



ANNUAL REPORT **2011** **2012**

Marine Science Institute
University of California , Santa Barbara



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Director's Statement

Director's Statement



Once again, I am pleased to provide the introduction for this annual report.

Researchers affiliated with the Marine Science Institute span the globe pursuing their research interests and in any given year support is received from over 100 different agencies.

One source that accounts for nearly 10% of the new awards received by the Institute this year is the National Science Foundation's Collaborative Research Program. Projects eligible for this NSF program are required to have investigators from two or more organizations wishing to collaborate on a unified project.

Another source of funding from which MSI researchers receive considerable support each year is the California Sea Grant. Sea Grant is a unique partnership that unites the resources of the federal government, the state of California, and Universities across the state to create knowledge, products, and services that benefit the economy, the environment, and the citizens of California.

Whether regionally or internationally, working individually or partnering with other organizations, the intellectual activity of the researchers working at MSI is immense.

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

A handwritten signature in purple ink that reads "Mark Brzezinski".

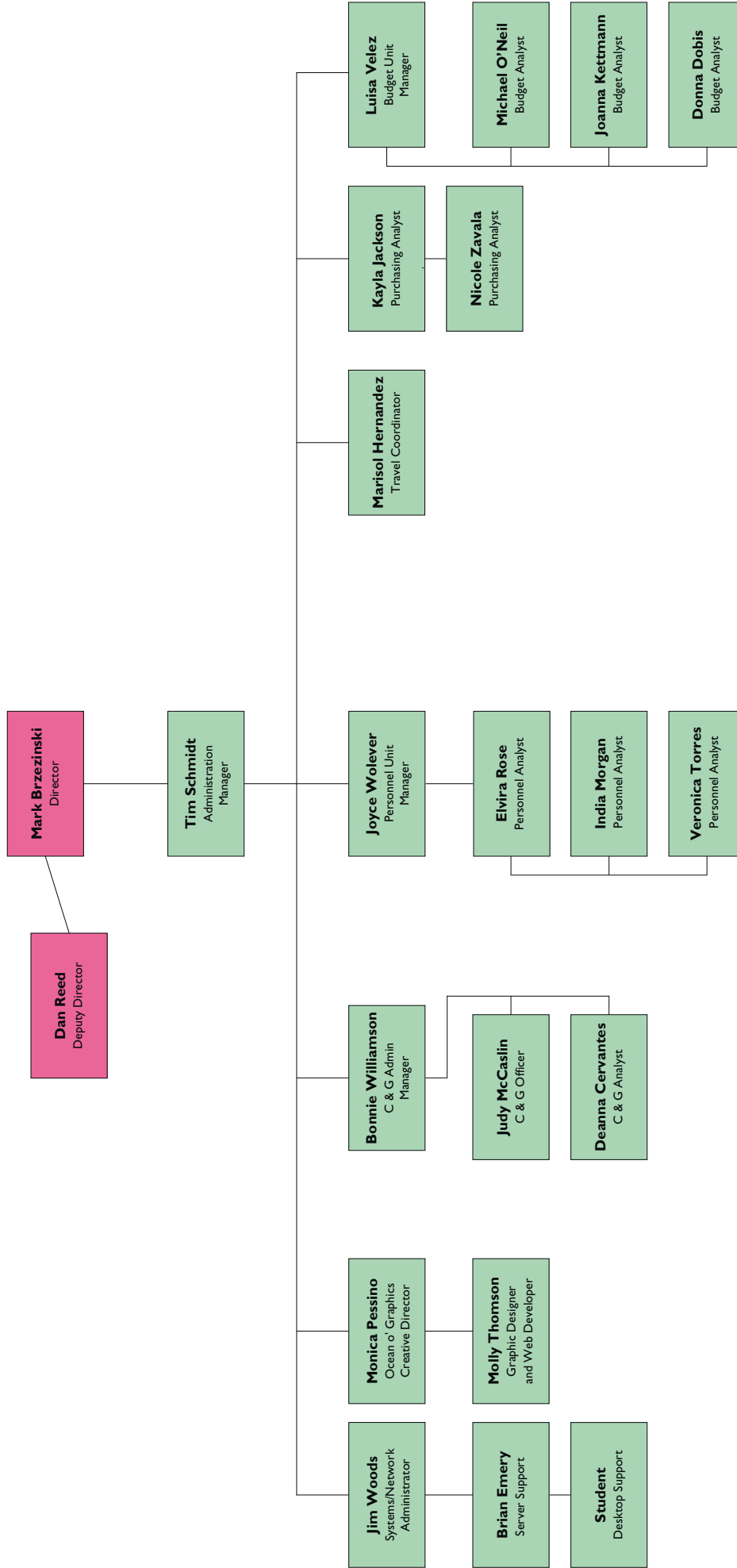
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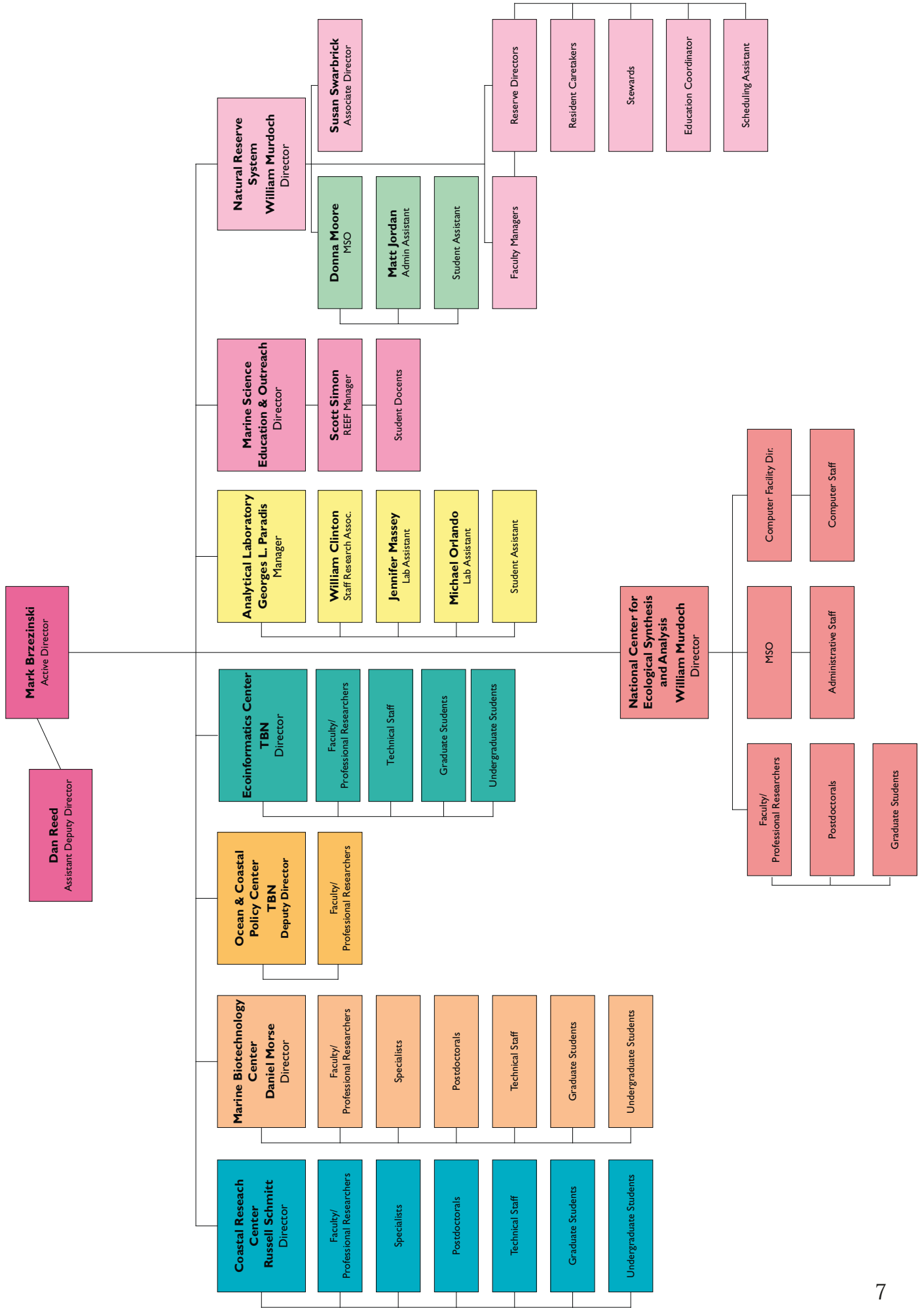
Organizational Charts

MARINE SCIENCE INSTITUTE

2011-2012 ORGANIZATIONAL CHART



MARINE SCIENCE INSTITUTE 2011-2012 ORGANIZATIONAL CHART





Other Projects & Activities

Seminars, Workshops, Conferences, and Meetings

July 1, 2011–June 30, 2012

The Marine Science Institute continues to support various seminars, workshops, conferences and meetings. During the 2011-2012 fiscal year 115 events took place, in which a wide range of marine science topics were highlighted.

Dates	Coordinators	Topic
July 6-9, 2011	Pete Edmunds, Ruth Gates	Tropical coral reefs of the future: Modeling ecological outcomes from the analyses of current and historical trends (Working Group)
July 7, 2011	Kim Selkoe	Seafood tasting BBQ, wild salmon
July 7-8, 2011	Jennifer Caselle, Dan Reed	Discussion of future collaboration between PISCO and CHON (Canada Healthy Ocean Network) scientists
July 6-10, 2011	Stephen Gosnell	Luce-NCEAS working group meeting
July 7-16, 2011	Myla Aronson, Katti Madhusudan, Paige Warren, Charles Nilon	Comparative ecology of cities: what makes an urban biota "urban"? (Working Group)
July 15-16, 2011	Scott Simon	NOAA/CINMS/MSI – Oceans for Life
July 18-22, 2011	Mark Maunder, Benjamin Bolker, Beth Gardner	Evaluating and improving open source software for nonlinear statistical (Working Group)
July 19, 2011	Scott Simon	NOAA/CINMS/MSI – Oceans for Life
July 19-20, 2011	Lisa Needles	Novel Ecosystems Working Group
July 19-21, 2011	Steve Gaines, Sarah Lester	Managing for Multiple Ecosystem Services in Bays and Estuaries (NOAA working group)
July 19-22, 2011	Matt Jones, Stephanie Hampton	DataONE: Observation Network for Earth (Working Group)
July 24-25, 2011	Scott Simon	NOAA/CINMS/MSI – Oceans for Life
July 26-28, 2011	Erica Fleishman	Ecological thresholds in the San Francisco estuary (Working Group)
August 1-4, 2011	Michael Alfaro, Luke Harmon	R-phylogenetics Training Workshop
August 5, 2011	Michael Kent, Oregon State Univ.	Survey of parasites in threatened stocks of coho salmon (<i>Oncorhynchus kisutch</i>) in Oregon

* Non-UCSB personnel



August 8-12, 2011	Erin Peterson, Jay Ver Hoef, Daniel Isaak	Spatial statistical models for stream networks: Synthesis and new directions (Working Group)
August 10, 2011	Stephanie Hampton	NCEAS alumni meeting at ESA
August 12-13, 2011	Laura Francis	NOAA Fish and Invertebrate Identification training
August 28-31, 2011	Andrew Liebhold, Deborah McCullough	Applying population ecology to strategies for eradicating invasive forest insects (Working Group)
August 29-31, 2011	Larry Crowder, Martin Smith	Envisioning a sustainable global seafood market and restored marine ecosystems (Working Group)
September 7-9, 2011	Gretchen Hofmann	Ocean Acidification Workshop
September 13-16, 2011	John Callaway, Steve Crooks, Pat Megonigal, Abe Doherty	Tidal wetland carbon sequestration and greenhouse gas emissions model (Working Group)
September 15, 2011	John Callaway, Univ San Francisco, & Pat Megonigal, Smithsonian Environmental Research Center	Carbon sequestration rates and methane emissions in tidal wetlands (Ecolunch Seminar)
September 16, 2011	Barbara Javor, National Marine Fisheries Service	Otolith morphometrics and population structure of Pacific sardine
September 22, 2011	Susan Alberts, Duke University	Age at maturity in wild baboons: genetics and parental effects (Ecolunch Seminar)
September 22-24, 2011	Karen Strier, Susan Alberts	Evolutionary ecology of primate life histories (Working Group)
September 23, 2011	Ben Halpern	Ocean Health Index Weighting wkshp
September, 26, 2011	Frank Davis	Joint TNC-NCEAS visioning meeting
September 26, 2011	Margaret O'Brien	LTER Information Managers Meeting
September 26-October 1, 2011	David Bowman, Jennifer Balch	Pyrogeography – fire's place in earth system science (Working Group)
September 27-30, 2011	Russell Schmitt, Sally Holbrook	Meeting with CREON (Coral Reef Environmental Observatory Network) researchers
September 28-29, 2011	Matt Jones, Corinna Gries	Environmental Information Management Conference



* Non-UCSB personnel

September 29, 2011	E. Christian Wells, Univ. of South University	Framing sustainability: citizenship, metabolism and resiliency (Ecolunch)
September 30, 2011	Amber Budden	DataONE: Observation Network for Earth, Training Workshop
October 2-6, 2011	Anthony Richardson, Elvira Poloczanska	Towards understanding marine biological impacts of climate change (Working Group)
October 4-7, 2011	Anne Guerry, Kai Chan	Cultural ecosystem services from marine and coastal systems: Counting the intangibles EBM (Working Group)
October 6, 2011	Kai Chan, University of British	Can ecosystem services research improve decision-making? Values, cultural services, and a proposed framework (Ecolunch Seminar)
October 7, 2011	Anthony Richardson, Elvira Poloczanska	IPCC Marine Impacts of Climate Change Discussion
October 8-9, 2011	John Sabo, Laura Bowling, Gerritt Schoups	Human impacts of water infrastructure on watershed ecosystems and the sustainability of irrigated agriculture in the coterminous US (Working Group)
October 10-14, 2011	Brad Cardinale, Dave Hooper, Emmett Duffy	Biodiversity and the functioning of ecosystems: Translating results from model experiments into functional reality (Working Group)
October 10-14, 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)
October 13, 2011	Cascade Sorte, University of Massachusetts, Boston	Global change delivers a double-whammy: ocean warming and invasive species dominance (Ecolunch)
October 14-16, 2011	Jeannine, Cavender-Bares, Stephen Polasky	Developing curricula and model systems for sustainability science Sustainability Science Distributed Graduate Seminar Meetings
October 20, 2011	Frank Davis, UC Santa Barbara	Population biology of a Mediterranean-climate oak (Ecolunch)
October 24-28, 2011	Brian Enquist, Bob Peet, Richard Condit, Brad Boyle, Steven Dolins	Developing an integrated botanical ecological impacts of global climate change on plant biodiversity (Working Group)



* Non-UCSB personnel

October 25-27, 2011	Stephanie Hampton	Marine Debris: Scale and impact of trash in ocean ecosystems (Working Group)
October 26, 2011	Kara Lavender Law, Sea Education Association, Woods Hole, MA	The science behind ocean “garbage patches” (Ecolunch Seminar)
October 28-November 2, 2011	Robert Condon, Carlos Duarte, William Graham	Global expansion of jellyfish blooms: Magnitude, causes and consequences (Working Group)
November 2-4, 2011	Jennifer Caselle	Research Today – Reefs Tomorrow working group
November 3, 2011	Mary Turnipseed, NCEAS	Re-imagining the Public Trust Doctrine to conserve US oceans (Ecolunch Seminar)
November 4, 2011	Dan Reed	Santa Barbara Channel LTER All Scientists Meeting
November 7-9, 2011	Russell Schmitt	Moorea Coral Reef LTER All Scientists meeting
November 8-9, 2011	Jai Ranganathan	Social Media for Scientists Workshop
November 11, 2011	Stephanie Pau, NCEAS	Diverse ecosystem responses to climate across space and time (Ecolunch Seminar)
November 11, 2011	Scott Simon	Oceans-To-Classrooms Training; Marine Protected Areas Watch
November 15-17, 2011	Matt Jones, Stephanie Hampton	DataONE: Observation Network for Earth (Working Group)
November 17, 2011	Carrie Kappel, NCEAS	Ecosystem service tradeoff analysis reveals the value of marine spatial planning for multiple ocean uses (Ecolunch Seminar)
November 29, 2011	Jim Brown, University of New Mexico	A common Scaling Rule for Abundance, Energetics, and Production of Parasitic and Free-Living Species working group
November 29-December 2, 2011	Benjamin Cook, Elizabeth Wolkovich	Forecasting phenology: Integrating ecology, climatology, and phylogeny to understand plant responses to climate change (Working Group)
December 1, 2011	Jai Ranganathan and Jarrett Byrnes, NCEAS	The SciFund Challenge: a new way to connect people to science and raise money for research (Ecolunch)



* Non-UCSB personnel

December 2, 2011	Scott Simon	Oceans-To-Classrooms Training; Marine Protected Areas Watch
December 10-13, 2011	John Sabo, Laura Bowling, Gerritt Schoups	Human impacts of water infrastructure on watershed ecosystems and the sustainability of irrigated agriculture in the coterminous US (Working Group)
December 12-16, 2011	Christopher Boone, Steward Pickett, J. Morgan Grove, Mary Cadenasso	Ecology of environmental justice in metropolitan areas (Working Group)
December 15, 2011	Mary Cadenasso, UC Davis	Ecosystem services in urban landscapes: Who benefits? (Ecolunch)
January 9-10, 2012	Steve Gaines, Michaela Clemence	Financing Fisheries Reform meeting
January 11-13, 2012	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)
January 16-19, 2012	Robin Waples, Jeffrey Hutchings	Red flags and species endangerment: Meta-analytical development of criteria for assessing extinction risk (Working Group)
January 17-21, 2012	Myla Aronson, Katti Madhusudan, Paige Warren, Charles Nilon	Comparative ecology of cities: what makes an urban biota "urban"? (Working Group)
January 25-26, 2012	Tess Freidenburg	Expert Judgment meeting
January 26, 2012	Steve Katz, Channel Islands National Marine Sanctuary	Alternative data streams for addressing maritime conservation and management problems in the Channel Islands (Ecolunch)
February 2, 2012	Christiane Elfes, UC Santa Barbara	High value and long life – double jeopardy for tunas and billfishes (Ecolunch)
February 8-10, 2012	Stephen Gosnell, Stephanie Diaz, Keely Roth	What makes reintroductions work? Developing a comprehensive frame-work to evaluate and guide reintroduction efforts (Luce Fellows)
February 8-9, 2012	Alison Whitmer	Pathway Professional Development planning meeting
February 8-10, 2012	Scott Simon, Michele Johnson	Math Science Partnership: Pathways Project



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February 9, 2012	Derek Grey, NCEAS	The influence of dispersal as fresh-water plankton communities respond to regional environmental change (Ecolunch)
February, 14, 2012	Forest Isbell, University of Minnesota	Causes & consequences of changes in grassland plant diversity (Ecolunch)
February 16, 2012	Werner Kuhn, Institute for Geoinformatics, Univ Münster	Spatial information in ecology - what are the core concepts (Ecolunch)
February 20-24, 2012	Robert Condon, Carlos Duarte, William Graham	Global expansion of jellyfish blooms: Magnitude, causes and consequences (Working Group)
February 21-24, 2012	Cascade Sorte, Joshua Lawler, Jeffrey Dukes	Climate change and invasive species: Are non-natives poised for greater success in future climatic conditions? (Working Group)
February 22-24, 2012	Ben Halpern	Identifying thresholds, developing key indicators, and operationalizing their use in CMSP (Working Group)
February 23, 2012	Rob Condon, Dauphin Island Sea Lab	Questioning the rise of gelatinous zooplankton in the world's oceans (Ecolunch)
March 1, 2012	Mark Browne, NCEAS	Water-tight solutions to engineering intertidal biodiversity in our cities (Ecolunch)
March 2, 2012	Bob Warner	Research Activities Panel (RAP)
March 6-7, 2012	Margaret O'Brien	ILTER Information Management: Data Package Quality
March 8, 2012	Ben Halpern, NCEAS	An Ocean Health Index: quantifying and mapping the health of global marine ecosystems (Ecolunch)
March 14, 2012	Stephanie Hampton	Kids do ecology Poster Day
March 15, 2012	Benoit Parmentier, NCEAS	Characterization of fire scars in Alaska using remotely sensed environmental variables (Ecolunch)
March 21-22, 2012	Frank Davis	Trends in Ecological Analysis and Synthesis
March 21, 2012	Jennifer Balch	Synthesis Ecology: An NCEAS Postdoc Perspective



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April 5, 2012	Stacy Rebich Hespanha, NCEAS	Society and nature in regional and national U.S. new coverage of climate change: visual framing of a global environmental issue (Ecolunch)
April 5-6, 2012	M. Rebecca Shaw	Global climate change and adaptation of conservation priorities (Working Group)
April 6, 2012	Scott Simon	Oceans-to-Classrooms Training
April 12, 2012	Mariah Carbone, NCEAS	The influence of fog and low clouds on the metabolism of a coastal pine ecosystem (Ecolunch)
April 17-19, 2012	Matt Jones, Stephanie Hampton	DataONE: Observation Network for Earth (Working Group)
April 19, 2012	John Parker, Arizona State University	Ideas, emotions, and intergenerational change in apex scientific groups: the micro-politics of intellectual fields (Ecolunch)
April 20-22, 2012	John Parker, Edward Hackett	Advancing theory and research on scientific synthesis (Working Group)
April 20-23, 2012	Jeannine, Cavender-Bares, Stephen Polasky	Developing curricula and model systems for sustainability science Sustainability Science Distributed Graduate Seminar Meetings
April 25-27, 2012	Matt Jones, Stephanie Hampton	DataONE: Observation Network for Earth (Working Group)
April 26, 2012	James Salzman, Duke University	Creating markets for ecosystem services (Ecolunch)
April 29-May 3, 2012	Anthony Richardson, Elvira Poloczanska	Towards understanding marine biological impacts of climate change (Working Group)
May 1-4, 2012	Matt Jones	Software Tools for Sensor Networks (LTER, DataONE, NCEAS) workshop
May 9-11, 2012	Erin Mordecai	Eco-labeling Marine Fisheries (Luce Fellows)
May 17, 2012	Jarrett Byrnes, NCEAS	Engagement leads to crowd-funded science (Ecolunch)
May 23-24, 2012	Amber Budden	Data Management Short Course
May 24, 2012	Jennifer Balch, NCEAS	Frontier fire in the Amazon: Local to global consequences of human-altered fire regimes in tropical forests (Ecolunch)



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May 31, 2012	David A. Siegel, Earth Research Institute, UC Santa Barbara	Global phytoplankton dynamics: the SeaWiFS legacy (Ecolunch)
June 11-15, 2012	Michael Alfaro, Luke Harmon	R-phylogenetics Training Workshop
June 13, 2012	Carol Blanchette	Channel Islands National Marine Sanctuary: Ocean Acidification working group
June 18-19, 2012	Matt Jones, Stephanie Hampton	DataONE: Observation Network for Earth (Working Group)
June 18-19, 2012	Avery Parsons-Field	PISCO training
June 18-22, 2012	Carol Blanchette, Michele Johnson Scott Simon	Math-Science Partnership Teacher Professional Development Workshop
June 20-23, 2012	John Sabo, Laura Bowling, Gerritt Schoups	Human impacts of water infrastructure on watershed ecosystems and the sustainability of irrigated agriculture in the coterminous US (Working Group)
June 25-29, 2012	Christopher Lortie, Jarrett Byrnes	The future of publishing in ecology, evolutionary biology, and environmental science (Working Group)
June 27-29, 2012	Gretchen Hofmann	UC MEXUS Workshop
June 29, 2012	Susan Swarbrick	Sedgwick Reserve Seed Bank working group



* 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. Lutz, 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.

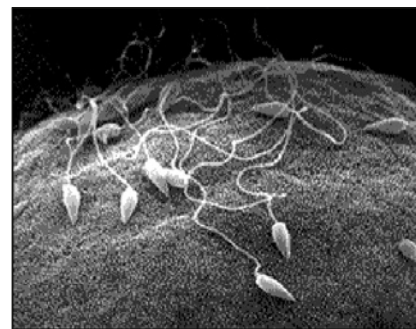
Researchers in the Marine Biotechnology Center are developing the tools and techniques of molecular and cellular biology to better understand the biodiversity of marine organisms, and how they affect, and are affected by, physical, chemical and geochemical oceanic processes. Marine biota, particularly 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, 2011 – June 30, 2012

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. Frank Davis is NCEAS' Director, Stephanie Hampton is the Deputy Director, Mark Schildhauer is the Director of Computing, and Matt Jones is Director of Informatics Research and Development.



The Science Advisory Board (SAB) of 18 eminent ecologists met October 3-4, 2011 to 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 2011-2012 fiscal year, NCEAS hosted 9 meetings, 27 working group projects, 5 training workshops, and 1 conference. In addition, the Center hosted 2 Sabbatical Fellows, 22 Postdoctoral Associates, 8 Center Associates, 9 graduate student interns, and one undergraduate intern.

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 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. A new Moore project "Identifying Thresholds, developing key indicators, and operationalizing their use in Marine Spatial Planning" will support several postdocs and working groups to pursue research at NCEAS.

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. An upcoming extension of this project will support a summer training initiative for early-career researchers in 2013.

In summer 2012, NCEAS completed work on a project supported by The Nature Conservancy, in which we assembled Working Groups 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, a distributed graduate seminar, and a graduate student.

NOAA is 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 funded 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.

The Ocean Conservancy supports a postdoc and working group to examine the impacts of marine debris on ocean ecosystems, and to evaluate a suite of potential solutions.

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 28 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, 2011 – June 30, 2012

WORKING GROUPS

Leader(s): Aronson, Myla; Katti, Madhusudan; Warren, Paige; Nilon, Charles
Title: *Comparative ecology of cities: What makes an urban biota “urban”?*
07JUL2011 - 16JUL2011 and 17JAN2012 - 21JAN2012

Leader(s): Boone, Christopher; Pickett, Steward; Grove, J. Morgan; Cadenasso, Mary
Title: *Ecology of environmental justice in metropolitan areas*
12DEC2011 - 16DEC2011

Leader(s): Bowman, David; Balch, Jennifer
Title: *Pyrogeography - fire's place in earth system science*
26SEP2011 - 01OCT2011

Leader(s): Callaway, John; Crooks, Steve; Megonigal, Pat; Doherty, Abe
Title: *Tidal wetland carbon sequestration and greenhouse gas emissions model*
13SEP2011 - 16SEP2011

Leader(s): Cardinale, Bradley; Hooper, Dave; Duffy, Emmett
Title: *Biodiversity and the functioning of ecosystems: Translating results from model experiments into functional reality*
10OCT2011 - 14OCT2011

Leader(s): Condon, Robert; Duarte, Carlos; Graham, William
Title: *Global expansion of jellyfish blooms: Magnitude, causes and consequences*
28OCT2011 - 02NOV2011 and 20FEB2012 - 24FEB2012

Leader(s): Cook, Benjamin; Wolkovich, Elizabeth
Title: *Forecasting phenology: Integrating ecology, climatology, and phylogeny to understand plant responses to climate change*
29NOV2011 - 02DEC2011

Leader(s): Crowder, Larry; Smith, Martin
Title: *Envisioning a sustainable global seafood market and restored marine ecosystems*
29AUG2011 - 31AUG2011

Leader(s): Edmunds, Peter; Gates, Ruth
Title: *Tropical coral reefs of the future: Modeling ecological outcomes from the analyses of current and historical trends*
06JUL2011 - 09JUL2011

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*
24OCT2011 - 28OCT2011

Leader(s): Fleishman, Erica
Title: *Ecological thresholds in the San Francisco Estuary*
26JUL2011 - 28JUL2011



Leader(s): Guerry, Anne; Chan, Kai
Title: *Cultural ecosystem services from marine and coastal systems: Counting the intangibles EBM*
04OCT2011 - 07OCT2011

Leader(s): Halpern, Benjamin
Title: *Identifying thresholds, developing key indicators, and operationalizing their use in CMSP*
22FEB2012 - 24FEB2012

Leader(s): Hampton, Stephanie
Title: *Marine Debris: Scale and impact of trash in ocean ecosystems*
25OCT2011 - 27OCT2011 and 05MAR2012 - 08MAR2012

Leader(s): Jones, Matthew; Hampton, Stephanie
Title: *DataONE: Observation Network for Earth*
19JUL2011 - 22JUL2011; 15NOV2011 - 17NOV2011; 17APR2012 - 19APR2012; 25APR2012 - 27APR2012; and 18JUN2012 - 19JUN2012

Leader(s): Liebhold, Andrew; McCullough, Deborah
Title: *Applying population ecology to strategies for eradicating invasive forest insects*
28AUG2011 - 31AUG2011

Leader(s): Lortie, Christopher; Byrnes, Jarrett
Title: *The future of publishing in ecology, evolutionary biology, and environmental science*
25JUN2012 - 29JUN2012

Leader(s): Maunder, Mark; Bolker, Benjamin; Gardner, Beth
Title: *Evaluating and improving open source software for nonlinear statistical modeling in ecology*
18JUL2011 - 22JUL2011

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)*
11JAN2012 - 13JAN2012

Leader(s): Parker, John; Hackett, Edward;
Title: *Advancing theory and research on scientific synthesis*
20APR2012 - 22APR2012

Leader(s): Peterson, Erin; Ver Hoef, Jay; Isaak, Daniel
Title: *Spatial statistical models for stream networks: Synthesis and new directions*
08AUG2011 - 12AUG2011

Leader(s): Richardson, Anthony; Poloczanska, Elvira
Title: *Towards understanding marine biological impacts of climate change*
02OCT2011 - 06OCT2011 and 29APR2012 - 03MAY2012

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*
08OCT2011 - 09OCT2011; 10DEC2011 - 13DEC2011; and 20JUN2012 - 23JUN2012

Leader(s): Shaw, M. Rebecca
Title: *Global climate change and adaptation of conservation priorities*
05APR2012 - 06APR2012



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?*
10OCT2011 - 14OCT2011 and 21FEB2012 - 24FEB2012

Leader(s): Strier, Karen; Alberts, Susan
Title: *Evolutionary ecology of primate life histories (funded jointly with NESCent)*
22SEP2011 - 24SEP2011

Leader(s): Waples, Robin; Hutchings, Jeffrey
Title: *Red flags and species endangerment: Meta-analytical development of criteria for assessing extinction risk*
16JAN2012 - 19JAN2012



MEETINGS HOSTED BY NCEAS

Leader(s): Balch, Jennifer
Title: *Synthesis Ecology: An NCEAS Postdoc Perspective*
21MAR2012 - 23MAR2012

Leader(s): Budden, Amber
Title: *Data Management Short Course*
23MAY2012 - 24MAY2012

Leader(s): Cavender-Bares, Jeannine; Polasky, Stephen
Title: *Developing curricula and model systems for sustainability science* Subtitle: *Sustainability Science Seminar Distributed Graduate Seminar Meetings*
14OCT2011 - 16OCT2011 and 20APR2012 - 23APR2012

Leader(s): Clemence, Michaela
Title: *Financing Fisheries Reform*
09JAN2012 - 10JAN2012

Leader(s): Freidenburg, Tess
Title: *Expert Judgment*
25JAN2012 - 26JAN2012

Leader(s): Gosnell, Stephen; Diaz, Stephanie; Roth, Keely
Title: *What makes reintroductions work? Developing a comprehensive framework to evaluate and guide reintroduction efforts (Luce Fellows)*
08FEB2012 - 10FEB2012

Leader(s): Hampton, Stephanie
Title: *Kids Do Ecology Poster Day*
14MAR2012 - 14MAR2012

Leader(s): Mordecai, Erin
Title: *Eco-labeling Marine Fisheries, Luce Fellows*
09MAY2012 - 11MAY2012

Leader(s): Richardson, Anthony; Poloczanska, Elvira
Title: *IPCC Marine Impacts of Climate Change Discussion*
07OCT2011 - 07OCT2011

CONFERENCE

Leader(s): Davis, Frank
Title: *NCEAS Panel Symposium (joint with NSF)*
21MAR2012 - 22MAR2012

TRAINING WORKSHOPS

Instructor(s): Alfaro, Michael and Luke Harmon
Title: *R-phylogenetics workshop*
01AUG2011 - 04AUG2011

Instructor(s): Amber Budden
Title: *DataONE: Observation Network for Earth (Hosted by NCEAS)*
30SEP2011 - 30SEP2011

Instructor(s): Ranganathan, Jai
Title: *Social Media for Scientists workshop*
08NOV2011 - 09NOV2011

Title: *R-phylogenetics workshop (Hosted by NCEAS)*
11JUN2012 - 15JUN2012

Title: *Software Tools for Sensor Networks (LTER, DataONE, NCEAS)*
01MAY2012 - 04MAY2012



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



2011 was a busy year for the REEF and MSI Ed/Outreach. After shifting program focus and rebranding to Oceans-To-Classrooms and our partnership with the Channel Island National Marine Sanctuary, our total outreach efforts have provided marine science and ocean awareness to over 14,000 (See Figure 1) people. While most were from San Luis Obispo, Santa Barbara and Ventura Counties, we had schools from Kern County (Bakersfield and Ridgcrest), as well as numerous schools from the greater Los Angeles Area. On a program-by-program level, we ran 366 programs; 102 were K-12, 104 were On Campus, 115 programs on Saturdays (Open Door) and over 45 from Off Campus and other colleges! Our Mobile Efforts were also strong.

