15,000**
Lindsey Kathryn Albertson
National Science Foundation

Dissertation Research: Impacts of Biological Diversity on Sediment Transport Conditions in Streams

Variation in the abundance, distribution, and diversity of biological organisms has long been recognized as a consequence of physical variation in the environment. In recent years, many fields of natural science have begun to suggest that biological organisms might not only respond to but also directly regulate the physical processes that structure ecosystems. An effort to better understand how organisms modify biogeochemical cycles, functioning of ecosystems, and formation of habitat has resulted in an explosion of studies that try to incorporate the influence of biological organisms into our understanding of abiotic processes. However, despite the progress and growth in this topic, we still typically assume that all biological species have identical impacts on their abiotic environment, a limitation that ignores interactions between multiple, coexisting taxa. This approach often satisfies modeling and engineering requirements but ignores the diverse array of species that might have unique effects and provide a more complete understanding of how biological communities impact physical processes. The dissertation research will test whether different species of animals have additive or non-additive impacts on the physical process of sediment transport due to species interactions.

Craig Carlson **8/15/08-7/31/13** **803,765**
National Science Foundation, OCE-0801991

MO: Collaborative Research: Transitions in the Surface Layer and the Role of Vertically Stratified Microbia Communities in the Carbon Cycle - An Oceanic Microbial Observatory

The objective of this project is to assess if the mesopelagic microbial community relies on diagenetically altered organic matter and subcellular fragments that are produced by microbial processes in the euphotic zone and delivered into the upper mesopelagic by sinking or mixing. In past efforts this microbial observatory had greater success cultivating members of the euphotic zone microbial community, and revealed an unanticipated growth requirement for reduced sulfur compounds in alphaproteobacteria of the SAR11 clade. Genomic information showed that intense competition for substrates imposes trade-offs on bacterioplankton - there are regions of N dimensional nutrient space where specialists win. The investigators postulate that specific growth requirements may explain some of the regular spatial and temporal patterns that have been observed in upper mesopelagic bacterioplankton communities, and the difficulties of culturing some of these organisms. This research will make cultures of novel bacterioplankton and genome sequences available to the scientific community, and findings may be used directly in foodweb and ocean carbon cycle models. The educational component of the project brings microbial oceanography training to students from many disciplines, through a summer course, and specialized training to graduate and undergraduate students involved directly in research.

Craig Carlson
Mark A. Brzezinski **4/1/09-3/31/12** **689,579**
National Science Foundation, OCE-0850857

Mechanisms Controlling the Production and Fate of DOM During Diatom Blooms

This research will contribute to the greater scientific goal of understanding the role of upper ocean food webs in carbon cycling. The findings will improve the basic understanding of DOM dynamics, aiding modelers in the development of improved representations of key processes in ecosystem models. The PIs will employ a combination of laboratory and field based approaches to: 1) investigate how limitation by either N or Si impacts the chemical composition of the DOM released by diatom blooms, and 2) determine how differences in the composition of DOM produced by diatoms experiencing different nutrient stresses affects its susceptibility to heterotrophic microbial processing through changes in the productivity, growth efficiency and community structure of bacterioplankton. The focus is on diatom blooms for two reasons. They are a regular feature in

regions of the ocean where DOC export is known to be significant, i.e., such as the North Atlantic, making the fate of the DOM produced during blooms a potentially significant mechanism of C export. In addition, the direct release of DOM from phytoplankton is the best studied of numerous DOM processes providing the background for formulating response that drives its consumption. Preliminary data indicates that the waters of the Santa Barbara Channel, California, are an ideal model system for conducting this research because the spring diatom bloom is sufficiently predictable and amenable to the types of manipulations required for these studies, and ambient DOM concentrations are low for coastal waters, allowing small changes in DOM concentrations to be resolved in both laboratory and field experiments.

Craig Carlson **2/1/09-1/31/12** **119,091**
University of Miami

Collaborative Research: Global Ocean Repeat Hydrography, Carbon, and Tracer Measurements, 2009-2014

Dissolved organic matter (DOM), represents one of the largest exchangeable carbon reservoirs on earth. The global dissolved organic carbon (DOC) pool is estimated to be 685 Pg C (Pg = 1015 g C; Hansell and Carlson, 1998a), a value comparable to the mass of inorganic C in the atmosphere. Small perturbations in the production or sink terms of the oceanic DOC pool could strongly impact the balance between oceanic and atmospheric CO2. In this global ocean repeat hydrograph, carbon and tracer program D. Hansell (University of Miami) and C. Carlson of UCSB will be responsible for at sea sampling and analyses of dissolved organic carbon (DOC) and nitrogen (DON) measurements. The proposed program includes 18 legs 13 cruises conducted in various ocean basins from 2009 – 2014.

Craig Carlson **11/1/09-10/31/12** **399,737**
National Science Foundation

Collaborative Research: ETBC: The coupling between DOM, algae, and microbes on coral reef platforms

The proposed research will investigate the coupling between primary producers and the utilization of dissolved organic matter (DOM) by marine heterotrophic microbes on coral reefs.

Previous metagenomic studies of the microbial communities associated with near-pristine and degraded coral reefs demonstrated a shift from a microbial food web similar to the open ocean (Prochlorococcusspp. and SAR11-like bacteria) to a community dominated by “super-heterotrophs”, most closely related to known pathogens like E. coli, Staphylococcus spp., Streptococcus spp., Enterobacter spp. and Vibrio spp. This shift is associated with a decline in coral cover and an increase in coral disease prevalence. Our previous research has also shown that dissolved organic carbon (DOC) concentrations are lower on coral reef platforms compared to measurements of offshore waters (60-80 μM). On degraded reefs, we have observed DOC measurements as low as 30 - 40 μM, a value similar to concentrations observed in the deep Pacific Ocean. The observation of low DOC measurements on degraded reefs is decoupled from the high abundance of macroalgae, which one might expect would raise levels of DOC through the release of photosynthate into the water column.

Craig Carlson **5/1/10-4/30/13** **392,501**
Gordon and Betty Moore Foundation

Microbial Oceanography: The Biogeochemistry, Ecology and Genomics of Oceanic Microbial Ecosystems

This Grant is in support of the BIOS Summer Course, one of five coupled grants that will train the next generation of microbial ecologists in non-traditional, immersive academic environments that emphasize cross-disciplinary collaboration and cutting-edge analytical techniques.

Craig Carlson **10/1/09-8/31/10** **7,192**
Woods Hole Oceanographic Institution

14C Dissolved Inorganic Carbon Collection on the P6 CLIVAR Repeat Hydrography Cruise

The Carlson laboratory had agreed to collect 14C / 13C-DIC samples for Ann McNichol and Bob Key from the trans Pacific CLIVAR cruise referred to as P6. The cruise ports are Brisbane Australia, Tahiti, and Valparaiso, South America. Carlson's Technicians Rachel Henry and Anna James have agreed to collect approximately 650 discrete samples over a 95 day research cruise -- broken into two legs. The technicians are responsible for coordinating sampling with science party, collect samples for dissolved inorganic carbon of sample collection, organizing logs, storage and assistance with shipping samples back to Woods Hole Oceanographic

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Jennifer Caselle **6/26/08-1/31/12** **200,000**
Marisla Foundation

Coral Reef Research in a Rare, Undisturbed Ecosystem: UCSB and Palmyra Atoll

This award enables the Marine Science Institute, UC Santa Barbara, to remain a member of the Palmyra Atoll Research Consortium for 2008-2010 in order to continue and expand research relating to coral reef ecosystem health and biodiversity. In addition, it provides support for UCSB and other PARC members to conduct research on the Atoll. The major outcome will be a better understanding of healthy coral reef ecosystems which will lead to rational conservation practices.

Jennifer Caselle **1/16/09-1/15/12** **22,900**
Santa Barbara County Air Pollution Control District

Repower the R/V Cormorant

State funds provided to renovate the Research Vessel Cormorant.

Jennifer Caselle **1/8/10-12/31/13** **1,153,706**
Gordon and Betty Moore Foundation

Partnership for Interdisciplinary Studies of Coastal Oceans: Science to Policy, the Marine Life Protection Act

Over the past decade, PISCO has played an integral role in California's MLPA effort in three main areas: MPA network design, MPA monitoring and evaluation and communication at the science-policy interface. Efforts will continue in order to achieve the single Outcome of "A well-designed and effectively monitored network of Marine Protected Areas in California." The project will continue the subtidal kelp forest monitoring program and ensure that existing MPAs in the central coast MLPA region are adequately monitored.

Jennifer Caselle **7/1/10-6/30/13** **122,482**
National Science Foundation

CAMEO: Comparative Approach to Predicting the Consequences of an Impending Reinvasion: Top-Predator Effects on Californian Nearshore Fisheries

Using an integrative two-fold comparative approach, we will perform a (i) spatiotemporal empirical comparison of the structure and dynamics of central and southern Californian nearshore ecosystems in order to (ii) parameterize and compare the performance of three ecosystem-based approaches for modeling the complex dynamics of these systems. Our goals are to develop analytical tools to facilitate ecosystem-based decision making and management, and to forecast how marine reserves and the impending reinvasion of sea otters to southern Californian waters will affect the region's valued fisheries.

Jennifer Caselle **8/23/09-8/31/11** **46,797**
COM National Oceanic And Atmospheric Administration

Maintenance of PISCO-CINMS Moorings in the Channel Islands National Marine Sanctuary

The sanctuary provides scientific and technical support to NOS, NOAA and the DOC for the management, conservation, and wise-use of the CINMS marine resources. Near-island instrumentation, customized for particular locations, provides information necessary to understand and track water mass movements that affect recruitment of key species in coastal habitat. Inter-annual and shorter-term upwelling and relaxation events have been shown to drive recruitment and movement of certain fish species. It is also likely that these events affect other resources, including key-stone species.

To provide CINMS with the data on water mass movements, six SEA stations were established in 2004 around the Channel Islands and customized to address the information needs of the individual areas. All are equipped with thermistor strings and Acoustic Doppler Current Profilers (ADCPS), oxygen sensors, and/or other equipment are part of the mooring instrumentation. These were placed to supplement and existing array of moorings along the west coast, either filling gap areas, or augmenting areas for the purpose of providing important information on water temperature and movements within the sanctuaries.

Jennifer Caselle **8/15/10-2/29/12** **15,821**
USDI National Park Service

Analysis and Publication of Long-Term Kelp Forest Monitoring Data Inside and Adjacent to the Channel Islands Marine Protected Areas

Project Investigators at UCSB will collaborate with National Park Service (NPS) staff to analyze the results of the early study for publication and presentation to the public and managers tasked with evaluating the efficacy of the Channel Islands MPA network. Second, UCSB will work with NPS in evaluating the methodological changes to NPS fish counting protocols over the history of the program and compare those results to the PISCO fish counting methods. The goal is to better understand any differences among the methods, evaluate how differences may change estimates of means and variance structure, and attempt to calibrate the datasets.

Scoot Cooper **8/5/10-7/1/11** **18,000**
COM Marine Fisheries Service

Documenting the Historic Distribution of Steelhead and Rainbow Trout (Oncorhynchus mykiss) in the Santa Ynez River, Santa Barbara County, California

This proposal addresses and agrees to perform the following four tasks outlined in the Scope of Work:

- Task 1 – Search for and gather evidence on the historical (pre-dam conditions: before Juncal, Gibraltar, and Bradbury Dams were built) presence and distribution of steelhead and rainbow trout (Oncorhynchus mykiss) in the Santa Ynez River watershed.
- Task 2 – Review information gathered in Task 1 and delineate pre-dam steelhead and rainbow trout distributions in the Santa Ynez River watershed.
- Task 3 – Prepare a written draft report describing the pre-dam presence and distribution of steelhead and rainbow trout in the Santa Ynez River watershed, based on a synthesis of the historical evidence.
- Task 4 – Revise the draft report to produce a final report.

Christopher Costello **1/1/09-12/31/10** **65,000**
Resources Legacy Fund Foundation

Model Development for Marine Life Protection Act

Develop "Flow, Fish, and Fishing" two dimensional optimization modeling tool for use in the MLPA Initiative design planning process.

Christopher Costello **3/1/10-2/28/11** **124,551**
Steven Gaines
Walton Family Foundation, Inc.

The Peruvian Anchoveta Fishery

The Peruvian anchoveta fishery is one of the world's most productive fisheries. Historically, this productivity served as the food base for an immense ecosystem. Today there is a significant tradeoff between fisheries profit (from extraction) and the productivity of higher trophic level which rely on anchoveta for prey. These higher trophic levels are themselves sources of economic value, e.g., guano harvest from seabirds or ecotourism related to marine mammal watching. Furthermore, because Peru's anchoveta harvest comprises approximately 40% of the global market for fish meal, the supply from Peru affects global supply and thus price. As a result, a switch to managing for maximum economic yield could lead to higher profits from lower catch (with cascading benefits for higher trophic levels) relative to managing for maximum biological yield. Superimposed on this management question is the added complication of an extremely variable environment – El Nino events and the Pacific Decadal Oscillation can have profound effect on anchoveta recruitment. Therefore, fishery regulations as determined by the Instituo del Mar del Peru (IMARPE) ideally must balance economic profit, fishery yields, and food supply for higher trophic levels, within the context of large environmental variability and uncertainty.

John Damuth **6/1/10-5/31/11** **80,000**
National Science Foundation

Collaborative Research: Were There "Too Many" Browser Species Worldwide in Local Faunas of the Early Miocene? Testing a Global Hypothesis using the Australian Fossil Mammal Record

Is there evidence for a worldwide change in terrestrial ecosystems approximately 12 million years ago? We believe that what we observed first as a regional pattern in the history of the North American Great Plains may be observable throughout the globe. We propose to use the Tertiary mammalian faunas of Australia – as taxonomically and ecologically different as one can get from the Great Plains and their faunas – for a robust test of whether vertebrate communities comprised of "too many" browsers was a global phenomenon.

Carla D'Antonio **9/1/10-8/31/11** **221,784**
National Science Foundation

Long Term Impacts of Grass Invasions and Fire on Community Change and Plant Soil Feedbacks

Ecologists generally lack knowledge about the long-term effects of biological invasions, and how invader-induced changes in ecosystem processes may alter the potential trajectory of a site. While it is often assumed that invasions exist in persistent alternative stable states, it may also be the case that the impacts of invaders will shift over time such that exotic species no longer reinforce their own dominance.

In Hawai'i Volcanoes National Park (HAVO), exotic grasses invaded seasonally dry forests in the 1960s, altering plant communities both via direct competitive interactions with native species and by promoting a new type of disturbance, fire. In the short-term, N-limited grasses facilitate themselves by establishing higher N cycling rates and fire frequencies. Therefore, exotic grasses maintain their dominance through suppression of native species recruitment early in succession, creating a stable condition in which restoration is extremely difficult. This proposal hypothesizes, that in the long-term, a lack of native species lowers plant uptake of N, leading to overall N losses from the system, especially in the absence of fire. This scenario would lower soil nitrogen availability ultimately leading grasses to decrease their own dominance via changes in ecosystem function. In essence, positive feedbacks between invaders and ecosystem function may change to negative feedbacks. If this has occurred, it is unclear whether the lower N availability will favor recovery of native species or invasion by a new suite of invaders.

Carla D'Antonio **7/1/11-6/30/12** **13,163**
Karen Ann Stahlheber
National Science Foundation

DISSERTATION RESEARCH: Islands of Invasion: Savanna Oak Trees and Plant Community Structure in California Grasslands

Over the last century many of the world's grassland and savanna communities have experienced significant changes in the abundance of shrubs and trees. In light of these changes and the high proportion of threatened organisms that occur in grasslands, there is a need to better understand the influences of trees on the composition of the herbaceous community, how these impacts vary across regional climate gradients, and the mechanisms that may buffer communities from change. In particular, the potential for trees to exert long-term impacts on communities following their death and the role of spatial factors such canopy size or isolation from other trees in determining species diversity have never been evaluated. My dissertation explores the structure of the California savanna at multiple scales, focusing on the relationship between the diversity of native and non-native species and the presence of oak trees. The proposed research will focus on two main questions: (1) What is the longevity of the oak impact on species diversity or soil properties? and (2) How does the spatial heterogeneity in resources created by savanna trees contribute to landscape and local patterns of species richness?

Frank Davis **10/1/06-9/30/12** **3,703,738**
National Science Foundation

NCEAS: National Center for Ecological Analysis and Synthesis

The National Center for Ecological Analysis and Synthesis (NCEAS) was established in 1995 in recognition of the need for a facility where ecologists and scientists in allied disciplines could collaborate to conduct multidisciplinary research. The Center's mission is to advance the state of ecological knowledge through the use of existing information, organize and synthesize ecological information to make it useful to all users, and to influence the way in which ecological research is conducted by promoting a culture of synthesis and collaboration. The Center supports three primary modes of research - working groups (2-20 individuals interacting to address important questions), Postdoctoral Associates (15-18 per year) and Center Fellows (4-6 sabbatical visitors per year). Because research at NCEAS relies on using existing information, the Center is involved with many collaborators to develop generic data access tools for a broad user community, from student and resource managers to scientists.

Daniel Dawson **9/1/09-8/31/10** **350,000**
National Science Foundation

Laboratory Modernization at the Sierra Nevada Aquatic Research Laboratory

Renovate and modernize a 279 m2 (3000 ft.2) laboratory building constructed in 1962. The building's layout and fixtures are outdated and limit the research of the station, and the structure is energy inefficient and in need of safety upgrades.

Daniel Dawson **10/1/09-10/1/11** **103,208**
California Fire Safe Council, Inc

UC Valentine Reserve: Forest Management at the Urban/Wildland Interface

Valentine Eastern Sierra Reserve (VESR), a unit in the University of California's Natural Reserve System, has not experienced a fire in over 160 years. Before this time, average fire recurrence intervals ranged from 15–25 years depending on the slope and aspect. As a result of fire suppression forest health has deteriorated, forest density is unnaturally high, and fuel loading is very high. The Reserve sits at the urban/wildland interface between the Town of Mammoth Lakes, a resort community with very high property values, and the Inyo National Forest. VESR has been engaged in active management of the forested parts of the Reserve for six years and have developed and used "boutique" logging methods that don't compromise the research and teaching values of the Reserve.

Anthony De Tomaso **11/1/09-10/31/12** **226,882**
National Science Foundation

Evolution of allorecognition in a basal chordate

Allorecognition is the ability of an individual to discriminate its own cells and tissues from those of another individual of the same species, with examples found in nearly all multicellular phyla. This phenomenon is ultimately based on the presence of highly polymorphic gene products, and is thus dependent on the creation and maintenance of genetic diversity. Polymorphisms at allorecognition loci are extraordinary and their presence is unlikely to be explained by neutral evolution. However the origins and persistence of these recognition systems are not well-understood.

Thomas L. Dudley **10/17/07-10/31/12** **56,500**
Kevin D. Lafferty
Armand M. Kuris
US Fish & Wildlife Service, 813327J015

Development of Biological Control for the New Zealand Mud Snail

Invasive non-indigenous species have the potential to alter food webs in aquatic ecosystems, inhibit or displace native species, including threatened or sensitive species, and to interfere with recreational and economic activities in waterways. The New Zealand Mud Snail (NZMS; Hydrobiidae: Potamopyrgus antipodarum), native to New Zealand but unintentionally introduced into other continents through human transport, has great potential to cause all three forms of impact to our natural resources. The NZMS is establishing rapidly throughout western waters. Despite efforts to control its spread by public outreach campaigns and cleansing of contaminated equipment, invasion continues. Early detection of invaders can enable pest eradication using physical or chemical treatments before unacceptable impacts occur, but once a new pest is widely established, control may be feasible only by using biological methods that suppress populations to acceptable levels. A series of steps is required to develop an effective and politically-acceptable biological control program, generally requiring several years of testing and evaluation before it can be implemented. Thus, it is critical that a control program be evaluated very soon, before NZMS infestations dominate benthic assemblages throughout North America. The PIs propose that Classical Biological Control (biocontrol), the introduction of natural enemies from the native region of the pest to suppress invasive pest species abundance, is a potentially appropriate, and probably only, means of achieving sustainable mitigation.

Thomas L. Dudley **4/15/08-2/28/11** **2,087**
San Francisco Estuary Institute

Ventura County Historical Ecological Study

This study is designed to research and document information about the pre-modification channel geometry and riparian habitat characteristics of the Santa Clara River. It will also assess channel stability/migration during the historical, pre-1927 era and document the historical extent of perennial, seasonal, and tidal wetland habitats as a basis for setting restoration targets. Specific historical ecological and geomorphic information about local habitats will be gathered and historical drainage network patterns, including discontinuous channels and how tributaries connected to the main channel will be studied.

Thomas L. Dudley **12/16/08-7/1/11** **899,959**
Clark County, Nevada

For Effectiveness Monitoring of Spring-fed Wetlands and Riparian Restoration Treatments

Effective management of tamarisk and other invasive plants depends on control treatments that provide sustained weed reduction and their replacement with self-replicating native and/or beneficial non-native plants. The project goal is to promote adaptive weed management that

provides maximal, cost-effective weed control with a minimum of collateral impacts to associated beneficial species, and integrates ecosystem functions into the habitat recovery process. The overall objective is to undertake an extensive evaluation of regional infestation sites, those where tamarisk has been treated and those where treatments may be proposed, to understand the underlying interrelationships among species and physical processes (flood and drought, physical disturbance, fire – both wild and prescribed). Resulting information will be used in weed control planning to ensure that tamarisk management yields substantive restoration of native riparian wildlife habitat, and minimizes the secondary invasion by other noxious weeds that are major inhibitors of ecosystem recovery.

Thomas L. Dudley **9/1/09-8/31/14** **625,017**
USDI Fish and Wildlife Service

Research and Restoration Through the Santa Clara River Reserve: A Proposal to Develop a University of California Research and Education Station

To build a multi-functional station to provide facilities, infrastructure and an institutional framework to carry out environmental studies and natural resource policy research that integrates existing information with newly acquired data to support conservation of biodiversity and ecosystem processes, primarily as it relates to large-scale restoration of riparian ecosystems.

Thomas L. Dudley **2/1/10-1/31/11** **2,000**
UC Sea Grant College Program

Development of Biological Control for the New Zealand Mud Snail - State Funds

The New Zealand mudsnail (NZMS) is rapidly invading western waters where it can dominate animal biomass, displace invertebrates critical as salmonid food resources, and is itself indigestible to trout. Regional economies are potentially affected where fisheries are economically important for recreational benefits or as direct commodities. Efforts to control NZMS spread through public education and gear decontamination are largely ineffective, and recommended control methods (draining, molluscicide application) are detrimental to ecosystems. Biological control may provide a cost-effective and ecologically benign method for suppressing NZMS abundances below ecological or economic thresholds. The introduction of a natural enemy (biocontrol agent) depends on establishing that the agent causes substantial pest impact (efficacy) and poses no significant risk to non-target species (safety), including sensitive species from the same family (Hydrobiidae). This research will provide the information basis regarding efficacy and safety of the intended NZMS biocontrol agent, Microphallus sp., necessary to proceed toward its eventual release into the natural environment.

Jenifer Dugan **5/1/09-3/1/12** **37,500**
California Coastal Commission

Evaluating Status and Trends in California's Sandy Beach Ecosystem

California's beaches are highly valued for recreation and tourism. Less appreciated is the role of beaches as ecosystems that support unique and rich biodiversity. The fate of California's beaches in the face of rising sea levels and continuing population growth prompts this research. This research project will investigate ecological changes in sandy beach ecosystems in southern California over the past 30 years and evaluate potential causes using comparisons of historic and modern information on ecological communities of beaches. This project will calibrate historically used and modern sampling methods, collect new data at a subset of historically sampled beach sites and archive the historic and more recent physical and ecological data needed to evaluate the status and trends in biodiversity and ecological conditions of sandy beach ecosystems in California. These comparisons will be used to provide baseline information needed for management and assessment of the impacts of climate change and human activities on sandy beach ecosystems.

Jenifer Dugan **3/1/10-2/25/13** **60,236**
UC Sea Grant College Program R/MPA-14

Baseline Monitoring of Ecosystem and Socioeconomic Indicators for MPAs along the North Central Coast of California – Sandy Beaches

Sandy beaches and adjacent surf zones are important foraging areas for shore birds and fishes that feed on intertidal invertebrates. The amount of wrack and plankton cast onto beaches is dynamically linked to adjacent ecosystem features, ocean climate and the growth rates and reproductive output of invertebrates. These links are the critical pathways through which direct and indirect effects of MPA implementation and variation in ocean climate will cascade, making sandy beaches an important target for long-term monitoring to asses ecosystem condition and functioning of the NCC region. Sandy beaches are also used extensively for a variety of recreational activities, including shore-based fishing, bait collection, beachcombing, ATVs, surfing, birding, dog-walking and picnicking. We will 1) provide the first comprehensive, baseline description of the biodiversity of sandy beaches of the NCC region, 2) develop informative ecosystem indicators and a plan for long-term monitoring of the network of MPAs involving citizen scientists (e.g., students, recreations fishers, members of conservation clubs) and collaborations with similar established volunteer groups in the region (e.g., Gulf of the Farallones Beach Watch program), and 3) interpret the important ecological links among the components of the ecosystem, including humans, for use in evaluating the effectiveness of the network of MPAs.

Jenifer Dugan **4/1/11-12/31/12** **34,988**
California Department of Boating and Waterways

The Ecological Services of Open Coast Sandy Beaches

Over the past fifteen years, much progress has been made estimating the recreational benefits of beaches and developing specific tools (e.g., CSBAT) to analyze the costs and benefits of specific policies, such as nourishment. According to Boyd and Banzhaf, "Ecosystem services are components of nature, directly enjoyed, consumed, or used to yield human well-being." Beaches provide a number of services that benefit humans directly, e.g., biodiversity, water purification, spawning for some valuable species, etc. The ecological functions underpin these services and must be understood and quantified if possible in order to fully understand ecosystem services. However, assessing the ecological services and functions of coastal management policies for beaches and other ecosystems is in its infancy. A widely scattered literature exists considering a few ecological services from various types of coastal habitats. A different literature also exists that attempts to quantify the economic benefits of some of these ecological services. This pilot study will create an inventory of and investigate the many ecological functions and services provided by open coast sandy beaches on the mainland coast of the Santa Barbara Channel. The study will concurrently examine and, if and where existing information is suitable, broadly estimate, the economic benefits and impacts of these ecological services. The project will also consider the ecological/economic impacts of selected coastal management policies on these ecological services.

Jenifer Dugan **2/1/10-1/31/11** **2,000**
UC Sea Grant College Program

Beaches as Threatened Ecosystems: An Evaluation of Status and Trends in the Ecology of California's Sandy Beaches - State Funds ½

Sandy beaches dominate the world's open coasts and underpin many coastal economies. More people enjoy sandy beaches than any other seashore type. Although often under appreciated and perceived as secondary to their economic value, the irreplaceable biodiversity and the unique ecological resources and services supported by beaches are just as important. Intrinsic ecological values and functions of beaches include rich invertebrate communities that are prey for shorebirds and fish, coastal fisheries, the filtration of large volumes of seawater, nutrient recycling and critical habitat for wildlife. Burgeoning coastal population growth is escalating pressures on sandy beaches at unprecedented scales and amplitudes. Beaches are trapped in a 'coastal squeeze' between development from land and manifestations of climate change at sea. As sea level rises, erosion

accelerates, and human populations expand, evaluating the ecological consequences of intensifying pressures on beach ecosystems becomes increasingly urgent. Limits of our scientific understanding of how beach ecosystems respond to climate change and a growing list of human threats are fast emerging as crucial impediments for the conservation of these threatened ecosystems.

Jenifer Dugan **2/28/11-2/28/12** **49,566**
Henry Page
Cal Department of Parks and Recreation

Evaluating Approaches to Enhancing Prey Resources for Nesting Shorebirds on Sandy Beaches

The seasonal program of wrack addition established by the Oceano Dunes SRVA program in the Western Snowy Plover nesting enclosure habitat offers an unparalleled opportunity to gain information on approaches that could enhance beach habitat and prey resources for nesting shorebirds. We propose to work closely with the snowy plover monitoring and wrack addition program at Oceano Dunes SRVA to choose suitable sampling schedules and spatial scales for evaluating strategies for enhancing beach ecosystem and prey resources required by nesting Western Snowy Plovers. We will compare prey resources among areas with widespread wrack and invertebrate additions to those with no invertebrate additions and to selected reference areas during the nesting season at ODSRVA. The design will allow us to examine the efficacy of supplemental additions of wrack and talitrid amphipods with respect to the spatial gradients in invertebrate abundance observed in previous years and to evaluate the effects of 1) distances from a natural source area at North Oso Flaco and 2) from experimental areas created by additions of talitrid amphipods in the nesting exclosure on talitrid abundance over time.