This year we also provided Teacher Professional Development during the summer to 25 regional secondary school teachers in collaboration with our NSF Math Science Partnership project: Culturally Relevant Ecology, Learning Progressions and Environmental Literacy. 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 AS Coastal Fund, The Office of Early Academic Outreach and Preparation (EAOP), the Santa Barbara Unified School District and many others.

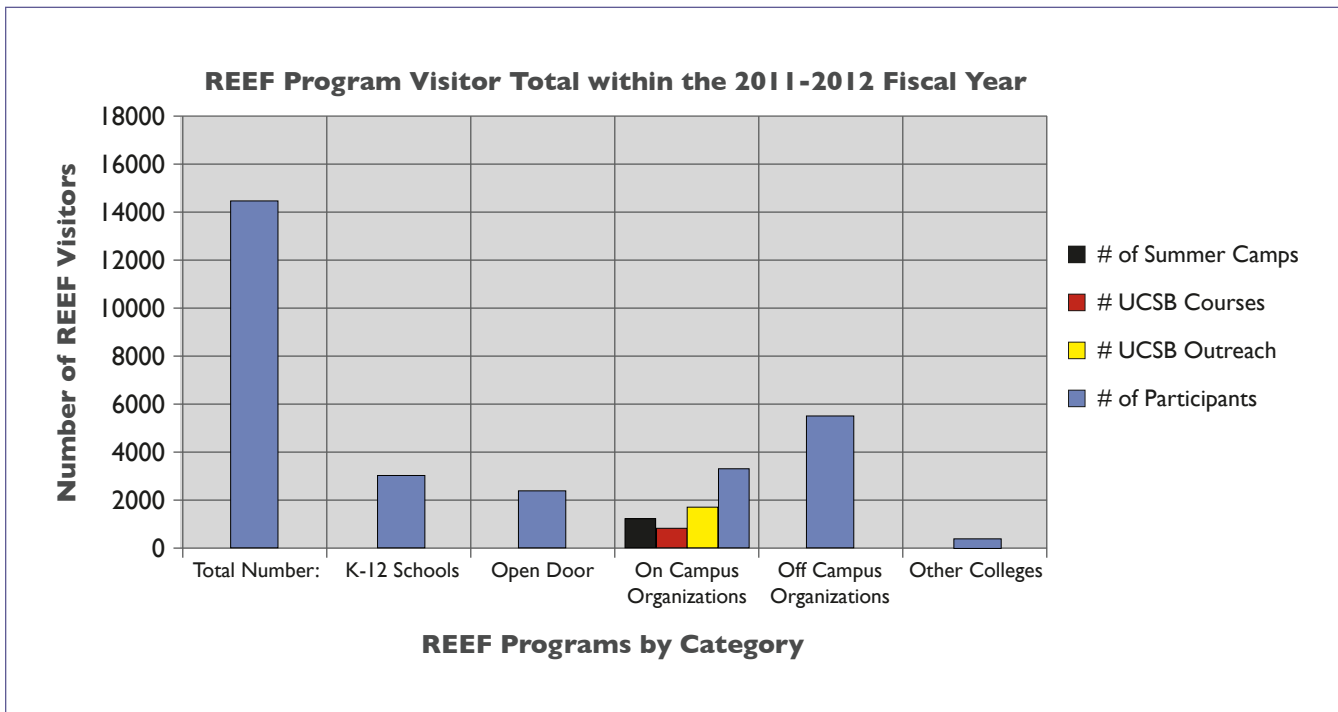


Figure 1. Graph of total number of participants served through MSI Ed/Outreach Efforts and the REEF.



Awards Administered

Awards Administered

CALIFORNIA COASTAL CONSERVANCY

C. Sandoval, S. Swarbrick 6/29/2011-06/30/2013 \$250,000
Access Improvements and Restoration at Coal Oil Point Reserve

California Coastal Conservancy Subtotal **\$250,000**

CODAR OCEAN SENSORS

L. Washburn 10/1/2011-9/30/2013 \$199,992
HF Radar Calibration with Automatic Identification System Ships of Opportunity

CODAR Ocean Sensors Subtotal **\$199,992**

COLLABORATIVE FISHERIES RESEARCH

C. Culver 12/1/2011-6/30/2013 \$25,000
Developing a Collaborative Volunteer Network for Expanding Biotoxin Monitoring
in California: Improving Seafood Safety

Collaborative Fisheries Research Subtotal **\$25,000**

COLORADO STATE UNIVERSITY

A. Whitmer 10/1/2008-9/30/2012 \$321,967
MSP: Culturally Relevant Ecology, Learning Progressions, and Environmental
Literacy

Colorado State University Subtotal **\$321,967**

CONSERVATION INTERNATIONAL

B. Halpern 7/1/2011-6/30/2012 \$233,294
Developing an Ocean Health Index

Conservation International Subtotal **\$233,294**

CONSORTIUM FOR OCEAN LEADERSHIP

D. Wilson 4/14/2011-6/30/2012 \$30,712
IODP Expedition 335 Shipboard Geophysicist \$14,446

Consortium for Ocean Leadership Subtotal **\$45,158**

DAVID AND LUCILE PACKARD FOUNDATION

S. Gaines, C. Costello 10/1/2011-3/31/2012 \$82,000
Structuring Risk from Fisheries Reform: A Scoping Project

David and Lucile Packard Foundation Subtotal **\$82,000**



ECOLOGICAL SOCIETY OF AMERICA (ESA)

M. Jones 11/14/2011-5/18/2012 \$149,920
Digital Resource Discovery and Dynamic Learning Communities for a Changing
Biology

Ecological Society of America (ESA) Subtotal \$149,920

GORDON AND BETTY MOORE FOUNDATION

S. Gaines, C. Costello 8/1/2010-12/31/2012 \$100,901
The World's Unassessed Fisheries: Status, Trends, and Food Security Implications

B. Halpern, K. Selkoe, C. Kappel 11/21/2011-7/31/2012 \$40,535
Identifying Thresholds, Developing Key Indicators, and Operationalizing their use in
CMSP

Gordon and Betty Moore Foundation Subtotal \$141,436

LAHONTAN REGIONAL WATER CONTROL BOARD

C. Nelson, R. Knapp 7/1/2012-6/30/2013 \$40,000
Assessment of Bacterial Water Quality at Targeted Streams in the Eastern Sierra

Lahontan Regional Water Control Board Subtotal \$40,000

MARISLA FOUNDATION

J. Caselle 3/30/2012-3/30/2014 \$175,000
Coral Reef Research in a Rare, Undisturbed Ecosystem: UCSB and Palmyra Atoll

Marisla Foundation Subtotal \$175,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

M. Fewings, L. Washburn 7/22/2010-7/21/2014 \$119,740
Satellite and Land-Based Remote Sensing of Atmospheric Wind Relaxations and the
Oceanic Response in the California Current Large Marine Ecosystem \$35,000

National Aeronautics and Space Administration Subtotal \$154,740

NATIONAL SCIENCE FOUNDATION

C. Briggs, R. Knapp 6/17/2007-8/31/2013 \$371,771
Collaborative Research: After the Crash: Factors Allowing Host Persistence Following
Outbreaks of a Highly Virulent Disease

C. Briggs, A. Jani 6/1/2012-5/31/2013 \$15,000
Dissertation Research: Associations between Symbiotic Bacterial Communities and
Infection by an Emerging Fungal Pathogen: Distinguishing Cause from Correlation

M. Brzezinski 6/1/2012-5/31/2013 \$248,737
Coupling of Silicon Isotope Distributions to Meridional Overturning Circulation of
the North Atlantic



C. D'Antonio	9/1/2010-8/31/2013	\$189,107
Long Term Impacts of Grass Invasions and Fire on Community Change and Plant Soil Feedbacks		\$7,500
F. Davis	2/1/2012-1/31/2013	\$98,853
Trends in Ecological Analysis and Synthesis		
A. De Tomaso	11/1/2009-10/31/2012	\$234,074
Evolution of Allorecognition in a Basal Chordate		
S. Hampton	9/15/2011-8/31/2015	\$347,437
Dimensions: Collaborative Research: Lake Baikal Responses to Global Change: The Role of Genetic, Functional and Taxonomic Diversity in the Plankton		
S. Hampton	7/1/2012-6/30/2014	\$128,008
Toads, Roads, and Nodes: Collaborative Course-Based Research on the Landscape Ecology of Amphibian Populations		
S. Hodges, S. Mazer, R. Finkelstein	10/1/2010-9/30/2013	\$1,401,334
Renovation of Research Greenhouses at UC Santa Barbara for Ecological, Evolutionary and Developmental Studies		40,750
G. Hofmann, E. Rivest	2/1/2012-1/31/2013	\$12,090
INTERNATIONAL: The energetic cost of an acidic, warm environment: changes in lipid consumption of <i>Pocillopora damicornis</i> larvae		
J. Krause, M. Brzezinski	1/1/2012-12/31/2014	\$224,088
Collaborative Research: Understanding the Role of Picocyanobacteria in the Marine Silicate Cycle		
J. Krause	4/1/2012-3/31/2015	\$453,487
Group-Specific Diatom Silica Production in a Coastal Upwelling System		
A. Kuris, K. Lafferty	8/1/2011-7/31/2016	\$2,149,447
Collaborative Research: Modeling Infectious Diseases: How Much Ecological Complexity Must We Address?		
J. Levine, E. Mordecai	4/1/2012-3/31/2013	\$12,654
DISSERTATION RESEARCH: Climate-mediated effects of pathogens on plant communities		
L. Lisiecki	9/1/2011-8/31/2015	\$303,207
CDI-Type II: Collaborative Research - 4 Dimensional Visualization of Past Ocean Circulation from Paleoceanographic Data		
S. Mazer	8/15/2007-9/30/2013	\$6,000
Collaborative Research: The Evolution of Life History, Physiological, and Floral Traits in <i>Clarkia</i> : do Genetic Correlations Affect Mating System Evolution?		
T. Oakley	4/1/2007-3/31/2013	\$119,999
CAREER: Exploring Congruence of Fossil and Molecular Estimates of Macroevolutionary Divergence Times in Ostracoda (Crustacea)		



T. Oakley	6/1/2012-5/31/2013	\$353,629
Collaborative Research: Eye Evolution in Sarsielloidea (Crustacea: Ostracoda): An Integrative Approach Based on Phylogenetics, Developmental Genetics, Behavior and Optics		
T. Oakley, M. Pankey	6/1/2012-12/31/2013	\$14,991
Dimensions: Collaborative Research: Can Evolutionary History Predict How Changes in Biodiversity Impact the Productivity of Ecosystems?		
H. M. Page, R. Miller	4/1/2010-3/31/2014	\$252,514
Sources of Particulate Organic Matter and Their use by Benthic Suspension-Feeders in the Coastal California Ecosystem		\$10,500
		\$10,500
S. Proulx, J. Hespanha	7/1/2012-6/30/2015	\$608,274
The Evolution of Dynamic Response Strategies: Optimal Control and Evolutionary Dynamics		
Q. Langdon, R. Ross	4/1/2011-3/31/2014	\$130,185
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,	12/1/2006-11/30/2011	\$820,000
D. Siegel, S. Holbrook		\$24,000
LTER: Land/Ocean Interactions and the Dynamics of Kelp Forest Communities		\$16,000
		\$79,086
R. Schmitt, S. Holbrook	9/1/2004-8/31/2012	\$16,000
LTER: Long-Term Dynamics of a Coral Reef Ecosystem		
R. Schmitt, S. Holbrook	9/1/2010-8/31/2013	\$24,000
LTER: MCR II - Long-Term Dynamics of a Coral Reef Ecosystem		\$10,000
		\$80,161
D. Valentine	6/1/2010-5/31/2015	\$99,090
Collaborative Research: Experimental Determination of Petroleum Biodegradation Patterns from Genomically-Informed Analytical Vista		
D. Valentine	4/15/2010-3/31/2015	\$8,575
Collaborative Research: Chemical Changes Accompanying Petroleum Weathering in the Coastal Ocean		
D. Valentine	6/1/2012-5/31/2015	\$362,907
Development and Application of a Radiotracer Rate Method for Ethane and Propane Consumption		\$25,725
L. Washburn	9/15/2010-8/31/2014	\$178,634
Collaborative Research: The Propagating Response of the Inner Shelf to Wind Relaxations in a Coastal Upwelling System		
National Science Foundation Subtotal		<hr/>
		\$9,508,264
NATIONAL INSTITUTES OF HEALTH		
S. Sokolow, A. Kuris	9/1/2010-12/31/2012	\$108,607
Emergence and Biological Control of Schistosomiasis		
T. Turner	8/1/2011-5/31/2013	\$284,329
Evolutionary Behavioral Genomics of Drosophila Courtship		
		\$287,852



J.H. Waite, J. Israelachvili Translating Mussel Adhesion	7/1/2012-6/30/2013	\$453,463
National Institutes of Health Subtotal		\$1,134,251
 OCEAN CONSERVANCY		
S. Hampton Marine Debris: Scale and Impact of Trash in Ocean Ecosystems	12/1/2011-1/1/2014	\$355,488
Ocean Conservancy Subtotal		\$355,488
 OREGON STATE UNIVERSITY		
S. Gaines, R. Warner, L. Washburn C. Blanchette, J. Caselle Understanding the California Current Large Marine Ecosystem under Climate Change: Delivering Sound Science for Policy	1/1/2012-12/31/2013	\$200,000
Oregon State University Subtotal		\$200,000
 PRINCE WILLIAM SOUND SCIENCE CENTER		
M. Jones, M. Schildhauer, S. Hampton Collaborative Data Management and Holistic Synthesis of Impacts and Recovery Status Associated with the Exxon Valdez Oil Spill	2/1/2012-1/31/2013	\$407,395
Prince William Sound Science Center Subtotal		\$407,395
 RESOURCES LEGACY FUND FOUNDATION		
W. McClintock, S. Gaines MarineMap Decision Support System, 2008-0046M	12/31/2010-12/31/2011	\$99,989
Resources Legacy Fund Foundation Subtotal		\$99,989
 SIMPSON & SIMPSON BUSINESS AND PERSONNEL SERVICES		
S. Schroeter, H. Page, D. Reed San Onofre Nuclear Generating Station Mitigation Project Monitoring Program	1/1/2012-12/31/2013	\$3,409,092
Simpson & Simpson Business and Personnel Services Subtotal		\$84,320
 SOUTHERN CALIFORNIA COASTAL WATER RESOURCE PROJECT		
D. Herbst Database Preparation and Merging for Transfer of SNARL Bioassessment to SWAMP – Physical and Benthic Macroinvertebrate Data from Stream Surveys	1/15/2011-3/31/2012	\$29,801
Southern California Coastal Water Research Project Subtotal		\$29,801
 SWISS FEDERAL INSTITUTE OF TECHNOLOGY (ETH)		
M. Brzezinski Annual Plant Coexistence at Sedgwick Reserve	11/1/2011-11/1/2013	\$71,718
Swiss Federal Institute of Technology (ETH) Subtotal		\$71,718



TRUCKEE RIVER WATERSHED COUNCIL

D. Herbst 8/1/2011-12/31/2012 \$88,200
Use of Biological Indicators in Evaluating Sediment Deposition Impairment on the Middle Truckee River, California

Truckee River Watershed Council Subtotal **\$88,200**

UC MEXUS

G. Hofmann 7/1/2011-12/31/2012 \$14,230
The Effect of Ocean Acidification on Marine Ecosystems of the Pacific Coast of Mexico and the US: A Binational Approach to Studying Ocean Change

UC MEXUS Subtotal **\$14,230**

UC SAN DIEGO

J. Caselle 9/1/2011-2/29/2012 \$7,000
Coral Reef Resilience Initiative: Proposal for a planning grant

S. Holbrook 1/1/2012-12/31/2012 \$30,000
Re-Deployable CI for Environmental Observing Systems

L. Washburn, M. Brzezinski 6/1/2010-5/31/2012 \$164,468
Southern California Regional Coastal Ocean Observing System: Surface Current Mapping, Harmful Algal Bloom, and Sub-Surface Water Sections

UC San Diego Subtotal **\$201,468**

UC SANTA CRUZ

J. Caselle 4/1/2012-3/31/2013 \$181,424
Regional Importance of Manmade Structures as Rockfish Nurseries

R. Ross, L. Quetin 8/21/2009-12/31/2012 \$62,535
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 **\$243,959**

UC SEA GRANT

C. Blanchette 9/1/2011-6/30/2014 \$259,856
Baseline Characterization and Monitoring of Rocky Intertidal Ecosystems for MPAs in the South Coast Region

J. Caselle 9/1/2011-6/30/2014 \$269,804
South Coast MPA Kelp and Shallow Rock Ecosystems: Baseline Data Collection and Long-Term Trends Using Historical Data

J. Caselle, C. Blanchette 9/1/2011-6/30/2014 \$265,000
Integrative Assessment of Baseline Ecological and Socioeconomic Conditions and Initial Changes within the South Coast MPA Region



C. Costello	2/1/2012-1/31/2013	\$39,063
Social and Economic Effects of ITQs on the West Coast Groundfish Fishery: Solving the Weak Stock/Bycatch Problem - Trainee		
C. Culver	4/1/2011-9/30/2012	\$33,055
Strategies for managing West Coast risks of Dreissenid mussel populations associated with long-distance water conveyance systems		
C. Culver	8/1/2011-1/31/2013	\$13,594
Sea Grant Extension Program Funds		
J. Dugan, H. Page	9/1/2011-6/30/2014	\$260,897
Sandy Beach Ecosystems: Baseline Characterization and Evaluation of Monitoring Metrics for MPAs along the South Coast of California		
G. Hofmann	12/1/2011-11/30/2012	\$32,000
Ocean Acidification Exacerbated by Coastal Upwelling: Monitoring of CO2 and O2 on the California Shelf and Effects on Red Sea Urchins, Abalone, and Oysters		

UC Sea Grant Subtotal \$1,173,269

UNIVERSITY OF ARIZONA

M. Schildhauer	3/1/2011-2/29/2012	\$26,453
iPlant/NCEAS Collaboration to Build the BIEN and Environment & Organisms Working Groups' Informatics Frameworks		

University of Arizona Subtotal \$26,453

UNIVERSITY OF MIAMI

C. Carlson	2/1/2009-1/31/2013	\$118,817
Collaborative Research: Global Ocean Repeat Hydrography, Carbon, and Tracer Measurements, 2009-2014		

University of Miami Subtotal \$118,817

UNIVERSITY OF MINNESOTA

S. Mazer	10/15/2011-9/30/2013	\$137,317
Project Baseline, a living plant genome reserve for the study of evolution		

University of Minnesota Subtotal \$137,317

UNIVERSITY OF MISSISSIPPI

U. Passow	9/1/2011-12/31/2012	\$348,497
Ecosystem Impacts of Oil and Gas Inputs to the Gulf (ECOGIG)		

University of Mississippi Subtotal \$348,497



UNIVERSITY OF NEBRASKA

D. Wilson 6/1/2009-3/1/2012 \$61,577
Modeling Antarctic Paleotopography

University of Nebraska Subtotal \$61,577

UNIVERSITY OF NEW MEXICO

K. Cavanaugh 6/1/2012-12/31/2012 \$36,922
Development and analysis of a database of Landsat Thematic Mapper imagery to support cross-site research

M.B. Jones, S. Hampton 8/1/2009-7/31/2012 \$467,198
DataNetONE: Observation Network for Earth

University of New Mexico Subtotal \$504,120

UNIVERSITY OF SOUTHERN CALIFORNIA, SOUTHERN CALIFORNIA EARTHQUAKE CENTER

C. Nicholson 2/1/2012-1/31/2014 \$40,000
Evaluating 3D Fault Geometry in Special Fault Study Areas and Improving the SCEC Community Fault Model (CFM)

University of Southern California Subtotal \$40,000

UNIVERSITY OF TROMSO

A. Kuris, K. Lafferty 6/1/2012-5/31/2015 \$36,000
The Role of Parasites in Food-Web Topology and Dynamics of Subarctic Lakes

University of Tromso Subtotal \$36,000

UNIVERSITY OF WASHINGTON

C. Costello, S. Gaines, R. Deacon 2/1/2012-1/31/2013 \$71,322
Social and Economic Effects of ITQs on the West Coast Groundfish Fishery: Solving the Weak Stock/Bycatch Problem

C. Costello 9/1/2011-8/31/2015 \$125,705
CNH: Diversification, Portfolio Effects, and the Sustainability of Fishing Communities

C. Costello, S. Gaines, R. Deacon 2/1/2012-1/31/2013 \$71,322
Social and Economic Effects of ITQs on the West Coast Groundfish Fishery: Solving the Weak Stock/Bycatch Problem

L. Kapsenberg, G. Hofmann 6/1/2011-8/31/2013 \$14,990
Assessment of Ocean Acidification in the Channel Islands National Park and its Impact on Local Marine Species

W. Rice 4/1/2008-5/31/2013 \$130,896
Working Group to Identify Critical New Directions in Marine and Coastal Ecosystem Science Research for NOAA Sea Grant



B. Walker, C. Culver, K. Selkoe	2/1/2012-1/31/2013	\$73,060
Towards Resilience and Sustainable Seafood Supply: Assessing Direct Marketing Approaches for the West Coast Fishing Communities		

University of Washington Subtotal	\$546,651
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US DEPARTMENT OF AGRICULTURE, FOREST SERVICE

E. Fleishman	3/9/2009-1/31/2012	\$3,000
Applying Population Ecology to Strategies for Eradicating Invasive Forest Insects		

US Department of Agriculture Forest Service Subtotal	\$3,000
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US DEPARTMENT OF AGRICULTURE, NATIONAL INSTITUTE OF FOOD AND AGRICULTURE

C. Culver, A. Brooks	3/9/2009-1/31/2012	\$99,447
Minimizing Impacts to Urban, Agricultural and Natural Water Systems: Evaluating Biocontrol Agents for Invasive Eurasian Mussels		

US Department of Agriculture NIFA Subtotal	\$99,447
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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
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US DEPARTMENT OF COMMERCE, NOAA

M. Myers	9/1/2012-8/31/2013	\$59,996
Satellite and Land-Based Remote Sensing of Atmospheric Wind Relaxations and the Oceanic Response in the California Current Large Marine Ecosystem		

US Department of Commerce, NOAA Subtotal	\$59,996
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USDI – BUREAU OF LAND MANAGEMENT

D. Herbst	9/10/2008-9/30/2012	\$12,000
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	\$12,000
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USDI BUREAU OF OCEAN ENERGY MANAGEMENT

M. Love 9/22/2011-9/30/2015 \$849,395
Renewable Energy in situ Power Cable Observation

M. Love 6/4/2012-5/31/2015 \$250,000
Analysis of Fish Population at Platforms off Summerland, California

M. Love 4/23/2012-9/30/2013 \$100,000
Biological Productivity of Fish Associated with Offshore Oil and Gas Structures on the Pacific OCS

D. Reed 9/22/2011-9/30/2013 \$249,927
DOI Partnership: Distinguishing Between Human and Natural Causes of Changes in Kelp Forests Using Long-term Data from DOI Monitoring Programs

USDI – Bureau of Ocean Energy Management Subtotal **\$1,449,322**

USDI FISH & WILDLIFE SERVICE

R. Jellison, D. Herbst 4/1/2010-12/31/2012 \$97,966
Assess Responses of Lahontan Cutthroat Trout Prey Items to Changing Hydrological Regimes and Salinity in Walker Lake, Nevada

USDI Fish & Wildlife Service Subtotal **\$235,118**

USDI GEOLOGICAL SURVEY

C. Nicholson 4/1/2012-3/31/2013 \$54,263
Mapping the 3D Geometry of Active Faults in Southern California

USDI - Geological Survey Subtotal **\$54,263**

USDI NATIONAL PARK SERVICE

S. Mazer 9/15/2011-6/29/2013 \$23,000
Instruct Teachers to use phenology as a means to monitor climate change - Parks as Classroom

S. Mazer 8/30/2010-5/30/2013 \$42,420
Facilitation of a Phenology Network to Assess Climate Change Response in California National Parks

USDI – National Park Service Subtotal **\$65,420**

WALTON FAMILY FOUNDATION, INC.

T. Dudley 11/1/2011-1/31/2013 \$217,655
Restoration Planning and Assessment for the Virgin River

Walton Family Foundation, Inc. Subtotal **\$217,655**



Research Summaries

(Contracts/Grants Administered)

July 2011 – June 2012



Lindsay Albertson 6/1/2011 to 5/31/2013 \$15 000
Bradley Cardinale
National Science Foundation DEB-1110571

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. In my dissertation research, I test whether different species of animals have additive or non-additive impacts on the physical process of sediment transport due to species interactions.

Sandy Andelman 9/1/2005 to 8/31/2011 \$496 549
National Science Foundation DEB-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.

Charlotte Beucher 6/1/2008 to 5/31/2012 \$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. We propose 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 the proposed work 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. The proposed work is to generate diatom-nitrogen and silicon isotope records in existing sediment cores from the Atlantic and Pacific sectors of the Southern Ocean across the last glacial cycle. Published age models and biogenic opal concentration and flux data exist for the selected cores as well as other ancillary data. The coupled isotope records will be built into the larger existing framework of climate related variation in regional productivity and species composition in the Southern Ocean. Ice core dust records will serve as a first approximation of glacial-interglacial changes in Fe availability.



Carol Blanchette 9/1/2011 to 6/30/2014 \$259 856
California Sea Grant College Program MPA 10-049

Baseline Characterization and Monitoring of Rocky Intertidal Ecosystems for MPAs in the South Coast Region

The goals of this project are to produce a quantitative baseline characterization of the structure of rocky intertidal ecosystems in all of the South Coast MPAs that have accessible rocky intertidal and to provide a quantitative comparison between the rocky intertidal ecosystems in these MPAs and associated reference areas in the South coast region using a combination of biodiversity surveys and targeted species sampling. Researchers will analytically explore the baseline characterizations for potential indicators of the state of the rocky intertidal ecosystems using newly collected data along with historical and contextual data from the region, evaluate the suitability of proposed draft metrics and other metrics for long term monitoring and assess initial changes in size and abundance of targeted species across newly created MPAs, existing MPAs and reference areas.