John Engle **5/1/10-4/30/15** **45,198**
UC Santa Cruz

Shoreline Assessment of Changes in Southern California Rocky Intertidal Communities

The UCSB portion of the MMS Rocky Intertidal Program will continue the work specified in the original Cooperative Agreement. This consists of coordination of database implementation and maintenance, protocol standardization, public and private websites, and other regional activities between MMS and the additional agency members of the Multi-Agency Rocky Intertidal Network (MARINE). The MMS/MARINE coordinator and assistant will interface with the Steering Committee, Data and Science Panels, and participating organizations to enhance communication and productivity by organizing meetings, overseeing standardization of taxonomy, survey methodology, and data transfer, as well as resolving technical issues. A key role will be coordination of implementation of the MARINE data management and information system such that standardized data are efficiently accessible for analysis, synthesis, and publication. The coordinator and assistant also will oversee updates to the public and private websites, and assist MARINE members in testing and implementing new field, laboratory, and data management procedures.

Melanie Fewings **4/15/10-3/31/13** **376,868**
Libe Washburn
National Science Foundation

The Influence of Coastal-Trapped Waves on the Inner Continental Shelf: Temperature and Circulation Patterns

In shallow nearshore areas of continental shelves, water temperature and ocean circulation fluctuations have large impacts on coastal ecosystems. Previous studies show substantial fluctuations in sea level, along-shelf velocity, and water temperature along the West Coast of North America are due to coastal-trapped waves. These waves propagate poleward, have periods of days to weeks, are mainly driven by wind fluctuations, and are a mechanism by which winds in one location influence the coastal ocean in other locations far away. Remote wind fluctuations in Baja have been observed to cause transport of warm and cold water masses into the nearshore Southern California Bight, with implications for nutrient supply to kelp forests, larval transport, strength of internal tidal temperature fluctuations, and trapping or flushing of nearshore pollution and harmful algal blooms. Coastal-

trapped waves are also suggested to affect the frequency and strength of internal tidal bores all along the West Coast.

Melanie Fewings **7/22/10-7/21/14** **145,059**
Libe Washburn
NASA Shared Services Center (NSSC)

Satellite and Land-Based Remote Sensing of Atmospheric Wind Relaxations and the Oceanic Response in the California Current Large Marine Ecosystem

Along the West Coast of North America in the California Current Large Marine Ecosystem, episodic relaxation of prevailing summertime upwelling-favorable winds causes warm water to propagate northward along the coast. These wind relaxations are an important characteristic of coastal upwelling systems worldwide. Although atmospheric wind relaxations have an important influence on coastal ocean dynamics, no description exists of the regional atmospheric patterns that lead to wind relaxations in central and southern California. We will use NASA remote sensing and reanalysis products, together with existing oceanographic observations, to describe the evolution of the atmosphere and coastal ocean color, temperature, and currents during upwelling relaxation events in this region.

Erica Fleishman **12/7/07-8/15/12** **1,280,807**
Gordon and Betty Moore Foundation, 1454

Prediction of Responses of Wild Pacific Salmon to Climate Change

Climate is a major driver of the geographic distribution and abundance of salmon. It is occurring globally, but there has been no organized effort to evaluate its potential effects, and potential management responses, on populations of salmon and their ecosystems. Empirical evidence shows that climate affects the viability of Pacific salmon, with cascading effects on human communities. However, predicting the effects of climate change on Pacific salmon is complicated by obstacles to downscaling coarse-grained climate models, resolving uncertainties in climate change scenarios, and understanding mechanistic responses of salmon and their resources to climate. Experts have identified high-priority research topics and developed a strategic framework for conducting targeted analyses. The National Center for Ecological Analysis and Synthesis (NCEAS) will conduct synthetic research on the following high-priority research topics: identification of mechanisms that limit the geographic range of salmon populations and exploration of how these mechanisms may adapt under projected scenarios of climate change; development of monitoring programs to identify changes in populations of Pacific salmon and attribute them to potential mechanisms, including climatic change; examination of the relative importance of evolutionary and plastic responses of Pacific salmon to climate change; and classification of salmon populations along a gradient of sensitivity or resilience to climate change, along with potential management and conservation strategies that may benefit salmon populations along that gradient under alternative future climates.

Erica Fleishman **4/27/07-4/30/11** **100,000**
Wilburforce Foundation, UCSB0703

Analysis and Conservation Prioritization of Landscape Connectivity in Nevada

Conservation area design (CAD) is being used by many landscape-scale conservation efforts in western North America to establish geographic priorities and to raise awareness within the scientific, practitioner, and lay communities of the importance of critical areas. CAD techniques can identify important locations, but it is generally acknowledged that these techniques currently cannot evaluate factors that allow species and their resources to persist over time. These factors include land-cover connectivity and the resilience of reserve networks to ecological processes such as fire. Several new methods for CAD are emerging that have the potential to improve greatly on past methods. These new methods are unfamiliar to most practitioners, and no comparative evaluation of their usefulness in different contexts exists. The National Center for Ecological Analysis and Synthesis (NCEAS) will support a meeting of approximately 10–12 scientists who are conducting some of the most innovative research on incorporating connectivity and ecological processes into conservation planning. Participants will test and compare new tools by applying them to conservation-planning challenges

in several geographic areas in North America, including the Great Basin and Pacific Northwest. Specifically, participants will develop a manual that evaluates new software tools for connectivity analysis (e.g., Zonation, FunConn, Conserv) with guidelines for use of those tools.

Erica Fleishman **6/6/07-9/30/11** **411,657**
USDI Fish and Wildlife Service

Integration, Analysis, and Synthesis of Results from the Evaluation of a Pelagic Organism Decline (POD) in the Upper San Francisco Estuary

The Interagency Ecological Program (IEP) for the San Francisco Bay / Sacramento-San Joaquin Estuary consists of nine member agencies: three State (Department of Water Resources, Department of Fish and Game, and State Water Resources Control Board), and six Federal (Fish and Wildlife Service, Bureau of Reclamation, Geological Survey, Army Corps of Engineers, National Marine Fisheries Service, and Environmental Protection Agency) and also includes a non-government organization (The San Francisco Estuarine Institute) among its program partners. Working together, the mission of the IEP partners is to develop a better understanding of the estuary's ecology and the effects of the State Water Project (SWP) and Federal Central Valley Project (CVP) operations on the physical, chemical, and biological conditions of the San Francisco Bay-Delta estuary (see http://www.iep.ca.gov/ and http://www.delta.dfg.ca.gov/IEP/ for more information). To accomplish its goals, IEP members conduct and sponsor a large number of long-term monitoring surveys as well as shorter term studies.

Steven Gaines **7/1/07-6/30/13** **450,000**
John Melack
O. James Reichman
Alice Alldredge
Oliver Chadwick
Bruce Luyendyk
Luce Foundation, SB070105

The Luce Environmental Science to Solutions Initiative

The pathway to environmental solutions has several key steps: synthesizing what we already know, strategic research to fill gaps, effective communication of results, and development and creative implementation of science-based solutions. This pipeline to success rarely flows smoothly, since it requires different people from different types of institutions who historically are not well linked. What should function as an efficient pipeline for new knowledge to produce societal and environmental benefit acts more like disconnected silos. Not surprisingly, environmental solutions are slow to emerge even when the pieces for success are at hand. The primary goal of this initiative is to educate and involve Ph.D. graduate students on the full trajectory from the identification of important environmental issues through knowledge accumulation and the development of suitable solutions to the actual implementation of those solutions. We will achieve this by supplementing the academic Ph.D. student experience with strategic policy and real-world enhancements. By engaging in focused projects that integrate academia, government and corporate perspectives, the graduates will be prepared to offer genuine solutions to our environmental problems and will have the unique skills needed to enhance the likelihood that they will be implemented. Our initiative will demonstrate to the students the advantages of collaborative teamwork in environmental science. Moreover, working and interacting with people outside of academia will acquaint students with political reality, economics, policy making, and legal dimensions.

Steven Gaines **8/1/09-4/30/11** **1,625,000**
Department of Commerce

Ocean Science Education Building

Award provides funding to support the building of the Ocean Science Education Building

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Steven Gaines **5/1/09-12/31/10** **38,318**
Environmental Defense Fund

Ocean Analytics

Ocean Analytics will organize a workshop, focused on analytical innovations in fisheries management.

Steven Gaines **4/1/10-1/31/11** **25,000**
University of Mississippi

The Legal Landscape for Marine Spatial Planning in the United States, with Emphases on Territorial Use Rights in Fisheries (TURFs) and Emerging Ocean Uses

The objective of this proposed project is to explore the legal contours of marine spatial planning in the United States, specifically with respect to territorial use rights in fisheries (TURFs). This project represents a timely exploration of this topic, as scientists, resource managers, the United States government, and state governments are all calling for a more comprehensive, place-based approach to the management of ocean ecosystems. This project would complement and enhance the recently released Interagency Ocean Policy Task Force report on marine spatial planning (1), the National Oceanic and Atmospheric Administration's (NOAA) Draft Catch Share Policy (2), and the March 16, 2010 House Subcommittee on Insular Affairs, Ocean and Wildlife oversight hearing on "Catch Shares as a Management Option: Criteria for Ensuring Success" (3).

Steven Gaines **10/01/10-9/30/11** **49,997**
COM National Oceanic And Atmospheric Administration

Working Group to Identify Critical New Directions in Marine and Coastal Ecosystem Science Research for NOAA Sea Grant

Sea Grant's Healthy Coastal Ecosystems (HCE) program has funded successful activities related to their priority areas of marine ecosystem based management, ecosystem restoration, and promoting stewardship of healthy ecosystem. However, emerging challenges in the context of healthy coastal ecosystems, including cumulative impacts of human activities, emerging ocean uses, the deign of marine spatial plans, and integrating new management tools such as catch shares fisheries management with existing management approaches, will require new and innovative research efforts. Strategically deciding how and where to allocate funding for these efforts requires a thorough understanding of our current state of knowledge. We propose to organize and host a two-part working group, closely following the highly successful NCEAS model (http://www.nceas.usbe.edu/research/wg), in which we convene a group of international and U.S. experts to synthesize the state of knowledge with respect to one of the emerging HCE challenges (topic chosen by the HCE steering committee) and identify near-term and longer-term research and funding priorities within this topic area. The working group will include participants spanning a range of international and national academic, NGO and government institutions with a broad diversity of expertise related to the topic area and the two meetings will be hosted at the Bren School of Environmental Science and Management at UCSB.

Jeffrey Goddard **12/1/07-11/30/10** **24,239**
UC Sea Grant, R/OPCENV-08-S-1/3

Long-Term Faunal Changes in California Nudibranchs: Climate Change and Local Ocean Health

The main objectives of this project are to determine: 1) if long-term changes have occurred in abundance, species richness, and community composition of rocky intertidal nudibranch gastropods in central California, and 2) if the observed changes can be explained by natural or anthropogenic climate change, or more localized environmental factors. Additionally, the PI will incorporate a regional example of the effects of climate change on marine ecosystems in exhibits at the Academy of Sciences in San Francisco and use his results on these colorful and popular organisms to highlight the importance of historical ecology and long-term studies for detecting significant ecological changes, and to illustrate the contributions that students can make to Marine Science.

David Greenberg **3/1/09-12/31/10** **15,665**
Heal the Ocean, Inc.

Spatial Patterns of Wastewater Discharge and Coastal Pollution in California

We propose to study spatial patterns of coastal pollution in California associated with effluent discharge by wastewater treatment plants (WWTPs). Effluent in coastal waters endangers human health (Brinks et al 2008; Griffin et al 2003; Henrickson et al 2001), and in California at least 38 WWTPs discharge directly into the Pacific Ocean. Oversight falls to the State Water Resources Control Board (SWRCB), which lacks data on how spatial patterns of coastal pollution relate to the distribution and effluent content of WWTP outfalls. We seek to provide such data, with an interest in helping to inform the regulatory process.

Benjamin Halpern **2/1/09-12/31/10** **193,320**
University of Massachusetts

Human Impacts Mapping

The project will develop critical scientific resources and decision support tools to advance more comprehensive and spatially explicit ocean management in Massachusetts. This will be accomplished with three distinct but overlapping components that build upon each other and leverage our past research, in which we will: 1) map and assess cumulative impacts and key ecosystem services in Massachusetts waters, 2) analyze tradeoffs among key ecosystem services, and 3) develop and apply scenario analysis models to evaluate a set of stakeholder-defined policy options. These three components, when integrated together, will provide a strong foundation for a comprehensive ecosystem-based approach to ocean management.

Benjamin Halpern **2/1/10-9/30/11** **711,000**
Conservation International Foundation

Developing an Ocean Health Index

Ocean Health Index (OHI) - NCEAS projects

- Teams work collaboratively with each other and with other scientific and non-scientific partners engaged in the OHI project.
- Teams make written reports of progress at scheduled times (quarterly).
- Teams informally communicate problems, needs and successes to Ben Halpern or the OHI Managing Director whenever desired or necessary
- Teams provide information and materials to be summarized as content for web site or other communication tools
- Teams participate in interviews, presentations or other forums for public or scientific communication.

Benjamin Halpern **1/1/11-12/31/11** **66,774**
Third Sector New England

TSNE Human Impacts Mapping

This project is the continuation and completion of a project funded and initiated last year entitled "Ecosystem Service Modeling, Valuation, and Tradeoff Analyses in Support of Integrated Multi-Use Ocean Management in Massachusetts." Most of the preliminary analyses have already been completed, which include identifying key ecosystem services to be modeled, identifying and gathering necessary data to model those services, and analyzing the nature of the tradeoffs among the services in a spatially-explicit context. Consequently, the work to be done in 2011 focuses on finalizing the tradeoff analyses, coordinating this work with the other team funded by MOP on this project (based at Boston University) that has been addressing the same questions but using a different modeling approach, and to write up and publish the results from the work. People supported by this

project will be responsible for these tasks. The goal of this work is to inform and advise the efforts in the Commonwealth of Massachusetts to implement marine spatial planning in their coastal waters.

Scott Hamilton **7/1/10-5/31/12** **14,999**
Robert Warner **7/1/10-6/30/11** **4,950**
UC Sea Grant College Program

Effects of Marine Reserves on Behaviorally-Mediated Changes in Spawning Success of California Sheephead

We will conduct behavioral observations of sheephead on SCUBA, using standard techniques in behavioral ecology. Sheephead are sexually dimorphic and generally site attached, which will facilitate observations. We will collect behavioral data on sheephead, including time budgets and instances of a variety of activities, including foraging, aggressive actions toward conspecifics of the same and opposite sexes, courting, and spawning. Divers will select focal individuals haphazardly and follow them for 10 minutes, recording their behaviors as well as encounter rates with other individuals and their behaviors (e.g. aggressive behaviors, courting and spawning). Divers will also estimate territory size, using a float line with a hand-held GPS at the surface or weighted markers that demarcate the edges of the territory. We will survey transects to record density, size structure, and sex-ratio of sheephead, and a variety of habitat variables, including benthic cover, densities of potential prey items and other mobile invertebrates, kelp stipe density, and benthic rugosity. To measure the effects of fishing on behavior of sheephead, we will compare time budgets and other behavioral responses inside and outside MPAs, using a paired design to match habitats between an MPA and a nearby fished area. These data will allow us to estimate the behavioral effects of fishing on spawning success.

Stephanie Hampton **8/12/07-9/30/11** **99,855**
O. James Reichman
COM - National Oceanic & Atmospheric Administration, AB133F07SE3931

Design and Implementation Guidance for a Programmatic Approach to Intensively Monitored Watersheds and Similar Large-scale Management Action Experiments

There is a long history of large-scale ecological experimentation in the research community, but no generalized guidance as to its implementation. There is no corresponding history of large-scale experiments within the resource management community, so the necessary policy guidance is also lacking. Given the wide range of unknowns and resulting odd foundation on which to develop guidance for the design and programmatic implementation of resource management experiments, a collaborative process that brings together experts from a wide diversity of disciplines is the most reasonable approach. A professional, technical working group in a neutral setting is an appropriate approach because it takes the issue out of the immediate political and resource management community (Salmon Recovery in the Pacific Northwest) and allows access by a diverse set of academic, agency and organization science staff who have the technical expertise to tackle the general problem of designing and implementing large-scale ecological experiments in a resource management context, but who traditionally do not work in this arena. The National Center for Ecological Analysis and Synthesis (NCEAS) will host a working group to prepare the following: 1) Experimental design guidelines for large-scale (e.g., watersheds) ecological experiments to demonstrate the effect of management actions such as aquatic habitat restoration on population processes of species of interest, and 2) Implementation guidelines for development of a program of large-scale management action experiments that balances replication, spatial representativeness and cost-effectiveness.

Stephanie Hampton **4/29/08-4/1/11** **96,953**
Gordon and Betty Moore Foundation, 1673

Finding Common Ground in Marine Conservation and Management: A Proposal for a Distributed Graduate Seminar

There is increasing concern among scientists, resource managers, and the general public about the current state of marine fisheries and their supporting ecosystems. Recent scientific progress on this

topic has been partly overshadowed by significant controversy on how to assess marine resources and how to address current problems in ocean management. Marine ecologists and fisheries scientists often tend to favor contrasting approaches, and we observe that these schools of thought have polarized over time. We now recognize this situation as counterproductive and propose to address this controversy where possible. To help address this concern, the National Center for Ecological analysis and Synthesis (NCEAS) is supporting a Working Group to define common ground among marine ecologists and fishery scientists by 1) developing a unifying terminology and a common analytical framework for assessing marine fisheries and ecosystem change, 2) applying this framework to a number of representative marine ecosystems around the globe, and 3) assessing management successes and failures in order to identify a set of tools that have been proven to reverse trends of degradation in marine fish stocks and ecosystems. This process should also identify areas of continued disagreement, important for focusing future research. The central question we are trying to answer is: how can we merge contrasting objectives, tools, and scientific criteria among marine ecology, fisheries science, and management into a unifying framework. We envision that this group will be acting as a catalyst for joining scientific forces in a quest to sustain and restore valuable marine resources.

Stephanie Hampton **6/25/09-12/31/10** **20,000**
Nature Conservancy

A Workshop on Global Climate Change and Adaptation of Conservation Priorities

NCEAS will work with TNC to continue to convene workshops in Santa Barbara, California to gather experts, partners and stakeholders to evaluate current methodologies for understanding the impacts of climate change on natural systems and identifying and prioritizing opportunities for adaptation. This working group will develop methods for the production of future climate projections at biologically-relevant scales (30m-1km). Methods explored will include expert-driven and Baysian probability frameworks. The group will use case study areas in California to test methods developed. The methods developed will allow use of information from GCMs and RCMs where appropriate, but use expert opinion of other sources of information where the climate models clearly to not capture local conditions well (e.g., fire weather, fog, snowpack). This method will be relevant to local changes in individual species and viable for individual management areas, such as individual parks and conservation areas.

Stephanie Hampton **1/1/10-8/15/11** **84,320**
Julia Baum
Schmidt Research Vessel Institute

Sharks on Coral Reefs - Ecosystem Consequences of Eliminating the Ocean's Apex Predators

Award provides support for the research of Dr. Julia Baum.

Stephanie Hampton **8/15/06-12/31/10** **50,531**
Nature Conservancy

The Economic Impact of Non-Native Forest Pests and Pathogens in North America

The intent of the project is to quantify the economic impact of non-native forest pests and pathogens in North America. Although there are well-documented examples of non-native forest pest and pathogens altering forest composition (e.g., hemlock wolly adelgid, chestnut blight) the economic costs of these impacts have not been credibly estimated. There is a sense, however, that the economic threats are substantial, and rising because additional non-native pests and pathogens continue to establish in the United States, at a rate of approximately one potentially significant introduction per year.

Stephanie Hampton **8/1/10-7/31/13** **41,559**
National Science Foundation

Collaborative Research: CAMEO: Comparative Analyses of Natural and Human Influences on Coral Reef Community Structure, Diversity, and Resilience

Coral reefs are among the most diverse and productive marine ecosystems, but are also among the most threatened by human activities. At the local scale, fishing and land-based sources of pollution can directly alter the structure of reef communities, and at the global scale, the effects of climate change and ocean acidification are expected to impose episodic and chronic stresses to even the most remote reefs. To most effectively implement ecosystem approaches to the management of coral reefs, it is critical to understand the pathway by which reef 'health' is degraded and the functional consequences of these changes. The Pacific Islands region is NOAA's largest geographical management area, and includes much of the nation's most biologically diverse and pristine coral reef ecosystems. The Coral Reef Ecosystem Division (CRED) of NOAA PIFSC has been monitoring the coral reef ecosystems of over 50 U.S. Pacific islands in the central and western Pacific since 2000. The Pacific Reef Assessment and Monitoring Program (RAMP) provides a methodologically consistent set of data with which to use comparative approaches to address fundamental questions of the role of ecosystem organization and structure in maintaining ecosystem resilience. The sampling design spans across space, time and multiple gradients of anthropogenic disturbance allowing for replicated tests of the effects of local versus global stressors on the current status and recovery of these systems from human disturbances. Analysis of Pacific RAMP data will provide an unprecedented view of how anthropogenic activities affect coral reef community structure, diversity, and dynamics in the U.S. Pacific.

Stephanie Hampton **4/1/11-3/31/12** **23,668**
David Marsh
National Science Foundation

An Undergraduate Network for Analyzing Plant Invasion in U.S. National Wildlife Refuges - A Workshop Proposal

This proposal requests funding for the workshop component of a synthetic ecological research project designed at NCEAS for undergraduate classes at eight colleges around the U.S. The project focuses on the analysis of a database on invasive plant species in U.S. National Wildlife Refuges. Undergraduate Ecology and Conservation Biology courses will analyze predictors of invasibility (e.g. refuge size, habitat heterogeneity, native species richness) for refuges within their own ecological region. They will then contribute their results to a continent-wide analysis of the predictors of invasibility. The scientific goals of the project are 1) to determine the variables that best explain geographic variation in the magnitude of invasion by non-native plant species, and 2) to use undergraduate efforts to update and expand the invasive species database for U.S. National Wildlife Refuges.

Ryan Hechinger **2/1/07-6/30/11** **24,870**
Armand Kuris **2/1/07-2/28/12** **30,000**
Kevin Lafferty
UC Sea Grant College Program

Parasites as Indicators of Coastal Wetland Health

We will take important steps in the development of the trematode ecological indicator tool by focusing on analyses and publication of how well the tool performs in indicating wetland condition. We will perform some field work to increase the resolution and accuracy of the indicator tool by confirming second intermediate host use throughout the range of the CA horn snail, and by continuing our work carefully documenting trematode life cycles. This involves morphological description of undescribed larval stages in first intermediate hosts, and experimental confirmation of second intermediate host use. Associated with this work will be the collection of photographs and other information to be used in a guide to using the trematodes as ecological indicators. We will communicate our findings to wetland managers and also finalize outreach products.

Monica Heintz **11/1/07-7/31/10** **40,000**
David Valentine
National Academy of Sciences, SB080050

Biological Control on the Flux of Methane from Marine Hydrates to the Atmosphere: A Research Plan

Marine methane hydrates are suspected to be the largest global reservoir for natural gas. Recent estimates of the amount of methane carbon in these deposits range from 500 - 24,000 Gt, with a consensus value of about 10,000 Gt. Methane is a powerful greenhouse gas, 26 times more potent than CO2 on a mole to mole basis. Thus, processes that moderate the flux of methane from hydrate deposits to the atmosphere are an important consideration in development of hydrates as an energy resource, and in understanding the potential role of hydrates as agents of global climate change. The goal of this research is to develop a predictive capacity for the impact of methane-consuming bacteria within the water column, on the flux of methane from marine hydrate deposits to the atmosphere. Microbial oxidation is a primary control on methane flux from today's ocean, yet this process is poorly constrained.

David Herbst **3/31/08-12/31/10** **70,000**
California Regional Water Quality Control Board, 07-125-130

Characterization of Benthic Communities and Instream Physical Habitat in the San Lorenzo River Watershed

The California Regional Water quality Control Board, Central Coast Region (RWQCB), is the State agency responsible for protection of water quality within the Central Coast Region of California. The San Lorenzo River and associated tributaries are listed as impaired due to sediment, and the RWQCB must utilize Total Maximum Daily Loads (TMDLs) to address the impairments. In order to develop TMDLs and associated implementation actions for sediment, the RWQCB needs better information on the linkage between sediment loads and impairment of aquatic life beneficial uses. Aquatic habitat quality may be evaluated by sampling in-stream invertebrate communities and calculating composite measures of community structure (such as diversity, biotic index, and taxonomic indicator groups), and through multivariate methods that consider physical habitat parameters as well as community structure. The collection of such information is called "biomonitoring" and the assessment of biological integrity using the biomonitoring data is called 'bioassessment." The objectives of this project are to provide a comprehensive picture of aquatic health of the San Lorenzo River and its tributaries with respect to sediment loading; and numeric target measurements to determine water and habitat quality.

David Herbst **8/25/08-9/30/13** **73,270**
USDI Fish and Wildlife Service

Monitoring Aquatic Ecosystem Indicators of Spring Restoration on the Sheldon National Wildlife Refuge: Feral Horse Grazing Exclosures

The purpose of this study is to determine the effects of feral horse use on riparian and adjacent areas in the absence of livestock grazing. We hypothesize that springbrook channels protected from feral horse use will have different aquatic life support capacity than areas used by feral horses, and protecting streams from feral horse use will also permit geomorphic recovery of channels (decrease width and increase depth). Damages to spring habitats on the Sheldon National Wildlife Refuge in northern Nevada are associated with trampling, overgrazing, and contamination by feral horse populations. Because cattle grazing has been removed from the SNWR for over a decade, protection of select spring habitats by riparian exclosures permits examination of the independent influence of horse grazing. The success of exclosures in recovering the biological integrity of riparian and aquatic habitat of these springs will be monitored through the use of benthic macroinvertebrate bioassessment. Contrasts of the diversity of these indicator organisms inside and outside exclosures will provide a measure of the progress and extent of improved habitat conditions over time. Complementary studies of riparian and upland vegetation community recovery will also be conducted.

David Herbst **9/1/08-6/30/12** **200,000**
USDA Forest Service

Monitoring of Sentinel Aquatic Management Indicator Species Sites to Account for the Influence of Global Climate Change on Stream Reference Condition

The objective of this study is to create a method to evaluate impacts from global climate change that will allow the Forest Service to credibly evaluate conditions of stream and lake habitats and confidently attribute any observed impacts to land management activities separate from the potentially confounding influence of global climate change.

David Herbst **9/3/08-9/30/12** **34,000**
USDI Bureau of Land Management

Quantitative Survey of Invertebrate Populations, Physical Habitat Characteristics and Water Chemistry in Rough Creek, Bodie Creek and Tributaries, Bodie Hills, Mono County, CA

To obtain and provide both relevant and timely information that will assist managers in a cooperative effort of the Walker River Implementation Team (WRIT), of which BLM is a member, to support recovery of Lahontan cutthroat trout, a Federally Threatened listed species. The project will also assist BLM and a host of cooperating State and Federal resource agencies in efforts to meet the mandates of both the Endangered Species Act (ESA) and the National Environmental Policy Act (NEPA). Specifically, the project will provide both relevant and timely information to WRIT for evaluation of the potential for establishment of a meta-population of Lahontan cutthroat trout in these waters in support of recovery efforts for this Federally Threatened listed species. Data relevant to recovery efforts collected as part of the proposed project will: 1) Document existing invertebrate populations and associated physical habitat characteristics, and 2): Ensure adequate environmental analysis of possible impacts to existing invertebrate populations that could result from treatments required to remove non-native trout prior to any reintroduction of Lahontan cutthroat trout. The WRIT has identified the evaluation of the potential establishment of this meta-population as a priority conservation action to be included in the updated short-term action plan for the implementation of the Lahontan Cutthroat Trout Recovery Plan, approve 1995.

David Herbst **8/25/08-9/30/13** **73,270**
USDI Fish and Wildlife Service

Monitoring Aquatic Ecosystem Indicators of Spring Restoration on the Sheldon National Wildlife Refuge: Feral Horse Grazing Exclosures

The purpose of this study is to determine the effects of feral horse use on riparian and adjacent areas in the absence of livestock grazing. We hypothesize that springbrook channels protected from feral horse use will have different aquatic life support capacity than areas used by feral horses, and protecting streams from feral horse use will also permit geomorphic recovery of channels (decrease width and increase depth). Damages to spring habitats on the Sheldon National Wildlife Refuge in northern Nevada are associated with trampling, overgrazing, and contamination by feral horse populations. Because cattle grazing has been removed from the SNWR for over a decade, protection of select spring habitats by riparian exclosures permits examination of the independent influence of horse grazing. The success of exclosures in recovering the biological integrity of riparian and aquatic habitat of these springs will be monitored through the use of benthic macroinvertebrate bioassessment. Contrasts of the diversity of these indicator organisms inside and outside exclosures will provide a measure of the progress and extent of improved habitat conditions over time. Complementary studies of riparian and upland vegetation community recovery will also be conducted.

David Herbst **9/28/10-6/30/12** **21,800**
Truckee River Watershed Council

Use of Biological Indicators in Evaluating Sediment Deposition Impairment on the Middle Truckee River, California

Sediment pollution of the Middle Truckee River (Lake Tahoe outflow to California-Nevada state line) from a variety of different land uses, including road and urban development, gravel mining, timber harvest, and natural sources, has resulted in listing as an impaired water body (303(d) list) and the need to develop a Total Maximum Daily Load for guidance on how much siltation impairs beneficial use values of the river.

Stream invertebrate communities reside on the bottom substrates or stream bed, and are sensitive to the amount and type of fine sediments that accumulate in these habitats. These organisms are appropriate as indicators of ecological health and biological integrity as they are native organisms, diverse, perform a variety of ecological roles and services in converting algae and organic matter to food for fish and riparian wildlife, and have been used extensively in the assessment of water quality throughout North America and in the local drainages of the Truckee River. These organisms may be used to define the quantities or coverage of sediments that impair ecological health relative to regional standards that have been developed for the eastern Sierra Nevada.

Sediments are transported during high flow events of snowmelt and storms, and deposited as flows decline. In order to be able to characterize the effects of sediment deposition, sampling during September low flows would best represent exposure of the benthic invertebrate community to bedded sediments. Even though the Middle Truckee River is larger than most streams used to develop eastern Sierra Index of Biological Integrity (IBI) data set, there are some large rivers in this region that are comparable: the West Walker, East Walker, West Carson, and East Carson Rivers. One context, therefore, in which to view the Middle Truckee is to look at the IBI scoring of these reference rivers where less sedimentation occurs relative to selected locations where sedimentation is suspected to be a problem. Sampling using several techniques would provide the most robust data set - specifically the Reach-Wide Benthos (RWB) and Target Riffle (TR) approaches (the former the standard method of the State Surface Water Ambient Monitoring Program, and the latter the method that was used to develop the eastern Sierra IBI). At each of 8 sites (4 on the Middle Truckee and 4 from each of the large reference streams), both RWB and TR samples will be collected, and compared using the multiple metric IBI scoring. Each sample reach will be selected to conform to a similar range of channel gradient. To be conducted in September of 2010.

Scott Hodges **10/1/10-9/30/13** **283,656**
Susan Mazer
Ruth Finkelstein
National Science Foundation

Renovation of Research Greenhouses at UC Santa Barbara for Ecological, Evolutionary and Developmental Studies

Plant scientists at the University of California, Santa Barbara (UCSB) are at the forefront of a diverse set of research areas in plant biology, including invasive species biology, controls of biodiversity, ecological & evolutionary genomics, and hormonal controls of development. Despite their many successes, plant research at UCSB has been severely hampered by a lack of modern growth facilities. The current greenhouse facilities were built nearly 50 years ago and have never had a major renovation. Numerous deficits to these facilities make growing plants difficult at best, and experimental control of environmental variables is impossible. In addition, the greenhouse facilities lack concrete flooring, drainage and the exclusion of pests and pollinators. Currently most researchers use the facility to maintain collections, make limited genetic lines, and propagate plants for field experiments. A host of new research will be possible with the complete renovation of these facilities. The proposed renovation will result in seven functional greenhouse bays comprising a total of 5,010 sq. ft. Each bay will have its own environmental controls for lighting, temperature and watering regimes. One greenhouse will have air□conditioning and structural components to allow high alpine environments to be replicated. Together, these new facilities will make possible numerous advances in plant biology, including experiments to test the specific morphological, physiological, and demographic traits responsible for the maintenance of plant diversity; identification of the genetic basis for adaptations to extreme environments and specific pollinators; tests of the how attributes of the physical environment influences plant distributions, productivity, and phenology; and an understanding of the genetic mechanisms underlying plant recognition and responses to a variety of stresses such as drought.

Gretchen Hofmann **5/1/09-4/30/11** **19,619**
National Science Foundation

A Proposal for a Workshop on Global Environmental Change & Biological Evolution in the Ocean

How the biology of the ocean will react to and modify the ongoing comprehensive global change-driven alterations in the marine environment is presently virtually unknown. The guiding questions of this workshop are:

What are the most compelling questions that are best addressed by an integrative approach combining oceanography and evolutionary biology to address biological responses to rapid environmental change in the ocean?

How can studies of present-day organisms and communities be used to predict long-term adaptations and biological responses to rapid regime shifts?

Can accurate models be developed to predict future effects of multiple environmental changes on organismal, population, and ecosystem level adaptations?

Assuming experimental evolution experiments are tractable, what are the best strategies (microcosms, mesocosms, and choices of organism)?

Gretchen Hofmann **5/1/05-4/30/12** **200,000**
National Science Foundation

Towards an understanding of protein homeostasis in cold-adapted Antarctic fish

The primary goal of this project is to investigate how Antarctic fish cope with cold–related protein damage machinery in Antarctic fish cells might be specially cold adapted to deal with elevated levels of protein first project revealed unexpected results suggesting that maintaining protein homeostasis – a process that accumulation is known to be cytotoxic – is more difficult in these cold adapted organisms than might be thought. set of experiments are: (1) the observation that a normally stress–inducible molecular chaperone, Hsp70, pilot experiments, high levels of ubiquitinated proteins have been measured in tissue of two Antarctic species this project will serve to highlight the strategies that account for the tolerance of cold denaturation of will use biochemical techniques to assess levels of midfolded proteins and we will also assess gene expression.

Gretchen Hofmann **3/18/10-4/30/11** **34,804**
4/8/11-12/31/11 **56,704**
Oregon State University

Understanding the California Current Large Marine Ecosystem under Climate Change: Delivering Sound Science for Policy

PISCO science has been a leader in understanding the functioning of the CCLME and in applying this understanding to issues of importance to society. Scientific advancement and policy change are fundamentally affected by all participants as part of the social change process; the changes and new knowledge sought by PISCO have been, and will continue to be strongly influenced by the participation and collaboration of many others. PISCO project outcomes are important guideposts for evaluating our progress, involving our important partners and collaborators in the successes, and working closely with a greater community to address challenges for reaching the goals of healthy and sustainable ocean ecosystems.

Gretchen Hofmann **12/1/10-11/30/11** **16,000**
UC Sea Grant College Program

Ocean Acidification Exacerbated by Coastal Upwelling: Monitoring of CO2 and O2 on the California Shelf and Effects on Red Sea Urchins, Abalone, and Oysters

Dr. Fabry will be responsible for overall coordination of the project. Drs. Feely and Sabine will manufacturer a pCO2 sensor to be deployed on a moored buoy off the northern coast of California. The project will use Humboldt State University's ship, the R/V Coral Sea to deploy the system. Dr. Abell will supervise regular sampling of seawater for dissolved inorganic carbon, alkalinity, oxygen and nutrients. Drs. Fabry and Dickson will design and build the experimental system for CO2-perturbation experiments and will conduct manipulative experiments in which red sea urchins, California mussels, and abalone are exposed to different pCO2 concentrations in seawater. Dr. Fabry will conduct measurements of calcification rates of larval, juvenile and adult stages of these species.

Dr. Dickson will analyze seawater samples for dissolved inorganic carbon and total alkalinity and calculate all the parameters of the seawater CO2 system in both perturbation experiments and at the mooring site in northern California. Dr. Hofmann will use different genomic tools to link Fabry's calcification rates measurements with gene expression. Aseltine-Neilson will provide input to experimental design and development of useful tools to assess the impacts of ocean acidification on selected important marine resources. The three trainees will work together with the investigators on the three major research areas: CO2 chemistry, calcification rates, and genomics.

Gretchen Hofmann **8/1/10-7/31/13** **563,446**
National Science Foundation

Effect of Ocean Acidification on Early Life Stages of Antarctic Sea Urchins (Sterechinus neumayeri)

The central focus of this project is to examine the effects of ocean acidification (OA) on embryos and larvae of a contemporary calcifier in the coastal waters of Antarctica, the sea urchin Sterechinus neumayeri. Ocean acidification is the process whereby the pH of seawater is driven down by the uptake of CO2 from the atmosphere. Since the industrial revolution, anthropogenic sources of CO2 have already resulted in the lowering of ocean pH by ~0.1 units and future atmospheric and oceanic CO2 levels are predicted to further acidify surface seawater, driving ocean pH to levels well below the current day pH of ~8.1 by perhaps as much as 0.5 pH units.

The effect of future ocean acidification is projected to be particularly threatening to calcifying marine organisms in coldwater, high latitude seas, making tolerance data on these organisms a critical research need in the Antarctic marine ecosystems. Due to a high magnesium (Mg) content of their calcitic hard parts, echinoderms, the focus of this proposal, are especially vulnerable to dissolution stress from OA because these organisms are already existing in seawater that is barely at the saturation level to support biogenic calcification. Thus, cold-water, high latitude species with a high Mg-content in their hard parts are considered to be the 'first responders' to chemical changes in the surface oceans. Studies in this proposal will use several metrics to examine the physiological plasticity of contemporary urchin embryos and larvae to CO2-acidified seawater, to mimic the OA scenario as defined by IPCC emission scenarios (Meehl et al. 2007) and by analyses of future acidification predicted for the Southern Ocean (McNeil & Mateur 2008). In a final study, we hope to learn about the biological consequences of developing under conditions of OA and further, whether embryos and larvae of S. neumayeri are affected by synergistic interactions of two converging climate change-related stressors – CO2- driven ocean acidification and ocean warming.

Gretchen Hofmann **9/1/10-8/31/13** **599,034**
National Science Foundation

Synergistic Effects of Climate-Related Variables on Larval Sea Urchins: Performance to Gene Expression

The central goal of this proposal is to characterize the response of larval purple sea urchins (Strongylocentrotus purpuratus) to the synergistic interaction of two climate change-related factors: ocean acidification and ocean warming. Due to increasing levels of anthropogenic carbon dioxide (CO2), ocean acidity and ocean warming are predicted to change dramatically by the end of the 21st century. Specifically, increased dissolved CO2 concentrations in the global ocean are predicted to reduce the pH of surface ocean waters from 8.1 now to ~7.8 by the year 2100 (IPCC 2007). Additionally, the average surface seawater temperatures are predicted to increase by anywhere from +1°C to +6°C by the year 2100. In manipulative laboratory experiments, I propose to raise cultures of larval sea urchins under varying CO2 and temperature conditions that reflect future ocean change conditions. In order to characterize the metabolic status of the larvae and the costs associated with development under varying pCO2 and temperature conditions, the following physiological processes will be measured: (1) respiration rate, (2) lipid content, (3) calcification rates, (4) total protein content, (5) tolerance of acute thermal stress, and (6) morphometric analysis of the larval endoskeleton. Additionally, gene expression profiling will be performed using an oligonucleotide DNA microarray and _next-generation_ RNA sequencing (Illumina mRNA-seq) to explore transcriptome dynamics

in response to changing conditions. This transcriptomic approach will provide mechanistic understanding into how the larvae respond to environmental change in a multiple stressor scenario.

Gretchen Hofmann **8/1/10-7/31/12** **8,394**
National Science Foundation

International: Biochemical Consequences of Ocean Acidification on Larval Development in a Temperate Sea Urchin

Ocean acidification (OA) is expected to be one of the most pervasive impacts of global climate change on marine systems. While calcifying organisms are predicted to be at greatest risk from decreased ocean pH, many other taxa may be at risk, particularly during environmentally sensitive early life-history stages. The proposed international collaborative research will investigate the impacts of ocean acidification on the physiology and biochemistry of larval sea urchins. Specifically, this work will explore how elevated CO2 affects the utilization of lipid resources during larval development. Lipids represent the primary energy source fueling larval development in a large number of marine taxa. The abundance of particular classes of lipids such as triglyceride, an energy storage lipid, can be a useful metric of physiological state. The rate at which these lipids are utilized during development may also provide useful information regarding larval metabolism. Paul Matson, a graduate student in the Hofmann Laboratory at UC Santa Barbara, will raise larvae of the purple sea urchin, Strongylocentrotus purpuratus, under elevated CO2 levels, simulating current and future levels of ocean acidification. Mr. Matson will collaborate with Dr. Mary Sewell at the University of Auckland, an expert in lipid metabolism of larval echinoderms, who will provide training and access to equipment for lipid analyses to quantify the presence and abundance of energy lipids in larvae during development. Intellectual merit: This work will increase our knowledge regarding the potential costs of developing in an acidified ocean, and what impacts it may have on populations in near-future climate change scenarios. There is currently a need for a greater understanding of sub-lethal effects of ocean acidification on organisms during development and this project will provide useful insight into changes in metabolism.

Gretchen Hofmann **10/1/10-9/30/13** **473,354**
Carol Blanchette
Libe Washburn
National Science Foundation

OCEAN ACIDIFICATION - Category 1: COLLABORATIVE RESEARCH: Acclimation and Adaptation to Ocean Acidification of Key Ecosystem Components in the California Current System

We will investigate the impacts of ocean acidification (OA) on two ecologically important, calcification-dependent marine invertebrates in relation to local-to-coastal variation in carbonate chemistry (e.g., pH and aragonite saturation) in the California Current Large Marine Ecosystem (CCLME). An interdisciplinary team of investigators with expertise in physical and chemical oceanography, marine ecology, biochemistry, molecular physiology, and molecular genetics will carry out an integrated, lab and field, multi-site investigation of the ecological, physiological, and evolutionary responses of sea urchins and mussels to spatial and temporal variation in OA. The research will take place in the context of a mosaic of variable oceanography, including recently documented latitudinal variation in carbonate chemistry along the upwelling-dominated US west coast. Variation in upwelling regimes from Washington to southern California generates spatial and temporal gradients in concentration of CO2 that shoal to surface waters during upwelling events, extending shoreward into the inner shelf region. Through well-known chemical pathways, influxes of CO2 cause present-day declines in pH in coastal ecosystems that are lower than values forecast for the ocean in general in the year 2200. Lower than "normal" pH can influence organisms by altering intracellular biochemistry, and especially, for calcification-dependent marine organisms, interfere with formation of hard parts as the aragonite saturation state falls near or below 1.0. Because calcifiers in the upwelling-dominated CCLME have historically experienced persistent regional variation in pH, populations are likely differentially acclimatized and/or adapted to a variable carbonate chemistry environment. The new challenge to these organisms is that with global change and the

resulting increase in seawater CO2, they already may be close to their acclimatization or adaptational capacity, and thus may have limited ability to respond to additional increases in CO2. It is this challenge, the mechanistic ability of calcifying invertebrates to acclimate or adapt to increasing CO2 and aragonite saturation states < 1.0 that we address here. Preliminary results from NSF-funded, local-scale studies of sea urchin and oyster larvae (by PIs included in the present team) has made inroads into this question, but the response of these widely-ranging species to ocean acidification across the full range of conditions in the CCLME remains unclear. Our proposed research includes five integrated elements. (1) To document the oceanographic context in which the study organisms live, we will build upon two local-scale NSF-funded networks of sensors (in Oregon and northern California) to quantify carbonate chemistry in four regions of the CCLME with contrasting upwelling regimes, and thus, likely a wide range of differences in carbonate chemistry. Based on NOAA surveys, OA should be most intense in northern California and Oregon, less intense in central California, and least intense in the Santa Barbara channel, east of Point Conception. (2) To examine physiological, genomic, and genetic mechanisms underlying acclimatization and adapation to OA conditions, we will carry out coordinated and integrated studies of adults and larvae of sea urchins and mussels collected from each of two sites within each of the four regions. In common-garden experiments using NSF-funded laboratory mesocosms at UCSB and UCD-BML, we will culture sea urchins and mussels under different CO2 and temperature regimes, and use genomics techniques to determine the tolerance of larvae to present and future OA conditions. (3) To determine evolutionary responses and adaptational potential to OA, we will conduct genetic surveys of urchins and mussels across the 8 sites and relate detected variability to the oceanographic conditions quantified by our mooring network. (4) To examine ecological responses to OA, we will transplant mussels and urchins in the field and monitor growth rates and shell accretion rates in relation to oceanographic and physical conditions. Our study should pioneer the way towards new, integrative approaches to investigation of the response of ecologically important calcifiers to OA.

Sally Holbrook **10/1/07-11/30/11** **275,400**
UC San Diego, 54181A

Building Community Based, Grass-Roots Networks: The Cases of Global Lake Ecological Observatory Network (GLEON) and of Coral Reef Ecological Observatory Network (CREON)

UC Santa Barbara, is the lead institution for the Moorea Coral Reef LTER site located in Moorea, French Polynesia. Key personnel leaders Sally Holbrook, Russell Schmitt and Andrew Brooks will provide the driving science for coral reefs. During the project period, they will work with other CREON sites to 1) define science questions to be addressed by the CREON network, 2) develop deployment plans for instruments, including agreement on nomenclature and measurement standards, 3) develop common database structures including metadata standards, and 4) identify future participants for CREON and facilitate their entry into the network. The MCR LTER site will serve as a test-bed for development of a sensor network node. CTD (conductivity, temperature, depth) sensors will be deployed on reefs at Moorea. The investigators will test the most efficient way to acquire data and make it available on the internet. One goal is to provide real-time streaming data. The researchers will also explore networking multiple sensors at the site, with the idea of developing an autonomous sensor network. The particular deployment of multiple sensors will be driven by a physical oceanographic science question that will shed light on biological processes. Using an interface such as the cyberdashboard, the prototype network will allow physical oceanographers to query the data and use them to develop and test real time models.

Sally Holbrook **1/1/11-12/31/11** **30,000**
UC San Diego

Re-Deployable CI for Environmental Observing System

Task 1. Assist in the benchtop testing of OA instruments, particularly in regard to development of middleware for real-time data collection (50% UCSB, 50% CSUN).

Task 2. Conduct test field deployments of the OA instruments on the existing real-time mooring in Moorea (60% UCSB, 40% CSUN). This will include deployment and retrieval of instruments, data download and sensor maintenance and calibration as needed, maintenance and troubleshooting of

the data transmission hardware on Moorea, maintenance of the existing real-time mooring (buoy, cable, power supplies, etc.).

Task 3. Evaluation of data streams from the real-time deployments, including QA/QC, comparisons between sensors, and assessments of spatial and temporal variation in measured variables (40% UCSB, 60% CSUN).

Task 4. Preparation of the report document that will present a justification and design of an expanded real-time sensor network to address research issues on ocean acidification in Moorea (50% UCSB, 50% CSUN).

Robert Jellison **4/1/07-3/31/12** **665,069**
David Herbst
US Fish & Wildlife Service, 842407J0007

Assess Responses of Lahontan Cutthroat Trout Prey Items to Changing Hydrological Regimes and Salinity in Walker Lake, Nevada

This research project will assess the responses of tui chub, benthic macroinvertebrates, and zooplankton to changing salinity and hydrological regimes over a 5-year period. The project contains four major components: 1) an expanded limnological monitoring program conducted in cooperation with all members of the Walker Lake Fishery Improvement Team (Service, Nevada Department of Wildlife, Walker River Paiute Tribe) with a primary focus on zooplankton dynamics, all of which will be integrated with ongoing monitoring conducted by the Nevada Division of Wildlife, 2) the first quantitative assessment of benthic macroinvertebrates in Walker Lake and implementation of an appropriate and efficient long-term benthic bioassessment monitoring program, 3) hydroacoustic surveys of the tui chub population allowing estimates of both population size and inter-annual variability in recruitment, and 4) mapping and monitoring of changes in the lakewide distribution of macrophytes. In addition to analyzing responses in each of these ecosystem components during 2007-2012 when new water management initiatives are expected to be implemented in the Walker Basin, results of this project will also be used to establish the scientific foundation for long-term monitoring of the "health" of Walker Lake.

Robert Jellison **8/1/09-7/31/10** **310,310**
John Melack
Los Angeles Department of Water and Power

Proposal to Provide Professional, Scientific, Expert, and Technical Services for the Mono Lake Limnological Monitoring

The project will provide "professional, scientific, expert, and technical assistance relating to the limnology of Mono Lake and various Mono Basin watershed management issues". The work proposed herein continues the Mono Lake limnological monitoring program begun in 1982 and is specifically designed to fulfill the requirements set forth in State Water Resources Control Board Order Nos. 98-05 and 98-07.

Matthew B. Jones **9/1/07-8/31/11** **450,000**
Mark Schildhauer
UC Davis, SUB0700051

SDCI NMI Improvement: Development of Kepler CORE - A Comprehensive, Open, Robust, and Extensive Scientific Workflow Infrastructure

The UC Santa Barbara work on this project will include participation in project meetings, interaction with the broader scientific community about requirements for Kepler, and contributions to the development of the Kepler Core software. Specifically, Matthew Jones will oversee and manage the UCS project; Mark Schildhauer will engage with domain scientists to elicit project requirements; the software engineer will participate in the design and re-factoring of Kepler core for maintainability, extensibility, and new core features; and the build and support engineer will re-factor the build

system to be NMI compliant, build the test system and write tests, as well as solicit test cases from the project developers and the broader community, and will create and maintain the collaboration infrastructure (web site, wiki, CVS, bug tracking, etc.).

Matthew B. Jones **8/1/09-10/31/11** **662,688**
University of New Mexico

DataNetONE (Observation Network for Earth)

To address the growing environmental, social, and technological challenges facing the world, scientists, educators, librarians, resource managers, and the public need open, persistent, robust, and secure access to well-described and easily discovered Earth observational data. DataNetONE is designed to provide the distributed framework, sound management, and reliable technologies which enable the long-term preservation of diverse and complex multi-scale, multi-discipline, and multi-national science data. DataNetONE will initially emphasize multi-disciplinary observational data collected by biological (genome to ecosystem) and environmental (atmospheric, ecological, hydrological, and oceanographic) scientists, national and international research networks, and environmental observatories.

Matthew B. Jones **10/1/06-5/31/11** **767,000**
National Science Foundation

Management and Analysis of Environmental Observatory Data Using the Kepler Scientific Workflow System

National initiatives such as the National Ecological Observatory Network (NEON) and the Ocean Observatories Initiative (OOI) have highlighted the need for improvements in cyberinfrastructure supporting environmental observatories. Although previous initiatives have focused on data acquisition and archiving, scientists also need cyberinfrastructure that supports integration of data acquired from different instruments, and modeling and analysis of archived and real-time data sources. In addition to scientists, resource managers and the public need access to data, modeling results, and analysis outcomes.

Matthew Jones **11/17/10-9/30/11** **45,931**
Mark Schildhauer
Ecotrust

Semantic Representation of Juvenile Salmon Outmigrant Data

The University of California Santa Barbara will participate in the Juvenile Outmigrant Exchange (JMX) project that is being run and coordinated by EcoTrust. As part of this project, UCSB will employ personnel at the National Center for Ecological Analysis and Synthesis that travel to sites in Washington State to meet with collaborators from the Washington Department of Fish and Wildlife to discuss the management of juvenile outmigrant data at their sites. The resulting knowledge about the structure, content, and semantics of outmigrant exchange data will then be used to construct a Juvenile Outmigrant Exchange (JMX) ontology. This ontology should be useful for linking together data from multiple sources that have independent data collection and management procedures but might have overlapping data semantics. The product of the work will be one or more documented ontologies as needed to link together outmigrant data. Matthew Jones and Mark Schildhauer will lead the project at UCSB, and UCSB will hire a knowledge engineer to build the ontology.

James P. Kennett **9/15/08-8/31/12** **175,625**
National Science Foundation

Collaborative Research: Co-Evolution of Submillennial and Orbital Scale Climate and Ocean Behavior During the Last 700 kyrs: The Unique Santa Barbara Basin Record

The proposed research will investigate abrupt and high-frequency climate change at an ultra-high resolution previously unobtainable before 150 ka, but here spanning most of the 100-kyr

climate regime back to ~700ka. Resolving short-term climate behavior before ~150ka is critical for understanding processes, thresholds, and feedbacks that contribute to abrupt climate change. Millenial-scale climate oscillations (Dansgaard/Oeshger cycles) reflect major abrupt shifts in the ocean-atmosphere system, yet knowledge of this important behavior is largely confined to the last glacial cycle, owing to the unavailability of suitable older sequences. This study will extend our understanding of these events and processes for the first time by analysis of a superb suite of 32 high-sedimentation rate (~80-120 cm/kyr) cores taken in 2005 on the Santa Barbara Mid-Channel anticlinal trend, where older, uplifted stratigraphic sequences crop out on the ocean floor. Our preliminary work confirms that Santa Barbara Basin can reveal climate history in unprecedented resolution for this time span, clearly recording earlier D/O-like cycles and abrupt climate-oceanographic behavior of the north Pacific through much of the interval dominated by the 100 kyr glacial-interglacial cycles, an interval not previously studied at this resolution.

Armand Kuris **9/1/09-8/31/10** **30,720**
Maria Leopoldina Aguirre-Macedo
UC MEXUS

Long-Term patterns in parasites communities of aquatic organisms from Yucatan

Fellowship to support the research of Dr. Maria Leopoldina Aguirre-Macedo.

Armand Kuris **9/1/09-8/31/10** **30,720**
Victor Manuel Vidal Martinez
UC MEXUS

The Sensitivity of Parasites of Aquatic Organisms to Global Climate Change

Fellowship to support the research of Dr. Victor Manual Vidal Martinez.

Adam Lambert **1/24/11-3/31/11** **19,042**
Thomas Dudley
Nature Conservancy

Development of a Strategic Plan for the Santa Clara River Research and Education Station/ Preserve

We request funding from The Nature Conservancy (TNC) for preliminary studies and evaluations that would provide the information base necessary to develop new research and outreach programs at the site of the proposed Santa Clara River Research Station/Preserve, Ventura/Los Angeles Counties. The primary objective of the Santa Clara River Reserve project is to build a multi-functional station to provide facilities, infrastructure and an institutional framework to carry out environmental studies and natural resource policy research that integrates existing information with newly acquired data to support conservation of biodiversity, ecosystem processes and agricultural sustainability in the SCR watershed. The funding will be used for salary and fringe benefits support for PI Lambert and for supplies and travel costs associated with project development.

David W. Lea **9/1/06-8/31/10** **321,073**
National Science Foundation

Collaborative Research: Establishment of a Climate Type-Section for the Tropical Atlantic from Cariaco Basin Sediments

The PI and a graduate student propose to participate in the R/V Knorr 195-5 research cruise from the Galapagos Islands. The objective of the cruise is to use the long piston coring facility in the R/V Knorr to recover long sediment cores from the Galapagos region that can be used to construct benchmark paleoceanographic records for the eastern tropical Pacific.

Ira Leifer **4/1/06-9/30/11** **230,000**
Cal State Lands Commission

UCSB Coal Oil Point Seep Studies

Research study will quantify aspects of natural marine oil and gas seepage from the Coal Oil Point seep field with respect to spatial and temporal emission rates. Specifically, this study will provide the spatial distribution of gas seepage fluxes and estimates of oil seepage as well as provide initial baseline data for studies that address seasonal and inter-annual variability. The study also develops approaches to allow cost benefit analysis of mitigation strategies based on field data.

Ira Leifer **10/1/08-3/31/11** **61,159**
Texas A&M University

Remote Sensing and Sea-Truth Measurements of Methane Flux to the Atmosphere from Near-Surface Gas Hydrates in Continental Margins

Participate in the TAMU project "Remote Sensing" and coordinate the Santa Barbara Channel field test, collect data, conduct data analysis, and numerical modeling of bubble fate.

Ira Leifer **10/1/08-3/31/12** **32,144**
UC MEXUS

Passive Acoustic Observations of Marine Seabed Bubbles

Passive acoustics is a highly promising, but largely undeveloped, bubble size measurement approach with widespread potential applications and advantages including long-term monitoring of seabed and wetland bubble emissions, both sources of the greenhouse gas, methane. This collaborative pilot lab and field project synergistically combines the extensive field and laboratory (but not theoretical) experience of Dr. Leifer for optical and sonar bubble measurements with UNAM's laboratory and theoretical expertise in bubble hydrodynamics and acoustics (e.g., Vasquez et al, 2005). Lab studies will compare theoretical bubble formation sounds for ideal (distilled, stationary) and field (currents, surfactants, seabed boundary) conditions with field data, improving upon Leifer & Tang (2006). Project leveraging includes hydrophone data on whale migration for interpretation based on the lab and field studies to derive long-term emissions at a SCUBA-accessible seep. This will yield further synergies with a remote-sensing methane study by providing temporal context, its "snap shot" of field emissions.

This UC MEXUS collaboration builds upon bubble-science discussions spanning many years through preliminary data acquisition for a collaborative, large-scale research proposal. We seek to provide regulatory agencies and policymakers with a critical tool to assess methane inventories from diverse aquatic sources under current and warmer climate conditions.

Ira Leifer **8/1/08-7/31/12** **127,743**
Bruce Luyendyk
University of Mississippi

Spatio-Temporal Measurement of Seep Emissions by Multibeam Sonar

By their nature, seeps are spatially and temporally variable and episodic; thus, effective emissions quantification presents significant challenges because measurements at any one time and location likely are unrepresentative. Moreover, Leifer et al. (2006) showed that large transient emissions are critical for allowing methane sequestered in deep-sea hydrates to reach the winter mixed-layer and thus the atmosphere. Thus, we propose to measure seep emissions including transient events over a wide spatial domain using a seabed-deployed, scanning multibeam sonar system. The system will use a low–cost and low power model, several of which are commercially available.