Cheryl Briggs 6/1/2012 to 5/31/2013 \$15 000
Andrea Jani
National Science Foundation DEB-1210682

Dissertation Research: Associations between Symbiotic Bacterial Communities and Infection by an Emerging Fungal Pathogen: Distinguishing Cause from Correlation

Symbiotic microbial communities are increasingly recognized as important players in the development and health of multicellular organisms. Due to their relevance to human health, much research has focused on the microbiota of humans and classical animal models (e.g. mouse), and this body of work has contributed a great deal to describing community composition and understanding molecular mechanisms of microbial interactions. Less is known about the diversity and function of microbial communities symbiotic to wildlife, but the few systems recently studied (e.g. termites, corals) have fundamentally changed our understanding of the evolution and phenotypic variation of those organisms. Working in the context of a wildlife (amphibian) disease system, the proposed study combines culture-independent methods for characterizing bacterial communities with an experimental approach that will (1) examine the contribution of host background and the aquatic environment in shaping the composition of bacterial communities inhabiting amphibian skin, and (2) clarify causal links in the interactions between skin-associated microbial communities and the emerging chytrid pathogen, *Batrachochytrium dendrobatidis*. Preliminary data show that variation in the composition of bacterial communities found on the skin of frogs correlates with

the severity of infection with *B. dendrobatidis*. The proposed study builds on these findings by experimentally distinguishing between cause and correlation to determine whether variation in bacterial community composition leads to differences in disease resistance, or, conversely, invasion by the pathogen perturbs the symbiotic microbial community, leading to the observed variation in microbial community composition. In addition, the study will begin to address the basic question of what factors control symbiotic bacterial community composition in the absence of the pathogen. The resulting data will advance fundamental understanding of the factors shaping symbiotic microbial communities and the contribution of those communities to host health and disease.

Cheryl Briggs
Roland Knapp

9/15/2007 to 8/31/2013

\$2 358 643

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 host populations. Factors such as host susceptibility and pathogen virulence can markedly alter disease outcomes, and can be the difference between host extinction or persistence. Unfortunately, such factors are often poorly understood, hampering the ability to predict the effect of emergent diseases. Chytridiomycosis is an emerging infectious disease of amphibians caused by the fungal pathogen, *Batrachochytrium dendrobatidis* (referred to hereafter as "Bd"). Since its discovery in 1998, chytridiomycosis has been implicated as a major cause of amphibian population declines and extinctions around the world. Many amphibians are highly susceptible to chytridiomycosis, and infection frequently results in host extinction. At the current rapid rate of global Bd spread, many amphibian populations will become infected within the next decade, and this will likely result in substantial numbers of species extinctions in this already imperiled group of organisms. The western United States is a hotspot of amphibian declines, and many of these declines are associated with chytridiomycosis. In California's Sierra Nevada mountains, Bd is rapidly spreading through previously uninfected amphibian populations. The mountain yellow-legged frog (*Rana muscosa*) is highly susceptible to chytridiomycosis, and has experienced hundreds of recent population extinctions due to Bd infection. Interestingly, although the majority of host populations are driven extinct following the arrival of Bd, a small fraction of populations persist with the pathogen, and disease dynamics in these persistent populations are fundamentally different from those during population crashes. The goal of the proposed research is to understand the mechanisms leading to these contrasting disease outcomes. In the proposed research, a model of the *R. muscosa*/Bd interaction that includes within-host Bd dynamics and host stage-structure will be parameterized and tested. In addition, four non-mutually exclusive hypotheses that could account for different disease outcomes will be tested using field and laboratory experiments. It is hypothesized that population extinction versus persistence is the result of between-population differences in (1) density-dependent disease dynamics, (2) Bd virulence, (3) frog susceptibility, or (4) environmental conditions. A functional genomics approach that utilizes complete Bd virulence and/or frog susceptibility. The proposed research will contribute significantly to the ability to predict outcomes of future diseases on wildlife and human populations.

Mark Brzezinski

11/1/2011 to 11/1/2013

\$71 718

Swiss Federal Inst Of Technology-DbA Eth (Switzerland) SB120062

Annual Plant Coexistence at Sedgwick Reserve

* PI will make measurements on a field experiment with annual plants at Sedgwick reserve * PI will analyze the results from the experiment * PI will write up results for publication * By the end of the period of this contract (November 2013), the analyses will be complete, and a manuscript draft will be produced. In addition, all fencing, plot markers and other experimental equipment will be removed at no cost to the reserve. * Application will be appended quarterly through the NRS on-line reservation system to maintain "ACTIVE" status of the project



Mark Brzezinski 9/15/2011 to 8/31/2013 \$248 737
National Science Foundation OCE-1129227

Coupling of Silicon Isotope Distributions to Meridional Overturning Circulation of the North Atlantic

We propose to collaborate with GEOTRACES which is scheduled to sample a section across the North Atlantic in October 2011. Among the water masses sampled will be surface and mode waters, the southward flowing North Atlantic Deep Water, and its northward flowing counterparts: Antarctic Intermediate Water and Antarctic Bottom Water. In addition, overflow waters from high latitudes may have a significant impact, as preliminary data indicate that waters from the Arctic basin have a uniquely heavy Si isotope signature.



Bradley Cardinale 3/1/2009 to 2/28/2013 \$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

We propose to 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. We suggest that these two perspectives can be unified with a multivariate model that distinguishes how three casual 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. We 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. We 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 both productivity and diversity. We further propose to extend this model to incorporate interactions between producers and consumers, which is important because the majority of diversity-production studies have focused only on simplified systems composed of just one trophic level (usually plants).

Craig Carlson 8/15/2008 to 7/31/2013 \$803 765
National Science Foundation OCE-0801991

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

The focus of this proposal is the role of bacterioplankton microbial community stratification in the ocean carbon cycle. Complex biological, chemical and physical processes control the efficiency of carbon transfer from the euphotic zone ocean to the deep sea, where sequestration is a possibility. Most organic carbon exported from the euphotic zone never leaves the surface 500m, with approximately ninety percent of the exported organic matter being remineralized in the mesopelagic zone (140-1000 m). Microbial communities are vertically stratified in the oceans, particularly in the surface layer (0-300m), which spans the region of deep mixing events and transition from the euphotic zone to the upper mesopelagic - the region of highest carbon remineralization activity. The premise of this proposal is that stratified bacterioplankton clades engage in specialized biogeochemical activities that can be identified by integrated oceanographic and microbiological approaches.

Craig Carlson 2/1/2009 to 12/31/2014 \$588 008
University of Miami P148822

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, 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

4/1/2009 to 3/31/2013

\$689 579

Mark Brzezinski

National Science Foundation OCE-0850857

Mechanisms Controlling the Production and Fate of DOM During Diatom Blooms

The residence time of DOM in surface waters of marine systems is the main factor determining its contribution to the efficiency and magnitude of the biological carbon pump. There is growing evidence that the export of DOM from the surface ocean represents a highly efficient pathway for the sequestration of organic carbon in the deep sea in some ocean regions. Current estimates are that 20% of the carbon transported to depth by the biological pump globally occurs via the export of DOC. Effective export of DOM requires that the DOM produced by phytoplankton persist in surface waters until vertical exchange processes transport the material to depth. The mechanisms controlling the time scale for the accumulation and persistence of DOM in surface waters are dominated by biological processes that both influence the amount and chemical character of the DOM produced and its consumption and decomposition by microbes. This proposal addresses these two coupled biological processes to examine controls on the accumulation of DOM during temperate diatom blooms. Diatom blooms are known to produce prodigious quantities of DOM upon entering nutrient stress with a chemical composition that varies with the type of nutrient limitation (Si or N). This variable composition likely influences the nutritional value of DOM to microbes driving species successions towards functional groups of heterotrophic prokaryotes that are best able to metabolize particular forms of DOM. To date each side of this coupled system of production / consumption has been examined independently. A few studies have examined how limitation by different limiting nutrients affects the chemical character of the DOM produced by phytoplankton, while others have focused on the fate of DOM without detailed understanding of the mechanisms influencing its initial chemical composition. We propose to examine both sides of this coupled process simultaneously to see how different forms of nutrient limitation drive the chemical character of DOM and the subsequent microbial response which together determine the fate of DOM produced during diatom blooms.

Craig Carlson

11/1/2009 to 10/31/2013

\$339 737

National Science Foundation OCE-0927411

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 (*Prochlorococcus* spp. 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 μ M). On degraded reefs, we have observed DOC measurements as low as 30 - 40 μ M, 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
Gordon and Betty Moore Foundation 2553

5/1/2010 to 4/30/2013

\$392 501

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

The Microbial Oceanography course at BIOS focuses on oligotrophic (low nutrient) marine systems, which represent approximately 70% of the world's oceans. The course offers students direct access to the historical field sites of Hydrostation S (1954) and the Bermuda Atlantic Time-series Study site (1988) and the extensive time-series data collected at these sites. These data provide students with a rich oceanographic context and are the basis for guided lectures, discussions, and student research. A cornerstone of this microbial oceanography course is the integration of genomic and metaproteomic approaches with the core disciplines of oceanography, and linking microbial activities to biogeochemical processes in the oceans is a central theme woven throughout the curriculum. To achieve these objectives, students carry out a novel oceanographic research project that includes a comprehensive microbial ecology study within the context of biogeochemical parameters measured routinely by established, long-term studies in the Sargasso Sea. Course components include sample collection during an overnight cruise on the Sargasso aboard the R.V. Atlantic Explorer, microscopic quantification, laboratory methods in metagenomics and metaproteomics, and bioinformatic analyses of genes and proteins identified in the Sargasso Sea.



Jennifer Caselle

8/23/2009 to 8/31/2011

\$14 597

COM National Oceanic and Atmospheric Administration AB133C-09-SE-3780

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

Near-island instrumentation provides data necessary to understand and track water mass movements affecting recruitment of key species to coastal habitats. Inter-annual and shorter-term upwelling and relaxation events drive recruitment and movement of certain fish species and affect other resources, including keystone species. How specific events function to affect living resources depends on the timing of reproduction and behavior of the various life stages of the animals and plants. Some rockfish species with larval phases offshore in the upper water column for example, may only recruit to coastal habitats when upwelling drivers allow relaxation, and offshore surface waters approach shore. Rockfish with deeper larvae would be held offshore during such times, and move towards shore only when upwelling resumes. Understanding these dynamics provides a measure of predictive capacity for managers, could help explain anomalies, enable managers to make informed decisions as to placement and size selection of reserves designed to protect or restore particular resources, and explain changes in populations, trophic structure, forcing functions and processes. The PI will conduct multiple research cruises to obtain data from oceanographic instruments from six customized SEA stations that were established around the Channel Islands in 2004 for the purpose of providing information on water temperature and movement within sanctuaries.

Jennifer Caselle

4/1/2012 to 3/31/2013

\$181 424

UC Santa Cruz UCSCMCA 12-005

Regional Importance of Manmade Structures as Rockfish Nurseries

- 1) ASSIST IN ESTABLISHING SAMPLING DESIGN FOR FIELD SURVEYS Using the geodatabase developed by USGS and the recommendations obtained from the workshop on best approaches and statistical methods for geospatial analyses, the subcontractor (UCSB) will assist USGS in developing a field sampling design to determine, at the appropriate regional scale, the relative importance of nursery habitat created by offshore energy structures for commercially important rockfishes.
- 2) CONDUCT FIELD SURVEYS The subcontractor (UCSB) shall oversee field surveys conducted according to the sampling design established in Task 1. The field survey data shall be incorporated into the geodatabase. The field surveys shall collect biological information, and in particular juvenile fish density, concurrent with geological data. At each sampling unit "visual vouchers" shall be collected by recording underwater site characteristics with photographic images. These images can be

linked to the geodatabase and referenced at a later date to determine if geological features influence patterns or rates of long term change in biological communities.

Jennifer Caselle 1/16/2009 to 1/15/2012 \$22 900
Santa Barbara County Air Pollution Control District AP080908

Repower the R/V Cormorant

State funds provided to renovate the Research Vessel Cormorant.

Jennifer Caselle 3/30/2012 to 3/30/2015 \$175 000
Marisla Foundation 1-12-065/1

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

The Marine Science Institute at UCSB requests continued funding to remain a member of the PalmyraAtoll Research consortium for 2012-2014 in order to continue and expand our research programsfocusing on coral reef ecosystem resilience and conservation. The major outcomes will be a betterunderstanding of how healthy coral reef ecosystems function in the face of climate change andknowledge to inform conservation practices globally.

Jennifer Caselle 1/8/2010 to 12/31/2013 \$1 153 706
Steven Gaines
Gordon and Betty Moore Foundation 2420

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

In an effort to prevent and reverse declining trends in coastal marine ecosystems, California is moving rapidly toward a new era of marine resource management that emphasizes consideration of the role of humans in and their influence on entire marine ecosystems, called Ecosystem-based Management (EBM). Marine Protected Areas (MPAs), by protecting and conserving all components of marine ecosystems in specific locations are one essential spatial tool for EBM. California's Marine Life Protection Act (MLPA) was passed in 1999 with the purpose of establishing a statewide network of MPAs. MLPA is using a regional approach, designating MPAs over time in 5 regions of the state's 1,100-mile coastline. 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. Here we propose to continue with those efforts in order to achieve the single Outcome of "A well-designed and effectively monitored network of Marine Protected Area's in California."

Jennifer Caselle 7/15/2010 to 6/30/2013 \$122 482
National Science Foundation OCE-1041489

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
Carol Blanchette

9/1/2011 to 6/30/2014

\$265 000

UC Sea Grant College Program R/MPA-23

Integrative Assessment of baseline ecological and socioeconomic conditions and initial changes within the South Coast MPA region

The SCSR of the Marine Life Protection Act is unique from other regions in several aspects. First, southern California marine ecosystems are among the best studied anywhere in the state (and, arguably, the West Coast). Second, the South coast study region is the third region in the MLPA process (after the central and north-central regions) and also follows the successful implementation of a network of MPAs in the northern Channel Islands in 2003 and now part of the MLPA network. More than other MLPA regions, a large body of both ecosystem monitoring data and a wealth of contextual data exist (e.g. oceanographic and water quality data, remotely sensed data, habitat maps). However, many of these datasets have yet to be analyzed outside of the context for which they were originally created and even monitoring data from similar habitats have yet to be combined into synthetic measures of ecosystem health. Here we have the opportunity to create the partnerships and data products that will be required in order to step up from single location or single habitat analyses and for the first time, move towards cross ecosystem syntheses to support measures of ecosystem health and MPA performance. We have developed a collaborative group that has committed to the goals of synthesis among our various individual projects. The key innovation of our proposed approach is the collaborative nature of the program, which should carry forward in the design, databases and analyses for a more comprehensive and integrated long-term monitoring program. The collaborative and integrated characterizations of separate ecosystem features will also facilitate outreach efforts that transcend individual features and, by including collaborations with the fishing (consumptive) and recreational (consumptive and non-consumptive) sectors, strengthen collaborations of future monitoring programs.



Jennifer Caselle

9/1/2011 to 6/30/2014

\$269 804

UC Sea Grant College Program R/MPA-27B

South Coast MPA Kelp and Shallow Rock Ecosystems: Baseline Data Collection and Long-term Trends Using Historical Data

Our approach to creating a baseline characterization of kelp and shallow (0-30m depth) ecosystems in the MLPA South Coast Study Region (SCSR) involves (1) new surveys of targeted elements of kelp forest and rocky reef ecosystems using SCUBA and (2) analysis of existing historical datasets on rocky reef communities. Sampling will address all kelp and shallow rock ecosystem Vital Signs (Ecosystem Feature Checkup) and Key Attributes (Ecosystem Feature Assessment) as designated by the Monitoring Enterprise (ME) in the Monitoring Plan for the South Coast MPA Baseline Program with the exception sea otters and predatory birds. Our proposed sampling design and protocols are a geographic extension of comparable design and protocols that are being used to generate baseline characterizations of kelp and shallow rock ecosystems in the Central Coast Study Region (CCSR) and the North Central Coast Study Region (NCCSR). Further, the study design and protocols were also employed in the network of MPAs in the Northern Channel Islands (NCI), which were implemented in 2003 and now form part of the SCSR. Results from these methods were incorporated into the successful five-year data review of the NCI MPAs (Airame and Ugoretz 2008; Hamilton et al. 2010). We propose to maintain similarities in the design and protocols to maintain standardization across the Study Regions until necessary changes in design or sampling protocols are identified.

Jennifer Caselle

9/1/2011 to 2/29/2012

\$7 000

UC San Diego 3067-01

Coral Reef Resilience Initiative: Proposal for a Planning Grant

We will provide GBMF with a detailed project proposal to address the following core question: How can we manage coral reefs to retain or regain resilience? A detailed proposal for a project to understand the science of coral reef resilience in the face of human impacts and apply these findings

in selected reef ecosystems will be delivered to GBMF before December 31st 2011. As part of the pre-planning grant funds have been provided for salary time for both PIs and student support at several of the institutions (sub-grants).

Kyle Cavanaugh 6/1/2012 to 12/31/2012 \$36 922
Daniel Reed
University of New Mexico PO113451

Development and Analysis of a Database of Landsat Thematic Mapper Imagery to Support Cross-Site Research

We propose to generate a cross-site database of existing Landsat TM satellite imagery covering each of the 26 current sites in the LTER network from 1985-present. We will then collaborate with researchers from a subset of sites to create higher-level cross-site data products including atmospherically corrected surface reflectance data and time-series maps of detailed land cover/land use change.

Scott Cooper 8/5/2010 to 7/1/2011 \$18 000
Peter Alagona
COM Marine Fisheries Service JF133F10SE2662

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. More specifically, this proposal addresses studies of the following issues. 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 in the Santa Ynez River watershed. The Consultants and their associates agree to search appropriate sources, including but not limited to agency and university files, scientific journals, news articles, historical society files, libraries, archeological reports, media releases, and personal accounts and communications, to obtain information on the pre-dam presence and distribution of steelhead and rainbow trout in the Santa Ynez River system. Additionally, NMFS will provide the Consultants with relevant information that is maintained on file at NMFS' Southwest Regional Office. The Consultants will create and maintain electronic copies (pdf) of all of the evidence obtained, organized by informational source (e.g., scientific journals, agency reports, anecdotal accounts, photographs, etc.). Task 2 – Review information gathered in Task 1 and appraise pre-dam steelhead and rainbow trout distributions in the Santa Ynez River watershed. The Consultants will appraise pre-dam steelhead and rainbow trout distributions in the Santa Ynez River and its tributaries based on a synthesis of the evidence gathered in Task 1, including information related to habitat accessibility (documented natural barriers) for steelhead and rainbow trout to different parts of this system. Maps of the Santa River system showing documented instances of pre-dam steelhead or rainbow trout presence, natural barriers, and current dams will be developed and included in the draft and final reports. 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. The Consultants will serve as the senior authors and, in collaboration with other author(s) selected by the Consultants, prepare a written draft report that includes: An introductory statement; A detailed description of the sources and strategies used to gather information (Task 1) and the methods used to delineate the historical distributions of steelhead and rainbow trout in the Santa Ynez system, including the upstream extent of their ranges (Task 2); A written narrative and maps describing the pre-dam distribution of steelhead and rainbow trout in the Santa Ynez River, based on a synthesis of the historical evidence; Conclusions; and A list of the sources cited in the report. The Consultants will submit five camera-ready copies of the draft



report to NMFS' Southwest Regional Office (attention Anthony Spina, National Marine Fisheries Service, 501 West Ocean Blvd., Suite 4200, Long Beach, California 90802), as well as electronic copies of the categorized reference materials. Task 4 – Revise the draft report to produce a final report. The Consultants will work with NMFS' personnel to make mutually agreeable revisions to the draft report to produce a final written report. The Consultants will submit five camera-ready copies of the final report to NMFS' Southwest Regional Office (attention Anthony Spina, National Marine Fisheries Service, 501 West Ocean Blvd., Suite 4200, Long Beach, California 90802).

Christopher Costello
Steven Gaines
Robert Deacon

2/1/2012 to 1/31/2013

\$71 322

Washington Sea Grant R/SOC-01-F-1/2

Social and Economic Effects of ITQs on the West Coast Groundfish Fishery: Solving the Weak Stock/Bycatch Problem

The objectives of the proposed work dovetail with several key WSG priorities: (1) Maintain the vitality of coastal communities, particularly balancing economic growth with sustainable use of fishery resources: Our modeling analysis will examine social, economic and ecological outcomes of different management approaches to identify options that meet this important triple bottom line for fishing communities along the West Coast. (2) Identify social and economic impacts and benefits of fishing: Our empirical analyses will identify the short-term social and economic impacts and benefits of a transition to IFQ management in the West Coast Groundfish fishery, while our modeling work will suggest likely longer term impacts and benefits of this and other key management changes (consolidation caps, spatial closures, etc.). (3) Understand ecosystem effects of fishing: Bycatch of weak stocks compromises the health of marine ecosystems and our modeling results will demonstrate the range of circumstances under which risk pools or other shifts in fleet behavior can overcome this challenge. Both our empirical and modeling work will inform effective internal rules for risk pools. This will result in a novel contribution to the scientific literature and a practical and cost-effective approach to protecting ecosystem integrity. (4) Evaluate alternative management approaches for fisheries: Our simulation modeling of "policy experiments" will inform near-term management changes for the West Coast Groundfish fishery, while also providing a framework for other US fisheries that may similarly benefit from reform. We will communicate the results of this project through numerous scientific publications and presentations to fishery managers, fishermen, and regulators. This project will also provide training in cutting-edge science at the interface of bioeconomic modeling, empirical analysis and fishery management to two graduate students.

Christopher Costello
Steven Gaines
Robert Deacon

2/1/2012 to 1/31/2013

\$39 063

UC Sea Grant College Program R/SOC-01-TR-1/2

Social and Economic Effects of ITQs on the West Coast Groundfish Fishery: Solving the Weak Stock/Bycatch Problem - Trainee

The objectives of the proposed work dovetail with several key WSG priorities: (1) Maintain the vitality of coastal communities, particularly balancing economic growth with sustainable use of fishery resources: Our modeling analysis will examine social, economic and ecological outcomes of different management approaches to identify options that meet this important triple bottom line for fishing communities along the West Coast. (2) Identify social and economic impacts and benefits of fishing: Our empirical analyses will identify the short-term social and economic impacts and benefits of a transition to IFQ management in the West Coast Groundfish fishery, while our modeling work will suggest likely longer term impacts and benefits of this and other key management changes (consolidation caps, spatial closures, etc.). (3) Understand ecosystem effects of fishing: Bycatch of weak stocks compromises the health of marine ecosystems and our modeling results will demonstrate the range of circumstances under which risk pools or other shifts in fleet behavior can overcome this challenge. Both our empirical and modeling work will inform effective internal rules for risk pools. This will result in a novel contribution to the scientific literature and a practical



and cost-effective approach to protecting ecosystem integrity. (4) Evaluate alternative management approaches for fisheries: Our simulation modeling of “policy experiments” will inform near-term management changes for the West Coast Groundfish fishery, while also providing a framework for other US fisheries that may similarly benefit from reform. We will communicate the results of this project through numerous scientific publications and presentations to fishery managers, fishermen, and regulators. This project will also provide training in cutting-edge science at the interface of bioeconomic modeling, empirical analysis and fishery management to two graduate students.

Christopher Costello
University of Washington 735344

9/1/2011 to 8/31/2015

\$125 705



CNH: Diversification, Portfolio Effects, and the Sustainability of Fishing Communities

This proposal concerns the bioeconomics of fishery management under uncertainty, a topic that Professor Costello has focused on for his past 11 years at UCSB. Costello’s primary role will be to develop and implement analytical and statistical models to address the research proposal’s key themes. Specifically, Costello will play a leading role in developing and implementing models of salmon fishery management strategies that explicitly cope with environmental variability, tradeoffs between ecosystem sustainability and economic performance of salmon fisheries management, and how capital investment in salmon fisheries is influenced by environmental stochasticity. What follows is a brief description of Costello’s role in each of these themes: Theme 1: Salmon Management with Environmental Variability. The key research question here concerns how management decisions can influence the ecological and economic consequences of a variable environment. Alaska’s salmon fisheries are notoriously variable, largely due to highly stochastic interannual and decadal-scale fluctuations in the environment that affect reproduction, recruitment and growth. Ignoring this variability in the determination of management strategies can have severe consequences to both fishermen’s livelihoods and to fish stocks themselves. Costello’s role will be to develop and implement dynamic stochastic optimization models that predict and inform optimal management of this bioeconomic system. These models will be parameterized with data from other aspects of the project and will be implemented in Matlab. Theme 2: Tradeoffs between sustainability and economic performance. Any given management strategy will deliver both an ecosystem outcome and an economic performance. This theme concerns the tradeoff between those two. It is sometimes argued that these two always go hand-in-hand: higher economic performance is always coupled to positive ecological outcomes. While it is widely acknowledged that a collapsed fishery cannot produce optimal economic outcomes, it is not so obvious that a fishery managed for optimal economic performance results in strong ecological condition. Costello will develop stochastic models of decision-making under uncertainty to address this theme. He will also develop a tradeoff analysis which provides a graphical depiction of the tradeoff between ecological and economic objectives for different strategies for managing salmon fisheries in Alaska. These are analytical and computation approaches, and Costello will develop both theoretical insights and practical solutions for this particular study region. Theme 3: Capital Investment in Stochastic Fisheries. Salmon fisheries are notoriously capital intensive. Processing salmon requires large plants that depreciate rapidly. These plants are expensive to build and maintain, and must be sufficiently large to handle the large volumes of fish that are landed in short periods of time. This theme addresses the question of how much harvest capacity is efficient, and how much harvest capacity would we expect from the private sector. Risk and variability in harvest size over time both influence these questions. Costello’s role will be to model capacity investment in Alaska’s salmon fisheries and to predict the capacity investments we would expect from the private sector under different management approaches. The results of these models will inform management of Alaska’s salmon fisheries. This work is both analytical and computer-based. Costello will work by himself to accomplish these tasks. Pending other funding sources, there may be funds to hire a PhD student or post-doc to work with Costello on these items. Costello will also be a central player in the larger research team. He will travel to Alaska annually, and will collaborate with other personnel to achieve the broader goals of this ambitious research project.

Carolynn Culver 8/1/2011 to 1/31/2013 \$13 594
UC Sea Grant College Program A/EA-14CC-F-1

Sea Grant Extension Program Funds

Culver: Sea Grant Extension Program Funds This award is in support of Dr. Culver's Sea Grant Extension program. This program is focused on discovering and transferring science-based knowledge to help California and its residents better balance the competing needs of using and conserving coastal and marine resources for future generations. Funds will be used to support activities and operating expenses for her research, education and extension program. Some funds are allocated toward support staff that will assist Culver with program activities, including undergraduate assistance with assembling and processing of samples and office support. General operating expenses are also included for such things as telephone, duplication, IT support.



Carolynn Culver 12/1/2011 to 2/28/2013 \$25 000
Collaborative Fisheries Program 12-54

Developing a Collaborative Volunteer Network for Expanding Biotxin Monitoring in California: Improving Seafood Safety

The goal of this project is to improve seafood safety of commercial and recreational fisheries in California by improving monitoring of biotoxins. Objectives are fourfold: 1) develop a coordinated network of collaborators to expand biotoxin sampling in southern California; 2) develop effective, efficient, user-friendly sampling, communication and reporting protocols, 3) train collaborators and pilot test network program, and 4) identify needs for HAB outreach materials for the fishing community. The overarching research question is: Can the existing CDPH monitoring program be expanded and enhanced through the development of a collaborative network of volunteers from fishing and coastal communities?

Carolynn Culver 4/1/2011 to 9/30/2012 \$33 055
UC Sea Grant College Program A/EA-11C-F

Strategies for Managing West Coast Risks of Dreissenid Mussel Populations Associated with Long-distance Water Conveyance Systems

This project addresses the need for additional efforts to eradicate and control newly detected and existing mussel populations. Our objectives include: educating managers and staff of lakes/reservoirs/rivers and other stakeholders about ways to reduce existing populations of mussels engaging and preparing lake managers for action through improved knowledge of costs, equipment and training needed for various management strategies evaluating the effectiveness of research and outreach programs through an iterative approach. We will achieve these objectives by organizing a workshop that builds upon the 2008 control workshop. Prior to the workshop, we will develop information sheets for various control strategies that describe the method and outline logistical requirements and resources. These sheets will guide exploration of other resources and needs during workshop break-out sessions. Specific tasks for Year 1 are: 1) meet with agency partners to identify workshop date, develop agenda and discuss information sheets, and 2) draft information sheets. The workshop will not be held until Year 2 of the project. The second project phase has been approved for funding, but transfer of funds is dependent on the budget. In addition to the workshop, we will gather mussel recruitment information and conduct recruitment-related field and laboratory work.

Carolynn Culver 9/1/2011 to 8/31/2013 \$99 447
Andrew Brooks
USDA 2011-34103-30856

Minimizing Impacts to Urban, Agricultural and Natural Water Systems: Evaluating Biocontrol Agents for Invasive Eurasian Mussels

This research project addresses integrated pest management for invasive quagga (*Dreissena bugensis*), and potentially zebra (*D. polymorpha*), mussels that impact agricultural, urban and natural freshwater systems throughout the Western Region. Our goal is to evaluate the feasibility

of fish predators as site specific (not system-wide) biological control agents for quagga mussels. Objectives include: 1) determining whether the planktivorous threadfin shad, *Dorosoma petenense*, can minimize mussel infestations through predation of larval mussels and 2) evaluating whether the carnivorous redear sunfish, *Lepomis microlophus*, can reduce mussel infestations through predation of juvenile and adult mussels. We will contain these fishes in experimental cages with substrates and quantify mussel infestations on the substrates over time. Differing substrate orientations, water depths and mussel densities will be examined to address variability in mussel infestations in the Western Region. Commonly used mussel control methods (mechanical removal, chemical applications) are problematic for systems in the Western Region that largely serve as water sources for humans and/or are open systems. Biocontrol agents offer an ecologically sound solution for minimizing pesticide use, as well as human contact required to remove mussels mechanically. This approach supports W-RIPM program priorities by investigating methods that protect environmental quality, reduce health risks associated with application of management strategies to drinking water and irrigation systems, and provide an additional tool that targets multiple life stages of a pest through an integrated management program. It also addresses a high priority research need identified by the Western Regional Panel of the federal Aquatic Nuisance Species Task Force.