Ira Leifer **4/1/11-3/31/13** **45,500**
Lockheed Martin Corporation

Multibeam Sonar Application to At-Sea Fish Aquaculture

Velella Phase II implements the first operational mobile fish pen. In order to conduct aquaculture in the open ocean on a drifting platform the husbandry activities must be automated. One of the keys to automating many husbandry activities such as cleaning, feeding, and mortality removal is precision underwater positioning relative to the cage. This challenge will be solved by applying a UCSB multibeam sonar rotator system, ROSSCAN, developed for seep bubble monitoring to provide real-time underwater spatial measurements. The multibeam operates in vertical fan mode, scanning a 3D volume up to 100-m radius, as fast as 10° s-1. Cabled deployment allowed real-time adjustment of sonar parameters (range, gain, ping rate, etc.) and scanner parameters (speed, angular limits). Sonar direction is recorded at 10 Hz. 4D (time-varying) mapping of all scatterers in the scan volume is derived from the sonar data with 20 to 50 cm spatial precision or better, depending upon range setting. Data structure (vertical orientation) allows discrimination between bubbles and fish, both of which have strong sonar returns. Algorithms that identify structural orientation and persistence are based on techniques developed for particle velocimetry and enable automated segregation between seep bubble plumes and fish.

In order for a technology to be useful to aquaculture, however, it must be able to weather harsh conditions over long periods of time. This effort will deploy an instance of the SONAR to test whether the capabilities degrade over the course of a grow-out cycle (nine months). The concept will be considered validated if the accuracy is still sufficient at the end of the period.

Ira Leifer **9/1/10-8/31/13** **224,088**
National Science Foundation

COLLABORATIVE RESEARCH: The East Siberian Arctic Shelf as a Source of Atmospheric Methane: First Approach to Quantitative Assessment

We propose to study methane (CH4) release over the East Siberian Arctic shelf (ESAS), the largest and the shallowest shelf of the world oceans, which was previously considered not a significant CH4 source and thus completely isolated from modern biogeochemical cycle by the impermeability of sub-sea permafrost. As a region, where the largest hydrocarbon stocks in the world are stored mostly in form of hydrates, the ESAS represents an enormous potential CH4 source to the atmosphere that could be triggered by permafrost degrading from global warming. Such increase can occur gradually, in form of numerous single seepages, or abruptly, as conglomerations of bubbles forming over large areas of venting fields. Due to extreme ESAS shallowness, CH4 here will avoid oxidation and escape to the atmosphere. Global CH4 levels have increased by almost 28 Tg in the past two years and there could be a contribution of the ESAS.

Our main hypothesis is that current CH4 emissions from the ESAS are significant to global atmospheric budgets. We further hypothesize that the controlling processes of fluid migration through the ESAS seabed have changed in recent years leading to significant increases in CH4 emissions as part of a positive feedback cycle leading to accelerated CH4 emission.

Ira Leifer **8/1/10-7/31/12** **110,711**
Dar Roberts
Bruce Luyendyk
National Science Foundation

Fossil-Fuel Extraction Industry Methane Emission Ground Reference Measurements during the AVIRIS Response to the Gulf Oil Spill

Methane emissions from fossil fuel production are estimated as one of the major sources of the greenhouse gas CH4, estimated responsible for ~30% the radiative transfer impact of CO2 (Shindell et al 2005), yet, virtually no peer-reviewed studies have field-evaluated these emissions, which EPA estimates are the largest non-anthropogenic US CH4 source. As such, refinement of this key part of the global carbon cycle would greatly reduce uncertainty in natural global budgets. The current state of knowledge is in part because of the need for imaging spectrometric remote sensing, recently first demonstrated with AVIRIS (Airborne Visual Infrared Imaging Spectrometer) for a marine geologic source and sunglint (Roberts et al 2010).

Our approach is to use vicariously collected AVIRIS hyperspectral data during transit between

Ellington AFB and the oil spill, during the current mission (Leifer is Airborne Mission Coordinating Scientist for the NASA spill response) of Gulf of Mexico platform flaring (>4300 active platforms). Typical uncombusted flaring CH4 is 5x106 m3 dy-1. These data will ground reference GOSAT data (Leifer/Roberts are on the GOSAT science team). Platform sources will be far easier to evaluate than the geologic source, and AVIRIS could collect order ~1000 platform-source observations over the current mission, but not critical ground reference measurements. Results also will aid future satellite platform development, like HyspIRI.

Ira Leifer **1/1/11-12/31/12** **0**
Japan Aerospace Exploration Agency (Jaxa)(Frmly Nasda)(Japan)

Validation of Satellite-Derived Methane Budgets from Fugitive Fossil Fuel Industrial Emissions

In 2009, we proposed combining GOSAT CH4-data with in situ CH4 emission data from several important California sources, the Coal Oil Point seep field, and central valley rice paddies and feedlots, and have secured California Air Resources Board (CARB) support for ground measurements. Analysis of SCIAMACHY data with the Univ. of Bremen, strongly suggested that in many countries, like the US, CH4 anomalies are in large part explained by fossil fuel industry (FFI) fugitive emissions. During the Gulf Oil Spill response, extensive platform flaring data (hundreds of platform-observations) were acquired with the NASA AVIRIS imaging spectrometer, and are being analyzed. Furthermore, Expedition Methane America!! (Oct 7-12) collected transcontinental, ground CH4 data. Preliminary analysis documented the importance of FFI as well as other important sources. These data provide an opportunity to validate GOSAT retrievals with GOSAT complementing data by providing lacking long-term information. Specific GOSAT data products we will use include L2 TIR CH4 columns and profiles, and L4 CH4 fluxes and distributions acquired multiple times within each season. Work outlined herein will be completed within an 18-month time frame to coordinate with the NSF-funded and CARB-funded research projects.

Jonathan Levine **10/21/04-10/20/11** **695,752**
The David and Lucile Packard Foundation

Understanding Biological Invasions from Introduction through Impact

Biological invasions are a leading threat to natural ecosystems and cost the American economy tens of billions of dollars annually. At the same time, invasions can be regarded as large scale perturbations to ecological communities, providing unique opportunities to understand how these systems are structured. This proposal outlines a research program applying principles of population, community, and ecosystem ecology to understand the factors controlling the success and impacts of biological invasions. The proposed research couples mathematical models with field experiments to understand such fundamental questions as how many new invaders we should expect over the coming decades, and what factors regulate the impact of invaders once they have established. By examining key questions at the introduction, establishment, spread, and impact stages, the proposed research aggressively pursues a rigorous understanding of the entire invasion process.

Jonathan Levine **3/15/08-2/29/12** **338,106**
National Science Foundation, DEB-0743365

Collaborative Research: Niches, Neutral Controls Over the Coexistence of California Serpentine Annual Plants

One of the most enduring mysteries in ecology is how multiple plant species coexist. For almost a century, efforts to answer this question almost invariably invoked niche differences between species. This changed, however, with the recent rise of neutral models suggesting that species similarities, rather than differences, drive their coexistence. Apparent conflict between the role of species differences in neutral and niche theories has spurred interest in a new framework for coexistence. In this framework, species coexist when niche differences, called stabilizing processes, overcome fitness differences between species. This theoretical insight, however, has identified new gaps in the understanding of coexistence. Most importantly, ecologists have little understanding of overcoming large fitness differences among species versus weak stabilization combined with small

fitness differences. Where real communities fall along this continuum reveals the importance of niche differences for coexistence, and goes to the heart of debate between niche and neutral theory. This research combines field experiments with population dynamic and statistical models to ask how niche differences and fitness inequality shape the coexistence of California serpentine annual plants.

Annie Lindgren **7/1/09-6/30/11** **10,000**
National Science Foundation

The Cephalopod Cornea as a Model of Convergent Evolution

One of the leading edge questions in evolutionary biology is how similar structures evolve multiple times. Understanding such transitions sheds light on the replicability of complex morphological features: recent advances in molecular techniques and analyses now allow researchers to investigate the relative roles of genetics and environment with respect to convergence and homology. The proposed research investigates the molecular basis for convergent evolution using cephalopod corneas, which have evolved at least twice, once in squids and once in octopods.

Lorraine Lisiecki **9/1/09-8/31/12** **317,113**
National Science Foundation

Climate forcing of Atlantic overturning over the last 3 Myr

Atlantic overturning experiences dramatic changes over glacial cycles with potentially dramatic effects on climate. However, its pre-LGM spatial and temporal variability and its primary forcing are poorly understood. The SPECMAP project [Imbrie et al.,1992] proposed that summer insolation at 65N, i.e., Milankovitch forcing, drives the same sequence of climate responses (including Atlantic overturning) over 100-kyr eccentricity cycles, 41-kyr obliquity cycles, and 23-kyr precession cycles. The implication of this hypothesis is that global climate is extremely sensitive to changes in the North Atlantic and that all other climate changes (e.g., in the tropics and Southern Ocean) are only responses or feedbacks to changes in Atlantic overturning or northern hemisphere ice volume.

Lorraine Lisiecki **10/1/10-9/30/13** **157,017**
National Science Foundation

CMG Collaborative Research: Probabilistic Stratigraphic Alignment and Dating of Paleoclimate Data

Paleoclimate studies are important for placing current climate change in the context of past natural climate changes and for quantifying the sensitivity of the climate system to different types of forcing. Marine sediment cores are a common source of paleoclimate data and the source of nearly all paleoclimate time series of >800 kyr in length. The development of age models for these paleoclimate records is crucial for establishing the causes of climate change and the interactions between different parts of the climate system. Age models for long marine cores are developed either by aligning climate responses to changes in Earth's orbital parameters (orbital tuning) or to the climate responses observed in other marine cores (stratigraphic alignment). To date, these crucial tasks (upon which all future analyses of the paleoclimate time series are based) have been performed either by manual, qualitative comparison [e.g., Shackleton et al., 1995; Prell et al., 1986] or by deterministic algorithms [e.g., Martinson et al., 1982; Lisiecki & Lisiecki, 2002; Huybers & Wunsch, 2004]. We propose to develop probabilistic algorithms for both stratigraphic alignment and orbital tuning.

Milton Love **8/22/07-8/31/10** **760,000**
USDI - Minerals Management Service, M07AC13380

Continuation of Fish Assemblages Associated with Platforms and Natural Reefs in Areas Where Data are Non-Existent or Limited

The fate of spent offshore platforms off California has been a subject of considerable debate, much of which is focused on the potential importance of fish populations residing at these facilities. Data gaps concerning the fish assemblages exist at some of the oldest facilities, yet these facilities may be

the first to be decommissioned. Knowledge of the potential importance of the local population at platforms to the depleted Pacific rockfish stocks is essential for fully evaluating the various options proposed for decommissioning California's offshore oil platforms. Using manned submersible and scuba surveys, this project quantifies spatial and temporal patterns in species composition, density and size structure of fish assemblages at offshore oil/gas platforms and nearby natural reefs. Surveys make use of seafloor habitat maps and regional oceanographic patterns to interpret findings.

Milton Love **5/15/08-5/14/11** **460,000**
USDI - Minerals Management Service, M08AX12732

Spatial and Seasonal Variation in the Biomass and Size Distribution of Juvenile Fishes Associated with Petroleum Platforms off the California Coast

Although hundreds of thousands of juvenile rockfishes sometimes inhabit POCS platform midwaters, the role that platforms play as nursery grounds for these badly depleted fishes is not well understood and will be of critical importance to the MMS in assessing the ramifications of different platform decommissioning options. It will also be of great interest to Federal and State agencies concerned with rebuilding overfished stocks and to nongovernmental organizations involved in the decommissioning process. Because fish populations are usually limited by available habitat, energy, or recruitment, it is essential to know the role of each platform as habitat for early life stages, particularly as compared to the natural reefs in the vicinity of platforms. In this study, SCUBA surveys at platforms and natural reefs that are at depths of at least 25 m will provide comparative data on which species settle (i.e., recruit), their densities, size distributions at platforms and natural reefs, as well as the depth at which they recruit at platforms throughout the Santa Barbara Channel region and off central California. Further, a novel experiment employing fish attraction devices (FADs), is designed to evaluate the importance of the shallow portion of platforms (<25 m) for recruitment. The SCUBA survey and FAD experiment build upon previous research to assess the importance of depth for fish recruitment at the platforms. This is particularly crucial in order to analyze the environmental consequences of decommissioning alternatives on local and regional fish populations.

Milton Love **6/1/08-3/31/11** **192,236**
USDI Geological Survey

Arctic Marine Fish Ecology Catalog

This project involves summarizing what is known about the biology, systematics, and ecology of the fishes living in the Chukchi and Beaufort seas, in the northern pare of Alaska.

Milton Love **4/22/10-5/31/12** **400,000**
Department of Interior

Completion of Fish Assemblage Surveys around Manmade Structures and Natural Reefs off California

The fate of spent offshore platforms off California has been a subject of considerable debate, much of which is focused on the potential importance of fish populations residing at these facilities. Data gaps concerning the fish assemblages exist at some of the oldest facilities, yet these facilities may be the first to be decommissioned. Knowledge of the potential importance of the local population at platforms to the depleted Pacific rockfish stocks is essential for fully evaluating the various options proposed for decommissioning California's offshore oil platforms. Using a manned submersible, this project quantifies spatial and temporal patterns in species composition, density and size structure of fish assemblages at offshore oil/gas platforms and nearby natural reefs. Surveys make use of seafloor habitat maps and regional oceanographic patterns to interpret findings.

Milton Love **6/1/08-3/31/12** **32,236**
USDI Geological Survey

Comparison of Levels and Profiles of Polycyclic Aromatic Hydrocarbon Metabolites in Bile of Fishes from Off-Shore Oil Platforms and Natural Reefs Along the California Coast

The study will address three objectives, 1) Survey and determine the nature and extent of PAHs present as hydroxylated or glucuronide conjugates in the bile fluids of platform resident fish; 2) Compare platform resident body burdens and PAH metabolite profiles to those found in similar sizes and species of fish at paired natural seep locations adjacent to the platforms; 3) Interpret PAH metabolite levels in fishes within the context of the local and regional geospatial background by considering the variability in PAH metabolite levels and profiles in platform and natural seep fish species.

Milton Love **10/1/10-6/30/12** **100,372**
UC Santa Cruz

Investigations in Fisheries Ecology

We will conduct biological and ecological research on the deepwater corals and sponges of California. This research will include 1) underwater surveys of coral and sponge habitats, 2) the relationship of fishes with these structure-forming invertebrates and 3) taxonomic and genetic studies of corals and sponges.

Sally MacIntyre **4/1/07-3/31/11** **528,622**
National Science Foundation

Turbulent Mixing, Internal Waves, and Intrusions: Temporal and Spatial Variability of Resource Supply and Metabolic Productivity in Lakes

The long term goal is to develop a predictive understanding of how physical forcings in lakes effect and control ecosystem function. Our knowledge of hydrodynamic processes in lakes has increased in the last decade, and I am using these insights and state-of-the-art instrumentation to identify key physical processes and their links to ecosystem function.

We now know that turbulence production in the upper mixed layer, thermocline and bottom waters of lakes is intensified when frontal systems which induce cooling and higher winds pass through a region. The amplitude of internal waves, whose breaking cause's turbulence, increases during these events and varies with bottom slope. In addition, these frontal systems induce stream inflows which spread into lakes at various depths as a function of temperature and discharge. Consequently, during storm events, we can now envision hot spots where solute fluxes and metabolic activity are intensified and cold spots where change is only possible if currents transport water from hot spots. The proposed work will build upon this knowledge to design experiments to locate these hot and cold spots and quantify the bacterial and primary productivity. Via time series arrays, collaborative modeling efforts, and adaptive sampling based on real time data on the physical state of the lakes, we will be positioned to more accurately quantify lacustrine bacterial and primary productivity than ever before.

Susan Mazer **8/15/07-1/31/13** **259,858**
National Science Foundation

Collaborative Research: The Evolution of Life History, Physiological, and Floral Traits in Clarkia: do Genetic Correlations Affect Mating System Evolution?

Mating system is among the most evolutionarily labile of plant traits. To date, the primary explanations for the evolution of selfing in angiosperms are adaptive ones, focusing on the genetic and ecological consequences of selfing independent of other traits. For example, natural selection may strongly favor autogamous (within-flower) self-fertilization where pollinators are scarce or unreliable, or where short growing seasons favor rapid reproduction (which is facilitated by selfing). Self-fertilization in plants, however, often evolves along with a suite of physiological, morphological, and life history traits. This joint evolution of multiple traits raises the possibility that the evolution of selfing is influenced by selection on other traits with which it may be developmentally, physiologically, or genetically correlated.

Susan Mazer **2/27/08-2/28/11** **10,000**
University of Wisconsin

Collaborative Research: RCN: USA National Phenological Network

Dr. Mazer will fulfill the following goals as part of the educational and outreach activities associated with the USA National Phenological Network. The Phenology Handbook: a guide to phenological monitoring for students, teachers, families and nature enthusiasts will provide a foundation from which observers at all experience levels can be trained to identify, recognize, measure, record, analyze and interpret a wide range of phonological data on agricultural or wild plant species. The Handbook will include the following major sections: A detailed introduction that provides necessary information on: understanding phenology at multiple biological and geographic scales, the relationship.

Susan Mazer **8/30/10-5/30/13** **286,000**
USDI National Park Service

Facilitation of a Phenology Network to Assess Climate Change Response in California National Parks

In this project, investigators from the University of California, Santa Barbara (UCSB) will collaborate with National Park Service (NPS) staff and the director and staff of the National Coordinating Office of the USA-National Phenology Network to develop a phenological monitoring network emphasizing NPS units in California. The activities to be developed include: (1) identifying compelling scientific questions that can be addressed by park-based phenological monitoring programs, that apply to multiple California parks and nearby state or federal landholdings and preserves, and that may apply to national parks across the United States (a particular focus will be on using phenology to assess climate change response); (2) selecting charismatic, ecologically important, and/or keystone species, that address scientific questions of interest, for phenological monitoring within and across California national parks; (3) designing and testing park-specific as well as park-wide species-sampling schemes and monitoring protocols; (4) designing, testing and evaluating activities to engage national park visitors, including families, institutional groups, and school groups in conducting phenological observations; (5) developing in collaboration with park-based educators informal science education programs and curricula for the public that can be implemented in each of the California national parks and with nearby schools; (6) developing a monitoring framework for all NPS units in CA in which species and protocols are identified and packaged; (7) training park staff to implement phenological monitoring and educational programs; (8) developing written materials and manuals that can be used by park staff to engage the public and to maintain consistent and high standards for phenological data acquisition; (9) creating a CA phenology network website for information and reference materials to be readily accessible to project participants and the public; (10) developing protocols to assure high quality data accumulation, archiving, and accessibility; and (11) assessing programmatic success with follow-up visits to participating parks, participating staff and members of the public. Partnerships will also be developed with the directors and staff of the University of California Natural Reserve system's field stations and sister federal agencies who wish to participate in the design and implementation of a statewide phenological monitoring network. Depending upon future needs and funding availability this task agreement may be modified in future years.

Susan Mazer **9/13/10-8/31/11** **49,900**
USDI Geological Survey (Incl Natl Biological Service)

Phenology Literacy: Understanding through Science and Stewardship (PLUSS)

Scientific literacy in disciplines that influence governmental policy and environmental quality is critical for the development of an informed and well-educated electorate. These disciplines include climate change, plant biology, phenology, and environmental science, and mastering these fields requires early and recurrent hands-on educational opportunities at every level of scholastic achievement. In collaboration with the USA National Phenology Network (USA-NPN), we will initiate and develop a new program, "Phenology Literacy: Understanding through Science and Stewardship (PLUSS)" to:

- provide hands-on educational experiences in climate change research to underrepresented and at-risk students;

- to assist teachers in the use of curricular materials that relate phenological observations to patterns of climate change both in the classroom and in phenology gardens on school
- grounds;
- to assess the understanding of the link between phenology and climate that is gained by students from these activities;
- to engage the public (including students' families) in the recording and understanding of phenological data;
- to provide a model for public schools and citizen scientists in the recording and use of phenological data for the purpose of understanding its relationship and sensitivity to climate change.

In short, our aims are to build climate literacy and human capacity in the biological and physical sciences, introducing and engaging young children with the goal of helping them to develop a lifelong familiarity with and understanding of the natural world.

Ed McCauley **10/1/06-9/30/11** **3,707,721**
Stephanie Hampton
National Science Foundation

The National Center for Ecological Analysis and Synthesis (NCEAS) was established in 1995 in recognition of the need for a facility where ecologists and scientists in allied disciplines could collaborate to conduct multidisciplinary research. The Center's mission is to advance the state of ecological knowledge through the use of existing information, organize and synthesize ecological information to make it useful to all users, and to influence the way in which ecological research is conducted by promoting a culture of synthesis and collaboration. The Center supports three primary modes of research - working groups (2-20 individuals interacting to address important questions), Postdoctoral Associates (15-18 per year) and Center Fellows (4-6 sabbatical visitors per year). Because research at NCEAS relies on using existing information, the Center is involved with many collaborators to develop generic data access tools for a broad user community, from student and resource managers to scientists.

William McClintock **9/1/08-12/31/10** **45,001**
Steven Gaines **10/1/08-6/30/11** **7,000**
Resources Legacy Fund Foundation

MarineMap Decision Support System - 2008-0045M

This Agreement is a continuation of Agreement 2008-0035M and supports University of California, Santa Barbara staff that provide support to the MLPA Initiative by hosting the MarineMap Decision Support System ("DSS") and providing Geographic Information System ("GIS") and technical assistance.

William McClintock **1/1/11-12/31/11** **150,000**
Steven Gaines
Tides Foundation, The (Incl Tide Center)

Extending MarineMap for Nationwide Coastal and Marine Spatial Planning

The MarineMap decision support tool is a web-based application built on the Google Earth API that has been used for marine protected area (MPA) siting in California. We propose extending MarineMap for coastal and marine spatial planning (CMSP) in general, including wind and wave energy siting, conservation, transportation and fisheries management. We anticipate that in the upcoming year, MarineMap will be used nationwide to resolve environmental conflicts through collaborative, science-based and stakeholder-driven decision-making.

To prepare our free and open-source application for purposes that go beyond MPA planning, we seek to improve MarineMap's out-of-the-box features, including (1) a more generalized data model, (2) improved discoverability, (3) an enhanced kmltree. Specifically, this grant would support:

1. A refactoring of our data model to accommodate more user-defined feature classes. This will allow us to represent new features such as renewable energy sites, seasonal closures, shipping lanes, and other designs that future MSP processes need built into the MarineMap framework.

    a. Refactoring of server-side modules to support the definition of new "feature classes" that interact with existing functionality and services to form a spatial content management system.

    b. Extending our data model and user-interface to support point, line, and 3d model representations of designs in addition to the existing polygon support.

    c. Enhancement of the user-interface to help users manage all these feature classes, including support for multiple-select, bulk-editing operations like copy and delete, organization of features into nested folders, and a better organized editing interface.

    2. Improved data discover-ability and accessibility for content generated for and within MarineMap.

    a. A module will be developed to aid in publishing a sitemap.xml file for all instances of MarineMap and expose our content to search engines. This will include all public KML data layers and proposals generated by stakeholders. In the case of the California North Coast MLPA application, public proposals - including the accepted final MPA boundaries - will be made visible through this sitemap.

    b. Materials related to spatial designs, such as MPA attributes, habitat and economic impact reports, will be made accessible outside the main MarineMap application via standalone pages. These pages can be bookmarked and linked to by users, and also be indexed by search engines and linked to from KML files included in the sitemap. This will greatly improved the accessibility of content.

3. Maintenance and enhancement of kmltree. kmltree is an open source spin-off project that can be used as an interactive data layer list in conjunction with the Google Earth API. It provides a layer list that matches much of the functionality of the Google Earth desktop product that is missing from the plug-in API. For the term of this grant, we will update kmltree to track changes in the Google Earth Plug-in API and take advantage of new features that become available.

Science-based, stakeholder-driven decision-making about ocean resource use and management has never been accomplished at the national scale. There are many reasons for this, including the inherent technical limitations imposed by most web-based mapping applications. MarineMap stands to be the first web-based mapping tool that brings state-of-the-art science to the desktops of average, non-technical users and "level the playing field" for all stakeholders wishing to participate in important decisions about how our oceans are used. Our proposed enhancements will prepare MarineMap for use on a national scale.

John Melack **6/1/10-5/31/12** **150,000**
Bodo Bookhagen
Carla D'Antonio
Scott Cooper
Christina Tague
National Science Foundation

RAPID: Fires in coastal California: Watershed and ecological responses to an acute environmental disturbance

Fire frequency has increased and fire timing has changed in California and the western US in association with climate warming, increased human population density, and an expanded urban-wildland interface. Three major fires occurred in the foothills and mountains above the greater Santa Barbara area over the last year, all within the area being studied by the Santa Barbara Coastal LTER program. Because high rainfall is expected during the El Ninõ conditions forecasted for this year, burned ecosystems will show their greatest responses to fire during and after the upcoming rainy season, which begins in October 2009. Hence, these fires afford an extraordinary, but urgent, opportunity to examine the effects of fire on terrestrial, riparian, stream, and coastal ecosystems.

Daniel Morse **6/1/09-9/30/10** **276,914**
Duke University

Dynamic Camouflage in Benthic and Pelagic Cehalopods: An Interdisciplinary Approach to Crypsis Based on Color, Reflection, and Bioluminescence

Cephalopod reflectin proteins are capable of self-assembling into any number of photonic structures, and the reflective outputs of these structures appear to be well-tuned for dynamic, reflective camouflage in the specific light environments in which they evolved. Our first objective is to quantify the correspondence between the optical properties of the reflectin-based iridophore layers in cephalopod skin and the dynamic optical environments in which they are found (characterized as described in detail in Task 1, above), in order to understand how this match enhances the camouflage abilities of the organism. Our second objective is to uncover the biophysical principles driving the neurotransmitter-induced self-assembly of the photonically active reflectin proteins, and the resulting changes in the Bragg reflectors of the iridosomes (cf. our recent paper, Izumi et al., 2009), in order to facilitate the subsequent development of synthetic analogs of these structures.

William Murdoch **8/26/10-12/31/11** **960,000**
Susan Swarbrick
Department of Cal Ra Fish and Game

Sedgwick Reserve Infrastructure and Facilities Project: Phase 2

The purpose of the project is to provide matching fund to upgrade utilities, repair roads, fencing, and a roof, construct a maintenance shop, and remove two buildings at the Sedgwick Reserve. This project is for the construction and development of facilities that will be used for research and training to improve the management of natural land and the preservation of California's wildlife resources.

Craig Nicholson **7/1/08-6/30/11** **201,427**
Christopher Sorlien
National Science Foundation, EAR-0810278

Uplift, Subsidence, and Sedimentation Along the Evolving Pacific-North American Plate Boundary

The offshore California Continental Borderland is an ideal natural laboratory to investigate many aspects of continental deformation and plate boundary evolution, including oblique rifting and transform initiation. The Borderland was the locus of Pacific-North America plate motion for about 70% of its displacement history, and recent GPS data suggest that up to 20% of current plate motion is still located offshore. This is generally an area of deposition rather than erosion, suggesting that the record of plate boundary deformation is more complete, more geophysically accessible, and can be better imaged in 3D offshore. Active offshore structures represent a largely as yet unknown hazard to many California coastal communities, and provide important analogs to active buried (less-accessible) onshore structures likely to produce large, damaging earthquakes in the Los Angeles basin and other areas. The PIs will make use of extensive grids of newly released high-quality industry marine multichannel seismic (MCS) data to investigate the crustal deformation and tectonic evolution of the offshore portion of the PAC-NAM plate boundary. Evaluating the offshore structure, stratigraphy and plate boundary deformation of the Continental Borderland will address important questions about the evolution of continents and continental deformation, including: how does strain accumulate and how is it partitioned within plate boundaries, and what controls the crustal architecture at plate boundaries?

Craig Nicholson **3/1/08-2/28/11** **255,144**
Christopher Sorlien
James Kennett
National Science Foundation, OCE-0751807

Collaborative Research: A Test for Extending the High-resolution Climate Record back to 1.2 Ma & Investigating the Mid-Pleistocene Climate Transition in Santa Barbara Basin

High-quality, well-dated records are essential for understanding global climate change. ODP Site 893 in Santa Barbara Basin provides one of the highest-resolution paleoclimatic archives of the late Quaternary in the world's oceans, yet has not been extended beyond ~160 ka with deeper drilling, due to safety concerns. In 2005, a towed-chirp and coring cruise verified that deep basin sediments extending to ~700 ka are accessible on the Mid-Channel Trend. These cores contain high-quality partially laminated (varved) sediment with abundant well-preserved microfossils optimal for ultra-high-resolution paleoclimate studies. Newly released multichannel seismic (MCS) data, along with chirp, sonar and industry dart core data indicate that a similar sequence of upper bathyal sediments have been uplifted, folded, and exposed on the northern outer shelf of Santa Barbara Basin, now accessible to piston coring. These sediments extend back to more than 1.2 Ma. IODP is enthusiastic about drilling to recover this older high-resolution record, if suitable, safe drilling strategies can be developed. This project will test the feasibility of extending the record from Santa Barbara Basin back to ~1.2 Ma by conducting 3D modeling of the structure and outcrop stratigraphy of the northern shelf to locate optimal core sites, and by conducting needed IODP site surveys, test coring and core analyses. This work will further understanding of climate variability and major climate transitions, and of factors related to climate destabilization and abrupt climate change, a current societal concern given uncertainties related to global warming and future climatic instability.