Carla D'Antonio 9/1/2010 to 8/31/2013 \$579 953
National Science Foundation DEB-1029168

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. The research will evaluate species composition and nitrogen cycling in burned grass-invaded sites that were studied in detail in the 1990s but which have not yet burned again. To ask how N cycling has changed over time, net soil N fluxes, as well as plant net primary productivity and N uptake, will be tracked over two years in burned and unburned sites. These data will then be compared to historical data taken between 1994 and 1996 offering a rare test of the long-term ecosystem impacts of biological invasions. Next, this proposal evaluates the long-term effects of fire and invasion on plant community composition with a set of competitor removal, fertilization, and seedling outplanting experiments. These specifically ask how changes in soil N cycling alter the ability of invaders to remain dominant, for new invaders to establish, or for native species to re-establish.

Carla D'Antonio 7/1/2011 to 6/30/2013 \$13 163
Karen Stahlheber
National Science Foundation DEB-1110569

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 as 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?

John Damuth 6/1/2010 to 5/31/2013 \$140 000
National Science Foundation EAR-0958250

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.

Frank Davis 10/1/2006 to 9/30/2013 \$18 402 599
Stephanie Hampton
National Science Foundation DBI-0553768

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 (www.nceas.ucsb.edu/eoinformatics).

Frank Davis 2/1/2012 to 1/31/2013 \$98 853
National Science Foundation R/MPA-24A

Trends in Ecological Analysis and Synthesis

Funding is requested for a 1-day (2-night) panel symposium examining trends in ecological analysis and synthesis since NSF established NCEAS. The symposium has several objectives: recognition and acknowledgement of many individuals who have contributed to NCEAS’ intellectual impact; consideration of lessons learned from the NCEAS experience over the past 15 years in cross-disciplinary synthesis research methods, data and information management, communication and outreach; consideration of emerging trends and opportunities for synthesis research in ecology and related fields; and, discussion of the impact of networking technologies for accelerating synthesis research, training and outreach. The symposium will engage a diverse group of leading thinkers in ecology, eoinformatics, and scientific journalism.



Daniel Dawson 9/1/2009 to 12/31/2011 \$350 000
John Melack
National Science Foundation DBI-0934053

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 10/1/2009 to 8/1/2012 \$103 208
Susan Swarbrick
California Fire Safe Council, Inc. 10USFS-ES306

UC Valentine Reserve: Forest Management at the Urban/Wildlife 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 11/1/2009 to 10/31/2013 \$680 872
National Science Foundation IOS-0842138

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 Dudley 11/29/2010 to 12/20/2015 \$250 000
USDI Fish and Wildlife Service F11AC00779

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

The 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 broad mission of our University of California program in the Santa Clara watershed consists of three general objectives: Research Station Development: Build the organizational structure to locate, design and develop the financial basis for, and implement the construction of the dedicated research station and reserve; Research and Education: Develop a research program that integrates existing resource information and undertakes or facilitates new research and monitoring initiatives that promote biodiversity conservation and agro-ecosystem sustainability; Riparian Restoration: Evaluate and implement comprehensive restoration programs, in concert with regional partners, to reduce impacts of invasive species, biological pollutants, and other stressors to enhance the structure and function of floodplain ecosystems and protect habitats for native terrestrial and aquatic species.



Thomas Dudley
Clark County, Nevada 601346-08

12/16/2008 to 7/1/2011

\$46 430

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 Dudley
Kevin Lafferty
Armand Kuris

10/17/2007 to 10/31/2012

\$56 500

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 Dudley
Walton Family Foundation 2011-1209

11/1/2011 to 1/31/2013

\$217 665

Restoration Planning and Assessment for the Virgin River

The Virgin River is a major riparian area in the southwest, providing habitat or migration corridors to more than 200 species of wildlife. Although the river system comprises only 1% of the total watershed acreage, that 1% supports half of the bio-diversity of the entire region, including the endangered Southwestern willow flycatcher (SWFL), several species of federal or state protected fish, amphibians, and snails, as well as the Yellow-billed Cuckoo and the Yuma Clapper Rail. (Concept paper: Virgin River Watershed, Tamarisk Coalition, 2011) Tamarisk is the dominant vegetation type in the lower Virgin River comprising 95% of woody floodplain vegetation and accounting for about 10,000 acres of infestation in the main floodplain. (Concept paper: VR Watershed, TC, 2011) The recent introduction of the tamarisk leaf beetle into the Virgin watershed for biocontrol of tamarisk provides an opportunity to sustainably reduce its dominance in riparian ecosystems. Yet in the short term, there is concern that rapid defoliation by the beetle could pose a risk to birds nesting in this non-native tree, especially the SWFL. Not all sites along the river provide the hydrological

conditions to facilitate intensive restoration and revegetation. Of special concern are the significant scouring flood flows that are frequent on the Virgin River, as illustrated by December 2010 flooding which destroyed restored riparian woodlands that, in retrospect, were not implemented in a way that incorporated the risks of natural hydrological processes. The Objectives of this integrated restoration design and assessment project for the Virgin River system in Nevada, Arizona, and Utah are, thus, to enhance the recovery of the endangered southwestern willow flycatcher (SWFL) by: Identifying the most suitable locations in the Virgin River watershed for sustainable riparian restoration based on historical hydrologic and ecosystem processes including prior flood path analysis, environmental conditions (Ecohydrological Restoration Action Feasibility Assessment), patterns and trends in existing vegetation and SWFL occupancy, and implications of climate projections; Providing supporting documentation of pre- and post-restoration status of vegetation and key ecosystem attributes for wildlife assessment, particularly for the SWFL, at targeted restoration sites, including status of invasive tamarisk and tamarisk leaf beetle introduced to and currently colonizing through the watershed; Building the Science Team that would be responsible for developing, in consultation with the SWFL-Technical Advisory Committee (TAC) and watershed stakeholders, the Restoration Plan, Monitoring and Evaluation Protocols, and Information Processing and Adaptive Management system for the SWFL Habitat Enhancement program. In addition, support will enable leveraging for development of additional funding from stakeholder organizations and agencies to provide adequate capacity for carrying out the mission of the Science Team; and Providing to land managers and watershed partnerships recommendations and protocols for enhancing restoration success.



Jenifer Dugan 2/1/2010 to 2/28/2012 \$40 612
Adrian Wenner
 UC Sea Grant College Program R/ENV-210-F(R)

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

Climate change is a key environmental driver of the structure and function of California's ocean and coastal ecosystems. Projecting the impacts of climate change must include understanding the consequences of both ecological and socioeconomic responses to climate change. This need is most crucial along the 1172 miles of coast where California's growing population and economy depends on a narrow strip of land that lies on the edge of an ocean that is warming, rising, and becoming stormier in response to global climate change. As sea level rises, erosion accelerates, and human populations expand on the coast, evaluating the ecological consequences of intensifying pressures on beach ecosystems becomes increasingly urgent. Once abundant intertidal species appear to have disappeared from many beaches, including species from the upper and lower intertidal zones (e.g. Hayes 1974, Fitch 1950) and extinctions on local to regional scales may have occurred for a number of beach invertebrates. Commercial fisheries for at least 3 beach clam species have collapsed and sport harvest for these species has declined significantly statewide (Fitch 1950, McLachlan et al 1996). Although invasive species of plants and animals are recognized as problems for ecosystems that interact directly with beaches including dunes, rocky shores, and coastal wetland, knowledge of the distribution and impacts of species invasions on beaches is lacking. The limits of our scientific understanding of how sandy beach ecosystems respond to the plethora of human threats are fast emerging as crucial impediments for the conservation of these threatened ecosystems (Schlacher et al 2007).

Jenifer Dugan 2/28/2011 to 5/31/2012 \$49 566
Mark Page
 Cal Department of Parks and Recreation C1053011

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 enclosure on talitrid abundance over time.

Jenifer Dugan 9/1/2011 to 6/30/2014 \$260 897
Mark Page
UC Sea Grant College Program R/MPA-24A

Sandy Beach Ecosystems: Baseline Characterization and Evaluation of Monitoring Metrics for MPAs along the South Coast of California

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 reproductive output of invertebrates. The condition of beach ecosystems is also linked to the reproductive success of beach-nesting fishes and birds. 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 assess ecosystem condition and functioning of the SC region. Sandy beaches are also used extensively for a variety of recreational activities, including shore-based fishing, clamming and bait collection, beachcombing, dog-walking, jogging, sunbathing, surfing, swimming, volleyball and other sports, birding, and picnicking. We will: provide a comprehensive, baseline description of the biodiversity of sandy beaches of the SC region using both new and historical/existing data develop informative ecosystem indicators and a plan for long-term monitoring of the network of MPAs involving citizen scientists (e.g., students, LIMPETs, recreational fishers, members of conservation clubs) and collaborations with similar established volunteer groups in the region (e.g., Audubon etc), and interpret the important ecological links among the components of this and other ecosystem features, including humans, for use in evaluating the effectiveness of the network of MPAs.

Jenifer Dugan 5/1/2009 to 12/31/2012 \$37 500
California Coastal Commission SB090092

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 4/1/2011 to 12/31/2012 \$34 988
Dept. of Cal Ra Boating and Waterways 10-106-108

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 3/1/2010 to 12/31/2013 \$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 assess 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, recreational 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.

John Engle 5/1/2010 to 4/15/2015 \$223 407
UC Santa Cruz N10AC2000

Shoreline Assessment of changes in Southern California Rocky Intertidal Communities

This project comprises the UCSB portion of a multi-campus Minerals Management Service (MMS) program to assess long-term changes in rocky intertidal habitats in California. The primary Cooperative Agreement exists between MMS and UCSC, with subcontracts extended to other State of California institutions. The UCSB portion of the MMS Rocky Intertidal Program will be conducted by the Principal Investigator (PI), with help from a laboratory assistant. The work will consist of coordinating communications for the Multi-Agency Rocky Intertidal Network (MARINE), providing network information to others, maintaining standards for network protocols, overseeing network database operations and websites, and facilitating other interactions between MMS and MARINE. As the MMS/MARINE coordinator, the PI will interface with network Steering Committee, Data and Science Panels, and participating organizations to enhance productivity by organizing meetings and resolving technical issues, including species taxonomy and survey methodology. In addition to coordinating MARINE information management to promote analysis, synthesis, and publication, the PI also will maintain the network internal website, plan updates to the public website, and assist MARINE members in testing and implementing field surveys as well as laboratory, and data management procedures. The principle product of this project is coordination and facilitation of activities by others who will produce and update a variety of products including a standardized data management system, private and public internet sites, reports, publications, and oral presentations. In addition, the principal investigator will produce the following: Minutes of meetings of Steering

Committee, Science Panel, and Data Panel meetings. Updated information for placement on MARINE websites. Updated summary lists of MARINE presentations, reports, and scientific publications. Updated field data entry forms for core MARINE protocols. Updated Unified Protocol Handbook for MARINE.

Melanie Fewings 4/15/2010 to 3/31/2013 \$376 868
Libe Washburn
National Science Foundation OCE-0957948

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 7/22/2010 to 7/21/2014 \$634 694
Libe Washburn
NASA NNX10A094G

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 7/1/2008 to 4/30/2012 \$13 295
USDA Forest Service 08-CA-11272138-072

A Risk Assessment for Climate Change and Forest Pathogens in Western North America

The National Center for Ecological Analysis and Synthesis (NCEAS) proposes to collaborate with the Western Wildland Environmental Threat Assessment Center (WWETAC) and the USDA Forest Service, Pacific Southwest Research Station to develop a risk assessment for climate change and forest pathogens in western North America. This project will bring together individuals with expertise in forest pathology, quantitative modeling, and climate science. Ultimately, we anticipate that the project will yield to products: (1) a manuscript, suitable for submission to a peer-reviewed journal, on design and output of models describing relationships between climate change and forest pathogens in western North America and (2) a risk assessment for forest pathogens in Western North America under a changing climate. Under the leadership of Erica Fleishman, NCEAS will be responsible for the following. 1. In collaboration with Susan Frankel (USDA Forest Service, Pacific Southwest Research Station) and her colleagues, assemble background materials, invite working group participants, and discuss modeling approaches that may be appropriate for the group's work. 2. Arrange logistics for working group (and reimburse travel according to NCEAS and UCSB guidelines



and policies). 3. Host and facilitate working group at NCEAS. 4. If requested by Frankel and colleagues, provide feedback on draft manuscript and risk assessment. 5. Discuss follow-up activities with Frankel and colleagues as appropriate.

Erica Fleishman

6/6/2007 to 9/30/2011

\$797 438

USDI Fish and Wildlife Service 81332 7 J002

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

The stressors and mechanisms that might be responsible for the POD trends are numerous and likely interact in complex ways. Data and information sources potentially providing insight into the POD problem are similarly numerous, and the available data spans many temporal and spatial scales, trophic levels, marine, estuarine, and freshwater environments, and scientific disciplines, making appropriate and efficient data and information integration, analysis and synthesis a complex and challenging undertaking. Also, expectations for swift progress in unraveling the POD problem are high. Additional, unbiased analysis and synthesis expertise and tools are needed if the POD project is to succeed. Four large scale planning processes have been started by CALFED that all relate to estuary issues and all have major product delivery dates for late 2007. These are the Delta Vision, Delta Risk Management Study (DRMS), Bay Delta Conservation Plan (BDCP), and Delta Region Ecosystem Restoration Plan. It is anticipated that major decisions regarding the Delta and water management will be made at the end of CALFED's stage 1 in late 2007 and that these decisions will be influenced by the results of the POD synthesis and these other planning efforts. Therefore it is important that the POD synthesis efforts be linked and coordinated with these other efforts. This coordination will be provided by the POD management team. The overall goal for the proposed work with NCEAS (including but not limited to working groups) is thus to conduct and/or guide the integration, analysis, and synthesis of POD and other relevant data and information in a more efficient, sophisticated, unbiased, and synergistic manner than would be possible with local resources alone. The focus of the NCEAS working group (and other activities as appropriate) should be identification of and testing of hypotheses about POD trends, individual and interacting stressor(s) associated with the observed POD trends, the linkages among these stressors, and the mechanistic pathways leading to the observed trends. The degree of uncertainty associated with any conclusions should also be clearly identified. A secondary goal for the proposed NCEAS working group is to identify other similarly impacted estuaries and programs around the world that could serve for comparative studies of approaches and techniques. The goal would be to advance the scientific understanding of dealing with problems such as POD where there are broad arrays of stressors that act alone or in concert. Some more specific goals or objectives are to: Conduct and/or guide integration, analysis and synthesis of relevant data and results to provide resource managers, policy makers, and the public with a more complete scientific background for informed decision making. Design and implement a framework for continued analysis and synthesis of new data after the initial NCEAS effort is finished. The sustained program might or might not involve NCEAS. Identify data gaps or inadequacies of existing or new data that limit the ability to reach conclusions regarding the stressors associated with the POD. In addition, suggest new sampling programs or research efforts needed to address these problems. Identify other systems around the world that could serve as models for how to approach impacts of multiple stressors on estuarine species. Maintain an open, scientifically objective workgroup process that can be communicated to the public. Communicate progress and problems to the public in a clear and timely manner. IEP scientists would take the lead on this, with assistance from NCEAS staff and working team members, as appropriate. We believe that a thorough evaluation of the problem is a necessary step BEFORE proposing solutions in the form of management alternatives and strategies. These types of solutions may, however, become the subject of future POD work and perhaps POD-NCEAS working groups.

Erica Fleishman

3/9/2009 to 1/31/2012

\$76 751

USDA Forest Service 09-JV-11330110-027

Applying Population Ecology to Strategies for Eradicating Invasive Forest Insects

The National Center for Ecological Analysis and Synthesis (NCEAS) proposes to collaborate



with the National Centers for Environmental Threat Assessment and the USDA Forest Service, Northern Research Station to formulate and optimize new strategies for eradicating alien species and for identifying conditions under which eradication is practical. These goals primarily will be accomplished via a multidisciplinary working group. Eradication refers to management activities that result in the extirpation of a species from a given area. Despite the considerable amounts of money and effort expended on eradication programs and the importance of these programs to mitigation of undesirable effects of non-native species, there is no scientific basis for eradication founded on basic principles of population ecology. This project will assemble a team of ecologists with expertise in invasive forest insects and eradication efforts, ecologists with expertise in dynamics of low-density populations, and economists with backgrounds in optimization and decision theory. The group will assemble historical data and develop population models that capitalize on knowledge of Allee effects, stochastic dynamics, and spatial ecology. This work will facilitate examination of potential strategies for eradicating non-native species and for assessing circumstances under which eradication is practical. Under the leadership of Erica Fleishman, NCEAS will be responsible for the following. 1. In collaboration with Andrew Liebhold (US Forest Service, Northern Research Station) and Deborah McCullough (Michigan State University), identify areas of expertise germane to the proposed work. Identify and invite potential participants in the working group. 2. As requested, assist with development of draft agenda for working group meetings and assembly of background materials. 3. Host and facilitate working group meetings (approximately three meetings of four to five days each) at NCEAS by providing meeting rooms, expertise in scientific computing and associated facilities, and administrative support for participant travel. 4. As necessary, provide support for documentation of project metadata and derived data according to the NCEAS Data and Information Policy. 5. Discuss follow-up activities with Liebhold, McCullough, and colleagues as appropriate.



Erica Fleishman 12/7/2007 to 4/15/2013 \$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 1/1/2008 to 12/31/2012 \$1 150 000
David and Lucile Packard Foundation 2007-31848

Development and Application of Scientific Knowledge to Ecosystem-Based Management of Coastal Marine Systems

Ecosystem-based management typically is defined as an integrated approach to management that considers the entire ecological, physical, and socioeconomic system. Such a definition engenders little controversy but is difficult to translate into operational guidelines, explicit objectives, and clear

measures of success. The National Center for Ecological Analysis and Synthesis (NCEAS) aims to develop scientific knowledge about ecological and socioeconomic processes that affect management and legislative regulation of coastal-marine ecosystems. The particular emphasis is to examine, both conceptually and via empirical evidence, how such knowledge can be transferred effectively to planning, decision-making, and implementation at different scales and in different geographic locations worldwide. This project builds on work conducted from 2004 to 2007 to advance and synthesize scientific understanding needed to support an ecosystem-based approach to managing coastal marine systems. This phase involves a portfolio of complementary activities including scoping workshops with practitioners, working groups, postgraduate training, and informatics support for working groups and the Packard Foundation's seven regional ecosystem-based management initiatives. These activities will be amenable to development and implementation of communication strategies that inform policy, management, and public behavior.



Steven Gaines 1/1/2012 to 12/31/2012 \$200 000
Robert Warner
Libe Washburn
Carol Blanchette
Jennifer Caselle
 Oregon State University F0720A-C

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

Dr. Kirsten Grorud-Colvert, located at Oregon State University (OSU), will work together with Dr. Jennifer Caselle at University of California, Santa Barbara (UCSB) to analyze data from a decade-long time series of juvenile fish recruitment and adult fish population dynamics coordinated by the Partnership for the Interdisciplinary Studies of Coastal Oceans (PISCO). Dr. Grorud-Colvert will have primary responsibility for data analyses and manuscript preparation, working closely with project PI Dr. Caselle to ensure accuracy of results.

Steven Gaines 5/1/2005 to 4/30/2013 \$6 495 699
 Department of Commerce NA05NOS4291158

Ocean Science Education Building, Phase I

As a collaboration between the Channel Islands National Marine Sanctuary (CINMS) and the University of California, Santa Barbara (UCSB) the proposed Ocean Science Education Building will function as both an Outreach Center for Teaching Ocean Science (OCTOS) and the primary administrative office for operation of the sanctuary (CINMS). The combination will be a unique learning center that brings together science process, environmental policy, and the human connection by focusing on the special marine ecosystem of the Channel Islands. OCTOS will be a state-of-the-art educational facility that connects invited participants to the Channel Islands National Marine Sanctuary and the Marine Science Institute at the University of California, Santa Barbara through compelling, hands-on programming. A goal of the project is for the building to be designed and constructed to a gold LEED standard, serving as a demonstration for sustainable design.

Steven Gaines 11/16/2011 to 5/18/2012 \$100 901
Christopher Costello
 Gordon and Betty Moore Foundation 3184

The World's Unassessed Fisheries: Status, Trends, and Food Security Implications

We propose extending our previous analysis of the world's unassessed fisheries to estimate the potential benefits of management reform. Capturing nearly 10,000 data-poor fisheries from all fish producing regions of the world, we will assess current biomass status relative to biomass that would return maximum sustainable yield. We use those estimates to produce estimates of the potential increases in extant fish in the sea and protein yield that would result from fisheries reform, teasing apart these results for the full range of geographic, economic, and biological characteristics represented in our database. We further explore the timing of recovery across these important variables.

Steven Gaines
Christopher Costello

10/1/2011 to 7/31/2012

\$82 000

David and Lucile Packard Foundation 2011-37125

Structuring Risk from Fisheries Reform: A Scoping Project

Although solutions to a wide range of ocean conservation challenges are well known and have been demonstrated to be successful, they rarely are replicated elsewhere. As a result, the pace of emerging problems commonly outstrips the pace of implemented solutions even when solutions readily available. This is particularly true with problems associated with overfishing. Many management tools (e.g., rights based management, spatial management incorporating Marine Protected Areas, etc.) have been clearly demonstrated to improve fisheries management, often with benefits to both fish and fishermen. Yet, these solutions remain rare while the problem continues to grow. We believe that a major contributor to this conundrum is the role of financial risk that stakeholders perceive from a proposed management change. If short term risk is high (in reality or in perception), changes will be opposed even when the long term benefits are clearly large. This proposal seeks to tackle this problem by exploring diverse risk reduction mechanisms that may be able to enhance the pace of conservation changes in the sea. These represent different forms of insurance against downside risk to enhance the likelihood that managers will implement a potential solution and that stakeholders will be proponents of the change rather than opponents. We propose to draw on the expertise of the use of risk structuring tools in other sectors to develop a framework for the class of problems where such insurance may help drive change and to provide a rubric that matches the class of insurance tool with the class of problem to maximize success. To achieve this goal, we propose a two phase project. First, we will host a multiday workshop of diverse potential investors and asset holders to complete development of a comprehensive risk reduction framework for marine fisheries. Second, we will evaluate a large set of fisheries using the resulting framework to set the stage for future implementation of these tools in settings with a high probability of success. We seek a transformative new approach that engages the private sector in driving better conservation of the oceans through the management of risk in situations where solutions produce long term financial benefits.



Steven Gaines

10/1/2010 to 9/30/2012

\$49 997

Com National Oceanic and Atmospheric Administration NA10OAR4170257

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

Sea Grant's mission is to promote environmental stewardship, economic development and responsible use of America's coastal, ocean and Great Lakes resources. Within this broad mission, the national strategic plan (2009-2013) identified a handful of focus areas for concentration of effort. The largest program focus is in the area of healthy coastal ecosystems, which includes ecosystem based approaches to managing coastal environments, restoration of degraded ecosystems, and efforts to promote stewardship of healthy ecosystems. Sea Grant has funded diverse activities in these areas with broad success, although a number of emerging challenges in the context of healthy coastal ecosystems warrant new forward looking activities. For example, a) how do we assess the cumulative impacts of multiple stressors to ecosystem health when they are poorly predicted by their separate individual impacts?, b) how do we develop a new framework for marine spatial planning in the face of rapidly emerging ocean uses (e.g., wave and wind energy farms, offshore aquaculture)?, c) how will recent changes in ocean management including large networks of marine protected areas and catch share fisheries management interact to affect coastal ecosystem dynamics? Answering such questions will undoubtedly require new research efforts. Strategically deciding how and where to allocate funding for these research efforts, however, would be greatly facilitated by syntheses about what we already know or can learn from pulling together existing information. Synthesis working groups to tackle such efforts have been the hallmark of the National Center for Ecological Analysis and Synthesis (NCEAS) at the University of California Santa Barbara, which has had a transformative effect on the discipline of ecology by bringing together interdisciplinary teams to tackle challenging questions with analyses of existing data. We believe the emerging challenges of Sea Grant's Healthy Coastal Ecosystems (HCE) focus area is ripe for using this type of synthesis tool to strategically focus its future efforts on one of these emerging challenges. Therefore, we propose to organize and host a two-part working group, closely following the NCEAS model, 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 and identify near-term and longer-term research and funding priorities within this topic area. The topic to be addressed with this working group will be chosen by the HCE steering committee, but is likely to emerge from the questions above or related issues. By drawing on the expertise and experience of leading experts in the field who will synthesize what is known from existing science and data, Sea Grant will be poised to maximize its impact in advancing sustainable and ecosystem-based approaches to coastal and marine resource management.

Benjamin Halpern Third Sector New England SB110085	1/1/2011 to 12/31/2011	\$66 774
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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.

Benjamin Halpern Nature Conservancy CR0002-64689	6/25/2009 to 12/31/2011	\$90 000
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A Workshop on Global Climate Change and Adaptation of Conservation Priorities

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Benjamin Halpern Kimberly Selkoe Carrie Kappel Gordon and Betty Moore Foundation 2897	11/21/2011 to 7/31/2013	\$40 535
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Identifying Thresholds, Developing Key Indicators, and Operationalizing their Use in CMSP

Coastal and marine spatial planning is emerging as a primary tool for implementing ecosystem based management on the west coast of North America and in other parts of the world. As decision-makers begin to develop marine spatial plans for the west coast, they are faced with the problem of how to define objectives for the ecosystem, and how to evaluate whether the management actions they take are working towards and meeting those objectives. Identifying key ecological and socio-economic thresholds, where small changes in conditions produce large and sometimes abrupt responses in ecosystem state or function, remains a fundamental scientific and management need. In addition, knowing where such nonlinearities do not exist is as important as knowing where they do exist, as the former situations require value judgments rather than science to set a target, or desired state, for management. Relying on our team’s extensive ecological, social, legal and policy experience in the region, we will use a two-phase research program (Phase 1: characterize thresholds, Phase 2: develop indicators) book-ended by participatory processes to develop a framework and tools to inform and guide nascent marine spatial plans in the California Current and British Columbia, as well as a general approach that can be applied to CMSP processes elsewhere. The planning grant is strategically designed to hone and refine the ideas and approach to be taken in a full project. Members of our team have been instrumental in developing all of the five foundational research themes listed in the RFP and have a deep familiarity with nearly all available data for the region. We are uniquely poised to rapidly and comprehensively advance the science needed for understanding ecosystem thresholds and integrating them into management decision-making.



Benjamin Halpern

2/1/2010 to 8/31/2012

\$944 294

Conservation International Foundation SB100063

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.



Scott Hamilton

7/1/2010 to 5/31/2012

\$14 999

Robert Warner

UC Sea Grant College Program R/ENV-214EPD

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

Over the last few decades, marine protected areas (MPAs) have become increasingly important as tools for conservation and fisheries management. California is in the process of implementing a state-wide network of MPAs with the dual goals of promoting conservation and increasing fishery yields. Abundance, biomass and reproductive potential of exploited species are expected to increase inside reserves, but there may be other unanticipated behaviorally-mediated effects on some species, especially those with complex social systems. California sheephead are ecologically important fish that support recreational and commercial fisheries and have shown significant increases in abundance and biomass inside reserves. Sheephead are also sex-changing fish with complex social and mating systems, and work on a closely related species with a similar social system found significant differences in spawning behavior between reserves and fished sites, with the result that reproduction outside reserves nearly dropped to zero despite similarities in abundance between sites. We will investigate differences in spawning success of sheephead inside and outside of marine reserves in the Channel Islands, combining observations of mating and other behaviors of focal individuals with surveys of adult densities, size structure, and sex ratios. Based on previous work on sheephead and a related species, we predict that there will be significant differences in per-capita spawning behaviors between reserves and non-reserve sites, with the result that per capita spawning success will be much lower in exploited areas than would be predicted from estimates of abundance and spawning biomass alone.

Stephanie Hampton

7/1/2009 to 6/30/2012

\$140 793

COM National Oceanic And Atmospheric Administration NA09NMF4720180

CAMEO: Building the Foundation, New statistical tools for analyzing community dynamics with applications to marine zooplankton

There is a wide variety of ecosystem models currently being used to inform fisheries management (Plagányi 2007). These range from highly detailed and spatial models, such as ATLANTIS (Fulton et al. 2004), to energy flow models based on diet estimates, such as EcoSim (Pauly et al. 2000), and individual-based models, such as OSMOSE (Shin and Cury 2004). Although these approaches are quite different, they all attempt on some level to develop a mechanistic model of the system and require data (or assumptions) about diets and the functional form of the interactions among species. In systems where such diet and functional-relationship information are missing or change over time as environmental conditions change, the development of mechanistic ecosystem models is challenging and requires assumptions that are difficult to cross-validate against data. Over the past decade, theoreticians, statisticians and freshwater ecologists have been developing and applying an alternative approach to ecosystem modeling. This approach is based on modeling the time series of species abundances produced by ecosystem dynamics and species interactions rather than modeling the underlying mechanisms themselves (Ives 1995, Ives et al. 1999, Ives et al. 2003). This approach views the system as a stochastic process in which species trajectories within the community are

random walks resulting both from internal dynamics, interactions with other species, and interactions with environmental covariates (e.g., temperature, fishing pressure). The model itself is theoretically well-grounded in population and community dynamics and is based on a log-linear stochastic approximation of different types of non-log-linear ecosystem dynamics. The approximation is a system of multivariate auto-regressive (MAR) equations. In the MAR framework, comparative properties of communities are easily defined in terms of the stability properties of the matrix of species interaction strengths. For example, metrics such as resistance to disturbance, resilience, and return time after disturbance can be easily calculated from a MAR model (Ives et al. 2003). Multivariate estimation methods can be used to generate a MAR model from multi-species time series data. This means that an ecosystem model – modeling between species interactions, within species interactions, and interactions between species and environmental factors – can be estimated from a time series of species abundance and measurements of relevant abiotic factors, such as might be collected in standard monitoring protocols. The uncertainty of the parameter estimates can be calculated using standard approaches for multivariate models. The data support for different model structures can be measured using likelihood calculations. These features put the MAR approach on a firm statistical foundation and allow researchers to quantify parameter and model uncertainty in a rigorous and uniform manner. The usefulness of MAR modeling for discerning the underlying direct and indirect interactive pathways that drive community dynamics have been demonstrated in freshwater communities (Klug and Cottingham 2001, Beisner et al. 2003, Ives et al. 2003); the MAR analysis is able to identify the key players and pathways within a community and factor out the covariates (e.g., temperature, salinity) that obscure the underlying dynamics. Importantly, the MAR approach effectively identifies reciprocal effects (e.g. Hampton and Schindler 2006) that can confound other statistical techniques. For example, when a predator reduces prey in one time step, and the predator then increases in the following time step, the relationship between predator and prey is both positive and negative; using statistical analyses that do not account for interaction pathways, this relationship would be obscured by the reciprocal dynamics. MAR models have been particularly important in elucidating freshwater plankton dynamics (Ives et al. 1999, Klug and Cottingham 2001, Beisner et al. 2003, Hampton and Schindler 2006, Hampton et al. 2008). In these freshwater systems, studies have demonstrated that the abiotic drivers of community responses and the pathways for indirect and direct ecological effects of environmental change can be readily discerned by analyzing abundance time series using MAR modeling (Hampton and Schindler 2006). The resulting models have both reinforced existing hypotheses concerning structure and relationships within the ecosystems under study and elucidated new relationships among interacting biota (Hampton et al. 2006). The PIs been central to this research. By applying this statistical technique in hypothesis-driven research, we have not only answered basic ecological questions about the environmental variables and interactions that drive plankton dynamics but have also clarified the behavior of models in ways that inform future applications. The behavior of MARs with respect to freshwater plankton is now quite well understood; however, understanding the drivers of marine plankton productivity and phenology, and the mechanisms by which plankton responds to climate change and other stressors remains an important challenge for marine science and management (Hays et al. 2005). Transfer of the MAR techniques from freshwater to marine systems through the analysis of marine plankton data sets is a clear and logical progression for MAR applications. Appropriate marine plankton data sets are available (e.g., www.st.nmfs.noaa.gov/plankton). And because marine plankton is not directly harvested by humans - unlike many fish and benthic species - the dynamics of plankton biota are less complicated by additional factors than are many other marine data sets. Further, marine plankton is an important driver of fish production, has major impacts on water quality (e.g., red tides), and is an excellent integrator and indicator of climate change effects (Hays et al. 2005). Here we propose a pilot study to execute the first application of MAR modeling to marine plankton datasets. Our primary goal is to identify major drivers of plankton productivity and dynamics. As with freshwater plankton, nutrients, light, temperature, competition and predation have all been suggested as major drivers of marine plankton. Unlike freshwater systems, substantial attention has been paid to the importance of minor nutrients, such as iron, and to the disruptive potential of acidification. In addition to this goal of discerning generalizable drivers, we will conduct comparative studies of marine and freshwater plankton communities that will a) elucidate important issues in applying MAR to marine studies, and b) test hypotheses that address ecological attributes that may be inherently different between marine and freshwater plankton, for example stoichiometry (Elser and Hassett 1994) and trophic cascades (Shurin et al. 2002, Stibor et al. 2004). However, current



MAR model estimation methods only work on long-term, high-quality datasets and are not designed to utilize spatial data. Successfully applying MAR models to marine plankton data will require significantly extending the MAR framework to accommodate 1) observation error within the data, 2) spatially replicated time-series spread over large geographic regions, 3) temporally non-uniform sampling, 4) reduced autocorrelative structure due to openness of the system and monitoring schemes that use long times between samples (monthly versus weekly), and 5) slow computational speed for large datasets, such as marine plankton datasets. Before the MAR approach can serve as a viable tool to assist in ecosystem management decision-making, it must be extended to account for these types of challenges, which are common for fisheries monitoring data. The PIs at the Northwest Fisheries Science Center (NWFSC) are leaders in the theory and estimation of stochastic ecological processes and have done extensive work on methods to resolve these types of problems for univariate and multivariate auto-regressive models (Holmes 2001, Holmes and Fagan 2002, Scheuerell and Williams 2005, Holmes et al. 2007, Hinrichsen and Holmes 2008, Semmens 2008, Ward et al. 2008). For this proposal, those of us at the NWFSC will work closely with the NCEAS researchers to test extended MAR model-fitting algorithms using real data, specifically marine plankton data. In addition, we will develop a statistical package for estimating extended MAR models from multi-site datasets. Working in collaboration with biologists on a biological research question is a key to the development of modeling methods and other tools that are useful for biologists, and is an approach we have applied successfully in our previous work.



Stephanie Hampton 1/4/2011 to 8/15/2011 \$84 320
Julia Baum
 Schmidt Ocean Institute SB100054

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

To support the research of Dr. Julia Baum.

Stephanie Hampton 8/1/2010 to 7/31/2013 \$41 559
 National Science Foundation OCE-1041705

Collaborative Reseach: 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 9/15/2011 to 8/31/2015 \$347 437
 National Science Foundation DEB-1136637

Dimensions: Collaborative Research: Lake Baikal Responses to Global Change: The Role of Genetic, Functional and Taxonomic Diversity in the Plankton

Anthropogenic global change is profoundly altering most Ecosystems on Earth. Understanding how ecological communities will re-organize under global change is one of the main challenges facing

ecologists today. Responses of communities will depend on the underlying genetic and functional diversity within and across species, as well as on the taxonomic diversity within communities. Here we will characterize these different aspects of diversity in the plankton of Lake Baikal, the oldest, largest (by volume) and most diverse lake in the world. Lake Baikal's planktonic food web is dominated by endemic species that are sensitive to changing climate and other anthropogenic stressors. These organisms fuel the rest of Baikal's incredibly diverse biota making responses of the plankton crucial to understanding how Lake Baikal ecosystem will respond to global change. We will repeatedly sample Lake Baikal to characterize the spatial, seasonal and interannual variability of each of three aspects of biodiversity (taxonomic, genetic and functional). For taxonomic diversity, we will compare microscopic and molecular approaches and genetic diversity, we will assess the population structure of the ecologically important endemic and cosmopolitan species of both phytoplankton and zooplankton. We will characterize key functional traits for different species and strains (i.e., cell/body size distributions, growth rate responses to temperature, light and nutrients, grazer susceptibility and grazing rates) and compare these traits to the genetic diversity of endemic vs. cosmopolitan species. The genetic information and functional trait distributions of focal plankton species will then be used to parameterize novel mathematical models of plankton communities, allowing us to predict how they will reorganize in the future. We will explore whether, due to limited genetic and functional diversity and narrow thermal niches, endemic species will be unable to adapt to changing conditions and be replaced by cosmopolitan species, resulting in a shift in size structure and energy transfer efficiency. A unique 60-year dataset on plankton dynamics will be used to test the models, independently infer ecological preferences of species, and relate species replacements to environmental drivers and community composition. The results and approach of this project will be applicable to other systems with high diversity and endemism, as well as to other polar and subpolar aquatic environments undergoing rapid warming.



Stephanie Hampton 4/1/2011 to 3/31/2012 \$23 668
David Marsh
 National Science Foundation DEB-118353

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.

Stephanie Hampton 7/1/2012 to 6/30/2014 \$128 008
 National Science Foundation DUE-1140911

Toads, Roads, and Nodes: Collaborative Course-Based Research on the Landscape Ecology of Amphibian Populations

We propose to link networks of undergraduate ecology and conservation biology courses to study the factors that promote the persistence of amphibian populations at landscape and regional scales. Using existing data from the North American Amphibian Monitoring Program (NAAMP) and satellite imagery from Google Earth, students in 10 classes will relate the presence/absence of amphibian species in their own state or region to landscape features such as forest cover, road density, and urbanization. Representatives from each class will then bring their data to a meeting at the National Center for Ecological Analysis and Synthesis (NCEAS) to compile and analyze them at the national scale. In the first year of the project, classes will examine the effects of current landscape features on amphibian distributions. In the second year, classes will use older satellite imagery to discern the residual effects of past land use on amphibians and determine the lag time

over which forest loss and road construction affect amphibians. In each project year, students will engage with a complete piece of scientific research from hypothesis to conclusion, and each year's project should result in a research publication. With respect to assessment, the multi-year, multi-class structure of our project will allow for strong inference about the impact of the project on student attitudes and abilities.

Stephanie Hampton 6/25/2009 to 12/31/2011 \$20 000
Nature Conservancy CR0002-64689

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 Bayesian 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 do 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 12/1/2011 to 1/1/2014 \$355 488
Ocean Conservancy SB120078

Marine Debris: Scale and Impact of Trash in Ocean Ecosystems

Widespread claims of islands of trash in the middle of the ocean have received significant media attention and have stimulated strong public emotions. Legislators across the country and globe are rushing to ban plastic bags because of the threat they cause to marine life and the land-based litter problem. However, at present there is no credible science behind these large-scale public and government actions. We propose a working group from the National Center for Ecological Analysis and Synthesis (NCEAS), hosted at NCEAS but supported with external funding, to develop the scientific theory of marine debris. Marine debris is described as any manufactured object discarded, disposed of, or abandoned that enters the marine environment. In the last decade there has been an increase in the number of scientists researching marine debris and in the publication of peer-reviewed literature. However, because the discipline is still emerging, a comprehensive analysis of the large-scale ecological impacts on ocean environments and associated marine life does not exist. This proposed working group will bring together a group of leading ecologists, oceanographers, social scientists, industry market experts, behavioral economists, and plastic polymer scientists to evaluate existing data and published information and to conduct integrative modeling that will significantly advance the scientific understanding of marine debris globally. To construct the theory of marine debris incorporating the needs of nonscientific constituencies, this working group will accomplish the following goals: 1) compile and synthesize existing information to determine how much harmful debris is in our ocean; 2) compile and synthesize existing information to determine impacts of marine debris on ocean populations and ecology; 3) compile and synthesize existing information to determine impacts of marine debris on human populations; 4) identify the three most prominent sources/items of plastic debris for which behavior-oriented solutions can be implemented; and 5) analyze research regarding efficacy of policy solutions such as plastic bag bans as they relate to ocean trash items. Working group participants will include active marine debris researchers as well as academics who are leaders in their respective fields but have not yet applied their skills to the marine debris problem. The working group will collaborate with industry scientists and consultants who have access to large market data sets that have yet to be incorporated into marine debris analyses on large-scale ocean ecosystems. We have secured funds to buy these data in order to integrate them into working group models and analyses to yield unprecedented results. The working group



will provide significant outreach of the scientific results to nonacademic audiences. The resources of NCEAS will make it possible to bring these experts together to ascertain a comprehensive understanding of marine debris and to create a scientifically based and solutions-oriented philosophy to address ocean trash.

Ryan Hechinger 9/19/2008 to 9/30/2012 \$91 763
Armand Kuris
USDI Geological Survey 5027WS0003

Status and Potential Distribution of the Invasive New Zealand Mudsnailed Aboard Marine Corps Base Camp Pendleton

Status and Potential Distribution of the Invasive New Zealand Mudsnailed Aboard Marine Corps Base Camp Pendleton The primary goal of this baseline survey is to determine the presence/absence of New Zealand Mud snail (NZMS) within the water resources of Marine Corp Base Camp Pendleton. Secondary objectives are to provide information on the distribution and abundance of the NZMS, as well as on encountered non-target gastropods.

Ryan Hechinger 2/1/2007 to 2/28/2012 \$30 000
UC Sea Grant College Program R/OPCENV-01-S-3/3

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.

David Herbst 9/1/2008 to 6/30/2012 \$200 000
USDA Forest Service 08-JV-11052007-233

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

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 9/1/2009 to 7/30/2013 \$45 854
USDI National Park Service J8C07090019

Evaluating Recovery of Stream Invertebrate Communities following Removal of Introduced Trout in Kings Canyon National Park

The Sierra Nevada Ecosystem Project identified aquatic and riparian systems as the most altered and impaired habitats of the Sierra Nevada. Sequoia and Kings Canyon National Parks (SEKI) has hundreds of miles of high elevation streams, including several Wild and Scenic Rivers, which provide critical habitat for native invertebrate communities. These habitats harbor high proportions of endemic species in insect groups such as stoneflies (25% of species in the Sierra are endemic) and caddisflies (19% endemic species), representing a significant national resource. Fishless stream environments may be critical habitat for large and vulnerable insects, such as the rare endemic mayfly *Edmundsius agilis*. Stream invertebrate communities are often composed of dozens of species



with diverse roles in food webs are primary prey of trout, which were introduced to the high Sierra beginning in the 1860's. Recent research in Yosemite National Park (published in 2009) compared physical, chemical, and biological parameters of 22 fishless stream segments with adjacent matched streams containing trout. Results show that fishless streams contained a greater diversity of total taxa and large invertebrate predators than found in matched trout streams, while trout streams contained a greater total percentage of midges and a greater density of algae than fishless streams. These data suggest the nonnative trout cause significant changes in the ecology of high elevation streams, and thus native resources are vulnerable to direct and indirect effects of trout predation.

David Herbst

9/28/2010 to 12/31/2012

\$110 000

Truckee River Watershed Council SB110029

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.

David Herbst

9/24/2012 to 12/31/2016

\$130 000

Scott Cooper

USDA Forest Service 12-JV-11272139-070

Aquatic Invertebrate Research for Experimental Watersheds in the Kings River System

Samples of benthic invertebrates will be collected from the lower regions of the streams draining the experimental headwater catchments in June of 2013, using a standard D-frame collection net (30 cm wide, 250 μ m mesh). This is the spring following the summer (2012) that thinning treatments will be put in place. If funding is available, we will also sample stream invertebrates in treated and control basins in June of 2014, September 2014, and June 2015, after both tree thinning and controlled burn treatments have been completed. As in previous collections, invertebrates will be gathered from riffle habitats by pooling the contents of three cross-channel D-net samples from each of three separate riffles within a defined 100-meter reach (total area = 9 square feet or 0.81 square meters), and from pool habitats by combining single D-net samples from each of 3 separate pools within



the reach (total area = 3 square feet or 0.27 m²). Each square-foot (30 x 30 cm) area is sampled for a standard 60 seconds, by turning and rubbing rock and debris surfaces in riffles, with the current carrying all dislodged material and organisms into the downstream net, and by stirring bottom pool substrata and using sweeping hand motions to sweep dislodged and suspended pool material and organisms into the D-net. Each of the composited riffle and pool samples are processed in the field by rinsing, cleaning and discarding rocks, leaves, wood, moss, and lichens after collecting any clinging invertebrates, elutriating remaining material to collect invertebrates, then hand-picking the remaining sand to remove mineral-case caddisflies, mollusks, and any other heavy invertebrates. These processed samples are preserved in 90% ethanol and stained with Rose Bengal to aid in later laboratory sample sorting. Each composited riffle and pool sample is subsampled in the laboratory using a rotating-drum sample splitter to sequentially divide the sample into fractions to obtain 500 to 1000 organisms which are then sorted, identified and counted. All invertebrates are identified to the level of genus or species (including midges and water mites) with the exception of oligochaetes (segmented worms) and ostracods (seed shrimp), which are not further distinguished. These studies are conducted in collaboration with the Pacific Southwest Research Station of the US Forest Service in Fresno (Carolyn Hunsaker, project leader). The annual and seasonal data collected over the pre-treatment period forms a baseline for establishing current, natural variability in stream invertebrate communities. These data are currently being analyzed and prepared for publication. The proposed research, then, will allow us to compare statistically these pre-treatment baseline data to post-treatment data to determine how stream invertebrate communities respond to tree thinning in their basins.



David Herbst **1/15/2011 to 3/31/2012** **\$29 801**
 Southern California Coastal Water Research 8281

Database Preparation and Merging for Transfer of SNARL Bioassessment to SWAMP - Physical and Benthic Macroinvertebrate Data from Stream Surveys

(I) Data compilation from all years of SWAMP collections (2000-2008) in Access database format, organized for compatibility with SWAMP database. Work performed by Scott Roberts in cooperation with Dave Herbst. Physical Habitat Data Entry Biological Data from Benthic Macroinvertebrate Collections Data Entry Meta-data records to specify procedures and changes in all methods used for both field and laboratory protocols over the entire period of data collection (II) Contact coordination between Marco Sigala and Scott Roberts to facilitate data transfer. Database management to organize tables of data into proper structure to make transfer compatible and accurate. Merge SNARL data into SWAMP. (III) Quality control checks of taxonomic lists from early years of collections 1996-1999. Involves examination of every vial of sorted and identified specimen from all samples to verify that the taxonomic designations are correct (performed by Dave Herbst). Deliver taxonomic justified database. (IV) Contact between Dave Herbst and SAFIT / ABL taxonomy groups to ensure compatibility of SNARL data set with SWAMP taxonomic lists. Cross-checking of naming conventions, validation of uncertain identifications, and additions of new taxa.

David Herbst **8/25/2008 to 9/30/2013** **\$73 270**
 USDI Fish and Wildlife Service 14620-8-J161

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

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 enclosures permits examination of the independent influence of horse grazing. The success of enclosures 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

9/3/2008 to 9/30/2012

\$66 000

USDI Bureau of Land Management L08AC14572

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, approved 1995.



Scott Hodges

10/1/2010 to 9/30/2013

\$1 725 740

Susan Mazer

Ruth Finkelstein

National Science Foundation OTA-0963547

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. This project will have many direct broader impacts, particularly through the training of undergraduates, graduate students and postdoctoral associates. Numerous independent research projects will be possible given the number of independent greenhouse bays and concomitant possible environments. This diversity will allow students to investigate a broad range of plant species and research questions. In addition, research questions on

invasive species and their biological control will have direct societal impacts. The facility will be used to advance the development of a new model genomic system, and these resources will be available to the wider research community. Further research into the genetic mechanisms affecting seed quality and germination will have direct relevance to mitigating crop losses due to pre-harvest sprouting.

Gretchen Hofmann

1/1/2010 to 12/31/2013

\$2 469 005

UC Office of the President 142997

Ocean Acidification: A Research & Training Consortium

The goal is to form a multidisciplinary collaboration to study ocean acidification (OA) and its impacts on the coastal marine ecosystems of California. As the need to forecast the impacts of ocean acidification on marine ecosystems has become more urgent, it is clear that sound science and contributions to strategies will only be found through multidisciplinary collaborations within the broad marine science community. Thus, we propose a consortium to integrate and strengthen our research programs to work on critical questions about how ocean acidification will impact marine communities. In addition, we propose to focus especially on designing and implementing multidisciplinary training for graduate students and postdoctoral fellows, and a major part of the budget will be used for traineeship support. These efforts will position UC to compete more effectively for upcoming federal funds to study ocean acidification, and train the next generation of scientists who will contribute to knowledge on ocean acidification and impacts on the California coast. The activities of this proposal will fulfill three goals that are central to the UC MRU program. (1) The studies described here will directly address the impacts of climate change on coastal marine ecosystems, a critical issue for California, (2) this proposal strategically prepares a research team within UC that can compete for external research funds for the study of ocean acidification, and (3) support for this group will build a multidisciplinary team that takes advantage of complementary expertise among graduate students and postdoctoral fellows in the UC system. Ultimately, this program will serve as an outstanding recruitment tool to attract high quality graduate students to the UC campuses.



Gretchen Hofmann

12/1/2010 to 11/30/2012

\$48 000

UC Sea Grant College Program R/OPCENV-09-S

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

The project will be conducted by a multidisciplinary team of experts in physical chemistry, biological oceanography, molecular ecology, and management of marine resources. Team members include: Victoria Fabry, Professor, CSUSM, biological and ecological impacts of ocean acidification Andrew Dickson, Professor-in-Residence, UCSD, inorganic carbon system in seawater Gretchen Hofmann, Professor, UCSB, use of genomic tools in assessing affects of climate change Jeffrey Abell, Assistant Professor, Humboldt State University, carbon, oxygen and nitrogen cycling in oceans Richard Feely and Chris Sabine, Chemical oceanographers, NOAA's Pacific Environmental Marine Laboratory, field observations of oceanic uptake of anthropogenic CO₂, pCO₂ sensors Deborah Aseltine-Neilson, Senior Biologist Specialist (Marine/Fisheries), Department of Fish and Game, research and data partnerships 3 Sea Grant Interns (1 each at CSUSM, UCSD, and UCSB) 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 4/8/2011 to 12/31/2011 \$56 701
Steven Gaines
Libe Washburn
Oregon State University F0696A-C

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 9/1/2010 to 8/31/2013 \$599 034
National Science Foundation IOS-1021536

Synergistic effects of climate-related variables on larval sea urchins: Performance to gene expression

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

Gretchen Hofmann 8/1/2010 to 7/31/2014 \$613 812
National Science Foundation ANT-0944201

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. For these experiments, sea urchins will be raised in culture at the habitat temperature for *S. neumayeri* (-1.8 °C) at different CO₂ partial pressures that are consistent with IPCC predictions of future levels of atmospheric CO₂. Then, we will perform a series of measurements on the early life history stages. We will: (1) assess the effect of CO₂-acidified seawater on the development of early embryos and larvae, (2) using morphometrics, examine changes in the larval endoskeleton in response to development under the high-CO₂ conditions of ocean acidification, (3) using a DNA microarray, profile changes in gene expression for genes involved in biomineralization and other important physiological processes, and (4) measure costs and physiological consequences of development under conditions of ocean acidification.



Gretchen Hofmann
Carol Blanchette
Libe Washburn

10/1/2010 to 9/30/2013

\$473 354

National Science Foundation OCE-1041229

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.

Gretchen Hofmann

5/1/2005 to 4/30/2012

\$735 623

National Science Foundation ANT-0440799

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

2/1/2012 to 1/31/2013

\$12 090

National Science Foundation OISE-1219542

INTERNATIONAL: The Energetic Cost of an Acidic, Warm Environment: Changes in Lipid Consumption of Pocillopora Damicornis Larvae

Emily Rivest, a graduate student advised by Dr. Gretchen Hofmann at the University of California Santa Barbara, will collaborate with Dr. Peter Edmunds (CSUN) to incubate larvae of the coral Pocillopora damicornis in seawater of combinations of CO₂ concentration and temperature. The treatment levels used in this experiment approximate current and end-of-the-century conditions experienced by these larvae in the surface ocean. Emily will collaborate with Drs. Chii-Shiang Chen and Hsing-Hui Li at the National Museum of Marine Biology and Aquarium, who will provide access to the necessary equipment and training to perform analyses to analyze the lipid content and composition of these larvae. From the data, we can then better understand how elevated CO₂ and temperature interact to challenge the energy budget of these larvae, facilitating predictions of effects on planktonic duration and settlement success. Emily will also use a SeaFET pH sensor to measure the variation of pH on the natal reef of the coral used in this study, working with Dr. Tung-Yung Fan at NMMBA.

Gretchen Hofmann

8/1/2010 to 7/31/2012

\$8 394

National Science Foundation OISE-1026358

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
UC MEXUS SB120050

7/1/2011 to 12/31/2012

\$14 230

The Effect of Ocean Acidification on Marine Ecosystems of the Pacific Coast of Mexico and the US: A Binational Approach to Studying Ocean Change

The primary objective of this proposal is to form a consortium to study the impacts of ocean acidification on the coastal marine ecosystems that are of central importance to Mexico and California. If funded we plan to name our group the Consortium for the Study of Ocean Change (CSOC, pronounced 'sea-sock'). The requested funding will support the following: (1) two workshops to develop the network, (2) activities to define best and shared practices in the OA research field, and (3) to create training opportunities for graduate students. Finally, we plan to use this network as a platform to seek additional funding from external agencies to support our collaborative research in ocean change. In order to facilitate the building of this network, the PIs have identified other options for external funding and are currently pursuing those opportunities. Specifically, these opportunities exist in a timely fashion for this group, should our proposal be funded. For example, the "Catalyzing New International Collaborations" (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12815) within the U.S. National Science Foundation has a deadline of September 1, 2011; additionally, the Partnerships for International Research and Education (PIRE) has recently announced a focus on sustainability and our group would be able to compete for these funds in the future (call for PIRE proposals to be released in April 2011; see http://www.nsf.gov/pubs/2011/nsf11025/nsf11025.jsp?WT.mc_id=USNSF_25&WT...). Within Mexico we have the opportunity to apply to the Basic Science Call for Proposals from CONACYT, to be released in July and December 2011 (see <http://www.conacyt.gob.mx/fondos/FondosSectoriales/SEP/Paginas/SEP-CONA...>).



Sally Holbrook

1/1/2011 to 12/31/2012

\$60 000

University of California San Diego SB110067

Re-Deployable CI for Environmental Observing Systems

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

8/1/2009 to 7/31/2012

\$310 310

John Melack

Los Angeles Department of Water and Power 87874

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.

Robert Jellison 4/1/2007 to 6/30/2013
USDI Fish and Wildlife Service F12AC00125

\$946 624

Limnological Monitoring of Walker Lake, Nevada, During a Period of Changing Hydrological Regimes and Stability

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.



Matthew Jones 11/17/2010 to 9/30/2011
Mark Schildhauer
Ecotrust SB110037

\$45 931

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.

Matthew Jones 8/1/2008 to 7/31/2013
Mark Schildhauer
Joshua Madin
Margaret O'Brien
National Science Foundation DBI-0743429

\$599 999

Semantic Enhancements for Ecological Data Management

The wide range of relevant data and the lack of standard methods used in ecological studies hinder current techniques for managing ecological data. This data heterogeneity creates several major informatics challenges that impede the sharing of data collected by individuals, institutions, and scientific communities. While current data management approaches include the use of structured metadata (e.g., EML - the Ecological Metadata Language) and community-wide data networks (e.g., KNB - the Knowledge Network for Biocomplexity), software tools are still needed that address the often-subtle and implicit semantics of ecological data. Such tools in particular must encode and utilize the semantics of scientific observations to directly confront issues impending broad-scale discovery, access, interpretation, and synthesis of data by ecologists. The development

and use of formal ontologies has become more prevalent within ecology and the environmental sciences. However, efforts towards ontology standardization and development of production software systems to leverage these advances and facilitate adoption by the broader community are still needed, especially when compared to the benefits gained by similar efforts in other scientific disciplines such as molecular biology and biomedicine. The investigators propose to reduce this gap by leveraging existing ontology standardization efforts within the community, developing reference implementations of these standards, and incorporating these implementations into existing production systems for managing ecological data.

Matthew Jones 7/15/2008 to 6/30/2012 \$45 366
University of New Mexico 976014-873R

INTEROP: Creation of an International Virtual Data Center for the Biodiversity, Ecological and Environmental Studies

The scientific community needs infrastructure that enables open, stable, persistent, robust, and secure access to well-described and logically organized biodiversity, ecological and environmental data. What is needed is a virtual distributed network of data centers that seamlessly supports discovery and user-friendly access to a broad array of data, metadata, and other digital products that are archived securely and permanently in multiple locations. We will develop new community capacity and new technologies to support the design, implementation, and deployment of a Virtual Data Center (VDC) for biodiversity, ecological and environmental data—all founded on open standards and protocols for interoperability among existing and new data centers. Semi-annual week-long meetings of Technical Working Groups (engaging information scientists from data centers representing many diverse disciplines), a developer, and numerous students will contribute to VDC prototypes and adopting and adapting basic system interoperability standards, such as the Open Archives Initiative Protocol for Metadata Harvesting from the digital library community and various scientific community data exchange standards (e.g., SEEK EarthGrid protocols, the oceanographic communities' OPeNDAP protocol, and the web community's grid service protocols).

Matthew Jones 8/1/2009 to 12/31/2012 \$1 635 320
Stephanie Hampton
University of New Mexico 63014-873R

DataNetONE: Observation Network for Earth

NCEAS hosts the second Coordinating Node and supports three of the ten Working Groups. Co-PI Stephanie Hampton initially co-leads the DataNetONE community engagement and outreach activities until the AD CE&O is hired and, thereafter, serves as a co-leader of the Community Engagement and Education Working Group. She also will oversee integration of Best Practices modules into existing informatics presentations to all NCEAS working groups, reaching hundreds of scientists and students during the first phase of DataNetONE. Co-I Matthew Jones serves on the Core CI Team and acts as co-leader of the research and development activities during year 1 until the AD D&O is hired. UC Santa Barbara and NCEAS, as part of their commitment to DataNetONE, provide the 24/7 operational environment for the Coordinating Node and high-speed bandwidth access, as well as furnishing office space and conference facilities for the Node staff, students, and three Working Groups. NCEAS, through the leadership of Deputy Director Hampton and Director of Informatics Research and Development Jones, has extensive experience facilitating training, outreach, and interdisciplinary collaborative research by hundreds of scientists each year in its world class facilities. Furthermore, Co-I Jones provides leadership in earth observational science metadata standards, data management software, and scientific workflow systems.

Matthew Jones 8/1/2011 to 12/31/2012 \$149 920
Ecological Society of America DUE-1044359

Digital Resource Discovery and Dynamic Learning Communities for a Changing Biology

The Ecological Society of America (ESA) has requested that the National Center for Ecological Analysis and Synthesis be a sub-award on their proposal to the NSF NSDL program entitled "Digital



Resource Discovery and Dynamic Learning Communities for a Changing Biology.” The overall goals of this project are to enhance discovery and use of digital library resources from the EcoEd Digital Library and other digital libraries under the BEN (BioSciEdNet) umbrella. ESA intends to collaborate with the Cornell Lab of Ornithology Science Pipes project (NSF DUE-0734857) to achieve these goals in an undergraduate education context. Science Pipes now provides access to biodiversity data for students and teachers to create and share analyses and visualizations. NCEAS will collaborate with the Cornell Lab of Ornithology, specifically Paul Allen, and with ESA to extend Science Pipes to provide access to exemplar ecology datasets, data templates, and models that illustrate core ecological concepts. In addition, components will be added to Science Pipes to allow students to use these datasets and models in analyses and visualizations. This entails 1) communicating with Paul Allen from Cornell (and indirectly a panel of ecology educators) to determine relevant datasets, dataset templates, analyses, visualizations, and models to target for implementation; 2) developing a dataset upload feature for chosen dataset templates; 3) creating and deploying new Science Pipes components for targeted datasets, templates, analyses, visualizations, and models; 4) revision of those components based on teacher and student feedback; 5) providing links on Science Pipes to EcoEdDL resources supporting relevant datasets, analyses, and visualizations; 6) provide materials on the Science Pipes website to support use of these new components.