Craig Nicholson **2/1/07-1/31/12** **75,000**
University of Southern California, 119525

Helping to Evaluate the SCEC 3D Community Fault Model and Regional Seismicity Catalogs

This project will help evaluate 3D fault representations in the SCEC Community Fault Model (CFM), using recently developed relocated earthquake catalogs. This will form the basis for identifying and developing new and alternative representations for faults that are currently missing, incompletely or inaccurately defined in the current CFM, as well as help distinguish between existing alternative fault models. The results will be used to define a set of reference 3D fault surfaces (or calibration points) that exhibit a high degree of consistency between their surface and subsurface expressions such that the position of the fault at depth can be ascertained with a high degree of confidence. These 3D control points can then be used to help calibrate and evaluate the relocated earthquake catalogs. This is particularly critical in areas like the Imperial Valley and along the southern San Andreas and San Jacinto fault systems, where different velocity models and location procedures can significantly shift earthquake hypocenters relative to their mapped surface fault traces. In collaboration with other members of the SCEC CFM Working Group, the results will be used to identify and establish a set of calibration control points, such as reference 3D fault surfaces and principal earthquake hypocenters and focal mechanisms, which based on kinematic consistency and other independent data sets can be used to define the orientation and position of active subsurface fault segments.

Roger Nisbet **9/1/07-8/31/11** **416,999**
National Science Foundation, DEB-0717259

QEIB: Modeling Disturbances in Systems with Unidirectional Flow

Many questions in fundamental and applied ecology involve relating biotic responses to abiotic forcing at multiple spatial and temporal scales. It is commonly impossible to establish such links empirically, even with large quantities of data and sophisticated statistical approaches. Simple mathematical models can help elucidate these links and contribute to understanding the broader implications of mechanisms found to occur at one particular scale in space or time. This study focuses on models of populations that disperse in advective media, media with net unidirectional flow. Examples include drifting invertebrates in rivers and streams, marine organisms whose larvae are dispersed in local longshore currents, and plants with wind or waterborne seeds. The emphasis is on population dynamics in rivers and streams, for which many ecologists have gathered data on local demographic and behavioral processes operating over small time scales. The models will be used to determine the implication of these findings at larger spatial, and longer temporal, scales. Stream and river systems exhibit high spatial and temporal variability, and the PI will use simple models to address questions arising from this variability. The models will make predictions as to the population level consequences of changes in flow regime. As a result, it will be possible to relate the

work directly to some very practical issues in environmental management, including calculation of "instream flow needs," i.e., the flow regime in a river that must be maintained to ensure viability of resident populations and communities.

Roger Nisbet **4/1/08-3/31/12** **555,011**
Frank Doyle
National Science Foundation, EF-0742521

Collaborative Research: Homeostasis, Stoichiometry and Dynamic Energy Budgets at Multiple Levels of Biological Organization

Dynamic energy budget (DEB) models describe the rates at which individual organisms assimilate energy and elemental matter, using it for maintenance, growth, reproduction and development. DEB theory offers a powerful theoretical framework for relating suborganismal (biochemical, genetic, and physiological) processes to organismal performance, and thereby to population, ecosystem, and evolutionary change. However, establishing such relationships in particular systems requires a more sophisticated treatment of homeostasis within individual organism than current DEB theory offers. This research will extend DEB theory by exploring the consequences at many levels of biological organization of a broad range of biochemical and physiological control mechanisms. It will emphasize dynamics in variable environments, adaptive dynamics, and both inter- and intra-specific metabolic scaling relations. There will be parallel efforts to develop general theory on one particular application: the biology of stony corals, a system that requires non-traditional theory, since the interactions of a cniderian host with symbiotic dinoflagellates (zooxanthellae), as well as with intra-cellular and etracellular microbial communities, create a context where traditional distinctions between levels of biological organization fail, and where the time scales of physiological, ecological, and evolutionary processes overlap. Theoretical developments address general biological problems and will have wide applicability, including leguminous plants and Rhizobium bacteria, ruminants and their intestinal flora, chemi-autotrophic taxa in deep seas habitats, and moss-lichen associations.

Todd Oakley **4/1/07-3/31/12** **636,797**
National Science Foundation

CAREER: Exploring Congruence of Fossil and Molecular Estimates of Macroevolutionary Divergence Times in Ostracoda (Crustacea)

The PI proposes an empirical study of origination times of numerous lineages of Ostracoda (Crustacea). This study will have broad implications for understanding the controversies surrounding divergence time estimation by investigating hypotheses to explain observed incongruities between fossil and molecular divergence time estimates in Ostracoda. A primary goal is to examine in detail causes of incongruence observed in preliminary data; considering molecular, statistical and paleontological explanations. To ensure a balanced approach, the PI proposes to collaborate with two postdoctoral researchers (sequentially) with primary training in morphology/taxonomy and paleontology. In addition to detailed inquiries into the causes of molecular/fossil incongruence, the lineage divergence times in question have direct bearing on several important evolutionary hypotheses that are a focus in the lab of the PI, such as the recent origin of compound eyes in myodocopid ostracods. A primary goal is to examine the sensitivity of character evolution hypotheses to different possible divergence time estimates.

Todd Oakley **9/1/10-8/31/12** **200,000**
National Science Foundation

Collaborative Research: Developing Genomic Tools for Integrative Biology Research

A major goal of modern research in biology is to achieve an integrated understanding of the function and evolution of biological systems across levels of organization, from genes to phenotypes. However, species amenable to physiological, developmental, biochemical or evolutionary research have not always been simultaneously amenable to the development of genomic tools. New technologies have the potential to change this. Namely, high-throughput, next-generation ("next-gen") sequencing technologies now make the development of genomic tools feasible in most any organism, even in invertebrate animals where the density of available full genome sequences is low

relative to species diversity. We propose to capitalize on new technologies and develop protocols for transcriptome (the suite of genes expressed in a tissue) sequencing that can be used across organisms and across different phenotypic systems. In addition, we will develop bioinformatic tools and tutorials for transcriptome analyses, including assembly, annotation, and evolutionary analyses. These generalized protocols and tools will be especially useful to a diversity of researchers in various disciplines who do not yet have experience with next-gen sequencing approaches. To illustrate the utility of these tools, we propose to apply them to organisms that are well-studied and/or well-suited to vision research, but that are not traditional genomic model organisms. We will make available in public databases the sequences of genes expressed in eyes of multiple invertebrate organisms. These data can be used to test important hypotheses in vision research, integrate across levels of organization from genes to phenotype, and further elevate animal vision as a 'model phenotype' for integrative systems biology research.

Todd Oakley **10/1/10-9/30/12** **515,722**
National Science Foundation

Dimensions: Collaborative Research: Can Evolutionary History Predict How Changes in Biodiversity Impact the Productivity of Ecosystems?

While a spectacular variety of life is perhaps the most defining feature of our planet, loss of this biological diversity is one of the most pronounced forms of environmental change in the modern era. Researchers have made great strides in understand how changes in biodiversity impact essential biological processes, such as the efficiency by which ecological communities capture limited resources and produce new biomass. However, we still do not understand the mechanisms by which diversity affects the productivity and sustainability of ecosystems, or which dimensions of biodiversity matter most. We believe this is partly due to the fact that most prior work has been preoccupied with variation among species as our primary measure of biodiversity. But 'species' are little more than a form of packing for all the genetic, functional, and trait variation that influence the efficiency and metabolism of an organism, and these differences are themselves shaped by patterns of evolutionary history and common ancestry. If we want to understand the functional consequences of diversity loss, we must first understand the evolutionary processes that generate and maintain diversity at levels spanning genes to communities.

Here we propose a collaboration that will integrate phylogenetics, genomics, and community ecology to test the hypothesis: Evolution leads to genetic differentiation among species that controls the strength of niche partitioning and, in turn, how efficiently communities capture the limited resources needed to produce biomass. Using a group of algae that are among the most widespread and ecologically important in lakes throughout North America, we will:

1. Create a new molecular phylogeny that can be used to test whether assemblages of freshwater planktonic green algae are more genetically diverse than predicted by chance.
2. Experimentally manipulate the evolutionary and genetic divergence of species to assess how these aspects of biological diversity control niche differences and community productivity.
3. Conduct transcriptome analyses to identify the genetic basis of niche differentiation among species, and relate these to the production of biomass by phytoplankton communities.

Henry Page **1/1/08-12/31/11** **2,078,317**
Daniel Reed
Stephen Schroeter
Simpson and Simpson Business and Personnel Services, Inc., SB080067

San Onofre Nuclear Generating Station Mitigation Project Monitoring Program

In 1974, the California Coastal Commission (CCC) issued a coastal development permit to Southern California Edison Company (SCE) for Units 2 and 3 of the San Onofre Nuclear Generating Station. A condition of the permit required studying the impacts of the operation of the units on the marine environment offshore from San Onofre, and mitigation of any adverse impacts. As a result of the

impact studies, the Coastal Commission added new conditions requiring restoration of southern California wetlands, construction of a kelp reef, installation of fish barrier devices at the power plant, and provision of funds for a marine fish hatchery. The new conditions also require SCE to fund a program for monitoring the implementation of the mitigation effort to be carried out by appropriate and independent scientific and technical personnel and consultants under the direction of the Executive Director of the Coastal Commission. The UCSB investigators will work with CCC officials on implementation and monitoring of the Wetland Restoration and the Mitigation Artificial Reef projects. Their activities will include entering, organizing and managing data, as well as preparation of reports to the CCC on the progress of these projects.

Henry Page **12/1/07-9/30/10** **102,772**
Jenifer Dugan
UC Agriculture and Natural Resources, SA7429

Fouling Dynamics and Control Research and Outreach Assessment to Assist California's Coastal Boaters in Reducing Risks from Hull-Borne Invasive Species

Recreational boaters, boating businesses and the marine life that boaters enjoy are threatened by aquatic invasive species (AIS). Boats carry AIS from ports to harbors along the coast. AIS can foul and damage hulls and coastal structures, out-compete and over-grow native marine life, and cause or carry disease. Boaters and boating businesses in the near future will need to adapt to new AIS and antifouling water quality regulations. Boat owners and boating businesses, coating companies, agencies, policy makers, academics, and environmental organizations will need research-based information in the next few years to make technically, ecologically and economically sound decisions and create sustainable policies for controlling AIS among hull fouling while protecting water quality. The PIs will conduct experiments to provide data on the effects of seasons, submersion times, hull coating type, hull cleaning practices, and influence of water quality. Harbors in San Diego Bay and Santa Barbara were selected for study sites because they are located in different biogeographic sub-regions, thereby providing information on fouling patterns on a broader spatial scale and for a larger group of fouling organisms. These harbors are also frequented by small craft, including recreational boats in San Diego and both commercial and recreational boats in Santa Barbara.

Henry Page **4/1/10-3/31/12** **267,426**
Robert Miller
National Science Foundation

Sources of particulate organic matter and their use by benthic suspension-feeders in the coastal California ecosystem

Sessile invertebrates that depend on suspended particulate organic matter (POM) for food are typically the most abundant group of primary consumers on shallow coastal reefs worldwide (Gili and Coma 1998, Witman and Dayton 2001). In highly productive temperate regions, the source of organic matter sustaining these benthic consumers, however, is poorly known. Phytoplankton form the trophic base for some of the world's most productive coastal ecosystems, including the California Current (e.g. Huyer 1983, Mann and Lazier 1991). Nevertheless, a body of work based primarily on stable isotope evidence has concluded that detritus derived from benthic macroalgae, particularly kelp, which is also extremely productive, makes up a significant portion of POM in coastal waters, and is a major food source for benthic suspension-feeders (see references below). These studies have typically measured isotope values of suspension-feeders, and estimated their trophic base using mixing models with kelp and phytoplankton as the two end-members. A major methodological issue, however, which has also been a problem for studies in freshwater systems (e.g. Hamilton et al 2005), has been the failure to separate phytoplankton from bulk POM to obtain uncontaminated isotope values of this source. Instead, offshore phytoplankton, cultured phytoplankton, or values from the literature have been assumed to represent the reef phytoplankton end-member; these isotope values are invariably highly 13C-depleted relative to 13Cenriched kelp. This assumption can be problematic, however, because many factors that vary widely in space and time, such as growth rate and taxon, strongly influence isotopic fractionation, and thus the isotope value of phytoplankton (e.g. Laws et al. 1995, Fry 1996).

Dorothy K. Pak **7/1/08-8/31/11** **64,607**
UC Office of the President

Acidification of California Coastal Waters: The Geological Record of Natural and Anthropogenic pH Variability

The proposed research relates directly to several CEQI priorities, as it addresses gaps in knowledge on the effects of ocean acidification on coastal ecosystems, provides paleoclimate records from the coastal zone for the recent past, and will address the question of how different California coastal environments respond to climate change. Additionally, this research addresses priorities outlined by recent workshops on ocean acidification that recommended "increased and improved monitoring of the carbonate system….in coastal and open-ocean carbonate environments" (Kleypas et al., 2006).

Dorothy K. Pak **9/1/08-8/31/12** **90,915**
National Science Foundation

Collaborative Research: An Ultra-High Resolution, Multiproxy Study of the Past 2,000 Years of Climate Change in Southern California

Santa Barbara Basin 9SBB) is the only location in the northeast Pacific that can provide quality, high-resolution paleoclimate reconstructions due to suboxic bottom waters (minimal bioturbation), high biogenic sediment input (including sufficient foraminiferal carbonate for dating, etc.) and extremely high sedimentation rates (hence high resolution). The study must be high resolution to capture information about specific climate events such as the Little Ice Age (LIA), MCA and the rapid warming of the 20th-21st centuries. Furthermore, the study must be multiproxy to capture short duration events that may only be reflecting specific environmental conditions in the basin and therefore be recorded by specific proxies. The location of the SBB in the subtropics makes it sensitive to record variability associated with strong expressions of the El Nino Southern Oscillation (ENSO) as well as indices of extratropical climate state, i.e. the Pacific Decadal Oscillations (PDO). Both ENSO and PDO variability have been linked to western US drought patterns [Cook et al., 2007; MacDonald and Case, 2005]. Finally, a multiproxy annual to decadal surface ocean reconstruction will enormously benefit the prediction of drought in the western US by providing tests for causal relationships.

Uta Passow **9/1/09-8/31/12** **705,703**
Alice Alldredge
National Science Foundation

Will Ocean Acidification Diminish Particle Aggregation and Mineral Scavenging, Thus Weakening the Biological Pump?

The pH of the ocean is predicted to decrease by 0.2-0.5 pH units in the next 50 to100 years as a result of increasing atmospheric CO2. To date almost all the research on impending ocean acidification has focused on the impacts to calcifying organisms and the carbonate system. However, ocean acidification will also affect other significant marine processes that are pH dependent. In this proposal we investigate the impact of ocean acidification on the organic carbon or "soft tissue" biological pump. We predict that a decline in oceanic pH will result in an increase in the protonation of negatively charged substances, especially of Transparent Exopolymer Particles (TEP), the gel-like particles that provide the matrix of aggregates and bind particles together. A decreased polarity of these highly surface-active particles may reduce their "stickiness" resulting in decreased aggregation of organic-rich particles and a decreased ability of aggregates to scavenge and retain heavy ballast minerals. A reduction in aggregation will lower the fraction of POC enclosed in fast-sinking aggregates. Decreased scavenging of minerals by aggregates will result in reduced sinking velocities and consequently a decline in the fraction of material escaping degradation in the water column. Both processes ultimately reduce carbon flux to depth. The resulting weakening of the biological pump will alter pelagic ecology and potentially produce a positive feed-back pathway that further increases atmospheric CO2 concentrations.

Uta Passow **7/1/10-6/30/12** **67,025**
National Science Foundation

RAPID Deepwater Horizon Oil Spill: Collaborative Research

Clearly the accident at the BP oil well in the Gulf of Mexico five weeks ago caused an oil spill of unprecedented magnitude and consequences. Preliminary data collected in the beginning of May at the site of the accident show very high concentrations of marine snow in the water – especially in close proximity to the oil/dispersants. The goal of this proposal is to evaluate the role these large marine snow-like particles play in the ecosystem during the following weeks to months. Neither the formation mechanisms nor the aggregate composition are known. We will monitor the distribution of marine snow, characterize these particles and measure sedimentation rates to try to understand the role of snow formation and sedimentation in the ecosystem response.

Uta Passow **10/1/10-9/30/13** **971,524**
Mark Brzezinski
Craig Carlson
National Science Foundation

Will High CO2 Conditions Affect Production, Partitioning and Fate in Organic Matter?

There is no question that rising atmospheric CO2 concentrations are leading to an increase in the concentrations of total carbon dioxide (TCO2) and a concomitant decrease in pH in the surface ocean (Caldeira and Wickett 2003; Fabry 2008). It is also clear that these changes in the carbonate chemistry of the ocean, which are summarily termed ocean acidification, will have consequences for many, if not all biological processes, potentially changing ecosystem functioning and biogeochemical cycling of elements in the oceans. So far, the ocean has taken up ~30% of all anthropogenic carbon (Sabine and Tanhua 2010). Future changes in marine biogeochemical cycling of carbon and especially in the functioning of the biological carbon pumps will determine whether or not the ocean continues to be a strong sink for anthropogenic carbon. Currently, even the direction of changes in the biological pump in response to increases in CO2 is unresolved and controversial (Mari 2008; Riebesell et al. 2007).

We propose to examine basic mechanisms whereby ocean acidification may alter the strength of the biological carbon pump by changing the paths of carbon flow in pelagic food webs.

Specifically we will examine how increased inorganic C availability resulting from ocean acidification alters how phytoplankton partition the organic carbon fixed through photosynthesis between cellular biomass (i.e. particulate organic matter, POM) and exudates (dissolved organic matter, DOM) and whether CO2-induced changes in the size and chemical composition of each pool affects the efficiency of the biological carbon pump. The impact of ocean acidification on ecosystem processing of dissolved and particulate carbon is unknown with the only two published studies reaching opposing conclusions (Allgaier et al. 2008; Grossart et al. 2006).

Steven Proulx **7/1/08-6/30/12** **564,791**
National Science Foundation, EF-0742582

The Origin of Genetic Interactions by Natural Selection

An understanding of the evolutionary basis of gene interactions and genome structure has only recently become possible, due in large part to the advance of comparative genomics. The goal of this project is to develop theory to describe important components of genome evolution: genetic divergence and gene duplication. Genetic divergence, the evolutionary diversification of alleles, may precede gene duplication and represents an important source of genetic innovation. Natural selection can facilitate genetic divergence whenever a gene functions in multiple contexts, be they internal to the organism (e.g., differentiated tissues) or at the level of the organism (e.g., different environments). The project will focus on within-organism selection for genetic divergence and include gene regulation, dimerization, and alternative splicing. Secondly, it will explore how sources of variability that act at the population level can cause genetic divergence and gene duplication. The importance of a quantitative approach to all aspects of biology cannot be overstated. Creating mechanisms that allow mathematical theory in biology to be presented as part of everyday normal activities will help develop a culture of biologists that embrace theory as a normal part of biological research. This

project will contribute to this goal by holding workshops in theoretical biology for undergraduate and graduate students.

Langdon Quetin **4/1/11-3/31/12** **192,144**
Robin Ross
National Science Foundation

Palmer LTER Zooplankton 1993-2008: Synthesis and Integration of Time-Series Data, Zooplankton Aggregation Structure and Secondary Production of Antarctic Krill

The Palmer Long-Term Ecological Research (LTER) program is focused on the marine pelagic ecosystem west of the Antarctic Peninsula, one of most rapidly warming regions on the planet. The study region is composed of coastal, shelf and slope regions midway down the Antarctic Peninsula, in an area influenced by the Antarctic Circumpolar Current with warm Upper Circumpolar Deep Water flooding the shelf. Changes in seasonal sea ice dynamics, the heat content of the shelf and populations of a key predator, Adélie penguins, have been documented. Although the phytoplankton and zooplankton community have shown some changes in composition and production during the time series, most are not yet significant. The sampling design included an annual summer cruise (large spatial, short temporal scale) and seasonal sampling within 3.7 km of Palmer Station on Anvers Island (small spatial, long temporal scale). In the Southern Ocean, larger mesozooplankton and micronekton, particularly Antarctic krill (Euphausia superba) form the primary link between primary producers and upper-level predators, serving as both a grazer and prey. The overall goal of this proposal is to undertake a synthesis of zooplankton and micronekton data collected from 1991 through 2008 as part of this multi-disciplinary program, specifically to investigate spatio-temporal variability on multiple scales and to test hypotheses on the underlying causes of the variability documented. Data include community composition, abundance and biomass, from net tows and bioacoustic transects, and life history information for both Antarctic krill and the salp (Salpa thompsoni), the biomass dominants for zooplankton > 2 mm. Net and bioacoustic data are complimentary, and should be integrated. Net data yield samples for community composition, population demography and experiments, and serve for target identification of sound scatterers. Bioacoustic data yield data on smaller scales relevant to the ecology of the different sound scatterers and their predators, both biomass and aggregation characteristics. In addition, in situ rates of secondary production (growth, spawning and egg production) were measured experimentally for the key species Antarctic krill in order to estimate secondary production. This zooplankton data set combined with the coherent multi-disciplinary data sets collected by the Palmer LTER is uniquely suited for studies of spatio-temporal variability and mechanisms underlying that variability, partially due to the fact that the time period spans three full cycles of recruitment in Antarctic krill and variability in primary production.

Daniel C. Reed **12/1/06-11/30/12** **4,982,465**
Steven D. Gaines
Sally J. Holbrook
John M. Melack
David A. Siegel
National Science Foundation, OCE-0620276

LTER: Land/Ocean Interactions and the Dynamics of Kelp Forest Communities

The Santa Barbara Coastal LTER (SBC LTER) is an interdisciplinary research and education program investigating the relative importance of land and ocean processes in structuring ecosystems at the land-sea margin. Our principal study area is the Santa Barbara Channel and the coastal watersheds that drain into it, and our focal ecosystem is giant kelp forests, which occur on shallow rocky reefs at the interface of the land-sea margin throughout our study area and other temperate coasts throughout the world. The major focus of the work proposed here is developing a predictive understanding of the structural and functional responses of giant kelp forest ecosystems to environmental forcing from the land and the sea. The amount of nutrients and organic matter delivered to the kelp forest from land and the surrounding ocean varies in response to short- and long-term changes in climate, ocean conditions and land use. Variation in the supply of these commodities interacts with physical

disturbance to influence the abundance and species composition of the forest inhabitants and the ecological services that they provide.

Daniel Reed **1/1/10-12/31/11** **3,830,306**
Henry M. Page
Steven Schroeter
Simpson and Simpson Business and Personnel Services, Inc

San Onofre Nuclear Generating Station Mitigation Project Monitoring Program –Reef

In 1974, the California Coastal Commission (CCC) issued a permit to Southern California Edison company (SCE) for Units 2 and 3 of the San Onofre Nuclear Generating Station. A condition of the permit required: (1) monitoring the impacts of the operation of Units 2 and 3 on the marine environment offshore from San Onofre, and (2) mitigation of any adverse impacts. As a result of the monitoring studies, the CCC added new conditions in 1991 and 1997 requiring: (1) restoration of a southern California wetland, (2) installation of fish barrier devices at the power plant, (3) construction of an artificial reef to replace lost kelp bed resources, and (4) provision of funds for a marine fish hatchery. The new conditions also require SCE to fund a monitoring program of the mitigation effort that is to be carried out by appropriate and independent scientific and technical personnel and consultants under the direction of the Executive Director of the CCC. In addition SCE is required to provide the funding necessary for the CCC and Executive Director to perform their responsibilities for oversight of the mitigation project design and implementation (carried out by SCE) and for pre-construction and post-construction site assessments and monitoring activities.

O. James Reichman **3/15/05-2/28/11** **84,846**
National Science Foundation

A Workshop on Mapping and Valuing Ecosystem Services

Governments, businesses, and multilateral agencies routinely use cost-benefit analyses to select among policy alternatives and identify worthy investments. Unfortunately for biodiversity, the biosphere and the humans that rely on it, these cost-benefit analyses rarely include costs in terms of degraded ecosystem services. Using three focal project sites and a suite of multiplier projects, The Natural Capital Project is developing data and tools for melding the benefits of ecosystem services (or, conversely, the costs of their loss) with conservation and development planning. Conservation planning, priority-setting and project development have historically emphasized conserving the most species for the least amount of land. Recently, however, conservation NGO's have begun to undergo a revolution in their thinking, recognizing that a sole focus on safeguarding concentrations of biodiversity within protected areas is too disconnected from people. A broader consideration of the economic and social context of conservation decisions will increase conservation's relevance to a broader segment of society, while highlighting how conservation is as much about what happens outside of nature reserves as within the nature reserves themselves. The National Center for Ecological Analysis will support the development of the ecosystem service mapping and valuation tool for the Natural Capital Project.

William R. Rice **4/4/08-5/31/11** **409,050**
University of Washington

Drosophillia Seminal Fluid: Proteomic Discovery and Functional Variation Analyses

The seminal fluid proteins of Drosophila melanogaster have been extensively studied. Most fly seminal fluid proteins are accessory proteins (Acps), produced in a paired set of secretory organs called the accessory glands. Upon mating, these proteins are mixed with sperm and several other proteins to produce seminal fluid, which is then transferred to the female. These transferred proteins are responsible for several changes in female physiology and behavior; they induce ovulation and egg-laying, reduce female receptivity to re-mating, stimulate an immune response, and up-regulate feeding behavior. Acps are implicated in mediating sperm competition between males and causing an overall cost of mating in females. In spite of two decades of study, only a handful of seminal fluid proteins have been conclusively demonstrated to be transferred at mating to females, and specific

functions have been assigned to even fewer. This research seeks to comprehensively identify the set of seminal fluid proteins present in mated females. These proteins will then be examined for their patterns of molecular evolution and their effects on male reproductive success. The PI hypothesizes that for certain Acps, both coding sequence variation and levels of protein expression will affect male and female fitness.

Robin Ross **8/21/09-9/30/11** **71,182**
UC Santa Cruz

Improving Current Assessments and Future Predictions of Carbon Fluxes in the Southern Ocean as Mediated by the Dynamical Response of Ice-Ocean- Ecosystem Interactions to Climate Change

The UCSB Principal Investigators will provide zooplankton data for this collaborative study and will contribute their expertise on ecosystem data synthesis and modeling, and in interpreting and disseminating the products resulting from this project. They will attend annual workshops to meet with the other collaborators to discuss progress and results.

Anne Salomon **3/1/08-3/1/11** **163,206**
Steven Gaines
Society for Conservation Biology, SB080092

Forecasting the Ecosystem-Level Effects of Marine Reserves to Inform Ecosystem-Based Management

Mounting evidence suggests that over-fishing can trigger a cascade of indirect effects throughout marine food webs, thereby modifying marine ecosystems and the economic and social systems that rely on them. Fortunately, ecosystem-based management tools such as marine reserves are increasingly being implemented with the goal of restoring marine ecosystem function. Concurrently, managers are increasingly being asked to assess reserve performance at achieving this goal. However, the effects of marine reserves on ecosystem processes are rarely measured despite the fact that the restoration of ecosystem function is their paramount goal. The PI seeks to fill this gap by investigating the extent to which marine reserves alter key ecosystem processes such as predation, herbivory, productivity and carbon flow, all of which are known to drive ecosystem function. She will then use this empirically derived data to develop a predictive model that managers can use to determine where, when and under what conditions the cascading effects of fishing are likely to ensue. By revealing the ecological mechanisms that drive biological patterns of concern to conservation practitioners and managers, this innovative and mechanistic approach will improve scientists' predictive ability to forecast the ecosystem-level effects of marine reserves across a range of oceanographic conditions. This research project has been designed to explicitly inform ecosystem-based management, one of the foremost challenges facing conservation and management practitioners today.

Mark Schildhauer **10/1/07-9/30/11** **400,000**
Matthew B. Jones
O. James Reichman
Andrew W. Mellon Foundation, SB080054

Data Management and Analysis Tools Supporting Adaptive Management in South African Parks

Kruger National Park (KNP) is faced with a challenge common to many research stations where dozens of loosely coordinated monitoring and experimental projects are underway at any time. The main challenge is how to effectively collect, present, and preserve this highly variable collection of scientific data for collaborative and integrative analyses. The Andrew W. Mellon Foundation has supported a partnership between Kruger National Park and the National Center for Ecological Analysis and Synthesis (NCEAS) over the past two years to address this informatics challenge by implementing and refining an approach for archiving KNP's scientific field data using methods developed and tested by NCEAS, the Long Term Ecological Research program, and other partners. The successful deployment of a metadata archive (Metacat) at KNP, along with two successful training workshops in its use, has validated the power and viability of this approach. Kruger

National Park is now part of a global "Knowledge Network for Biocomplexity" (KNB), which is based on the use of metadata standards in ecology, particularly Ecological Metadata Language, or "EML" documents that are stored in Metacat database servers. This phase of the project entails the expansion of the data system to the broader collection of parks and research stations in South Africa, and the creation of the additional analysis infrastructure needed to effectively use these data in adaptive management approaches in the parks.

Mark Schildhauer **12/7/07-8/15/11** **1,036,961**
Gordon and Betty Moore Foundation, 1666

Public Domain ADMB Project

AD Model Builder (ADMB) is a tool for developing integrated statistical models of complex systems. The principal advantages of the ADMB software suite over other approaches are rapid model development, numerical stability, computational speed, precision of model estimates, and the capacity to accommodate relatively large numbers of parameters and data points. The ADMB software has earned acceptance by researchers working on all aspects of resource management. Population models based on the ADMB software are used to monitor more than 150 different sensitive endangered species and commercially valuable fish stocks around the world. ADMB applications extend beyond stock assessment. This software is used for applications critical to the development of place-based management policies and is an essential building block of the methods used to reconstruct movements of many species of animals tracked with electronic tags. ADMB applications are critical to the missions of fishery management agencies in the United States and abroad. A group of world-renowned resource scientists have established a non-profit charitable organization, the ADMB Foundation, to acquire the ADMB software and establish a system for maintaining and distributing it. As part of this project, the PI's will establish a partnership between the ADMB Foundation and the National Center for Ecological Analysis and Synthesis (NCEAS), with the goal of placing the ADMB software in the pubic domain so that it can be freely distributed via the world wide web.

Mark Schildhauer **3/1/11-2/29/12** **169,971**
University of Arizona

iPlant/NCEAS Collaboration to Build the BIEN and Environment & Organisms Working Groups' Informatics Frameworks

The geospatial analyst will develop a set of global raster environmental layers to meet the needs of plant biologists and ecologists seeking to understand the interaction between plants and their broad, geospatial environmental context. Attention will be paid to making this data product and the technologies supporting it extensible to accommodate analyses relevant to the marine environment and non-plant organisms.

Key deliverables will include:

1) developing an integrated information resource merging daily ground-based weather station data with satellite based measurements of weather;

2) creating select, derived products based on the above, that provide climate, extreme temperature and moisture events (such as return times or 50 year extreme temperatures), and bioagricultural variables such as growing degree days and AET;

3) producing a global, high-resolution terrain model that uses a digital elevation model and derives variables that are biologically relevant such as slope, aspect, slope position, soil moisture and insulation;

4) incorporating some additional layers to be determined, relating to land cover, vegetation and soils.

The GA's focus will be to develop a usable, initial version of these integrated layers, while keeping careful track of the workflows used in their creation. The GA will then coordinate with developers based at iPlant to make these workflows scalable and repeatable as a resilient part of CI (cyberinfrastructure) for plant biology.

Mark Schildhauer **8/1/08-7/31/13** **265,000**
National Science Foundation

INTEROP: A Community-Driven Scientific Observations Network to Achieve Interoperability of Environmental and Ecological Data

We propose to address interoperability issues in the environmental sciences by building a network of practitioners, the Scientific Observations Network (hereafter, shortened to the Network), which will initially include over two dozen key environmental researchers, computer science experts in knowledge representation and conceptual modeling of data, and scientifically trained information managers, working together to build generic, cross-disciplinary interoperability solutions for scientific data. The primary goal will be to advance the interoperability of data in the environmental sciences by (1) developing a core data model to unify the burgeoning number of domain-specific models for observational data, within (2) a semantic framework that allows for open-ended, but rigorous descriptions of the details and nuances of scientific terminology. This will be accomplished via (3) the coordinated development and eventual ratification (via an international standards body) of a core data model for observation and measurement based on open-standards for data exchange over the Internet, and then (4) developing discipline- specific extensions for this core model. The Network will also (5) develop prototype software applications to demonstrate the utility of these approaches with respect to data interoperability within and across environmental science disciplines. A final directive for the network will be to envision and propose a mechanism for sustaining these community efforts beyond the duration of the proposed project.

Joshua P. Schimel **9/1/08-8/31/12** **254,239**
National Science Foundation

Collaborative Research: Spatial and Temporal Influences of Thermokarst Features on Surface Processes in Arctic Landscapes

Recent summaries of international research clearly document the past and future extent of climate warming in the Arctic. These summaries suggest that in the future, rising temperatures will be accompanied by increased precipitation, mostly as rain: 20% more over the Arctic as a whole and up to 30% more in coastal areas during the winter and autumn. These climate changes will have important impacts on Arctic Systems. Of direct interest to the research we propose here is the likelihood that warming will promote permafrost degradation and thaw. Formerly frozen soils may be further destabilized by increased precipitation, leading to hillslope thermokarst failures. We have recently documented that thermokarst failures are abundant and appear to have become more numerous around Toolik Lake on the eastern North Slope and in the western Noatak River Basin in Alaska. We hypothesize that a widespread and long-term increase in the incidence of thermokarst failures will have important impacts on the structure and function of arctic headwater landscapes. We propose to use a systems approach to address hypotheses about how thermokarst failures influence the structure and function of the arctic landscape. Specifically we will focus on the composition of vegetation, the distribution and processing of soil nutrients, and exports of sediments and nutrients to stream and lake ecosystems. We further propose to line results obtained at this hillslope scale to patterns observed at the landscape scale to test hypotheses about the spatial distribution of thermokarst failures in the arctic foothills.

Russell Schmitt **3/1/08-6/30/11** **7,500**
Sally Holbrook
UC Office of the President, SB080096

UC LTER Network Planning Workshops

The LTER program is the flagship of the environmental sciences at NSF, designed to explore ecological phenomena that occur over many decades. Hence, a core research theme concerns the responses of the focal ecosystem to climate forcing. UC administers three of the 26 LTER sites, all with a coastal marine focus: the Santa Barbara Coastal (SBC), California Current Ecosystem (CCE) and Moorea Coral Reef (MCR) LTERs. Collectively, these three LTERs involve researchers and research facilities from 5 UC campuses as well as scientists from two California State Universities.

The UC LTERs represent the most productive and economically important coastal marine ecosystems of the Pacific Rim: forests of giant kelp (SBC), coral reefs (MCR) and the coastal pelagic upwelling biome (CCE). This project is designed to capitalize on NSF's long term investment in research and information management infrastructures of the UC LTERs, to enhance the range of issues UC scientists can address and to implement a new model for cross-disciplinary training of graduate students across UC campuses. Such a framework would greatly improve our ability to advance knowledge by facilitating research on major issues that cannot be answered by studying at a single LTER site or ecosystem, but could be addressed effectively using a network - level approach.

Russell Schmitt **9/1/04-8/31/12** **1,880,000**
National Science Foundation, OCE-04174412

LTER: Long-Term Dynamics of a Coral Reef Ecosystem

This award establishes a Long-Term Ecological Research (LTER) site focused on dynamics of coral reef ecosystems at the island of Moorea, French Polynesia, location of the University of California's Gump Research Station. Coral reefs are of great ecological importance, having the highest species diversity of any marine habitat and ranking near the top of all ecosystems with respect to annual total gross productivity. The communities are supported structurally by reef-building corals and trophically by efficient recycling. Unlike highly productive terrestrial ecosystems, the key biotic interaction underlying reef systems is the mutualistic relationship between hermatypic corals and photosynthetic zooxanthellae. Hermatypic corals are both functional autotrophs and hetrotrophs and derive carbon from multiple sources. In addition to biotic interactions, numerous other biological processes are influenced by a variety of abiotic events that can operate at spatial scales ranging from millimeters to hundreds of kilometers, and which can vary on short to long time scales. Both the scientific community and the public have tremendous interest in and concern about conservation of coral reef ecosystems. This project will greatly increase understanding of these systems, and as such, will inform government officials, resource managers and others charged with conservation and management of coral reefs.

Russell Schmitt **7/1/09-6/30/11** **150,000**
National Science Foundation, OCE-04174412

RAPID: Resilience of Coral Reef Ecosystems

We will take advantage of a large-scale, natural disturbance at the NSF-sponsored Moorea Coral Reef LTER site in French Polynesia to explore resilience characteristics of coral reef ecosystems to sets of pulse – press disturbance combinations that alter different attributes of the reef ecosystem. Resilience is the capacity of an ecosystem to return to its previous state following a pulse disturbance such as a cyclone or temperature excursion. Understanding what influences resilience is becoming ever more critical in light of forecasted alterations in disturbance regimes (pulse events) and environmental drivers (press events) associated with Global Climate Change (GCC). Global environmental change not only is altering the intensity of press events, it also is changing the frequency and strength of pulse disturbances. Given these complexities, the ability to forecast how ecosystems will respond to or recover from projected changes in pulse and press events ranks among our most vital scientific challenges.

Russell Schmitt **8/1/10-7/31/12** **48,105**
Sally Holbrook
National Science Foundation

OISE IRE: Planning Visit and Workshop Involving Two Marine LTER Sites and Two Chinese CERN Sites

The overarching objective of this proposal is to develop the capacity for mutually productive collaborations between US and Chinese marine scientists that are focused on coral reef and kelp forest ecosystems by linking two marine sites in the Chinese ILTER network (CERN - the Chinese Ecosystem Research Network) with two marine sites in the US LTER network. The NSF-funded Moorea Coral Reef (MCR) LTER already has developed productive collaborations with LTER or LTER-like coral reef sites in Taiwan1 and Australia2, and seeks to build similarly successful academic exchanges and research collaborations with scientists associated with the Hainan Tropical Marine

Biology Research Station (South China Sea Institute of Oceanography) at Sanya3. An emerging network involving Sanya, Kenting, Moorea and Australia (Great Barrier Reef) could form the basis of a scalable East Asia Coral Reef Alliance. Similar linkages between temperate (kelp) reef sites in China and the US have not yet been developed, and we propose to explore opportunities between the NSF-funded Santa Barbara Coastal (SBC) LTER site and the Jiaozhou Bay National Marine Ecosystem Research Station (Institute of Oceanography) at Qingdao4. Jiaozhou Bay is the only observation and research station in the temperate coastal region of China. The Jiaozhou Bay and Sanya research stations are both affiliated with the Chinese Academy of Sciences (CAS) and are members of the Chinese Ecosystem Research Network (CERN)5. CERN and the US NSF LTER program are founding members of the International Long Term Ecological Research network (ILTER)6, yet the rich opportunities for productive research and educational collaborations between these ILTER participants largely remain untapped.

Russell Schmitt **9/1/10-8/31/12** **940,000**
National Science Foundation

LTER: MCR II - Long-Term Dynamics of a Coral Reef Ecosystem

The Moorea Coral Reef (MCR) LTER is an interdisciplinary research and education program that was established in 2004, to explore the joint effects of climate and disturbance on the structure and function of coral reefs. Our study area is the reef complex that surrounds the island of Moorea in French Polynesia. Our initial focus (MCR I) was to advance understanding of major controls of processes that modulate ecosystem function, shape community structure and diversity, and determine abundance and dynamics of constituent populations. We build on this foundation by adapting a unifying conceptual framework (US LTER 2007) and developing a set of research themes to organize the MCR II research program and facilitate cross-site collaboration. Coral reef ecosystems appear especially vulnerable to changes in abiotic drivers associated with Global Climate Change (GCC). These arise from two mechanisms related to increasing concentrations of atmospheric CO2: rising seawater temperature due to greenhouse warming, and changing seawater chemistry known as Ocean Acidification (OA). A paradigm shift occurred within the past decade regarding the relative importance of these climate-related drivers to coral reefs. The focus initially was on rising seawater temperature because it triggered several large-scale, conspicuous coral bleaching (i.e., loss of the endosymbiont Symbiodinium) events. There now is widespread recognition that OA and its interaction with rising temperature have the potential to cause even more sweeping changes. These drivers occur against a backdrop of other press (e.g., fishing) and pulse (e.g., storms) perturbations. During MCR I, a brief outbreak of crown-of-thorns seastars (COTS) resulted in the death of virtually all coral on the fore reef of Moorea, bringing issues related to state change, resilience (recovery), interactive effects and indirect cascades to the forefront. The fundamental question that we address in MCR II is: How do drivers that operate over different spatial and temporal scales interact to influence the structure and function of coral reef ecosystems?

Our three organizing themes are: (i) interactive effects among drivers, (ii) indirect effects arising from structure – function linkages, and (iii) resilience and resistance in relation to structure – function feedbacks. The six goals of MCR II are to: (a) continue our long-term datasets on physical drivers, community dynamics and ecosystem processes; (b) maintain a long-term resilience experiment; (c) contribute to understanding of how Global Climate Change drivers will affect coral reefs and what factors influence resistance and resilience; (d) develop and test general ecological theory; (e) continue to improve our information management system to more fully meet the needs of the LTER network and broader scientific community; and (f) enhance our outreach components.

Stephen Schroeter **7/1/06-4/30/12** **56,000**
California Sea Urchin Commission, SB070019

Studies of Sea Urchins Settlement in Southern and Northern California

The patterns of settlement of red (Strongylocentrotus franciscanus) and purple (S. purpuratus) sea urchins may have important impacts on the commercial fishery and provide an important fishery-independent measure of stock health. The investigators have monitored weekly to bi-weekly sea urchin settlement at multiple sites in southern and northern California since February 1990. Studies to date have identified spatial and temporal patterns in sea urchin settlement (including the effects of periodic El Niños and La Niñas) and have identified some of the likely mechanisms responsible for

these patterns. They have added value to their work by volunteering their time and collaborating with University researchers and private industry. In particular, work done in collaboration with Jan Svejkovsky of Ocean Imaging has given important insights into the effects of large-scale oceanographic forcing on sea urchin settlement patterns, while collaborative work on population genetics with Dr. Ron Burton has shed light on the structure of parental source populations during a heavy settlement event. Perhaps most importantly, their long-term and geographically extensive record of sea urchin settlement continues to provide the only integrated, fishery independent index of the condition of the breeding stock, since larval supply and settlement are a function of the effective breeding population. The value of this inexpensive tool for monitoring the health of the sea urchin resource in California increases each year the study is continued.

Stephen Schroeter **1/1/06-12/31/11** **1,082,957**
Daniel Reed
Henry Page
Simpson and Simpson Business and Personnel Services, Inc., SB060076

San Onofre Nuclear Generating Station Mitigation Project Monitoring Program - Wetland

In 1974, the California Coastal Commission (CCC) issued a permit to Southern California Edison (SCE) for Units 2 and 3 of the San Onofre Nuclear Generating Station (SONGS). Conditions of the permit require monitoring the impacts of the operation of Units 2 and 3 on the marine environment offshore from San Onofre, and mitigation of any adverse impacts. As a result of the impact studies, the CCC added new conditions which require the permittee to 1) create or substantially restore at least 150 acres of southern California wetlands, 2) install fish barrier devices at the power plant, 3) construct a 300-acre kelp reef, and 4) partially fund the construction of an experimental white sea bass hatchery. This research program enables the UCSB principal investigators to assist the Commission in carrying out its oversight, monitoring and mitigation functions.

Susanne Sokolow **9/10/09-8/31/11** **116,041**
Armand Kuris
Kevin Lafferty
PHS Centers for Disease Control

Emergence and Biological Control of Schistosomiasis

Many newly emerging diseases have resulted from large-scale ecological changes that increase human exposure to animal reservoirs and environmental sources of disease. Approximately 60-80% of the infectious agents that cause disease in humans are shared with animal hosts. Veterinarians are excellent candidates to study these emerging diseases, but training programs specifically tailored to the integration of veterinary medicine and basic biological research to study the environmental and animal components of infectious disease emergence are scarce. The proposed training will provide a multidisciplinary program in infectious disease which aims to develop modern interdisciplinary approaches for public health research by combining fundamentals in biological science, experimental design, epidemiology, disease modeling, and global public health principles.

Sharon Stammerjohn **5/1/08-4/30/11** **215,502**
Robin Ross
Langdon Quetin
NASA Shared Services Center

Improving Current Assessments and Future Predictions of Carbon Fluxes in the Southern Ocean as Mediated by the Dynamical Response of Ice-Ocean-Ecosystem Interactions to Climate Change

The Southern Ocean (which is 10% of the Earth's total ocean area) is estimated to be responsible for up to 20% of the global ocean CO2 uptake of 2.2 Pg C yr-1 (Takahashi et al. 2002; Takahashi et al., in prep). However, a roughly two-fold uncertainty exists in the estimated CO2 uptake, and the uncertainty depends largely on whether polar continental shelves covered by seasonal sea ice act as one-way CO2 pumps: in winter out-gassing of CO2-rich water is prevented by the overlying sea ice cover, while in spring-summer rapid onsets of phytoplankton blooms at the ice-edge provide a CO2 sink. The extent to which phytoplankton blooms will provide a CO2 sink is uniquely dependent on downward carbon export, i.e., the biological pump. To improve current assessments and future

predictions of carbon fluxes in Southern Ocean sea ice zones, we will investigate the highly seasonally (and interannually) varying dynamic relationships between sea ice, ocean and the ecosystem using 15 years of data from the western Antarctic Peninsula (wAP) region. We are focused on the wAP region for two reasons; (1) it has been shown to be warming faster in winter than anywhere else on earth and (2) remote and in situ physical, biogeochemical and ecosystem data in this region are more extensive than anywhere else in the Antarctic/ Southern Ocean region.

Jennifer Thorsch **9/1/09-8/31/11** **284,213**
Carla D'Antonio
National Science Foundation

Infrastructure upgrade and curation of the Cheadle Center for Biodiversity and Ecological Restoration Herbarium at UCSB

The Cheadle Center for Biodiversity and Ecological Restoration (CCBER) is a unique resource for the Santa Barbara and central California coast region. A repository for ecological, evolutionary, and biogeographic information, CCBER was formed from the fusion of the former Museum of Systematics and Ecology (MSE) and the Ecological Restoration Program at the University of California Santa Barbara. In August 2005, CCBER was launched when the collections of the MSE's herbarium, the plant anatomy collection, and the vertebrate collections were consolidated into a newly constructed 4,000 square foot on-campus facility that houses CCBER staff, offices, a state-of the-art teaching lab, the C.H. Muller Conference Room and Library, specimen collection rooms, and interpretive displays. This facility is located in the Harder Building on UCSB's main campus.

David Valentine **4/15/05-3/31/11** **651,473**
National Science Foundation, 0447395

CAREER: Microbial Geochemistry of Natural Marine Gas Seeps - A Research and Education Plan

This project integrates research and education focusing on the fate of methane seeping naturally into the marine environment - an issue of environmental and economic relevance. The primary research goal is to determine the impact of microbial methane oxidation on the flux of methane from the sediments to the ocean/atmosphere in areas of active gas seepage. Educational goals are: 1) to train graduate students in the integrated study of microbiology and geochemistry; 2) to educate undergraduate students in the marine sciences through year-long research projects, and through incorporation of results into general education courses; 3) to incorporate undergraduate students into ocean going research by including them as active participants in proposed cruises through a formal field studies course; and 4) to introduce K-12 students and teachers to the topic of marine hydrocarbons through participation in UCSB's Floating Lab outreach program.

David Valentine **9/1/06-8/31/10** **360,148**
National Science Foundation, MCB-0604191

MIP: Interactions between Archaea, Bacteria and their Viruses in the Anoxic Sediments of a Modern Evaporative Basin: Salton Sea, CA

The PI will conduct a series of environmental and laboratory studies designed to assess the impact of energy availability and stress on Bacterial, Archaeal and viral communities in anoxic environments. The research site is at the Salton Sea, CA, where the dissolution of subsurface salt deposits and the rapid mineralization of sedimentary carbon generate strong gradients of energy stress and availability. Diverse Bacterial and Archaeal communities coexist throughout the sediment, and the site is readily accessible. The hypothesis that is being tested is : Energetic stress imparted on anoxic microbial communities tends to favor Archaea over Bacteria, also resulting in a concomitant shift in the composition of the viral community. The timing for research on the Salton Sea is critical, as the rapidly expanding population of southern California is pressing for major water transfers away from desert agriculture to urban uses. The Salton Sea is a terminal basin and receives nearly all its water from agricultural runoff; proposed changes to the rate of water input will lead to dramatic changes in volume and salinity (and thus biogeochemistry and ecology) of the Salton Sea. While the exact fate of the Salton Sea is uncertain, major changes can be expected - there is a clear need to study the novel microbes of this environment. Furthermore, this work will lead to an understanding of the microbial ecosystem present in the sediments of the Salton Sea, which may become useful to policy makers as this lake begins to dry.

David Valentine **10/1/08-9/30/12** **812,919**
DOE/Miscellaneous Offices and Programs

Assessing the Efficacy of the Aerobic Methanotrophic Biofilter in Methane Hydrate Environments

This proposal directly addresses methanotrophic activity in the ocean, and seeks to answer fundamental questions about the methanotrophic biofilter including: What are the primary controls on the methanotrophic biofilter? How rapidly is methane consumed in different environments? How efficient is the methanotrophic biofilter at the sea floor and in waters overlying gas seeps and methane hydrate?

David Valentine **6/1/10-5/31/12** **140,531**
National Science Foundation

Collaborative Research: Experimental Determination of Petroleum Biodegradation Patterns from Genomically-Informed Analytical Vista

This proposal describes a series of laboratory studies designed to assess the genomic and molecular patterns of petroleum biodegradation under a range of conditions relevant to the Earth's surface and subsurface. The concerted application of comprehensive, two-dimensional gas chromatography, Fourier transform ion cyclotron resonance mass spectrometry, and pyrosequencing-based metagenomics will provide unparalleled insight into petroleum biodegradation and the responsible microbes, and distinguishes this work from any previous studies.

David Valentine **4/15/10-3/31/13** **349,749**
National Science Foundation

Collaborative Research: Chemical Changes Accompanying Petroleum Weathering in the Coastal Ocean

This proposal addresses the weathering of petroleum hydrocarbons in the coastal ocean. While there have been countless studies on this topic, advances have stalled due to the narrow analytical windows provided by traditional analytical techniques, leaving fundamental questions unanswered. This proposal involves a concerted application of two advanced approaches: comprehensive, two-dimensional gas chromatography and Fourier transform ion cyclotron resonance mass spectrometry, to provide an unprecedented level of detail on the weathering of hundreds to thousands of petroleum hydrocarbons. Specifically, this research will identify and apportion the role of photolysis, evaporation, dissolution, and biodegradation associated with oil weathering at the natural oil seeps off Santa Barbara, CA, where more than 5 million liters of oil seep annually into the ocean.

David Valentine **6/1/10-5/31/11** **119,964**
National Science Foundation

RAPID: Assessing the Impact of Chemical Dispersants on the Microbial Biodegradation of Oil Immediately Following a Massive Spill

This proposal is being submitted in immediate response to the uncontrolled release of oil in the Gulf of Mexico that stemmed from the explosion and sinking of the Deepwater Horizon drilling platform. Among the many responses to this spill has been the unprecedented application of surfactants to the oil in order to prevent slick formation, and to disperse oil to the environment.

Surfactants were added directly to the buoyant plume of oil in the subsurface and are still being sprayed on oil slicks at the surface. Media reports estimate that half the supply of surfactants in the United States has been purchased by British Petroleum for use in combating this oil spill, and that 230,000 gallons have already been applied as of 5-5-10. The effects of mass surfactant addition to an oil spill are not well established 1 in a biological, chemical or physical sense, with our interests being in the biologically-mediated breakdown of chemicals that comprise oil.

Laboratory experiments with pure cultures have shown that surfactants can either stimulate or inhibit oil degradation, depending on factors such as the type and concentration of surfactant, type of oil, the bacterial strain, growth phase, and temperature 2-4. Some of these differences may be due to the method of hydrocarbon uptake (direct adhesion vs. transport of solubilized compounds) and

the effects of biosurfactants naturally produced by many hydrocarbon degrading bacteria 5-6. Very little work has been done on the impact of surfactants on the degradation of individual hydrocarbon compounds within crude oil, but it appears that surfactants may increase the degradation of some compounds while decreasing the degradation of others 4,7. How these factors interplay in a natural environment with a complex microbial community is unknown. This proposal seeks to capitalize on a unique opportunity to determine the impact of surfactants on the natural biodegradation processes that are acting on presently exposed oils in the Gulf of Mexico.

David Valentine **1/1/11-12/31/14** **915,552**
National Science Foundation

Dimensions: The Role of Viruses in Structuring Biodiversity in Methanotrophic Marine Ecosystems

Marine methanotrophic ecosystems are responsible for consuming >75 Tg of methane annually, preventing this potent greenhouse gas from entering the atmosphere. These microbial ecosystems thus play a vital role in the global climate system. The nature of these communities depends on the presence or absence of oxygen: methanotrophy is a bacterial lifestyle in aerobic shallow sediments, but in deeper anaerobic sediments it is the exclusive province of archaea, in syntrophy with sulfate-reducing bacteria. It is known which phyla are most commonly found in methanotrophic environments. However, because of these environments' physical inaccessibility and because nearly all microbes from these systems have resisted cultivation, understanding of these communities lags far behind their importance. The cultivation-resistance of microbial hosts from these systems has additionally prevented the use of classical methods to study the viral community. Thus, to date science is largely unable to fill in the broad outlines of marine methanotrophic biodiversity, to fully describe the microbial communities or determine what shapes them. The proposed research seeks to define the importance of viruses in structuring functional, genetic, and taxonomic diversity in methanotrophic marine ecosystems. The underlying assertion is that viruses structure the diversity of archaeal and bacterial communities in these ecosystems by causing both mortality and horizontal gene transfer. To establish viral contributions to biodiversity of aerobic and anaerobic marine methanotrophic ecosystems, this proposal combines biogeochemical, genomic, and metagenomic approaches, in both field and laboratory settings.

David Valentine **8/15/10-7/31/12** **124,313**
National Science Foundation

MRI RAPID: Acquisition of Two Cavity Ringdown Spectrometers to Quantify Hydrocarbon Conversion in Deep Waters of the Gulf of Mexico

The massive release of oil from the Deepwater Horizon incident has been accompanied by the release natural gas, estimated at 40% the mass of the oil. Results from recent cruises to the area indicate that nearly all of the leaking gas is trapped at depths below 750 meters in the vicinity of the spill site. The impact and fate of this gas in the Gulf of Mexico is an important lingering question and the primary driver of this Major Research Instrumentation proposal.

This proposal seeks support for the rapid acquisition of two cavity ringdown spectrometers for quantification of carbon isotope concentrations in methane and carbon dioxide, respectively. These laser-based instruments will find immediate use with samples from the Gulf of Mexico. Specifically, these instruments will be used to for quantification of hydrocarbon oxidation rates, for studies of microbial hydrocarbon uptake and conversion, and to aid in investigating the ecology of hydrocarbon degrading bacteria - all in the Gulf of Mexico (GoM).

David Valentine **8/1/10-12/31/10** **40,606**
Consolidated Safety Services

Pisces Cruise to Study the Effects of the Deepwater Horizon

Project personnel will participate on a cruise to the Gulf of Mexico aboard the NOAA Ship Pisces, where they will quantify the concentration of methane, ethane and propane in the deep subsurface hydrocarbon plumes emanating from the Deepwater Horizon event. Project personnel will also

conduct shipboard studies to assess the rate of hydrocarbon degradation in the aged plumes and to identify the bacteria present in the plumes. Further, project personnel will assist with other scientific operations shipboard as needed.

J. Herbert Waite **8/4/08-6/30/13** **1,828,886**
NIH Dental and NIH Research, National Institute of Health

Translating Mussel Adhesion

Moisture is the nemesis of strong polymer adhesion to metals and minerals. Most engineered adhesive polymers require extensive prior surface cleaning, drying, and sometime even chemical modification for effective adhesion to polar surfaces. Such surface preparation is difficult in vivo since biomineralized tissues and implant material surfaces are necessarily hydrated within the body. Various marine organisms have evolved highly effective adhesive strategies for wet surfaces. The broad goal of this proposal is to obtain mechanistic information about marine adhesion in order to translate it into effective applications for restoration and repair of hard tissues. While the discovery of 3,4-dihydroxyphenylalanine (Dopa)-protein involvement in adhesion has already inspired several new biomedical materials, Dopa is not the only bioinspired theme. The specific aims here are to determine using mass spectrometry whether and to what extent phosphoserine and 4-hydroxyarginine are linked to mussel adhesion on different surfaces, characterize the specific protein-protein interactions during adhesive cross-linking, and to explore how factors such as mass, primary sequence, and side-chain functionalization influence the coating or bridging behavior of mfp-1 on surfaces such as titanium and hydroxyapatite using the surface forces apparatus. Bio-inspired adhesives and sealants are much needed in dentistry and orthopedics not just to improve the strength and durability of bonding to hard tissues, but also to emancipate the present technology, particularly in dentistry, from reliance on highly reactive and toxic organic formulas.