Matthew Jones 10/1/2006 to 5/31/2012 \$1 956 203
Mark Schildhauer
 National Science Foundation DBI-0619060

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 9/1/2007 to 8/31/2011 \$450 000
Mark Schildhauer
 UC Davis SUB0700051

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

This project will be led by the PI at UC Davis (Bertram Ludaescher). The UC Santa Barbara subcontract is led by the co-PIs, Matthew Jones and Mark Schildhauer. 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 UCSB project; Mark Schildhauer will engage with domain scientists to elicit project requirements; the software engineer will participate in the design and refactoring 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 Jones 2/1/2012 to 1/31/2013 \$382 409
Mark Schildhauer
Stephanie Hampton
 Prince William Sound Science Center 12-81-01

Collaborative Data Management and Holistic Synthesis of Impacts and Recovery Status Associated with the Exxon Valdez

The AOOS-led Long-Term Monitoring (LTM) and the PWSSC-led Herring Research and Monitoring (HRM) programs propose an ambitious monitoring and research agenda over the next five years. These efforts could facilitate a more thorough understanding of the effects of the oil spill if the new data and information on the spill-affected ecosystems are effectively managed and collated along with historical data on these systems, and then used in a comprehensive synthesis effort. We propose a collaboration among NCEAS and the AOOS LTM and HRM teams to help build an effective data management cyberinfrastructure for proposed monitoring efforts and organize these data with historical data, including previous EVOSTC-funded efforts, to prepare for synthesis and ensure all data are organized, documented and available to be used by a wide array of technical and non-technical users. Building on the LTM and HRM syntheses and modeling efforts and the 20-year historical data from EVOSTC projects and any available current data, NCEAS would convene two cross-cutting synthesis working groups to do a full-systems analysis of the effects of the 1989 oil spill on Prince William Sound and the state of recovery of the affected ecosystems.



Lydia Kapsenberg 6/1/2011 to 8/31/2013 \$14 990
Gretchen Hofmann
 University of Washington SB110188

Assessment of Ocean Acidification in the Channel Islands National Park and it's Impact on Local Marine Species

Ocean acidification (OA), the decline in surface seawater pH as a direct result of anthropogenic CO₂ dissolving into surface oceans, is expected to affect many marine species, especially calcifying organisms. The result of these biological impacts will likely alter community structure of key marine ecosystems. Upwelling systems, such as the California Current Large Marine Ecosystem, already experience periods of low pH that were not expected for several decades and may therefore be sensitive to further OA. The Channel Islands National Park (CINP) spans a temperature gradient associated with the California Current Large Marine Ecosystem seasonal upwelling, however, there are no data regarding the local near-shore carbonate chemistry. This research proposal involves (1) the assessment of current pH conditions and (2) its effect on marine species in the CINP along an upwelling gradient. Deployment of two autonomous pH sensors at Santa Cruz Island pier and Anacapa Island pier will assess current pH in the CINP, for the first time. Using these data and the CO₂-mixing system in the Hofmann lab that was designed to study OA, I will test the effect of OA on fertilization of two sea urchins species (*Strongylocentrotus purpuratus* and *S. franciscanus*) from each island and evaluate the variation in tolerance with respect to pH. The results of this research will provide insight into the evolutionary history of sea urchins and their potential to tolerate or adapt to future OA. This project will advance CINP resource management by initiating a pH monitoring program within the Park's waters and by documenting near-shore carbon chemistry for the first time as well as advancing understanding of the effects of OA on local marine organisms. This project will help provide information that may focus climate change management efforts, in order to preserve and protect the CINP for future generations.

James Kennett 9/15/2008 to 8/31/2013 \$495 175
 National Science Foundation OCE-0825322

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 ~700 ka. Resolving short-term climate behavior before ~150 ka is critical for understanding processes, thresholds, and feedbacks that contribute to abrupt climate change. Millennial-scale climate oscillations (Dansgaard/Oeschger 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 change on decadal time scales. The cores provide ultra-high resolution windows into climatic-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.

Roland Knapp

6/4/2012 to 7/30/2014

\$116 146

USDI National Park Service P12AC10522

Preventing the Extirpation of Mountain Yellow-legged Frog Populations in Sequoia and Kings Canyon National Parks Following Disease-caused Mass-mortality Events

Mountain yellow-legged frogs (*Rana muscosa* and *Rana sierrae*) are highly susceptible to amphibian chytrid fungus (*Batrachochytrium dendrobatidis*; "Bd"), and most populations are extirpated following Bd arrival at a site. Skin swabs collected from Spur Basin in Sequoia and Kings Canyon National Parks on two occasions in 2011 indicated the onset of Bd and increasing prevalence and infection intensity. These patterns indicate that a frog die-off is likely sometime during 2012. Field trials using anti-fungal treatment and augmentation of beneficial bacteria both show promise in changing the outcome of Bd outbreaks from frog population extinction to persistence. With the impending Bd outbreak in Spur Basin, we have an opportunity to markedly increase the chances of frog population persistence, and be able to compare the relative effectiveness of different Bd treatments. We will treat hundreds of frogs in several adjacent populations, thereby potentially changing the outcome from likely extirpation of these populations to long-term coexistence between frogs and Bd. This study will have important implications for future disease interventions that will be important in conserving the remaining mountain yellow-legged frog populations across their respective ranges.

Jeffrey Krause

4/1/2012 to 3/31/2015

\$453 487

National Science Foundation OCE-1155663

Group-Specific Diatom Silica Production in a Coastal Upwelling System

This project seeks support to understand the variability in the contribution of individual diatom groups to total silica production in a field diatom population as a function of dissolved silicon availability. The value of the ecological and biogeochemical insights that would be gained from knowledge of the performance of individual groups has inspired several attempts, but the partitioning of silica production among different diatom groups has never been done in the field. Bulk measures of silica production have been made in all types of marine environments. When silica production studies also have taxonomic data, the lack of information on the performance of individual species makes it impossible to allocate the measured rates among cells. The assignment of the most numerically abundant diatom as the highest contributor to bulk silica production potentially leads to erroneous conclusions given interspecific differences in cell size and Si uptake kinetics. Quantitative estimates of the contribution of individual diatom taxa to total silica production would improve our understanding of the major biological and ecological drivers of silica production and identify key diatom species for inclusion in food-web and biogeochemical models. The proposed work will test hypotheses related to the general theme of using species-specific data to improve our understanding of the factors regulating diatoms' role in elemental cycles and marine food webs. By combining bulk measures of silica production using the radioisotope ^{32}Si with measures of silicon deposition rates by individual cells using the fluorescent probe 2-(4-pyridyl)-5((4-(2-dimethylaminoethyl-aminocarbonyl)-methoxy)phenyl)oxazole or PDMPO, quantitative estimates of the contribution of individual diatom taxa to total silica production will be determined for the first time. This study will assess differences in the distribution of silica production among diatom species along gradients in dissolved silicon concentration in a coastal upwelling system, evaluate the role of cell size, abundance and Si uptake capacity in determining the contribution of individual diatom taxa to total silica production, and determine species-specific kinetic parameters for Si uptake which govern the ability of individual species to compete for dissolved silicon.



Jeffrey Krause
Mark Brzezinski
National Science Foundation OCE-1131788

1/1/2012 to 12/31/2014

\$256 128

Collaborative Research: Understanding the Role of Picocyanobacteria in the Marine Silicate Cycle

We propose to pursue our discovery of significant accumulation of silicon by marine picocyanobacteria of the genus *Synechococcus* to assess the contribution of these organisms to the cycling of biogenic silica in the ocean. Oceanographers have long assumed that diatoms are the dominant marine organisms controlling the cycling of silica in the ocean. Si cycling by diatoms is coupled to their processing of other nutrient elements with consequences for the sequestration of carbon in the deep sea. Recently, however, single-cell analyses of picocyanobacterial cells from field samples surprisingly revealed the presence of substantial amounts of silicon within *Synechococcus*. The contribution of *Synechococcus* to biogenic silica often rivaled that of living diatoms in the two systems examined. Moreover, size fractionation of biogenic silica indicates that up to 25% of biogenic silica can exist in the picoplanktonic size fraction. Given that picocyanobacteria dominate phytoplankton biomass and primary production over much of the world's ocean, these findings raise significant questions about the factors controlling the marine silica cycle globally, as well as the proper interpretation of biogenic silica measurements, Si:N ratios in particulate matter, and ratios of silicate and nitrate depletion. It also suggests that picocyanobacterial populations may be subject to previously unknown constraints on their productivity. The proposed work will have both laboratory and field components. Because cellular Si varies substantially among the field-collected samples and laboratory strains so far analyzed, the laboratory component will document variability in Si uptake and cellular Si concentrations, while determining what role physiological and phylogenetic factors play in this variability. We propose using strains of the cyanobacterium *Synechococcus* for which there are existing genomes. Three separate laboratory components will 1) use ^{32}Si radiotracer uptake experiments to assess the degree of variability in Si content and Si uptake kinetics among strains of *Synechococcus* acclimated to different levels of silicate, 2) characterize the intracellular distribution and chemistry of silicon within cells using fractionation techniques, density centrifugation, electron microscopy and x-ray absorption spectroscopy, and 3) use bioinformatic analyses of published genomes to determine whether uptake of Si can be predicted based on phylogenetic relationships, to identify candidate genes for inactivation and to develop probes for community structure that can be related to cellular Si content. Field work at the Bermuda Atlantic Time Series (BATS) site will assess the contribution of *Synechococcus* and diatoms to total biogenic silica in surface waters at times of the year when the former are typically dominant. Field measurements will include size fractionation of biogenic silica biomass and Si uptake, and synchrotron-based x-ray fluorescence microscopy. We will also attempt to characterize *Synechococcus* communities using various molecular approaches to help explain the substantial spatial and temporal variation in expression of this trait.

Armand Kuris
Ryan Hechinger
Kevin Lafferty
National Science Foundation OCE-1115965

8/1/2011 to 7/31/2016

\$2 149 227

Collaborative Research: Modeling Infectious Diseases: How much Ecological Complexity Must We Address?

This project focuses on how ecological complexity influences infectious disease dynamics and how we should best go about predicting disease dynamics. Ecological systems are undeniably complex and to fully understand their dynamics we must first take their complexity into consideration. One of the most complex aspects of ecology is how biodiversity interacts in ecological networks. Ecologists have been making strides toward describing and analyzing complex ecological networks, but are only very recently considering the role of infectious diseases. Particularly challenging is that infectious diseases affect ecological networks while ecological networks affect infectious diseases. The research will not only increase our understanding of infectious disease dynamics, but also illuminate the general role of infectious processes in ecological systems, helping ecological science better address the fundamental and overlooked implications of parasitism.



Armand Kuris 6/1/2012 to 5/31/2015 \$36 000
Kevin Lafferty
University of Tromso SB120155

The Role of Parasites in Food-Web Topology and Dynamics of Subarctic Lakes

UCSB will give assistance in the project work with field sampling of parasites from the Norwegian lake sites involved in the study, taxonomical analyses of sampled parasites, and quantitative analyses of collected data on food-web topology and functioning (June 2012 – Dec. 2014); host the postdoc candidate during a research visit at UCSB (Sept. 2013 – May 2014); and participate in the dissemination and publication of findings from the Project (June 2012 – May 2015).



Ira Leifer 8/1/2008 to 7/31/2013 \$236 742
Bruce Luyendyk
University of Mississippi 09-08-015

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. We propose a two stage proposal, a pilot stage (described herein) to demonstrate the principle, followed by a second stage to optimize the approach and determine system limitations in distance, resolution, discrimination of fish, signal to noise, and optimum frequency: Stage 1 Phase 1: Laboratory calibration Phase 2: Mapping in seep field Phase 3: Field seabed, boat-based deployments (scuba accessible) Stage 2 Phase 4: Scanning seabed multibeam sonar construction Phase 5: Field seabed long-term deployment (i.e., seabed power) Phase 6: Field data analysis

Ira Leifer 10/1/2008 to 9/30/2012 \$32 144
UC Mexus SB090059

Passive Acoustic Observations of Marine Seabed Bubbles

Passive acoustics is 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 (eg., Vazquez 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 longterm 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 proposed 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 8/1/2010 to 7/31/2013 \$110 711
Dar Roberts
Bruce Luyendyk
National Science Foundation
AGS-1042894

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

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).

Ira Leifer Lockheed Martin Corporation SB110071	4/1/2011 to 3/31/2013	\$45 500
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Multibeam Sonar Application to At-Sea Fish Aquaculture

We propose applying a multibeam sonar rotator system, ROSSCAN, developed for seep bubble monitoring at UCSB, to fish farming application for interfacing with ROV servicing. 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 proposal is to collaboratively with Lockheed Martin to adapt the ROSSCAN sonar technology to aid in ROV positioning and detection of other critical fish pen aquaculture applications including monitoring, fish health, mortality, and feeding for realtime response during long-term deployments.

Ira Leifer Bruce Luyendyk Cal State Lands Commission C2005-041	4/1/2006 to 9/30/2012	\$230 000
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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 National Science Foundation ARC-1023600	9/1/2010 to 8/31/2013	\$224 088
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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 (~10% of the world ocean shelf area) and the shallowest shelf (mean depth <50 m) of the world ocean. Until recently, the ESAS was not considered a CH₄ source due to subsea permafrost's impermeability, which completely isolated it from modern biogeochemical cycles. The ESAS stores the world's largest hydrocarbon stocks, mostly as shallow Arctic hydrates, and thus represents an enormous potential CH₄ atmospheric source that could result from global warming-triggered permafrost degradation. Increased CH₄ fluxes could occur as numerous weak seeps or strong bubble plumes over large areas. Due to the shallow nature of the ESAS, the majority of ESAS CH₄ likely avoids oxidation and escapes to the atmosphere. To assess whether sudden, large-scale CH₄ release occurs or is likely to occur in the future, we will investigate the migration pathway characteristics and identify the controlling factors of CH₄ flux from the seabed, in the water column, and to the atmosphere.



Levine
National Science Foundation DEB-0743365

3/15/2008 to 2/28/2013

\$338 106

Collaborative Research: Niche and Neutral Controls Over the Coexistence of 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.



Jonathan Levine

10/21/2004 to 10/31/2013

\$675 000

David and Lucile Packard Foundation 2004-27672

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

5/1/2012 to 4/30/2013

\$12 654

Erin Mordecai National Science Foundation DEB-1210378

DISSERTATION RESEARCH: Climate-Mediated effects of pathogens on plant communities

Although the effects of pathogens and parasites are known to cascade through foodwebs, this widespread group of species is among the least studied by ecologists. In plant communities, pathogens are often thought to regulate populations and maintain diversity, but theory also shows that pathogens can promote competitive exclusion via processes such as pathogen spillover from tolerant to intolerant hosts. Better understanding when these different alternatives arise in natural systems is of particular importance because climate change will likely alter pathogen dynamics, which may in turn, affect host population regulation and community composition. Motivated by this concern, the proposed research will address (1) how a shared pathogen influences the outcome of competition between plant species and (2) how climatic conditions influence pathogen effects on plant community dynamics. To accomplish this, the research will integrate field parameterized mathematical models of pathogen impacts on plant populations with a direct manipulation of climate conditions hypothesized to mediate disease risk in this system. Although pathogen spillover is an important transmission mechanism for wildlife disease, its consequences for host community dynamics are rarely investigated. This research will examine the impact of spillover of a widespread fungal seed pathogen from an invasive annual grass to a native bunchgrass in the Great Basin of North America. The effect of the pathogen on the outcome of competition between invasive and native hosts will be quantified by parameterizing population growth models with

field-collected data. Field plots will track competition and seed bank dynamics throughout the growing season, yielding demographic parameters for the models. The key within and between species transmission parameters influencing host population dynamics will be quantified by experimental manipulations of seed density in controlled settings. Finally, a field manipulation of fall rainfall conditions hypothesized to affect disease risk will examine the influence of climate variability on pathogen-mediated host community dynamics. The study will show how pathogen attack influences cheatgrass invasion and dominance, and how this influence depends on the pattern of precipitation in the region.

Lorraine Lisiecki 9/1/2009 to 8/31/2013 \$317 113
National Science Foundation OCE-0926735

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 10/1/2010 to 9/30/2013 \$157 017
National Science Foundation CE-1025444

CMG Collaborative Research: Probabilistic stratigraphic alignment and dating of paleoclimate data

Stratigraphic alignment is the primary way in which long marine climate records (105 – 107 years) are placed on a common age model. However, currently there are no techniques for quantifying the uncertainty associated with these alignments. We propose to build probabilistic models of an automated stratigraphic alignment algorithm for paleoclimate records [Lisiecki & Lisiecki, 2002] as a means of characterizing this uncertainty. The development of this uncertainty analysis is important because the relative timing of climate responses (derived from stratigraphic alignment) is frequently used to evaluate causal relationships within the climate system. Therefore, we will also assess the effects of alignment uncertainty on these evaluations. Additionally, we will develop a probabilistic algorithm for age model development through orbital tuning. The improved accuracy and error estimates for paleoclimate age models that result from this work will improve estimates of the climate system's sensitivity to changes in radiative forcing [e.g., Hansen et al., 2007; Meyers et al., 2008]. The original software developed by PI L. Lisiecki uses dynamic programming to find the optimal alignment of paleoclimate records based on user-defined parameter settings and produces one best-fit alignment with no uncertainty analysis. The new version will provide users with alignments sampled in proportion to their probability and will provide error bars for the estimated relative ages at each point in the alignment. Specifically, we will develop two probabilistic versions of the alignment algorithm (pairwise and multiple) in the form of (pair and profile) Hidden Markov models (HMM) and develop a probabilistic HMM for creating orbitally tuned age models for paleoclimate data. The algorithm for age model development will incorporate knowledge gained about sedimentation rate variability from the pair and profile HMM algorithms. All three algorithms will be applied to create a new stack model of benthic $\delta^{18}O$ records (a proxy for global climate) with uncertainty estimates which include data noise, alignment uncertainty and age model uncertainty. This "probabilistic stack" is scientifically important because it will yield uncertainty estimates for a widely used measure of past climate change. For example, the deterministic $\delta^{18}O$ stack of Lisiecki & Raymo (2005) has >300 citations. We also propose to develop statistical methods to characterize the shapes of the posterior distributions of stratigraphic alignments and orbital tuning. This alignment problem is in a large class of discrete high dimensional problems that often have complex multimodal solution spaces which are difficult to characterize. To date the characterization of these spaces has been limited to a point estimate(s) and Bayesian confidence limits around these high-D estimates. In this project we propose to develop novel methods for the identification of clusters from multiple modes in these



high-D spaces and characterize them as specific probabilistic models using both direct samples from the posterior distribution and the probabilities of each sampled value. Given the limited utility of point estimates and confidence limits in such high-D spaces, these probabilistic characterizations of posterior spaces will greatly improve our ability to describe such posterior spaces.

Lorraine Lisiecki 9/1/2011 to 8/31/2015 \$303 207
National Science Foundation OIA-1125181

CDI-Type II: Collaborative Research – 4 Dimensional Visualization of Past Ocean Circulation from Paleoceanographic Data

One of the fundamental challenges in the study of climate change is how to combine models of past oceanographic circulation (as reconstructed from sparse geochemical data taken from deep sea sedimentary cores) with modern ocean circulation models (as constructed from modern oceanographic observations and computer simulations) to yield insight into the processes governing ocean circulation throughout the last glacial cycle from 150,000 years ago to the present. Similarly, a major challenge in computational data analysis and visualization is how to extract topological/structural information from sparse, time-varying 4D datasets, and how to effectively combine human-in-the-loop analysis of data (computational thinking) with automated data analysis, to extract new knowledge about features and processes. Our multidisciplinary and multi-institutional project will bring together computer scientists, physical oceanographers, paleoceanographers, and computational geophysicists to develop an innovative suite of visualization and analytical tools to explore fundamental questions about changes in global ocean circulation. This project will merge innovations in flow-dependent data approximation and reconstruction and topology-based analysis of ocean flow with 40 years of paleoceanographically relevant geochemical data from deep sea sedimentary cores in order to gain new insights into features of past ocean circulation change that were not previously possible. Our research will take advantage of the unique analytical resources and unique interdisciplinary collaboration provided by the UC Davis KeckCAVES (W.M. Keck Center for Active Visualization in the Earth Sciences). The KeckCAVES provides a visualization instrument and collaborative environment that exploits the human capacity to visually identify meaningful patterns in complex datasets and to interact with the data through pattern recognition, change detection algorithms, human-in-the-loop computing, and computational thinking. In this unique collaborative environment, we will develop methods based on flow fields that improve data interpolation, develop techniques to automatically extract flow patterns and detect changes in flow over time, and develop interactive means of visualizing and interacting with those large and time-dependent datasets.

Milton Love 4/22/2010 to 5/31/2012 \$375 000
Department of Interior M10AC20001

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 6/4/2012 to 5/31/2015 \$250 000
USDI Minerals Management Service M12AC00004

Analysis of Fish Population at Platforms off Summerland, California

The purpose of this award is to use BOEM-funded pre-existing methodology, applied through SCUBA and Remotely Operated Vehicle (ROV) surveys, to obtain observations of fish assemblages at eight very closely grouped platforms, within the Dos Cuadras oil field, off Summerland, Santa



Barbara County, California. The detailed purpose is to characterize the fish assemblages around the platforms, describe the spatial and temporal patterns of fish diversity, density and size distribution among platform habitat types, complete analyses and synthesis documents for the eight platforms themselves and within the context of the manned submersible data from other Pacific platforms and natural reefs, complete standing stock (biomass) and fish productivity modeling for each platform when compared to other nearby natural reefs for which similar production estimates are readily available, and compare production estimates in the literature of other marine ecosystems. The issue of platform decommissioning and decisions related to decommissioning and possible reefing will be decided on a platform by platform basis with each of the platforms judged on its own merits as far as ecological value is concerned. The eight platforms off Summerland California, Platforms C, B, A, Hillhouse, Henry, Houchin, Hogan and Habitat have been in operation for over four decades and are expected to be some of the first to be in line for decommissioning. Information is needed as soon as possible for the use by the State of California to consider for decommissioning options under the California legislation AB 2503 (the California Marine Resources Legacy Act). The Act requires California to consider reefing OCS oil and gas platforms, if their ecological value warrants, before decommissioning and potential removal. This study will also extend the application of the methodology to develop results applicable specifically for BOEM management decisions so that BOEM can specify requirements to industry or other interested parties when decommissioning occurs. Using the results, BOEM can ensure that specified criteria can be properly evaluated during the decommissioning process pursuant to the federal regulations at 30 CFR 250.1730 and the State of California can ensure proper evaluation under the California Rigs-to-Reefs Program law AB 2503 (the California Marine Resources Legacy Act). Thus, the overarching purpose of this research is to provide those responsible for making decommissioning decisions with a much more detailed assessment of the fish assemblages of these eight platforms (and by extension a more accurate picture of their ecological importance) than is currently available.



Milton Love	10/1/2010 to 9/30/2013	\$100 372
UC Santa Cruz NA100AR4320156		

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.

Milton Love	9/22/2011 to 9/30/2015	\$949 395
USDI Minerals Management Service M11AC00008		

Renewable Energy in situ Power Cable Observation

The BOEMRE requires information concerning the level of impacts of electromagnetic field (EMF) on some marine species. Submarine transmission cables that power offshore oil platforms in the Pacific Region provide an opportunity to assess potential behavior and reaction of electromagnetic sensitive species to industry activities. By comparing the fishes and invertebrates that associate with 1) an energized power cable, 2) an unenergized power cable, and 3) nearby seafloor, it will be possible to determine how some marine organisms relate to an EMF. The information will be applicable to all renewable energy power cable EMF considerations and will determine effectiveness of the commonly proposed mitigation of cable burial.

Milton Love	6/1/2008 to 5/31/2013	\$192 236
USDI Geological Survey GO5AC00038		

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 part of Alaska.

Milton Love
Department Of Interior M10AC20001

4/22/2010 to 5/31/2012

\$400 000

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
USDI Minerals Management Service M12AC00003

4/23/2012 to 9/30/2013

\$100 000

Biological Productivity of Fish Associated with Offshore Oil and Gas Structures on the Pacific OCS

Understanding the similarities and differences in the biological characteristics of the fish communities associated with manmade structures and natural reef habitats in the Southern California Bight is important to evaluating the potential biological effects of oil platform decommissioning options. Since decommissioning these platforms is an unavoidable issue that will face California's ocean managers in the near future, understanding the environmental consequences of the two decommissioning alternatives being considered in this region, partial and complete removal, on local and regional fish populations will be important information to consider. The proposed project will use a biological model to produce estimates of the standing stock and annual production of fishes on platforms in the Southern California Bight based on existing empirical studies and compare these metrics to nearby natural reefs and other marine and terrestrial ecosystems. We have developed a preliminary model that starts with the current standing stock on a given platform, defined as the total biomass of each species, and then calculates the future production and standing stock based upon various platform decommissioning options. We are requesting additional funds to refine, improve and publish the model in a peer reviewed journal. Publication of this model will provide foundational information from which specified criteria can be properly evaluated during the decommissioning process associated with Bill AB 2503 (the California Marine Resources Legacy Act). Additionally, this study will provide further background from which to evaluate the potential of new habitat created by proposed installations by alternative energy projects, on the Pacific OCS, to contribute to local and regional fish standing stock and production.

Susan Mazer
USDI Geological Survey G10AC00510

9/13/2010 to 8/31/2011

\$49 900

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.

Susan Mazer

8/15/2007 to 9/30/2013

\$579 608

National Science Foundation IOS-0718253

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

8/30/2010 to 10/15/2013

\$286 000

USDI National Park Service J8C07100014

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

9/15/2011 to 6/29/2013

\$23 000

USDI National Park Service J8C07110020

Instruct Teachers to use phenology as a means to monitor climate change- Parks as Classroom

The University of California, Santa Barbara (UCSB) and Santa Monica Mountains National Recreation Area (SAMO) will host a series of teacher workshops on phenology- the study of plant leafing and flowering biological phenomena related to climate. Workshops will align with California Science

Content standards for Life Science/ Biology and Investigation and Experimentation. Workshops will meet standards for seventh grade science and high school biology/ ecology curricula. UCSB and the NPS will develop workshops so that teachers will learn how to identify stages of plant leaf, bud development, and create lesson plans. After the first workshops teachers will implement what they develop and have their classes monitor plants; report leafing and flowering times at their schools through databases such as Project Budburst or the USA National Phenology Network's (USA-NPN) Nature's Notebook. Follow up workshops will identify weaknesses and ensure quality control. Teachers who complete both workshops will be provided with transportation to the park so that students will learn more about native plants and be able to compare and contrast natural and urban habitats. Workshops will be completed during calendar year 2012 and will serve 40 teachers. Through these 40 teachers, based on average class sizes, approximately 4,600 students will be indirectly served. After participating in these workshops, teachers will be able to instruct students on the identification of plant parts including leaves and flowers. On campus, as part of their regularly scheduled laboratory time, students will record and monitor plants and their changes throughout the year. Specific activities will be developed to match the standards for seventh and high school students. This project will contribute to the scope of the National Park Service (NPS) California Phenology project, an existing collaboration between UCSB, USA-NPN and NPS to develop and apply monitoring protocols for using phenology as a means of understanding resource conditions in the face of climate change. Results of this Parks as Classroom project will be incorporated into the CPP as a model for other parks to use.



Susan Mazer

12/8/2011 to 9/30/2013

\$77 674

University of St. Thomas 260068

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

The transfer of *Clarkia unguiculata* seed lineages from UST to UCSB: The UCSB team will cultivate and conduct the final episode of artificial selection on one of the three wild populations of *Clarkia unguiculata* that are the subject of this study. These seeds include 60 maternal lineages produced by the selective breeding of four selection regimes (Early-flowering; High autogamy; and two Control groups [self-fertilized and outcrossed]). The UCSB team will cultivate these 60 maternal lineages and enforce selective breeding as planned in the original grant proposal while also completing the cultivation and selective breeding of the three populations of *Clarkia xantiana* ssp. *xantiana* that have been the focus of UCSB's breeding program to date. March 2012 – September 2012: PIs Mazer and Dudley will analyze data from completed greenhouse experiments to prepare lineages for the upcoming 2012-2013 field experiments. October 2012 – July 2013: PIs Mazer and Dudley will raise the selected lineages in natural habitats off-campus in the southern Sierra Nevada, as described in the original grant proposal. A field assistant will accompany us in the field. February 2012 – July 2013: The UCSB team will monitor (in the southern Sierra Nevada) field-raised genetic lineages of *Clarkia unguiculata* and *Clarkia xantiana* ssp. *xantiana* prior to and during flowering to: 1) Determine whether phenotypes of lineages selected in the greenhouse (Early-Flowering and High-Autogamy, relative to the Control groups) through our artificial selection regime are also expressed in the field; 2) Measure the selected lineages' physiological rates and parameters under field conditions, including photosynthetic rate, transpiration rate, water use efficiency, water potential, and chlorophyll fluorescence; 3) Conduct phenotypic selection analysis in field-raised genetic lineages to estimate the direction and magnitude of natural selection (estimating both linear selection gradients and selection differentials) on the above-mentioned physiological rates and parameters; 4) Evaluate whether genetic correlations between flowering date and floral traits associated with self-fertilization are expressed in the field such that selection favoring early flowering may drive or promote the evolution of self-fertilization. 5) Collect seeds from field-raised plants to estimate fitness under natural conditions. July 2013 – August 2013: PIs Mazer and Dudley will prepare data sets and analyze data from the field component of this research.

Susan Mazer

10/15/2011 to 9/30/2013

\$137 317

University of Minnesota D002520602

Project Baseline, a Living Plant Genome Reserve for the Study of Evolution

The goal of this project is to collect seeds from multiple populations of each of 30-40 wild species of plants native to or introduced to California; these seeds will then be archived in the National

Germplasm Resources Lab in Fort Collins, Colorado. In the future, these seeds will be distributed to evolutionary biologists so that they can compare them to seeds obtained from the same populations in order to assess the degree and kind of evolutionary change that has occurred due to environmental change. Dr. Susan Mazer will direct all field components of this project that will be based in California and coordinate UCSB's research activities with collaborators in Minnesota and New York. The other collaborators (Dr. Julie Etterson [University of Minnesota-Duluth] and Dr. Steve Franks [Fordham University, New York]) will direct the field components to be performed in parallel in the Midwest and in New England. In addition, the activities of all collaborators will be integrated by a Project Director who will be based in Duluth. Susan Mazer's responsibilities include a variety of tasks that will require 1.5-2.0 months of activity per year, including: Recruitment of Assistant Specialist, who will perform many of the day-to-day activities of this project; assisting with species selection and the choice of collection locations in California; coordinating with the Project Director at UMN-Duluth and the Assistant Specialist at UCSB to plan the annual collecting route and collection sites; designing the most efficient collection schedule for the selected taxa; soliciting, writing, editing, and disseminating contributions to Project Baseline eNewsletter that reports each region's progress in the collection of seeds and provides communication among teachers, park staff, reserve docents, and citizen scientists about educational programs involving seed collection, seed preservation, and phenology; supervising the Assistant Specialist's adherence to Project Baseline protocols and data management plan; collation and organization of environmental data to be transmitted to the Project Director; designing and participating in training workshops to introduce the public, graduate students, and other scientists to the principles and methods of Project Baseline.



William McClintock
Steven Gaines

1/1/2011 to 12/31/2011

\$150 000

The Tides Foundation SB110057

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: 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. 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. Extending our data model and user-interface to support point, line, and 3d model representations of designs in addition to the existing polygon support. 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. Improved data discoverability and accessibility for content generated for and within MarineMap. 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. 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. 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.

William McClintock	12/31/2010 to 12/31/2011	\$1 407 771
Resources Legacy Fund Foundation 2008-0046M		

MarineMap Decision Support System

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. Dr. Will McClintock, Technical Director; GIS Manager; GIS Analyst; Cartographer; and Technical Assistant will perform the following tasks: Technical Director Provide project leadership; Systems architectural design and administration; Database development; Internet map service development; and Decision support tool management. GIS Manager Direct GIS staff, including GIS Analyst and Cartographer, in the production of maps and analytical reports; and Liaison between MLPA Initiative staff and GIS team. GIS Analyst Provide additional GIS analytical support and programming as directed by the Technical Director for the DSS; and Attend MLPA Initiative meetings to provide GIS support, as needed. Cartographer Create maps for MLPA Initiative study region regional profile and MPA proposals; Attend MLPA Initiative meetings to provide GIS support, as needed. Technical Assistant Provide Web-based tool development support and database support.

John Melack	6/1/2010 to 5/31/2012	\$150 000
Bodo Bookhagen		
Scott Cooper		
Carla D’Antonio		
Christina Tague		
National Science Foundation DEB-0952599		

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 Niño 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.

William Murdoch	8/26/2010 to 6/30/2013	\$960 000
Susan Swarbrick		
Dept of California Fish and Game WC-1014CF		

Sedgwick Reserve Infrastructure and Facilities Project: Phase 2

Sedgwick Reserve has all the attributes of a world-class field site for university research and teaching, except that its facilities are wholly inadequate. This proposal is for the development of basic infrastructure. It follows an initial phase and is prelude to a subsequent phase. The three phases, collectively, will create the needed facilities. The aim of the entire project is to create the facilities and infrastructure needed to serve Sedgwick’s current and projected needs and to turn it into a world-class natural reserve and field station. The Reserve currently supports 40 research projects including a number of long-term externally-funded programs investigating environmental problems important to preserving and managing California’s natural living resources. About 400 students in 20 university courses use the reserve each year. The reserve has vigorous K-12 educational programs, including field trips for more than 700 students (many from under-served groups) from 23 schools



and an environmental science program for 150 4th and 5th graders. There is a very active and large docent program, and partnerships with many local agencies. Our aim is to greatly increase research use and to fill out the teaching and outreach programs. The major facilities to be added over the entire project include the following: fully adequate infrastructure housing for the reserve director and the reserve steward a research center with accommodation for several researchers, kitchen, dining room, offices and wet/dry lab (remodel of existing Ranch House) a 12-bed dormitory for researchers and students a meeting house (capacity 75) with offices for the NRS staff an astronomical observatory with 1-meter telescope linked to a global telescope array a workshop, storage facilities, and a heritage center (refurbished existing hay barn) an upgrade of the existing Art Studio (capacity 30) for meetings and conferences. In preparation for the project, in 2004 through 2006 we developed a Master Plan and completed an EIR, improved the mile-long entrance road and repaired the Ranch House roof. In Phase 1, during the past few years, we constructed a solar-power-generating system, a pipeline that brings potable water into the reserve from the adjacent Woodstock community, an electronically-controlled entrance gate (essential for security), and an outdoor meeting area. Funding for 99% of this development came from private donors (total value \$1,088,472). The current proposal (implementation of Phase 2) will create the basic infrastructure needed for future facilities plus one emergency renovation. Infrastructure development includes: construction of the wastewater system distribution of a potable water supply upgrade of the electrical supply and distribution system and communications repair of fencing for controlled grazing & vehicle traffic emergency renovation of the Art Studio roof construction of a maintenance shop removal of 2 existing buildings. During the final phase, Phase 3, we will construct the two residences, the dormitory, the meeting house, and the astronomical observatory renovate the Ranch House (to create the research center), the Art Studio and the Heritage Barn. The complete project will increase both the quantity and quality of research and teaching at Sedgwick Reserve. Regarding quantity, we will triple the number of researchers and students that the reserve can accommodate overnight. The increase in student numbers will come mainly from University level classes. Regarding quality, the main changes will be increased quality of life for overnight-users, reserve staff and others working on the reserve, the ability of university classes to stay for longer periods, and, most important, the ability of researchers both to stay for long periods and to have the security to carry out long-term projects lasting a decade and more.



Craig Nelson	6/1/2012 to 3/31/2014	\$40 000
Roland Knapp		
Cal EPA Water Control Board 11-167-160		

Assessment of Bacterial Water Quality at Targeted Streams in the Eastern Sierra

The State Water Board and the Lahontan Regional Water Quality Control Board regulate the quality of California's surface waters in part via the adoption and enforcement of water quality standards for bacterial indicators. The Water Boards' current bacterial indicators and standards are decades old. The Water Boards need modern tools and information regarding bacterial indicators in order to amend and update existing water quality standards for bacteria, to adopt new or complementary water quality standards for bacterial indicators, and to develop appropriate Total Maximum Daily Loads (TMDLs) for bacteria and pathogens. This study shall examine the relative concentrations of various bacterial indicators at streams in California's eastern Sierra Nevada (Lahontan Region), using modern as well as traditional methods.

Craig Nicholson	2/1/2012 to 1/31/2014	\$40 000
University of Southern California Y81716		

Evaluating 3D Fault Geometry in Special Fault Study Areas and Improving the SCEC Community Fault Model (CFM)

I propose to continue conducting detailed studies of active faults along major fault zones in southern California. The primary focus would be to generate new and improved 3D fault models of principal slipsurfaces, especially in designated or soon-to-be-designated Special Fault Study Areas, and to incorporate these new fault representations into CFM in collaboration with Andreas, John, Egill and other members of the SCEC CFM Working Group. This includes evaluating earthquake hypocenters and focal mechanisms, developing new digital 3D fault surfaces for inclusion in CFM, and evaluating existing alternative fault representations. In 2011, we made substantial progress in developing revised 3D fault models for the San Andreas, San Jacinto, Elsinore-Laguna Salada and

other fault systems [Nicholson et al., 2011]. For 2012, we plan to largely focus on revising 3D models for other complex fault areas within the Transverse Ranges region and in specific Special Fault Study Area's to insure greater compatibility and consistency with the Qfault database and the relocated seismicity at depth. In addition, Andreas and I will complete the re-organization of the CFM-v.4.0 fault database to allow for a more systematic naming, numbering and database search system that can account for the increasing variety and complexity of multi-stranded principal slip surfaces, adjacent secondary faults, and alternative fault representations that have been, or are now currently being developed for CFM. Nominal travel funds have been included in the budget to allow Andreas and I to collaborate on and complete this CFM re-organization project.

Craig Nicholson

4/1/2012 to 3/31/2013

\$54 263

USDI Geological Survey G12AP20066

Mapping the 3D Geometry of Active Faults in Southern California

Accurate assessment of the earthquake hazard in southern California requires an accurate and complete description of the active faults in three dimensions. Dynamic rupture behavior, realistic rupture scenarios, fault segmentation, and the accurate prediction of fault interaction and strong ground motion all strongly depend on the location, orientation, sense of slip, and 3D geometry of these active fault surfaces. Several groups have now produced improved earthquake catalogs of relocated hypocenters and focal mechanisms in southern California [e.g., Lin et al., 2007; Hardebeck and Shearer, 2003]. These catalogs comprise over 430,000 earthquake hypocenters since 1981, and over 200,000 well-determined earthquake focal mechanisms. These extensive catalogs need to be carefully examined and analyzed, not only for the accuracy and resolution of the earthquake hypocenters, but also for kinematic consistency of the spatial pattern of fault slip and for the orientation and 3D geometry of active fault surfaces at seismogenic depths. The San Andreas fault system in southern California has a high probability of generating a major damaging earthquake. How big, when and where such an event will be generated will depend in part on subtle, complex variations in stress, strength and fault geometry, such as bends, offsets, changes in fault dip or strike, or other fault discontinuities that control fault segmentation and rupture behavior. As demonstrated by the 2010 El Mayor-Cucapah earthquake and previous events, rupture along major through-going faults in southern California can be complex and strongly affected by the sense of slip and relative orientation of secondary structures, including sub-parallel fault strands, left-lateral cross faults, tear faults, and basal detachments [e.g., Nicholson et al., 1986; Hudnut et al., 1989; Seeber and Armbruster, 1995; Nicholson, 1996; Carena et al., 2004; Lin et al., 2007; Nicholson et al., 2009; Hudnut et al., 2010]. Identification of these features prior to a major rupture, especially at seismogenic depths, often depends on a careful kinematic analysis of microearthquake hypocenters and focal mechanisms in three dimensions. I propose to continue various ongoing studies of seismicity patterns in both space and time to help identify and map active subsurface 3D fault surfaces, and to evaluate other geologic and geophysical data to improve our understanding of the regional tectonic framework and principal slip surfaces controlling crustal deformation in southern California. Active subsurface structures in and around San Geronimo Pass and the principal fault strands of the southern San Andreas and San Jacinto fault zones will be of highest priority. This project will largely consist of detailed kinematic analysis of large numbers of accurate relocated earthquake hypocenters and focal mechanisms to resolve active 3D fault geometry and patterns of strain accommodation. Where available, other sets of geologic and geophysical data, including surface topography, gravity, geodetic, and geologic mapping data, will be used. The results will be incorporated into both the Southern California Earthquake Center (SCEC) Community Fault Model (CFM), a digital database of 3D subsurface fault structure for southern California, and the USGS Quaternary Fault database, and thus used as input to UCERF-3 and for upgrading the USGS National Earthquake Hazard Maps in 2013. This effort is directly related to specific goals, objectives, and research priorities of Program Elements I and III for Southern California, as specified in the USGS FY2012 NEHRP Announcement. These include: Determine the activity of faults in southern California. Of particular interest are investigations of the San Andreas, San Jacinto, Elsinore and Newport-Inglewood faults, fault zones in the Transverse Ranges, and fault zones whose role in regional tectonics is not well understood. We encourage proposals to improve upon the synoptic understanding of the southern San Andreas fault system (including the San Jacinto fault) and its associated hazard. Use seismic data to determine earthquake source parameters and crustal structure, ... including further development and testing of 2- and 3-D structural models; Develop regional models of active deformation and of fault and earthquake interactions; Characterize the behavior of active fault segments and clarify the roles of seismic and



aseismic processes and seismogenic thickness. Los Angeles, San Bernardino, and Ventura basins are of particular interest; Further develop credible earthquake scenarios for the Los Angeles and San Bernardino regions.

Roger Nisbet

9/1/2007 to 8/31/2011

\$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.



Todd Oakley

6/1/2012 to 5/31/2014

\$14 991

Molly Pankey

National Science Foundation DEB-1210673

Dissertation Research: Transcriptomic Basis of Convergent Evolution in Bioluminescent Squid

The phenomenon of convergent phenotypic evolution fascinates biologists. Yet, the extent to which convergent molecular processes drive convergence at the phenotypic level remains unclear. Natural selection is frequently invoked to explain how taxa facing similar biotic or abiotic pressures may arrive at similar phenotypic solutions. I seek to understand if the possibilities of 'molecular solutions' for a favored phenotype are similarly limited. Is the combined power of selection and developmental/genetic constraints sufficient to give rise to traits convergent at both molecular and phenotypic levels? The recent feasibility of generating multiple transcriptomes with next-generation sequencing permits the examination of the genetic signature of convergence in study systems for which complex phenotypes are hypothesized to have evolved multiple times. Convergent forms of bioluminescence have originated often in diverse forms of life. Cephalopod molluscs include two distinct clades of squid which harbor closely related strains of luminous bacterial symbionts within elaborate, optically enhanced organs called "photophores". I am interested in understanding how the molecular profiles that underlie phenotypically similar traits relate to morphological and functional similarity by investigating 1) the phylogenetic origins of light-emitting organs ('photophores') in cephalopods; 2) the transcriptomic similarities among these phylogenetically convergent organs; and 3) the transcriptomic similarity among selected homologous traits for the same species.

Todd Oakley

6/1/2012 to 5/31/2015

\$353 629

National Science Foundation DEB-1146337

Collaborative Research: Eye Evolution in Sarsielloidea (Crustacea: Ostracoda): An Integrative Approach Based on Phylogenetics, Developmental Genetics, Behavior, and Optics

The genetic basis of phenotypic evolution is a topic of long-standing interest that has become approachable with new genomic technologies. We propose to resolve a species-level phylogeny for Sarsielloidea (Crustacea: Ostracoda), which will enable us to understand both the functional and genetic bases of an evolutionarily convergent phenotype. Multiple sarsielloid ostracods exhibit an amazing sexual dimorphism where only males have image forming eyes. Preliminary phylogenies

indicate the dimorphism evolved at least twice. Further resolving the phylogeny likely will point to additional convergent evolution. Preliminary manipulative experiments show that differential reproductive roles drive this dimorphism: Males use eyes to evade predators, which they are more likely to encounter than females because males leave the sediment more often in search of mates. In addition, the genetics of eye development is well understood in model arthropods, indicating candidate genes for the developmental control of eye dimorphisms in sarsielloids. By resolving sarsielloid phylogeny, two collaborating labs will be in a position to establish a foundation for a valuable and integrative research program to understand the genetic and functional bases of convergent characters. Therefore, we will be able to address fundamental evolutionary questions, such as whether the same ecological functions drive convergent phenotypes, and whether convergent developmental genetics underlie those phenotypes.



Todd Oakley 9/1/2010 to 8/31/2013 \$200 000
National Science Foundation IOS-1045257

Collaborative Research: Developing Genomic Tools for Integrative Biology Research

Biologists seek an integrated understanding of biological systems that ranges from genotype to phenotype. However, species amenable to phenotypic study were not always the same species that are amenable to genotypic study. Yet new technologies allow the development of genomic tools for most any organism, opening the door for genotypic studies in species and systems that are well-studied phenotypically. We propose to capitalize on new technologies and develop general protocols for sequencing the suite of genes expressed in a tissue. Specifically we will develop bioinformatic tools and tutorials for transcriptome analyses, including assembly, annotation, and evolutionary analyses. 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, integrating across levels of organization from genes to phenotype, and further elevating animal vision as a 'model phenotype' for integrative systems biology research.

Todd Oakley 10/1/2010 to 9/30/2014 \$669 457
National Science Foundation DEB-1046307

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: 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. Experimentally manipulate the evolutionary and genetic divergence of species to assess how these aspects of biological diversity control niche differences and community productivity. Conduct transcriptome analyses to identify the genetic basis of niche differentiation among species, and relate these to the production of biomass by phytoplankton communities.

Todd Oakley

4/1/2007 to 3/31/2013

\$516 798

National Science Foundation DEB-0643840

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.



Mark Page

4/1/2010 to 3/31/2014

\$869 438

National Science Foundation OCE-0962306

Sources of Particulate Organic Matter and Their use by Benthic Suspension-Feeders in the Coastal California Ecosystem

Understanding trophic connections and how resource variability affects consumers is necessary if we are to predict how food webs may shift in the face of environmental change. Macroalgae and phytoplankton support highly productive marine ecosystems. Research based on stable isotope analyses has supported the idea that macroalgal detritus, especially that of giant kelp *Macrocystis*, is a major source of dietary carbon to benthic suspension-feeders. However, our recent findings from a four-year stable isotope study suggest that phytoplankton, not kelp, are the main food resource for benthic suspension-feeders on reefs in the Santa Barbara Channel, and that variation in phytoplankton abundance, combined with feeding selectivity and the scale of consumer tissue turnover times, may drive variability in consumer isotope values. Our results suggest that a key assumption made in 'snapshot' isotope studies of coastal ecosystems over the past 20 years, that the isotope signature of coastal phytoplankton can be represented by that of offshore phytoplankton, could be incorrect. This assumption has been made because of the difficulty in separating phytoplankton from detritus to obtain an uncontaminated isotope signature, a problem in freshwater systems also. Our objectives are to 1) determine the contribution of phytoplankton and giant kelp detritus to the pool of suspended reef POM and whether POM composition varies with distance from kelp forests, and 2) evaluate how different components of the POM are used as food by reef suspension feeders. We propose to explore the contribution of phytoplankton and kelp detritus to POM in coastal waters using two complementary approaches: an advanced flow cytometry and cell-sorting system to separate phytoplankton from bulk POM, and analysis of essential polyunsaturated fatty acids (PUFA) in POM and consumers. We have obtained preliminary data that demonstrate the feasibility of both of these methods. Isotope values of isolated inshore phytoplankton and kelp, and compound-specific PUFA, will be used in mixing models to estimate contributions of these two major primary producers to suspension feeder diets. We will also test two hypothesized mechanisms that may influence isotopic composition of consumers: selective feeding on particular fractions of POM, and tissue turnover times. This project will provide new insights into the trophic support of benthic suspension feeders, an ecologically and economically important guild in coastal ecosystems. Our results will test the general hypothesis that giant kelp detritus is an important source of carbon to suspension feeders, a commonly accepted idea that needs re-evaluation in light of key assumptions that have been made in its support. Stable isotope analyses are an ideal tool for testing this hypothesis given the spatial and temporal scales of variability that exist in the abundance of phytoplankton and giant kelp at our study sites. Our proposal sampling scheme combined with longer-term data on producer biomass provided by the Santa Barbara Coastal LTER will enable us to capture this variability, which is generally missed by studies based on 'snapshot' stable isotope analyses.

Dorothy Pak
James Kennett
UC Office of the President SB090062

7/1/2008 to 8/31/2011

\$64 607

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 Pak
National Science Foundation OCE-0751803

9/1/2008 to 8/31/2013

\$90 915

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 biturbation), 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
University of Mississippi SB120113

9/1/2011 to 12/31/2012

\$348 497

Ecosystems Impacts of Oil and Gas Inputs to the Gulf (ECOGIG)

Together with collaborators Asper and Diercks we will deploy 4 deep times series sediment traps to collect time integrated samples throughout the year. The deployments must be put together, currently only 1 trap deployment exists. These traps will be deployed at strategic positions at the main sampling sites and will be turned at least around annually. Trap samples (20 per year per trap) will be analyzed for particle composition (microscopically), POC, PON, TEP, dry weight, PO13C, PO15N, oil (PAH) and corexit (doss). Biogenic minerals and Al or a different marker for resuspended material will also be measured. At the time of deployment and retrieval of traps the water column parameters, especially the distribution of marine snow will also be analyzed. This data will be put into context of sediment and water column data, which will also be collected within the project. Moreover, a series of experiments on the formation of marine snow in the presence of oil and/ or dispersant and on the characteristics of this snow will be preformed. Natural material and fresh oil, or aged oil with or without dispersant etc will be incubated and the formation of flocks monitored. This series of experiment will test all the different parameters potentially affecting flock formation – e.g. the aging of oil bacterially or by light. Sinking velocity of flocks, as well as composition, size and density will be characterized. The hypothesis that these flocks do not form by aggregation or from feeding structures is to be tested. In collaboration with Arnosti I will investigate the fate of such flocks, and the role of specific bacteria and changes in the bacterial community composition. During aging the change s in carbon, nitrogen, TEP etc will be monitored and the partitioning between phases tracked. Bacterial activity and turnover will be assessed. For this in situ and experimental work, we will be working at different sites, representing different types of releases of oil and gas. The above described measurements will be conducted at the different site to compare the impact of the release on flock formation and sedimentation.

Uta Passow
Alice Alldredge
National Science Foundation OCE-0926711

9/1/2009 to 8/31/2013

\$705 703

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 to 100 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
National Science Foundation OCE-1045330

7/1/2010 to 6/30/2012

\$79 903

RAPID Deepwater Horizon Oil Spill: Collaborative Research: Marine Snow and Sediment

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
Mark Brzezinski
Craig Carlson
National Science Foundation OCE-1041038

10/1/2010 to 9/30/2013

\$971 524

Will high CO₂ conditions affect production, partitioning and fate in organic matter?

The ocean has taken up ~30% of anthropogenic carbon, and future changes in marine biogeochemical cycling of carbon, and especially in the functioning of the biological carbon pump, will determine whether or not the ocean continues to be a strong sink for carbon. IPCC scenarios assume continued uptake of CO₂ by the ocean, but currently even the direction of change in the biological pump in response to increases in CO₂ is unresolved and controversial. Coastal waters are already experiencing episodic exposure to carbonate conditions that were not expected until the end of the century making understanding the response to these episodic events as important as understanding the long-term mean response. Among the most striking examples are those associated with coastal upwelling along the west coast of the US, where the pH of surface waters may drop to 7.6 and pCO₂ can reach 1100 μatm. Upwelling systems are responsible for a significant fraction of global carbon export making them prime targets for investigations on how ocean acidification is already affecting the biological pump today. It is the goal of this proposal to investigate the potential effects of ocean acidification on the strength of the biological pump under the transient increases in CO₂ experienced due to upwelling. Increases in CO₂ are expected to alter the path and processing of carbon through marine food webs thereby strengthening the biological pump. Increases in inorganic carbon without

proportional increases in nutrients result in carbon overconsumption by phytoplankton. How carbon overconsumption affects the strength of the biological pump will depend on the fate of the extra carbon that is either incorporated into phytoplankton cells forming particulate organic matter (POM), or is excreted as dissolved organic matter (DOM). POM and DOM follow very different paths through the pelagic ecosystem. POM is exported primarily through gravitational sinking. DOM can either form exopolymer particles that facilitate aggregation accelerating sedimentation rates of POM, or, in its dissolved form DOM export occurs when DOM that has accumulated in surface waters is carried to depth by physical processes. There is evidence that carbon overproduction leads to more carbon rich POM and to a rise in exopolymer formation, increasing particle aggregation and export. Carbon overconsumption may additionally enhance the production of low quality (high C: N) exudates that resist microbial degradation allowing a greater fraction of DOM produced under high CO₂ to accumulate in surface waters and eventually be transported to depth. Thus, ocean acidification may enhance the export of both POM and DOM strengthening the biological pump and accelerating the rate at which increases in atmospheric CO₂ are transferred to the deep ocean. Results from mesocosm experiments demonstrate that the mechanisms controlling the partitioning of fixed carbon between the particulate and dissolved phases, and the processing of those materials, are obscured when both processes operate simultaneously under natural or semi-natural conditions. Here, POM and DOM production and the heterotrophic processing of these materials will be separated experimentally across a range of CO₂ concentrations by conducting basic laboratory culture experiments. In this way the mechanisms whereby elevated CO₂ alters the flow of carbon along these paths can be elucidated and better understood for use in mechanistic forecasting models.



Stephen Proulx

7/1/2008 to 6/30/2013

\$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.

Stephen Proulx

9/1/2011 to 8/31/2014

\$608 274

Joao Hespánha

National Science Foundation EF-1137835

The Evolution of Dynamic Response Strategies: Optimal Control and Evolutionary Dynamics

Organisms are constantly responding to change. The abiotic environment fluctuates, physiological processes are noisy, and other individuals behave unpredictably. The dynamic changes in conditions over time contain information that can be sensed, remembered, processed, and acted upon. We define the dynamic response strategy of a genotype as the dynamical system they use to produce a response given a time series of sensed inputs. This project will develop theoretical approaches based on optimal control theory and population genetics to understand biological scenarios involving sensed environmental input and a dynamic response. Specific focus will be given to determining how the reliability of sensory input and the tempo of environmental variation relate to the optimal strategies for gathering, processing, and responding to information. The focus is on cellular dynamic response systems including simple gene regulation, regulation of interacting genes in a network, cellular sensory mechanisms, and competitive foraging. For each biological system, the mechanistic

details of the dynamic response will be modeled and population genetic techniques will be used to determine the evolutionary outcomes. The optimal control solutions define an upper bound to fitness and can be compared to the biologically constrained evolved strategies. This comparison will show how well biological systems can approximate the optimal solutions, explain the general principles behind the evolution of dynamic response strategies, and address whether the optimal solutions are evolutionarily achievable. This project has the potential to be transformative because our methods apply equally well to single cell responses, developmental responses, physiological responses, and behavioral responses.

Langdon Quetin
Robin Ross-Quetin

4/1/2011 to 3/31/2014

\$322 329

National Science Foundation ANT-1010688

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. Focus areas for the data synthesis proposed include: (1) A Principal Components Analysis and Canonical Correlation Analysis (PCA-CCA) approach, as recently used to document zooplankton abundance and distribution patterns, will be used for analysis of the time-series 1993-2008 of zooplankton and the biological-biological and biological-physical linkages. Three workshops will be convened with colleagues with complimentary hydrographic, sea ice and phytoplankton data to test hypotheses and produce manuscripts. (2) After full restoration, the bioacoustic data will be analyzed for patterns and/or trends in biomass and aggregation characteristics, and relationships to environmental factors and ecosystem function. With the British Antarctic Survey (BAS), zooplankton (Antarctic krill and other sound scatterers) biomass and aggregation characteristics within the Palmer LTER study region will be compared to the South Georgia region. These data will be archived in a format easily used by future investigators as a consensus on such variables as target strength emerges. (3) Secondary production experimental data will be modeled as a function of environmental variables such as food quantity and quality and individual size and sexual maturity, then integrated with acoustic biomass data to estimate secondary production rates and production:biomass ratios (turnover) and their spatio-temporal variability throughout the study region. In addition funds will bring to fruition separate collaborative efforts on somatic growth and life cycle timing for salps in this region (P. Kremer), and the use of Antarctic krill



length frequency data to explore linkages among populations around the continent (BAS). Included are resources for multiple data base activities: completion of sample analysis and data submittal for the 0708 field season, interactions with the Palmer LTER information manager, and submittal to the LTER data directory of completed derived products as described above.

Daniel Reed 1/1/2010 to 12/31/2011 \$2 737 349
Steve Schroeter, Mark Page
Simpson and Simpson Business and Personnel Services, Inc SB100050

San Onofre Nuclear Generating Mitigation Project Monitoring Program

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.

Daniel Reed 9/22/2011 to 9/30/2013 \$249 927
USDI Minerals Management Service M11SC00012

DOI Partnership: Distinguishing Between Human and Natural Causes of Changes in Kelp Forests Using Long-term Data from DOI Monitoring Programs

Monitoring and predicting the potential impacts of outer continental shelf (OCS) energy production on nearshore ecosystems requires an ability to distinguish between changes caused by natural processes and those caused by human activities. This ability is often hampered by the lack of long-term data to describe natural variation. Offshore southern California, two Department of the Interior (DOI) monitoring programs that focus on kelp forest communities have the potential to provide considerable insight into the patterns and causes of change in kelp forest ecosystems. Analysis of these data sets (which span 25+ years) will enable scientists and managers to evaluate possible impacts from offshore oil and gas and renewable energy activities and develop options to mitigate these impacts. This is especially important in light of global climate change and the need to understand the cumulative impacts of multiple projects on the OCS.

Daniel Reed 12/1/2006 to 11/30/2013 \$6 058 895
Steven Gaines
John Melack
David Siegel
Sally Holbrook
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.

Omer Reichman 3/15/2005 to 2/28/2012 \$365 914
National Science Foundation DEB-0444217

CRB: The Role of Apparent Competition and Patch Geometry in Mediating the Invasion and Restoration of Grassland Communities

Our NSF-funded research project is unique in its focus on the role of native consumers in affecting the success of invasive exotic plants. Our primary hypothesis is that exotic plants alter the foraging and abundance of native consumers, increasing the impact of native consumers on native plants (i.e. apparent competition; Holt 1977). Our current project has documented that vertebrate consumers can have important impacts on native plants (Orrock et al. in press), and mollusk herbivores may also prefer some native grasses (Motheral and Orrock in review). In addition to altering consumer impact, we have found that exotic plants also increase the abundance of rodent consumers (unpublished data). An open question is whether this change in rodent abundance leads to an increased prevalence of a tick, *Ixodes scapularis*, that attacks rodent and human hosts. This tick is the primary vector of *Borrelia burgdorferi*, the bacterium that causes Lyme disease. Lyme disease is the most frequently reported vector-borne disease in the United States, and rodents appear to be a key host affecting dynamics of ticks and disease transmission (see Ostfeld et al. 2006).