J. Herbert Waite **5/1/10-4/30/13** **125,000**
Human Frontier Science Program Organization (Intl)

The Calcified Byssus of Anomia: A Unique Solution to Underwater Adhesion

Sedentary animals attach to substrates with glues that work underwater, a feat we do not master in our technology. A well-known example is the blue mussel whose beard, called the byssus, is used to attach the soft mussel tissue to the hard substrates the animal lives on. The blue mussel byssus is made of protein. In contrast to the multi-thread pure protein byssus of the blue mussel, its cousins called the Anomiidae attach via a byssus plug made from a single thread that is calcified, i.e. contains calcium carbonate crystals in addition to proteins. Almost nothing is known about this strange attachment system and in particular the adhesive. We will investigate this intriguing solution to sticking in place using an interdisciplinary approach where we will understand both the mechanical function and the biomolecules involved in the adhesion. This is done by joining the forces of materials chemists and biochemists.

Libe Washburn **2/1/05-12/31/10** **85,189**
UC San Diego, 0478.03SB

Two Bight-Scale Sections Using an Underway CTD-Task C.1

As part of the Southern California Coastal Observing System (SCCOOS)m UCSB will collaborate with other institutions in the Southern California Bight, including Scripps Institution of Oceanography, USC and CalPoly San Luis Obispo to operate an array of HF radars for mapping surface currents. Researchers will use the current data obtained from the radar array to develop products for agencies charged with managing coastal ocean waters. UCSB will lead the research effort to acquire one line of CTD stations from ships that regularly travel between the mainland and one of the offshore islands in the Southern California Bight.

Libe Washburn **9/15/10-8/31/11** **212,420**
Carter Ohlmann
National Science Foundation

Collaborative Research: The Propagating Response of the Inner Shelf to Wind Relaxations in a Coastal Upwelling System

Poleward flows that rapidly develop over the continental shelf and slope following relaxations of upwelling-favorable winds (relaxation flows) are common but intermittent features of wind-driven upwelling systems in eastern boundary currents. These buoyant flows are important in coastal upwelling systems because they advect momentum, heat, dissolved materials, and water-borne particles poleward, opposite to the direction of mean transport. The relaxation flows may also produce significant cross-shelf exchange of these quantities. Existing studies of buoyant coastal currents focus on flows resulting from persistent buoyancy inputs with large density contrasts, such as river outflows [Hickey, 1998b; Hill, 1998; Lentz and Limeburner, 1995; Lentz et al., 2003; Rennie et al., 1999] or flows driven by low salinity water masses originating far from the coastal currents they drive (e.g. Shcherbina and Gawarkiewicz, 2008; Sutherland and Pickart, 2008). Previous observations of relaxation flows have been based on serendipitous observations from sparse cross-shelf arrays of moorings for observing other shelf processes.

We propose a comprehensive observational and analytical program to examine the dynamics and source waters of the relaxation flows in a coastal upwelling system on the central California coast. Using autonomous vehicles, high-frequency radars, moorings, and drifters, we will acquire pressure, density, and velocity data relevant to the relaxation flows. The spatial and temporal coverage will be sufficient to determine spatial scales of the flows, cross-shore density structure, cross-shore and alongshore velocity fields, pressure gradients, and the region of contact with the sea floor. Our study will extend previous results since the propagating relaxation flows fall in a buoyant flow regime that has only been described in numerical modeling and laboratory studies.

Our research will: 1) evaluate the roles of barotropic and baroclinic pressure gradient forcing, 2) identify regions where ageostrophic flows dominate the cross-shore and alongshore momentum balances, 3) determine source waters for the relaxation flows, and 4) examine the inner shelf circulation response to wind relaxations over an extensive coastal region (the northern part of the

Southern California Bight) by analyzing extensive regional data sets collected over many years.

The proposed work is also timely and important because ocean circulation models have increasing resolution and are better able to resolve flows, such as these relaxation flows, very near coastal boundaries.

Libe Washburn **6/1/10-5/31/12** **146,822**
Mark Brzezinski
UC San Diego

Southern California Regional Coastal Ocean Observing System: Surface Current Mapping, Harmful Algal Bloom, and Sub-Surface Water Sections

A network of HF radar system for measuring ocean surface currents is being developed and operated with funding from the California State Coastal Conservancy and NOAA which leverages several preexisting HF hardware and data management systems. The surface current mapping network will aid in remotely sensed measurement of ocean surface currents for purposes of assessing and mitigating impacts of impaired water quality, tracking oil spills, assisting search and rescue efforts, and monitoring the physical environment for purposes of understanding ecosystem change. The Southern California Coastal Ocean Observing System (SCCOOS) proposes to maintain and improve the network to ensure continued distribution of near real-time surface currents along the coast of Southern California. Funds obtained from this program will support continued operation and maintenance of HF Radar systems including supporting infrastructure.

Libe Washburn **7/15/09-12/31/10** **30,060**
UC San Diego

The UCSB Component of the Coastal Ocean Current Mapping Program (COCMP) Southern California Coastal Ocean Observing System (SCCOOS)

A network of HF radar systems designed to measure ocean surface currents is being developed, operated, and evaluated with funding from the State of California, State Coastal Conservancy and NOAA leveraging from several preexisting systems and data management practices. The surface current mapping network will aid in remotely sensed measurement of ocean surface currents for purposes of assessing and mitigating impacts of impaired water quality, tracking oil spills, assisting search and rescue efforts, and monitoring the physical environment for purposes of understanding

ecosystem change. The Southern California Coastal Ocean Observing System (SCCOOS) proposes to maintain and improve the network to ensure continued distribution of near real-time surface currents along the coast of Southern California. Funds obtained with this program will support continued operation and maintenance of HF Radar systems including supporting infrastructure.

The system within the UCSB domain will be composed of CODAR Seasonde systems, which are based on compact antenna design and rely on direction finding algorithms for determining the bearing angle of the ocean currents. The system locations extend from north of Point Dume to Point Sal. Two of the sites (PTC and FBK1) are currently maintained jointly with Cal Poly, San Luis Obispo (PI: Moline).

Libe Washburn **9/1/10-1/15/11** **31,659**
CODAR Ocean Sensors

HF Radar Calibration with Automatic Identification System Ships of Opportunity

In collaboration with Codar Ocean Sensors, we will develop methods to obtain HF radar antenna pattern calibrations by using backscatter from ships of opportunity and position data from Automatic Information System (AIS) broadcasts. The work plan for this research is outlined in the Phase I objectives of the SBIR proposal submitted by CODAR Ocean Sensors of Mountain View, CA:

1) Demonstrate the use of backscatter from ships and corresponding AIS position data to reproduce antenna patterns previously measured with a transponder from small boat surveys.
2) Determine the relationship between accuracy of the reproduced antenna patterns and the number of observations required to estimate those antenna patterns, and use this relationship to predict how frequently a pattern can be produced given a known level of AIS-equipped ship traffic.
3) Use historical AIS data to estimate the fraction of existing HF radars in the NOAA Integrated Ocean Observing System (NOAA/IOOS) that could use this technology and how often antenna patterns could be estimated for these radars.

Kristen Whalen **9/01/08-9/30/10** **181,660**
Gretchen Hofmann
National Science Foundation, OISE-0754319

PostDoctoral Research Fellowship

The central objective of this project is to develop the sea urchin microarray as a tool for understanding broader aspects of marine herbivore physiology and resistance to dietary chemical stressors. First, I will design and construct an oligonnucleotide array targeting over 2000 genes important in xenobiotic detoxification/efflux, signal transduction, nutrient metabolism and chemoreception. Secondly, I will use this custom designed microarray in combination with sea urchin feeding assays to profile herbivore gene expression in response to a range of chemically diverse (e.g. nonpolar and water-soluble allelochemicals) algal diets/extracts. Finally, I will conduct time-course sea urchin feeding assays with a diversity of algal diets to examine temporal changes in candidate gene expression using real-time quantitative PCR (RT-qPCR).

Allison Whitmer **10/1/08-9/30/11** **1,049,469**
Colorado State University

MSP: Culturally Relevant Ecology, Learning Progressions, and Environmental Literacy

Implement an environmental education program for middle and high school students at Goleta Valley Junior High School, Santa Barbara Junior High School, and Santa Barbara High School. As a component of this programming, we will administer assessments connected with research objectives associated with our environmental literacy framework development and culturally relevant, place-based education assessments. We will recruit one teacher per year to serve as our teacher-in-residence who will assist in mentoring graduate and undergraduate students placed in K12 classrooms. We will recruit teachers to participate in our Research Experience for Teachers summer program. We will also be responsible for recruiting scientists and students from the Santa Barbara Coastal Long-term Ecological Research (SBC LTER) program and the Marine Science Institute to support and participate in local programming.

Douglas Wilson **6/1/09-3/1/12** **85,451**
University of Nebraska

Modeling Antarctic Paleotopography

In the proposed research supported by this subcontract, Dr. Wilson will expand on existing work that has modeled West Antarctic paleotopography at the Eocene-Oligocene boundary, ~34 Ma (Wilson and Luyendyk, 2008; Fig. 1). The primary motivation is to provide realistic input for climate and ice-sheet models, e.g. DeConto and Pollard (2003), which so far have only accounted for modification of topography by ice loading. For West Antarctica, the work in progress makes additional restorations for thermal subsidence resulting from Late Cretaceous and early Cenozoic extension, for erosion and sediment deposition, and for post-34-Ma horizontal plate motion. The proposed work would involve (1) extending the 34-Ma work to include East Antarctica, especially restoring erosion and thermal subsidence along the continental margin, and (2) constructing a topographic model for the climate transition at 14 Ma, including restorations for both East and West Antarctica.

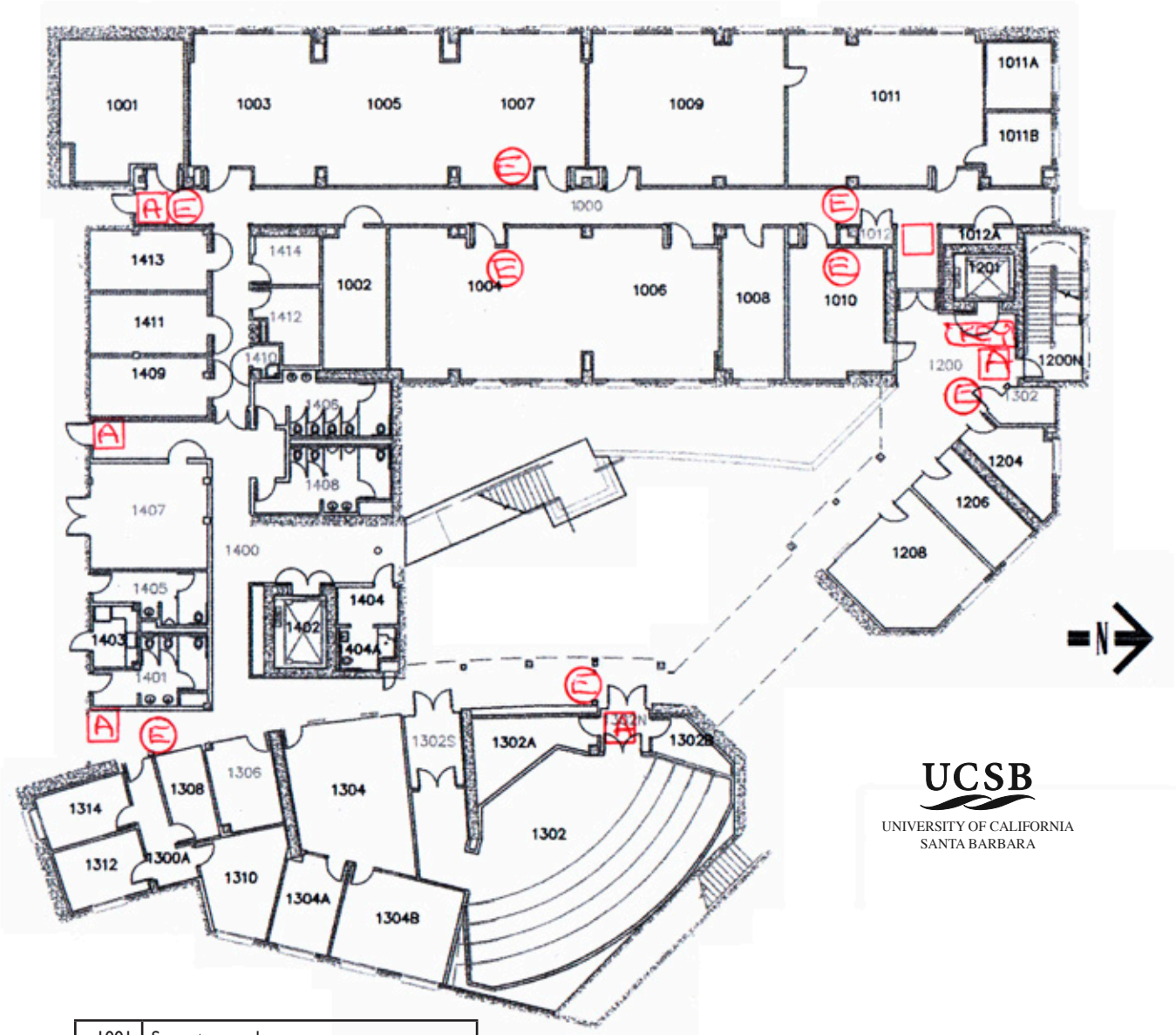
Pauline Yu **8/15/10-7/31/12** **10,000**
National Science Foundation

Postdoctoral Fellowship in Polar Regions Research: Effects of Ocean Acidification on Developmental Physiology of an Antarctic Sea Urchin, Sterechinus neumayeri

The primary research objective of this project is to study the effects of ocean acidification on developmental physiology in an ecologically dominant calcifying invertebrate, the Antarctic sea urchin Sterechinus neumayeri. An integrative experimental approaches will be employed to assess the effects of CO2-acidified seawater resulting from increased levels of atmospheric CO2 projected for future climatic regimes. Organismal approaches including physiological and biochemical measurements will be combined with proteomic analyses to investigate the metabolic costs and sub-lethal perturbations of development under conditions of increased environmental acidity. This locally abundant echinoid species is a key benthic herbivore in the shallow benthos of Antarctica (Clarke et al., 2007, Pearse and Giese, 1966), and has been extensively studied for its unique metabolic adaptations to the polar environment (Leong and Manahan, 1999, Marsh et al., 1999, Marsh et al., 2001, Pace and Manahan, 2007a, Shilling and Manahan, 1994). Its slow metabolism and high rate of protein synthesis make it an ideal system in which to study both the environmental effects of ocean acidification during the sensitive developmental stages when the larval skeleton is forming, and the basic biology of cold adaptation in lipid composition and metabolic enzymes. Notably the physiological response of contemporary benthic Antarctic invertebrates to acidification stress is nearly completely unexplored, with the few studies that have been conducted focusing on calcification and shell dissolution (Comeau et al., 2009, McClintock et al., 2009). Since the Southern Ocean is expected to reach critically under-saturated conditions sooner than other parts of the world's oceans (McNeil and Matear, 2008), and there is still substantial debate about the ability of Antarctic fauna to adapt to expected environmental change (Clarke et al., 2007), characterizing the plasticity and resilience of Antarctic calcifying organisms is a critical research objective for polar regions (Fabry et al., 2009).

Space

Marine Science Research Building
Bldg. No. 520 - 1st floor
06/2011

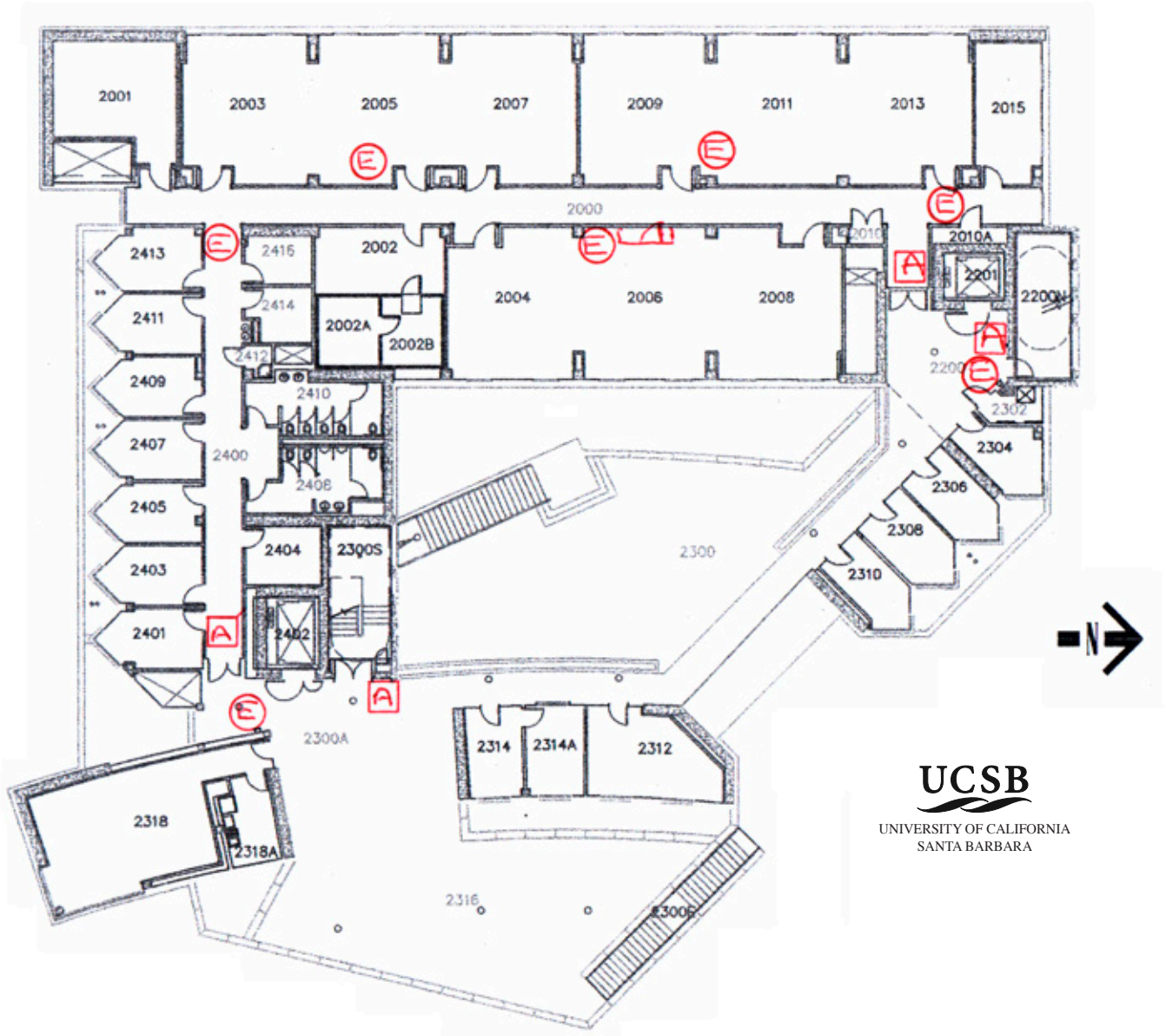


UCSB
UNIVERSITY OF CALIFORNIA
SANTA BARBARA

1001	Seawater workroom
1002	Common support laboratory
1003	Valentine laboratory
1004	Page/Dugan laboratory
1005	Valentine laboratory
1006	EPA laboratory
1007	Siegel laboratory
1008	Hacker laboratory
1009	Analytical laboratory
1010	Hacker laboratory
1011	Analytical laboratory
1204	Carolyn Culver
1206	Graduate Student office space

1208	Graduate student office space
1302	Auditorium
1304	Graduate student office space
1304a	Graduate student office space
1304b	Graduate student office space
1308	Copier room
1310	Graduate student office space
1312	Postdoc office space
1314	Postdoc office space
1409	Seawater workroom
1411	Seawater workroom
1413	Seawater workroom

Marine Science Research Building
Bldg. No. 520 - 2nd floor
06/2011



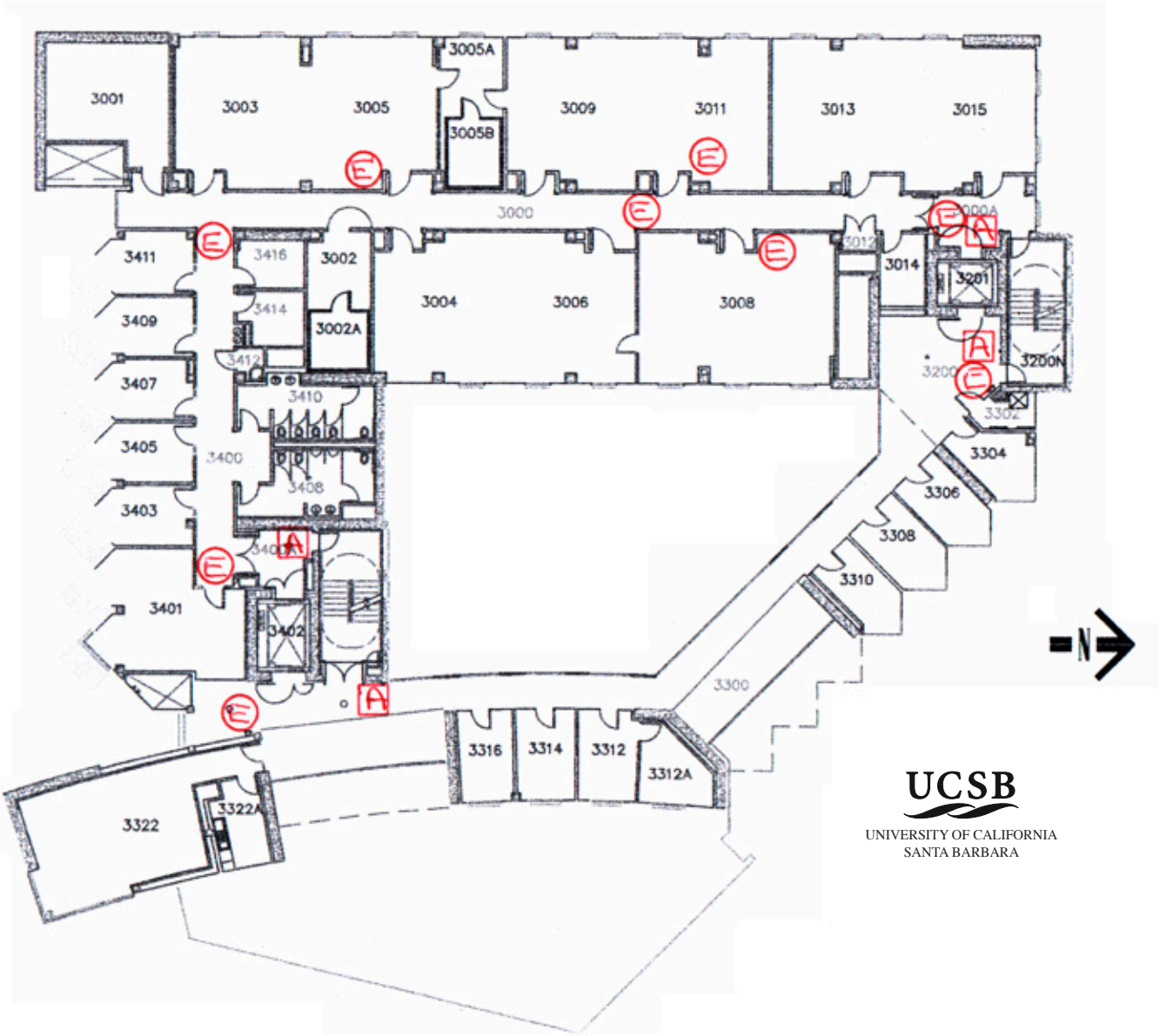
UCSB
UNIVERSITY OF CALIFORNIA
SANTA BARBARA

2001	Seawater workroom
2002	Common support laboratory
2002a	Environmental room
2002b	Environmental room
2003	Hofmann laboratory
2004	Quetin/Ross laboratory
2005	Hofmann laboratory
2006	Quetin/Ross laboratory
2007	Hofmann laboratory
2008	Shared laboratory
2009	Levine laboratory
2011	Levine laboratory

2013	Gaines laboratory
2015	Postdocs
2304	Postdoc office
2306	O'Donnell/Damschen
2308	Kevin Lafferty
2310	Shears/Salomon
2312	Natural Reserve System/ Donna Moore
2314	Natural Reserve System/ William Murdoch
2314a	Natural Reserve System/ Sue Swarbrick
2318	Conference room

2401	Mark Page
2403	Jenifer Dugan
2404	Storage
2405	Langdon Quetin
2407	Robin Ross
2409	Todgham/Place
2411	Gretchen Hofmann
2413	Postdoc office

Marine Science Research Building
Bldg. No. 520 - 3rd floor
06/2011



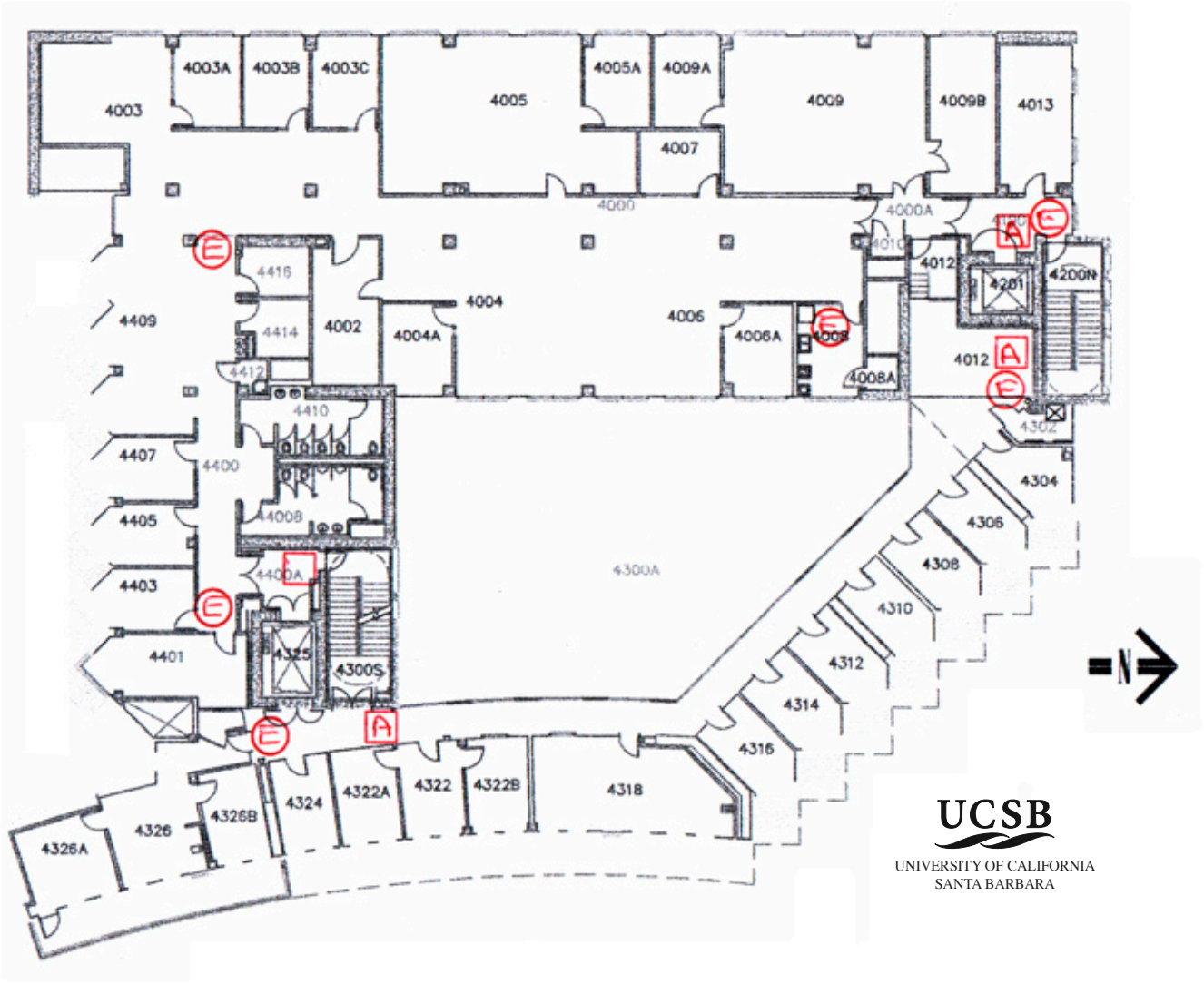
UCSB
UNIVERSITY OF CALIFORNIA
SANTA BARBARA

3001	Seawater workroom
3002	Common support laboratory
3003	Reed laboratory
3004	Holbrook laboratory
3005	Reed laboratory
3005a	Common support laboratory
3006	Schmitt laboratory
3008	Gaines laboratory
3009	Warner laboratory
3011	Warner laboratory
3013	Washburn laboratory

3014	Storage
3015	MacIntyre laboratory
3304	Jocelyn Ondre
3306	Postdoc office – Miller
3308	Dan Reed
3310	Andrew Brooks
3312	Postdoc office
3312a	Postdoc office
3314	Russell Schmitt
3316	Sally Holbrook
3322	Conference room

3401	Sustainable fisheries
3403	Margaret O'Brien – Mary Gastil-Buhl
3405	Econinformatics – Derik Barseghian
3407	Econinformatics – Benjamin Leinfelder
3409	Econinformatics – Mark Schildhauer/Dave Vieglais
3411	Econinformatics – Matt Jones

Marine Science Research Building
Bldg. No. 520 - 4th floor
06/2011



4002	Copier/mail room
4003a	Ocean o'Graphics – Monica Pessino
4003b	Storage
4003c	Joyce Wolever
4004a	Rachel Whitacre
4004c	Michele Ramirez
4004d	Mieke DeMeo
4005a	Elvira Rose
4005a	India Morgan
4005b	Veronica Torres
4005c	Nicole Zavala
4005e	vacant
4006a	Luisa Velez
4006a	Donna Dobis
4006b	Joanna Kettmann

4006e	Mike O'Neil
4007	Conference room
4008	Break room
4009a	Jim Woods
4009b	Marine Map
4009d	Mike Franklin
4012	Server room
4013	Marine Map
4304	Sally MacIntyre
4306	Libe Washburn
4308	Gail Osherenko
4310	William Freudenberg
4312	Jonathan Levine
4314	Jen Caselle
4316	Carol Blanchette

4318	Conference Room
4322	
4322a	Satie Airame
4322b	Robert Warner
4326b	Gay Larsen
4326	Development – Nannette Pedroso
4326a	MSI Director
4401	Tim Schmidt
4403	Chuck Cook
4405	Laurie Eusey
4407	Bonnie Williamson
4409a	Judy McCaslin
4409b	Deanna Cervantes
4409C	Marisol Hernandez

Marine Science Institute Trailers

319-a	Jack Engle
319-b	Jack Engle
319-c	Jack Engle
319-d	Herb Waite
319-e	Herb Waite
325-a	John Richards
325-b	Craig Nicholson
325-c	Craig Nicholson
325-d	Jack Engle
325-e	Jack Engle
334-a	Scott Simon
334-b	REEF
334-c	REEF

Statistical Summary

Research Support Summary
2010-2011

	Awards	Percentage of Total
Federal Agencies		
US Dept of Commerce, Marine Fisheries Service	$ 18,000	0.08%
COM National Oceanic And Atmospheric Administration	96794	0.42%
Department Of Interior	375,000	1.63%
DOE/Miscellaneous Offices And Programs	323,641	1.40%
NASA Shared Services Center (NSSC)	145,059	0.63%
National Science Foundation-NSF	14748890	64.00%
NIH Dental And NIH Research, National Institute Of	451,046	1.96%
PHS Centers For Disease Control	116,041	0.50%
USDI Bureau of Land Management	34000	0.15%
USDI FishaAnd Wildlife Service	160090	0.69%
USDI Geological Survey (Incl Natl Biological Service)	49,900	0.22%
USDI National Park Service	301,821	1.31%
Federal Totals	**$ 16,820,282**	**72.98%**
State		
California Coastal Conservancy	$ 960,000	4.17%
California Department of Boating and Waterways	34,988	0.15%
California Department of Parks and Recreation	99,077	0.43%
UC San Diego	206,882	0.90%
UC Santa Cruz	216,752	0.94%
UC Sea Grant College Program	95,319	0.41%
State Totals	**$ 1,613,018**	**7.00%**

Private

California Sea Urchin Commission	$ 10,000	0.04%
Clark County, Nevada	46,430	0.20%
CODAR Ocean Sensors	31,659	0.14%
Colorado State University	1,049,469	4.55%
Consolidated Safety Services	40,606	0.18%
Ecotrust	45,931	0.20%
Gordon And Betty Moore Foundation	846,492	3.67%
Human Frontier Science Program Organization (Intl)	125,000	0.54%
Japan Aerospace Exploration Agency (Jaxa)(Frmly Nasda)(Japan)	0	0.00%
Lockheed Martin Corporation	45,500	0.20%
Marisla Foundation (Frmly Homeland Foundation)	200,000	0.87%
Nature Conservancy	39,042	0.17%
Oregon State University	114,024	0.49%
Resources Legacy Fund Foundation	52,001	0.23%
Schmidt Ocean Institute (formerly Schmidt Research Vessel Institute)	84,320	0.37%
Third Sector New England	66,774	0.29%
Tides Foundation, The (Incl Tide Center)	150,000	0.65%
Truckee River Watershed Council	21,800	0.09%
University Of Arizona	169,971	0.74%
University Of Miami	119,091	0.52%
University Of Mississippi	127,743	0.55%
University Of Nebraska	41,103	0.18%
University Of New Mexico	968,122	4.20%
University of Southern California (So. Calif. Earthquake Center)	75,000	0.33%
University Of Washington	136,350	0.59%
Woods Hole Oceanographic Institution	7,192	0.03%
Private Totals	**$ 4,613,620**	**20.02%**
Total	**$ 23,046,920**	**100.00%**

Statistical Summary for the Marine Science Institute 2010-2011

	MSI	NCEAS	NRS	TOTAL
1. Academic personnel on payroll				
a. Faculty	22	1	1	24
b. Professional Researchers (including Visiting)	29	5	0	34
c. Project Scientists	17	1	0	18
d. Specialists	31	8	4	43
e. Postdoctoral Scholars	32	18	0	50
f. Postgraduate Researchers	0	0	0	0
g. Academic Coordinators	4	1	1	6
TOTAL	**135**	**34**	**6**	**175**

2. Graduate Students on payroll				
a. Employed on contracts and grants	53	0	0	53
b. Employed on other sources of funds	0	0	0	0
c. Participating through assistantships	0	0	0	0
d. Participating through traineeships	0	0	0	0
e. Other- students at other campuses	0	0	0	0
TOTAL	**53**	**0**	**0**	**53**

3. Undergraduate Students on payroll				
a. Employed on contracts and grants	143	4	7	154
b. Employed on other funds	0	0	0	0
c. Number of volunteers, & unpaid interns	0	0	0	0
TOTAL	**143**	**0**	**0**	**154**

4. Participation from outside UCSB: (optional)				
a. Academics (without Salary Academic Visitors)	0	0	0	0
b. Other (specify)	0	0	0	0
TOTAL	**0**	**0**	**0**	**0**

5. Staff (Univ. & Non-Univ. Funds):				
a. Technical	151	15	8	174
b. Administrative/Clerical	30	9	29	68
TOTAL	**181**	**24**	**37**	**242**

6. Seminars, symposia, workshops sponsored	-	-	-	0
7. Proposals submitted	176	5	0	181
8. Number of different awarding agencies dealt with*	105	-	-	105
9. Number of extramural awards administered	233	24	-	257
10. Dollar value of extramural awards administered during year**	$ 84,793,142	$27,109,348		$111,902,490
11. Number of Principal Investigators***			-	145
12. Dollar value of other project awards ****	$709,986	$32,199	$2,414,498	$3,156,683
13. Number of other projects administered	5	9	32	95
14. Total base budget for the year (as of June 30, 2010)	$1,238,532	$879,256	$1,354,744	$3,472,802
15. Dollar value of intramural support	$962,986	-	$30,502	$993,488
16. Total assigned square footage in ORU	38,807	-	-	38,807
17. Dollar value of awards for year (2010 Total)	$18,927,306	$4,119,614	$0	$23,046,920

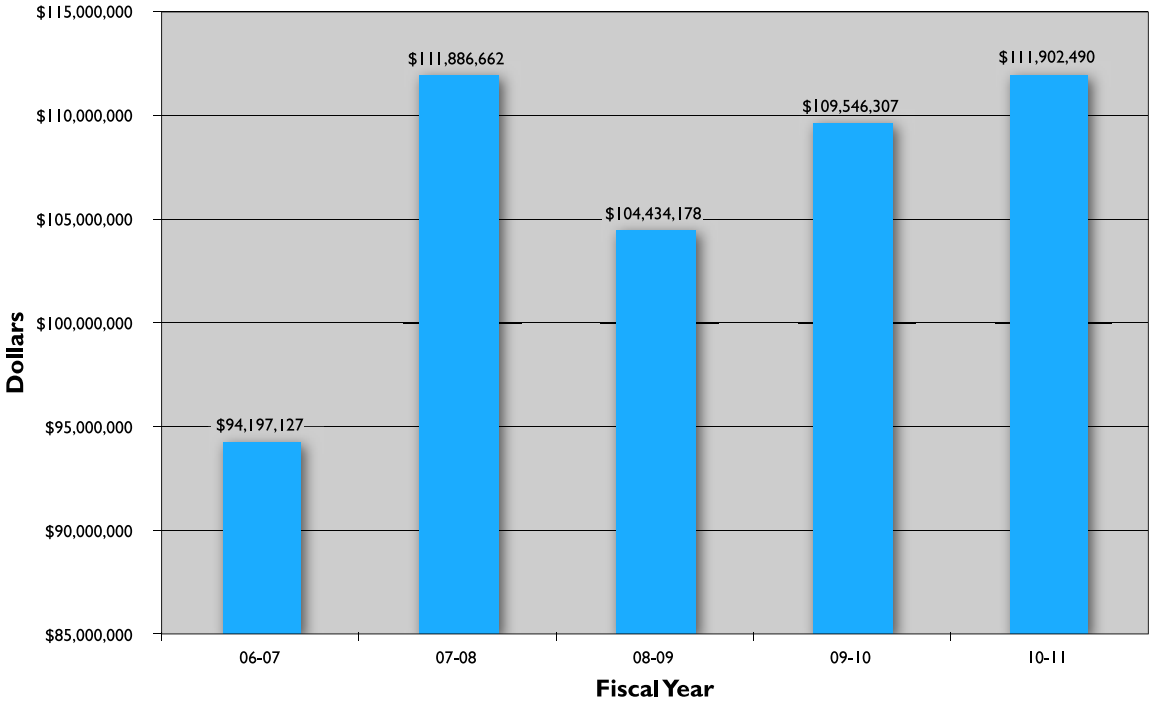
* Count each agency only once (include agencies to which proposals have been submitted).
** If the award was open during the year, even if for only one month, please include in total.
*** Number of PIs, Co-PIs and Proposed PIs (count each person only once.)
**** Other projects - such as donation, presidential awards, fellowships, anything that isn't core budget, extramural, or intramural.

Five-Year Statistical Summary 2007-2011

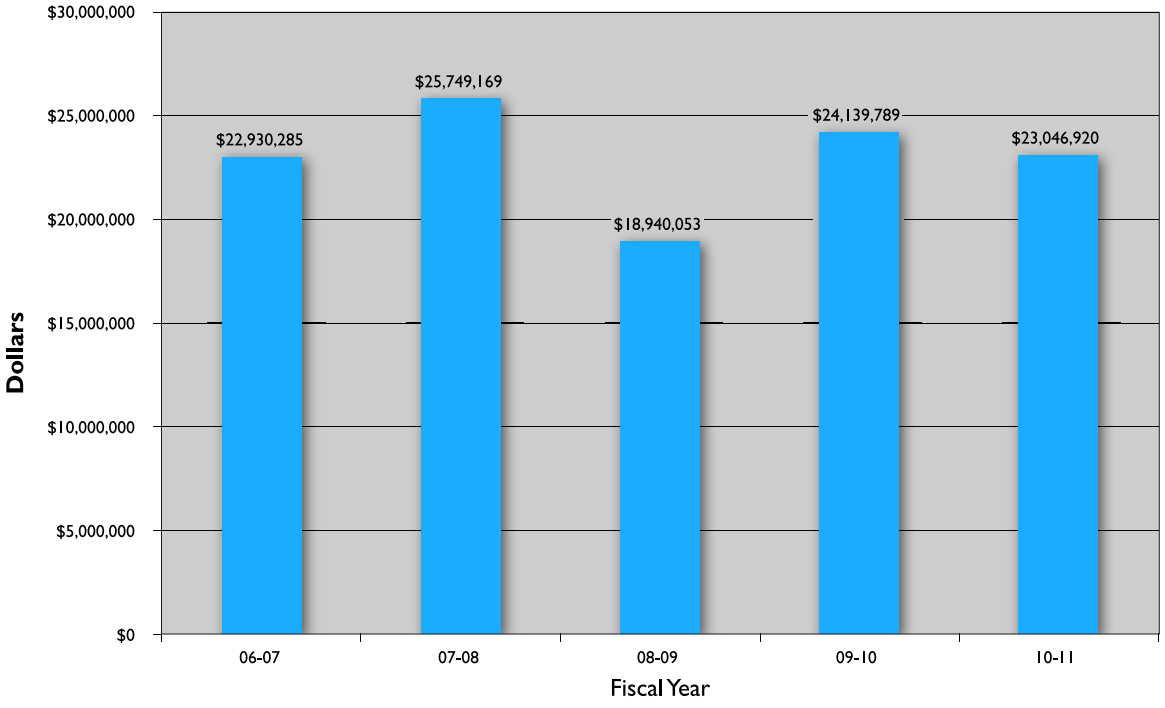
	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011
1. Academic personnel engaged in research					
a. Faculty	54	56	59	38	24
b. Researchers / Project Scientists	29	42	42	45	52
c. Visiting Researchers	8	8			
d. Specialists / Academic Coord / Academic Admin.	32	35	35	41	49
e. Postdoctorals / Postgraduates	63	85	54	56	50
Total	**186**	**226**	**190**	**180**	**175**
2. Staff (Univ. & Non-Univ. Funds)					
a. Technical	205	218	197	207	174
b. Administrative / Clerical	48	54	56	64	68
Total	**253**	**272**	**253**	**271**	**242**
3 Graduate students employed by MSI	105	99	61	67	53
4. Undergraduate students employed by MSI	164	179	211	175	154
5. Publications	1**	1**	1**	1**	1**
6. Seminars, symposia, workshops, etc., sponsored by MSI	141	163			
7. Proposals submitted	213	199	171	204	181
8. Annual extramural awards	$22,930,285	$25,749,169	$18,940,053	$24,139,789	$23,046,920
9. Extramural awards administered	289	300	290	278	257
10. Other project awards	$1,175,674	$1,283,705	$1,437,240	$4,175,455	$3,156,683
11. Other projects administered	57	61	107	121	95
12. MSI base budget	$974,238	$1,011,541	$1,626,165	$1,084,520	$1,238,532
13. Intramural support	$1,596,833	$1,710,775	$1,009,091	$331,430	$993,488
14. Total Funds Administered	**$94,197,127**	**$111,886,662**	**$104,434,178**	**$109,546,307**	**$119,525,463**

**Only Departmental Publications

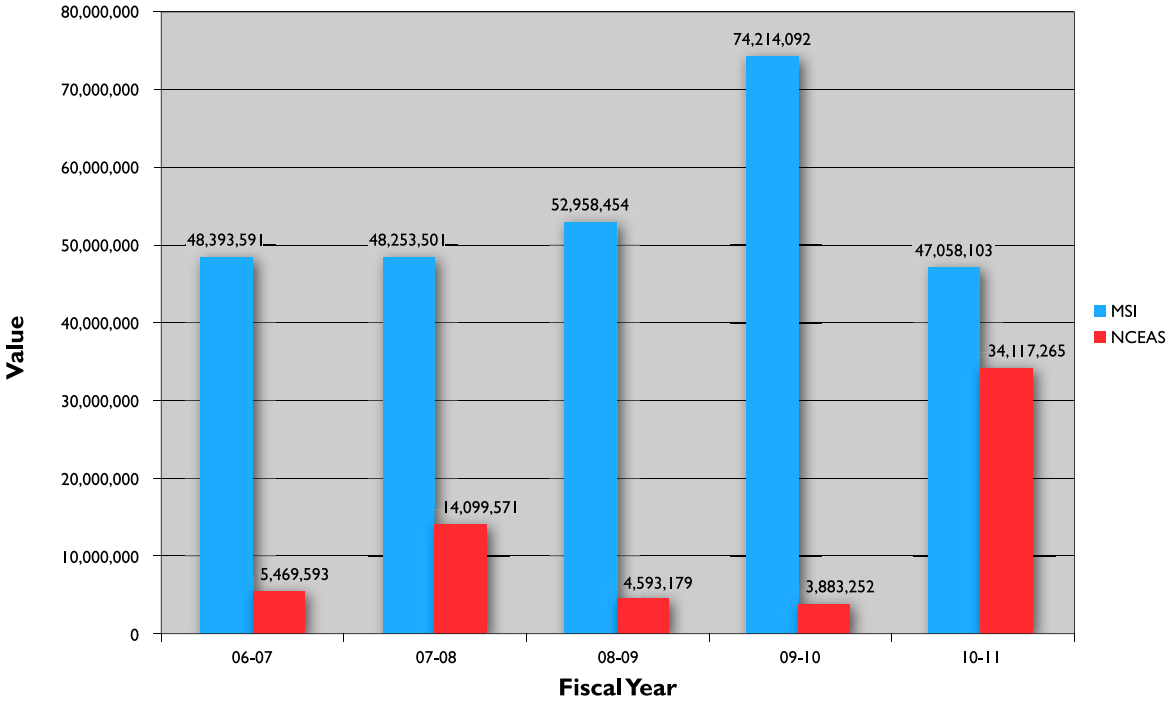
Marine Science Institute – Total Value of Awards Administered



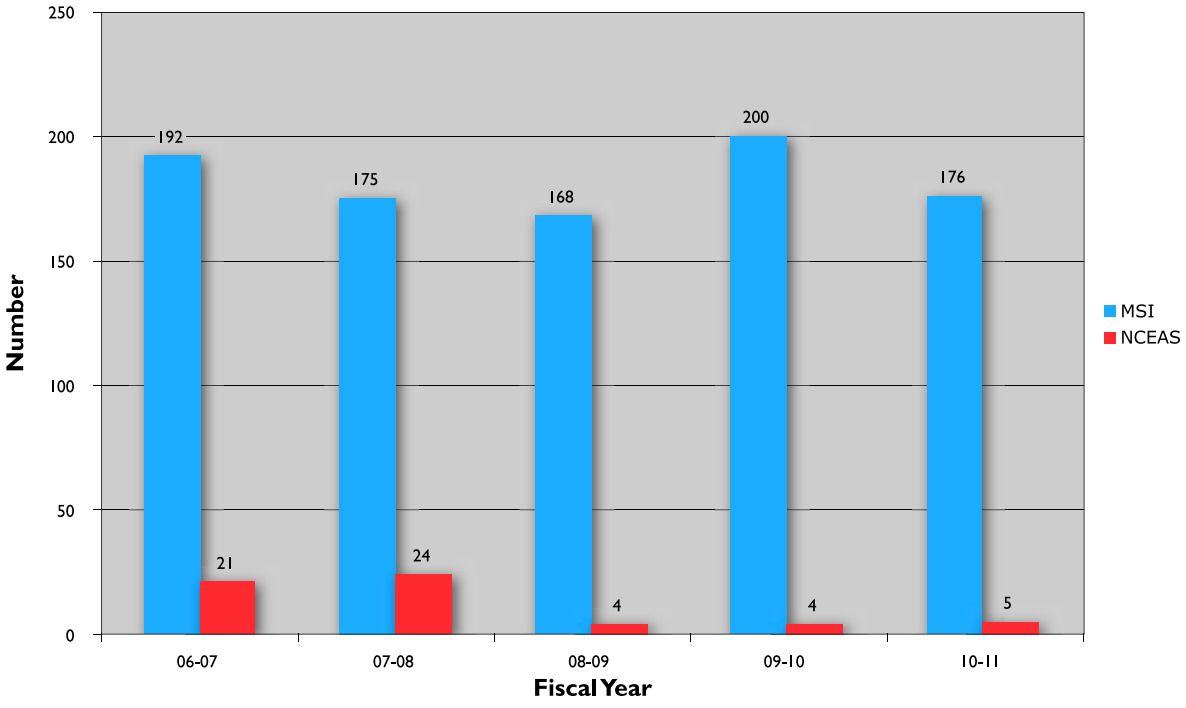
Marine Science Institute - Value of Extramural Awards Received Annually



Value of Proposals Submitted Annually by MSI & NCEAS



Number of Proposals Submitted Annually by MSI & NCEAS



Funding Agencies
2010-2011

American Wind Wildlife Institute

Andrew W. Mellon Foundation

Arizona State University, Tempe

Boston University

California Artificial Reef Enhancement

California Coastal Commission

California Coastal Conservancy

California Department of Fish and Game

California Department of Parks and Recreation

California Dept of Boating and Waterways

California EPA Water Resources Control Board

California Fire Safe Council, Inc.

California Sea Urchin Commission

California State Lands Commission

California Wildlife Foundation

Carnegie Mellon University

Clark County, Nevada

Coastal Fund (formerly Shoreline Preservation Fund)

CODAR Ocean Sensors

Collaborative Fisheries Research

Colorado State University

Conservation International Foundation

Consolidated Safety Services

Consortium for Ocean Leadership

David And Lucile Packard Foundation (The)

Desert Research Institute

Director of Central Intelligence

Duke University

Ecotrust

Environmental Defense Fund

Gordon and Betty Moore Foundation

Gulf of Mexico Research Initiative

Heal The Ocean Inc.

Human Frontier Science Program In'tl

Japan Aerospace Exploration Agency (JAXA) (Frmly NASDAa)(Japan)

Lockheed Martin Corporation

Los Angeles Dept of Water And Power

Luce Foundation

Marisla Foundation (Frmly Homeland Foundation)

Mineral Science Company, Inc.

National Academy Of Sciences

National Coastal Resources Research & Development Institute (NCRI)

National Institutes of Health, NIH General Medical Sciences

National Institutes of Health, NIH Research

National Institutes of Health, Public Health Services

National Science Foundation-NSF

Nature Conservancy, The

NYS DOS Division of Coastal Resources

Oregon State University

Paul G. Allen Charitable Foundation

PHS Centers for Disease Control

Resources Legacy Fund Foundation

Santa Barbara County Air Pollution Control District

Schmidt Ocean Institute (formerly Schmidt Research Vessel Institute)

Simpson and Simpson Business and Personnel Services, Inc.

Society for Conservation Biology, Smith Fellows Program

Sonoma County Water Agency

Southeastern Universities Research Association

Southern California Coastal Water Research Project Auth, A Public Agency

Southern California Wetlands Recovery Project

Texas A&M University

Third Sector New England

Tides Foundation, The

Truckee River Watershed Council

U.S.-Israel Binat'l Science Foundation (Bsf) (Intl)

UC Agriculture And Natural Resources

UC Berkeley

UC Davis

UC Discovery Research & Training Grant

UC Hansen Trust Fund

UC MEXUS

UC Office of The President

UC San Diego

UC Santa Cruz

UC Sea Grant College Program

United States Intelligence Community

University of Arizona

University of Florida

University of Massachusetts

University of Miami

University of Minnesota

University of Mississippi

University of Nebraska

University of New Mexico

University of Southern California

University of Southern Mississippi

University of Washington

University of Wisconsin

US Department of Defense

US Department of Energy

US Dept of Commerce, National Marine Fisheries Service

US Dept of Commerce, National Oceanic and Atmospheric Administration

USDA Forest Service

USDI Bureau of Land Management

USDI Bureau of Ocean Energy Management (formerly Minerals Management Service)

USDI Fish and Wildlife Service

USDI Geological Survey

USDI National Park Service

USDI, NPS, Channel Islands National Park

USDI, NPS, Kings Canyon and Sequoia National Parks

Walton Family Foundation, Inc.

Washington Sea Grant

Wilburforce Foundation

MSI Advisory Committee, Administrative, Professional & Technical Staff

Marine Science Institute
2010-2011

Chancellor	Henry T. Yang
Executive Vice Chancellor	Gene Lucas
Vice Chancellor for Research	Michael Witherell
Director	Steven D. Gaines
Deputy Director	Mark A. Brzezinski

Advisory Committee

Sarah Anderson, Bren School
Carol Blanchette, MSI
Craig Carlson, EEMB
Eckhart Meiburg, Mechanical Engineering
Mark Page, MSI
Russell Schmitt, Chair, EEMB
Syee Weldeab, Earth Science
Doug Wilson, MSI

Ex-Officio members -

Mark Brzezinski, EEMB, Interim Director
Gretchen Hofmann, EEMB, Ocean Acidification Center
Daniel Morse, MCDB, Marine Biotech Center Director
William Murdoch, EEMB, Natural Reserve System
Edward McCauley, EEMB, NCEAS Director
Dan Reed, MSI, Acting Deputy Director MSI
Tim Schmidt, Manager, Marine Science Institute
Russell Schmitt, EEMB, Coastal Research Center Director

Marine Science Institute
Administrative, Professional and Technical Staff

Deanna Cervantes, Contracts & Grants Analyst

Marie Ciluaga, Analyst

William Clinton, Staff Research Associate, Analytical Laboratory

Molly Thomson, Artist

Donna Dobis, Budget Analyst

Mieke DeMeo, Purchasing Analyst

Laurie Eusey, Financial Services Manager

Mike Franklin, Desktop Support

Marisol Hernandez, Desktop Support/Travel Analyst

Joanna Kettmann, Budget Analyst

Jenn Massey, Analytical Lab

Judy McCaslin, Contracts & Grants Officer

India Morgan, Personnel Analyst

Mike O'Neil, Budget Analyst

Michael Orlando, Analytical Lab

Georges Paradis, Manager, Analytical Lab

Veronica Perez, Personnel Analyst

Monica Pessino, Publication Manager

Elvira Rose, Personnel Unit Coordinator

Tim Schmidt, Manager

Scott Simon, Outreach Coordinator

Luisa Velez, Budget Unit Manager

Bonnie Williamson, Contracts & Grants Administration Manager

Joyce Wolever, Payroll & Personnel Unit Manager

James Woods, Information Technology

Nicole Zavala, Personnel Analyst

Marine Science Institute Principal Investigators 2010-2011

Marine Science Institute
Principal Investigators
2010-2011

Aguirre-Macedo, Maria	Assistant Researcher	Marine Science Institute
Airame, Satie	Academic Coordinator	Marine Science Institute
Alagona, Peter	Associate Professor of History	History
Albertson, Lindsey	Graduate Student Researcher	Ecology, Evolution & Marine Biology
Alldredge, Alice	Professor of Marine Science	Ecology, Evolution & Marine Biology
Andelman, Sandy	Specialist	Nat'l Ctr for Ecol. Analysis & Synthesis
Baum, Julia	Postdoctoral Researcher	Nat'l Ctr for Ecol. Analysis & Synthesis
Benson, James	Undergraduate Student	Marine Science Institute
Beucher, Charlotte	Assistant Researcher	Marine Science Institute
Blanchette, Carol	Associate Researcher	Marine Science Institute
Bookhagen, Bodo	Associate Professor	Geography
Briggs, Cheryl	Professor	Ecology, Evolution & Marine Biology
Brzezinski, Mark	Professor	Ecology, Evolution & Marine Biology
Carden, Kristin	Graduate Student Researcher	Bren School of Envir. Sci. & Management
Cardinale, Bradley	Associate Professor	Ecology, Evolution & Marine Biology
Carlson, Craig	Professor	Ecology, Evolution & Marine Biology
Caselle, Jennifer	Associate Project Scientist	Marine Science Institute
Chadwick, Oliver	Professor	Geography
Christie, Joceyln	Undergraduate Student	Marine Science Institute
Cooper, Scott	Professor	Ecology, Evolution & Marine Biology
Costello, Christopher	Associate Professor	Bren School of Envir. Sci. & Management
Culver, Carrie	Associate Researcher	Marine Science Institute
D'Antonio, Carla	Professor	Environmental Studies
Damuth, John	Researcher	Marine Science Institute

Davis, Frank	NCEAS Director; Professor	Nat'l Ctr for Ecol. Analysis & Synthesis
Dawson, Daniel	Reserve Manager	Natural Reserve System
Deacon, Robert	Professor of Economics	Economics
DeTomaso, Anthony	Assistant Professor	Molecular, Cellular & Devel. Biology
Dilley, Eric	Undergraduate Student	Marine Science Institute
Doyle, Frank	Professor	Chemical Engineering
Dudley, Leah	Assistant Project Scientist	Marine Science Institute
Dudley, Tom	Associate Researcher	Marine Science Institute
Dugan, Jenifer	Associate Researcher	Marine Science Institute
Engle, John	Associate Research Biologist	Marine Science Institute
Fewings, Melanie	Assistant Researcher	Marine Science Institute
Finkelstein, Ruth	Professor	Molecular, Cellular & Devel. Biology
Fleishman, Erica	Academic Coordinator	Nat'l Ctr for Ecol. Analysis & Synthesis
Foltz, Kathleen	Associate Professor	Molecular, Cellular & Devel. Biology
Foster, Matthew	Undergraduate Student	Marine Science Institute
Gaines, Steven	Dean, Bren School, Professor	Bren School of Envir. Sci. & Management
Goddard, Jeffrey	Project Scientist	Marine Science Institute
Goodridge, Blair	Graduate Student Researcher	Ecology, Evolution & Marine Biology
Gosnell, Stephen	Graduate Student Researcher	Ecology, Evolution & Marine Biology
Greenberg, David	Assistant Project Scientist	Marine Science Institute
Halpern, Benjamin	Researcher	Nat'l Ctr for Ecol. Analysis & Synthesis
Hamilton, Scott	Associate Project Scientist	Marine Science Institute
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