William Rice 4/1/2008 to 5/31/2013 \$670 624
University of Washington 541997

Drosophila 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 8/21/2009 to 12/31/2012 \$219 159
Langdon Quetin
UC Santa Cruz UCSB090185

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.

Cristina Sandoval 6/29/2011 to 3/31/2013 \$250 000
Susan Swarbrick
Cal Coastal Conservancy 10-112

Access Improvements and Restoration at Coal Oil Point Reserve

Staff is recommending that the Conservancy provide up to \$250,000 to the Regents of the University

of California (“grantee”) for coastal access improvements (the “COPR Access Project” or “the project”) at the Coal Oil Point Reserve (“the Reserve” or “COPR”) adjacent to Devereux Slough and owned by the Regents of the University of California (“Regents”), and managed by the University of California, Santa Barbara (“UCSB”), whose campus is nearby. The proposed COPR Access Project is a Tier One project on the Southern California Wetlands Recovery Project Work Plan and is recommended for priority funding. It is also the first project to implement the vision of the Ellwood-Devereux Open Space Management Plan to create a large coastal open space to serve the community and protect sensitive habitats. The project will enhance the quality of public access within the Reserve while providing increased protection for its natural resources. The Reserve is located near a large population center and the UCSB campus, is known for its scenic and ecological values, and is heavily used for recreation. The Reserve and surrounding open spaces are among the few natural coastal sites in Santa Barbara County that offer public access for recreation while simultaneously managing for protection of threatened and endangered plants and wildlife. Access improvements are needed to protect fragile habitats and ensure human activity occurs only in appropriate areas within the Reserve. The project will encourage visitors to stay on authorized trails and to avoid sensitive habitat areas using various approaches such as improving access points, closing and restoring unapproved trails, making improvements to the interpretive Pond Trail, replacing old fences and gates, and installing fencing and no-horse barriers in specified areas to reduce human impacts to sensitive areas. Trespassing has been successfully reduced on the northern and eastern perimeter of the Reserve by creating a “green fence”. All of the green fencing planted and planned for this project is on disturbed habitat and will replace exotic vegetation with native vegetation typical of the habitat. Thus the green fence serves as habitat restoration in addition to encouraging appropriate access. The proposed access improvements will be further enhanced by other improvements being implemented at the Reserve including the installation of 20 interpretive signs and development of a downloadable podcast to provide self-guided tours along Reserve trails. In addition, fundraising has begun to create an interpretive nature center on a nearby site recently acquired by the University and to take over management of the Cliff House. Collectively, these projects will provide unique and important opportunities to enjoy and learn about this special area. The Reserve proposes to construct access improvements at four sites within the Reserve and at one site outside the Reserve boundary on adjacent land owned by the University. Access improvements will be constructed at the public accessway at Sands beach (see Exhibit 2, Figure 4, Access B). An existing gate and 86 feet of aging chain-link fence will be replaced by a three-rail Woodcrete fence. The fence will be built in exactly the same position as the existing fence and the accessway through the fence will mimic the shape and location of the existing accessway to allow only pedestrian access to the beach. In addition, a six foot gate will be installed but kept locked to be used for emergencies, such as removing injured people and marine mammals from the beach. The proposed project also includes several improvements along the Pond Trail (Exhibit 1). The Pond Trail follows the western edge of the Devereux Slough mouth (Access C) to the Reserve’s northern access point, where it meets the Coastal Trail and the De Anza Trail. The main Pond Trail will remain in its current location, but other existing informal branching trails will be closed to protect sensitive habitat areas. To keep hikers on the designated Pond Trail wood log borders will be laid along each side of the trail. Shrubs and other native plants appropriate for the habitat will be planted outside of the log borders to eventually create a green fence around the trail. If the logs are removed or vandalized by people at any specific location along the trail, a post-and cable fence will be installed. At the northern boundary of the Pond Trail, an L-shaped trail entrance (similar in design to the entrance for Access B, described above) will be installed where none currently exists to allow pedestrians but prevent horses and bicycles from entering the trail. A 32-foot section of Woodcrete fencing will be installed on each side of the entrance. The southern end of the Pond Trail bisects the dune swale that connects the dune pond to the slough. During the rainy season this portion of the trail can flood. To allow continued access through this area during the rainy season a roll-out boardwalk will be laid out over the flooded section of the trail. This temporary boardwalk will not prevent people from stepping on water when the area is flooded but it will encourage people to stay on the path rather than walking on wetland vegetation. In addition, approximately six inches of fill on the trail will be removed to restore the hydrological connection of the dune swales on each side of the trail. The westernmost access point (Access D) is located on UC Santa Barbara’s South Parcel on North Campus, just outside the western boundary of the Reserve. At this access point, the trail from the bluff to the beach will be regraded to remove existing erosion ditches and control future erosion. In addition, the iceplant around this access point will be removed. The beach and bluffs will be revegetated with locally sourced native plants. A 760-foot long Woodcrete three-rail fence will be installed on the Reserve side of the western trail access to reduce unauthorized access to the dunes and wetlands from this area. Coal Oil Point Natural Reserve



is owned and managed by the University of California as part of its Natural Reserve System (“The NRS”). The Coal Oil Point Reserve Director lives on the site and coordinates all Reserve activities . The Director will be responsible for supervising this project. The Reserve is unique among the NRS sites because of its proximity to a large urban population, requiring a significantly higher level of management. Active habitat restoration at the Reserve has been carried out for over ten years and all projects have had successful outcomes. A large number of students and community members participate in restoration on the Reserve. In 2009, 900 volunteers participated in restoration workdays. Utilizing volunteers is cost-effective and helps the Reserve achieve its outreach and education goals.

Mark Schildhauer

3/1/2011 to 6/30/2013

\$196 424

University of Arizona Y562553

iPlant/NCEAS Collaboration to Build the BIEN and Environment & Organisms Working Groups' Informatic 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: developing an integrated information resource merging daily ground-based weather station data with satellite based measurements of weather; 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; 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; 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. The GA will work most closely with Drs. Brian McGill, Rob Guralnick, and Walter Jetz for scientific guidelines and deliverables tasking. Drs. Mark Schildhauer and James Regetz at NCEAS will provide direct supervision of the GA, and oversight of his/her activities relative to the collaboration among the iPlant and NCEAS technologists, and related Working Group activities (Environments & Organisms with McGill et al.; and BIEN with Enquist et al.). The GA will be a member of the geospatial infrastructure (GSI) group at iPlant and will be expected to participate in team meetings and work towards delivering the environmental layers specified in use cases developed by the GSI group headed by Brian Enquist and Nirav Merchant. The database developer will work in close collaboration with scientists associated with the NCEAS' BIEN Working Group, as well as iPlant and NCEAS' technical personnel, to create a web-accessible database in support of the Botanical Information and Ecology Network project. The envisioned database must accommodate multiple-millions of records of plant biodiversity data, including information about their taxonomic identity, geospatial location, time of sampling, as well as potentially related information regarding co-occurrence with other taxa, sampling methodologies, functional traits, and associated environmental measurements. Key deliverables will include: developing an integrated information resource by merging several well-established plant occurrence information resources, including specimen data from various natural history and botanical museums, as well as plots data; creating useful and appealing web interfaces and services for uploading and accessing these data for quantitative investigations of plant biodiversity; merging this information resource with other services and tools under development within the iPlant cyberinfrastructure, such as for taxonomic name resolution or geospatial quality control, as well as related efforts; planning for the architecture of this framework to be compatible with emerging data confederations in the earth and life sciences, such as DataONE and/or the Data Conservancy enabling this resource to be extensible to accommodate the growing array of relevant information useful for biodiversity research, including but not limited to information about geospatial and environmental context, plant phylogenies, and associated genomic and functional trait data. The DBD will work most closely with Drs. Brian Enquist, Brad Boyle, Rick Condit, Bob Peet, James Regetz, and Mark Schildhauer for scientific guidelines and deliverables tasking. Drs. Jim Regetz and Mark Schildhauer at NCEAS will provide direct supervision of the DBD, and oversight of his/her activities relative to the collaboration among the iPlant and NCEAS technologists. The DBD activities will also coordinate activities with the complementary activities in



plant sciences, including especially developments in geospatial intelligence technologies underway through the Environments & Organisms Working Group collaboration between iPlant and NCEAS.

Mark Schildhauer

8/1/2008 to 7/31/2014

\$750 000

National Science Foundation DBI-0753144

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

Advances in environmental science increasingly depend on information from multiple disciplines to tackle broader and more complex questions about the natural world. Such advances, however, are hindered by data heterogeneity, which impedes the ability of researchers to discover, interpret, and integrate relevant data that have been collected by others. A recent NSF-funded workshop on multi-disciplinary data management concluded that interoperability can be significantly improved by better describing data at the level of observation and measurement, rather than the traditional focus at the level of the data set. That is, for systems to interoperate effectively, the scientific community must unify the various existing approaches for representing and describing observational data. A community-sanctioned, unified data model for observational data is thus needed to enable interoperability among existing data resources, which will in turn provide the necessary foundation to support cross-disciplinary synthetic research in the environmental sciences. The investigators propose the Scientific Observations Network to initiate a multi-disciplinary, community-driven effort to define and develop the necessary specifications and technologies to facilitate semantic interpretation and integration of observational data. The technological approaches will derive from recent advances in knowledge representation that have demonstrated practical utility in enhancing scientific communication and data interoperability within the genomics community. This effort will constitute a community of experts consisting of environmental science researchers, computer scientists, and information managers, to develop open-source, standards-based approaches to the semantic modeling of observational data. Subgroups of Network experts will also engage in extending this core data model to include a broad range of specific measurements collected by the representative set of disciplines, and a series of demonstration projects will illustrate the capabilities of the approaches to confederate data for reuse in broader and unanticipated contexts.



Joshua Schimel

9/1/2008 to 8/31/2013

\$254 239

National Science Foundation ARC-0806451

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 link 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
Sally Holbrook

8/1/2010 to 7/31/2012

\$48 105

National Science Foundation OISE-1045000

OISE IRE: Planning visit and workshop involving two marine LTER sites and two Chinese CERN sites

This proposal requests funds for (1) a planning visit to China by US LTER scientists and (2) a one-day workshop at Sanya, China to plan academic exchanges and research cooperation between two marine research stations of the Chinese Academy of Sciences (CAS) - the Hainan Tropical Marine Biology Research Station (South China Sea Institute of Oceanography) at Sanya, and the Jiaozhou Bay National Marine Ecosystem Research Station (Institute of Oceanography) at Qingdao. Both stations are members of the Chinese Ecosystem Research Network (CERN), which together with the US NSF LTER program, are founding members of the International Long Term Ecological Research network (ILTER). Six US scientists from two marine sites in the NSF LTER network – the Moorea Coral Reef (MCR) and the Santa Barbara Coastal (SBC) LTERs – will visit both research stations, the South China Sea Institute in Guangzhou, and the Chinese Academy of Sciences in Beijing. In addition, we will participate in a one-day workshop. Objectives of the planning visit are to: (1) initiate the next phase in assembling an East Asia Coral Reef Alliance by involving Sanya in an emerging network with Moorea, Taiwan and Australia; and (2) network with scientists at Jiaozhou Bay to explore possible China – US LTER temperate reef associations. The aim of the workshop is to lay the groundwork for collaboration on a geographic study of coral resilience. Goals of an East Asia Coral Reef Alliance are to foster research cooperation (including among-site contrasts) and to enhance international educational opportunities. We anticipate outcomes of the planning visits and workshop to include longer research visits by US coral reef scientists to Sanya in 2011 and beyond, a PIRE submission on the next funding cycle, and a reverse visit by Chinese scientists to UC Santa Barbara. This grant will support the travel of a 6-person delegation to (1) visit CAS in Beijing and marine scientists in Qingdao (Drs. Sun Song and Yin Hong), Guangzhou (Dr. Tang DanLing) and Sanya (Dr. Dong JunDe, Dr. Huang Hui) over a 12 to 14 day period in August 2010, (2) participate in a one-day workshop at Sanya (hosted by Dr. Dong JunDe), and (3) house and feed 5 Chinese scientists on a subsequent reverse site visit.



Russell Schmitt
Sally Holbrook

9/1/2010 to 8/31/2013

\$2 010 161

National Science Foundation OCE-1026851

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

1/1/2012 to 12/31/2013

\$3 409 092

Mark Page

Dan Reed

Simpson and Simpson Business and Personnel Services, Inc SB120101

San Onofre Nuclear Generating Mitigation Project Monitoring Program

The following tasks will be undertaken by the Principal Scientists and contract wetland biologists: a. Conduct field surveys and use aerial photographs to assess the performance standards pertaining to topography and habitat areas. Observations by the Principal Scientists during construction monitoring indicate that noticeable sediment erosion and deposition can occur within a period of a few months. Therefore, field observational surveys will be done monthly throughout the restored San Dieguito wetland to monitor for any sign of substantial erosion or sediment deposition that could impede tidal flow within the wetland. Additional surveys will be done following extreme climatic events. Annual ground surveys using RTK GPS and low level aerial photographs taken in the spring will be used to determine whether the areas of planned wetland habitats (subtidal, intertidal mudflat, vegetated marsh) have changed from areas specified in the Final Plan. Commission staff has defined 4.5' NGVD as the upper limit of tidally influenced habitat for the calculation of acreage credit for this restoration project. Because of this, the upper edge of the 4.5' contour is of special interest and will be checked annually to evaluate compliance with the acreage requirement and performance standard on habitat areas. Professional surveyors will be engaged as needed to assist in this evaluation. b. Conduct field sampling and use environmental data loggers to assess the performance standards pertaining to water quality and tidal prism. Because of its documented importance to wetland health, the concentration of dissolved oxygen will be used to evaluate water quality within the restored wetland. Measurements of dissolved oxygen will be made using continuously recording environmental data loggers deployed in the restored and reference wetlands at sites that encompass average conditions. A reduction in the tidal prism of the restored wetland can have detrimental effects on water quality and alter the area of inundated habitat. Tidal prism will be calculated by integrating measurements of tidal discharge taken near the inlet using a portable acoustic Doppler profiler/discharge measurement system over predicted tides of 4.5' NGVD. The twice yearly tidal prism measurements will be supplemented with surveys of flow further within the restored wetland at channels leading to the large basin (W1) and the large intertidal area of W4 and W16 to proactively identify impeded tidal flow into or out of these areas and inform maintenance action. c. Survey fish, macroinvertebrates, and birds to assess the performance standards pertaining to biological communities and food chain support. During pre-restoration monitoring, the Principal Scientists developed and refined methods to sample fish and macroinvertebrates. These methods were published in the scientific literature and will be used to evaluate the performance standards pertaining to biological communities. Sampling fish in the restored and reference wetlands, in particular, is a labor intensive task that will require the employment of temporary field assistants to help with enclosure trap and seine sampling during the summer. The methods developed for fish sampling employ the minimum number of personnel for completing the task and a sampling design that balances the conflicting goals of adequate spatial and temporal sample replication to evaluate wetland performance with the time, cost and impacts of sampling in the restored and reference wetlands. The performance standard pertaining to food chain support will be evaluated by measuring bird feeding activity during the same period that bird densities are measured, and using bird species that are present in both restored and reference wetlands. Bird specialist will be retained to assist the Principal Scientists to determine the abundance and number of species of birds and assess bird feeding activity. Taxonomic specialist will be retained to assist with invertebrate identification and establishment of a reference collection. d. Use aerial photographs and ground surveys to assess the performance standards pertaining to the cover of wetland vegetation and open space and the coverage of algal mats. The use of low-level multi-spectral aerial photography provides a means of obtaining a whole wetland estimate of the cover of vegetation, bare space and macroalgae in the restored and reference wetlands. Multi-spectral photographs also allow the identification of



plant species assemblages throughout the wetlands, which is useful in locating the presence of exotic species. The photographs are ground-truthed by limited field sampling of vegetation cover during each aerial survey. Aerial photographs will be taken in the restored and reference wetlands in late spring to early summer, which is the period of maximum growth of marsh plants and algae. Ground surveys for the presence of unusually thick algal mats, which typically indicates poor tidal flushing or excessive nutrient enrichment, will also be made during routine water quality monitoring. e. Assess the performance standard pertaining to *Spartina* canopy architecture. This task will be accomplished through the measurement of the height of cordgrass stems in sampling quadrats located in stands of cordgrass. Sampling of cordgrass will be done in late spring to early summer concurrently with the monitoring of wetland vegetation. f. Sample seeds of salt marsh plants to evaluate the performance standard pertaining to the reproductive success of these plants. The reproductive success of salt marsh plants will be evaluated by measuring the set of viable seed in at least three plant species in the restored wetland. Sampling will be done annually in late summer-fall when seed set is expected to be greatest. The viability of seed from each species will be confirmed by the germination of seeds in culture. g. Evaluate sampling data and conduct a survey to assess the performance standard pertaining to exotic species. Monitoring data collected for fish, invertebrates, birds, and plants will be used to evaluate this standard. In addition, a special survey of exotic species that covers as much of the restored wetland as possible will be conducted once a year during the summer to adaptively manage for exotic species. This special survey will focus on plants and visible invertebrates and incorporate a snorkeling survey of the subtidal portion of the main basin (W1).



Stephen Schroeter 7/1/2006 to 6/30/2013 \$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 Svejksky 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.

Susanne Sokolow 9/1/2011 to 12/31/2012 \$338 036
Armand Kuris
Kevin Lafferty
 PHS Centers for Disease Control K08 AIU82284

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.

Evolutionary Behavioral Genomics of *Drosophila* Courtship

Genome-wide association studies hold the promise of comprehensive and systematic identification of the genetic basis of natural trait variation. By quantifying how genetic polymorphisms induce large, small, precise, general, or conditional effects on traits, we can unlock a vast reservoir of natural variation that will help us understand how biological systems function and evolve. However, good statistical power to identify variants with low population frequencies or modest effects requires sample sizes that are generally prohibitive. Here, we develop a new approach, “Evolve and Resequence” (E&R), that overcomes this barrier using the genetic model system *Drosophila*. We have re-purposed experimental evolution of *D. melanogaster*, which has been used for over 100 years to address fundamental questions in population genetics, and adapted it for use in genome-wide mapping. Together with high-throughput behavioral quantification and various statistical approaches, our technique will be used to build models of behavior based on genotype. The predictive power of these models will tell us a great deal about the nature of genetic information and the molecular systems that translate this information into behavioral output. The long-term goal of this research is to characterize the genetic and environmental influences that result in variation in courtship behavior, for both males and females, in multiple *Drosophila* species. This work begins with characterization of male courtship song production: during courtship, a *Drosophila* male extends a single wing and “twangs” this wing repeatedly to produce a wing vibration song consisting of a series of pulses. These traits are among the best characterized of *Drosophila* behaviors, both in *D. melanogaster* and across the genus, and they are currently the focus of intensive efforts in neurobiology and molecular genetics. As such, these traits serve as a model system for studying the genetic basis of behavior in animals. Specifically, this proposal aims to 1) locate and characterize the genetic variants affecting courtship song in *D. melanogaster*, 2) do the same for the closely related *D. simulans*, to compare and contrast results from multiple species, and 3) begin molecular genetic investigation of the genes and gene systems discovered in aims 1 and 2.

**David Valentine**

1/1/2011 to 12/31/2014

\$924 127

National Science Foundation DEB-1046144

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

The proposal first seeks to assess viral activity in situ by extending established stable isotope probing techniques to quantify rates of viral production at sea floor methane seeps. The same techniques will be used to track the flow of carbon from methane to microbes to viruses and to isolate genetic material from just those organisms that actively cycle methane-derived carbon, enabling the production of microbial and viral metagenomes that are anchored in ecosystem function. Comparisons among these metagenomes will reveal any functional sequences in transit between organisms, providing the basis for an evaluation of the relationships between functional and genetic diversity. At the same time, single-cell whole-genome amplification will pinpoint individual cells for comparison with the microbial and viral assemblages, permitting assessment of the relationships between taxonomic and genetic diversity. Last, the comparison of genomic and metagenomic data both within and across distinctive marine methanotrophic ecosystems will enable analysis of the relationship between functional and taxonomic diversity.

David Valentine

6/1/2010 to 5/31/2013

\$327 457

National Science Foundation EAR-0950600

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
National Science Foundation OCE-1042097

6/1/2010 to 5/31/2013

\$327 457

RAPID: Assessing the Impact of Chemical Dispersents 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
National Science Foundation OIA-1057736

8/15/2010 to 7/31/2012

\$124 313

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). The acquisition of these instruments will provide immediate benefit to ongoing studies on the biogeochemistry of hydrocarbons in the Gulf of Mexico by enabling rapid isotopic analysis of previously collected samples, by enabling the monitoring of ongoing incubations from samples collected in the Gulf, and by enabling a shipboard approach to isotopic analyses of methane and carbon dioxide for biogeochemical studies.

David Valentine
DOE DE-NT0005667

10/1/2008 to 9/30/2012

\$812 919

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
National Science Foundation OCE-0961725

4/15/2010 to 3/31/2013

\$373 024

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
National Science Foundation OCE-1155855

6/1/2012 to 5/31/2015

\$388 632

Development and Application of a Radiotracer Rate Method for Ethane and Propane Consumption

Ethane and propane are released in abundance to the ocean through natural seepage, as byproducts of photosynthesis, and by the petroleum industry. For example, ethane and propane together constituted greater than 5% of the total mass release during the Deepwater Horizon event, and were the primary drivers of oxygen decline in the deep waters of the NE Gulf of Mexico during the spill. Despite the importance of these gases, little is known about their release into the ocean, the capacity of marine bacteria to consume them, or the fate and impacts of the carbon and energy they store. This proposal will specifically address the consumption of ethane and propane in the ocean by developing, validating and applying highly sensitive tracer techniques to quantify consumption rates for these gases in ocean waters. Two specific hypotheses will be tested with the goal to better understand the factors controlling ethane and propane consumption in the ocean. Hypothesis 1: The capacity for ethane and propane oxidation is ubiquitous throughout the upper ocean and along continental margins, with constitutive rates that depend on regional input and total bacterial abundance; Hypothesis 2: Propane and ethane consumption are readily inducible beyond a basal level on the timescale of days, propane consumption more so than ethane consumption. The proposed research will address these hypotheses in two steps. The first step will entail the development of a method to quantify the consumption rates for ethane and propane, including the laboratory synthesis of radiolabeled ethane and propane, purification of the products, systematic investigations of tracer storage to minimize effects of autoradiolytic exchange, and validation of the measurement through inter-comparison. The second step is the application of the method to interrogate the rates of ethane and propane consumption in the ocean, including the coastal ocean and along the continental margin off California. The field component of the research will take place during a series of short cruises in the Santa Barbara Basin, and during one value added cruise aboard a UNOLS vessel.

David Valentine
DOE/Miscellaneous Offices and Programs 2222AS

10/8/2008 to 9/9/2012

\$812 919

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
Mineral Science Company, Inc SB090013

6/23/2008 to 7/31/2011

\$37 796

Cesium Chloride as a Bacterial Inhibitor

The aim of this project is to continue our investigations of the inhibitory properties of cesium salts on oral bacteria with the aims of assisting Mineral Sciences of developing an anti-microbial mouth wash formulation

Herb Waite
Jacob Israelachvili

8/4/2008 to 6/30/2013

\$2 224 158

NIH Dental And NIH Research, National Institute Of R01 DE018468

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 orthopaedics 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.

Herb Waite

5/1/2010 to 10/31/2013

\$375 000

Human Frontier Science Program Organization (Intl) 0004/2010

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.

Barbara Walker
Carolynn Culver
Kimberly Selkoe

2/1/2012 to 1/31/2013

\$73 060

University of Washington R/SOC-2-F-1/2

Toward Resilience and Sustainable Seafood Supply: Assessing Direct Marketing Approaches for the West Coast Fishing Communities

The overarching project goals are to contribute to the social science literature on fisheries and social change in local food systems, and generate information and tools to better enable West Coast fishing communities to determine whether and how they might use various types of DMAs. Project objectives are to: 1) rigorously evaluate the patterns, processes, and impacts associated with seafood DMAs, and 2) integrate this knowledge into practical tools for use by West Coast communities in



DMA decision-making. Combining applied social science research and engagement with fishing communities, we will produce a comparative case study of selected DMAs in two regions of the U.S. (the Carolinas, Washington State), and develop and pilot test a DMA assessment toolkit in two West Coast communities (Santa Barbara, CA, Coos Bay, OR). These products are expected to increase knowledge and inform decision-making about DMAs in the pilot test communities, supporting their resilience and contributing to sustainable seafood supply in the short term, and other such communities over the long term. In addition, the project will help build social science research capacity that can be used to further document and explore the social processes underlying coastal community change.

Libe Washburn
Mark Brzezinski

6/1/2010 to 5/31/2013

\$489 336

UC San Diego NA11NOS0120029

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

A network of HF radar systems 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. This Statement of Work is the UCSB component of the SCCOOS HF radar system. The systems operated by Washburn's research group at UCSB are deployed from Nicholas Canyon in the south (site to be installed in 2010) to Point Sal in the north as shown in the table below. Currently, two of the sites are maintained jointly with Cal Poly, San Luis Obispo (SLO, PI is Mark Moline): Pt. Sal and Pt. Conception. A third jointly-operated site will be installed at Pt. Arguello in 2010. The overall objective of the UCSB group will be to maintain HF radar operations of all sites. Site inspections will be conducted routinely to evaluate and maintain system health. Activities during the inspections include replacement of local backup data storage; inspection of antennas and cables; and maintenance of data acquisition computer, air conditioners, data transmission equipment, and power supply equipment such as UPSs and transformers. Antenna pattern measurements will be conducted in coordination with other groups to reduce costs. HF radar data will be transmitted to the central SCCOOS data management system at SIO/UCSD.

Libe Washburn

9/15/2010 to 8/31/2014

\$698 120

National Science Foundation OCE-1031893

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 flow 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 **10/1/2011 to 9/30/2013** **\$199 992**
 CODAR Ocean Sensors SB120053

HR Radar Calibration with Automatic Identification System Ships of Opportunity

In collaboration with Codar Ocean Sensors, Ltd., we will develop an operational product by implementing methods developed in our SBIR Phase I project to obtain HF radar antenna pattern calibrations by using backscatter from ships and position data from Automatic Information System broadcasts. The UCSB work plan for this research is outlined in the Phase II objectives: 1) Refine algorithms to calibrate antenna patterns automatically in real-time as a substitute for expensive, infrequent ship-based calibrations; 2) Develop quantitative indicators of the quality of the ship-derived antenna patterns; 3) Expand the azimuthal coverage of antenna pattern measurements and increase the number of patterns produced over time. 4) Apply the ship-based antenna pattern method to other commonly used frequency bands including those operating at frequencies around 5 MHz, 25 MHz, 42 MHz. UCSB personnel Brian Emery (Computer Network Technologist II) and Libe Washburn (Professor of Oceanography) will participate in the SBIR Phase II project. Emery will be responsible for the computer programming, algorithm development, and analysis of results. Washburn will work with Emery to develop algorithms and analyze results of the software for automatic measurement of antenna patterns.

Allison Whitmer **10/1/2008 to 9/30/2013** **\$1 790 817**
 Colorado State University G-3062-7

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 **6/1/2009 to 3/1/2012** **\$61 577**
 University of Nebraska 25-0550-0001-021

Modeling Antarctic Paleotopography

I propose, in continued collaboration with David Pollard and Robert DeConto, to generate models of past Antarctic topography for times of 23 and 14 Ma for the purpose of providing boundary conditions for coupled ice-sheet and climate models. These models will be necessary for linking geologic observations from ANDRILL SMS and MIS projects to a refined understanding of how global climate influences and responds to changes in the Antarctic ice sheets. Previous work has demonstrated that geologic changes in topography are very important for ice-sheet models over time

scales of tens of millions of years (Wilson and Luyendyk, 2009). The work will involve generating gridded surfaces for 23- and 14-Ma horizon surfaces for sediments in the Ross Embayment and possibly other sedimentary basins based on the ANTOSTRAT (1995) compilation and more recent data, generating simple erosion models for restoring sedimentary deposits to their source areas, and refining existing thermal models to more accurately predict subsidence. The detailed modeling sequence will follow the established pattern of starting with the BEDMAP topography restored for removing the load of ice, removing sediment younger than the age of the reconstruction model, reversing the subsidence driven by thermal contraction, and restoring eroded material to its modeled source position. At each step, full isostatic compensation will be calculated. Iteration on the erosion model will probably be necessary based on feedback from Pollard on the predictions of the ice-sheet model and comparison of model predictions to the drill-site data. Publication will include making grid models freely available.



Douglas Wilson 4/14/2011 to 2/28/2014 \$45 158
Consortium for Ocean Leadership T335A44

IODP Expedition 335 Shipboard Geologist

The proposed work builds on work already started on analyzing the downhole field measured as of Exp 312 (Fig. 1). Objectives include extending the depth range using the new Exp 335 measurements, and careful testing of models for magnetization as a function of depth using polygonal source models. The new GPIT measurements require calibration of the combination of fluxgate magnetometer bias and the non-zero field of the adjacent logging tools. The new Exp 335 profile will be a valuable constraint on the magnetic field deep in the hole, as it spans the entire depth range of the hole, unlike the Exp 312 measurements, which only covered the deeper ranges. Inference of in-situ magnetization from downhole field uses simple cylinder models following Worm et al. [1996], among others. In-situ magnetization, however, is a combination of the primary magnetization, which records reversals and therefore contributes strongly to sea-surface magnetic anomalies, and present-field overprint, which being relatively uniform contributes little to sea-surface magnetic anomalies.

Pauline Yu 8/15/2010 to 7/31/2013 \$10 000
Gretchen Hofmann
National Science Foundation

ANT-1019340

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) The primary research objectives of this proposal are: 1) To characterize

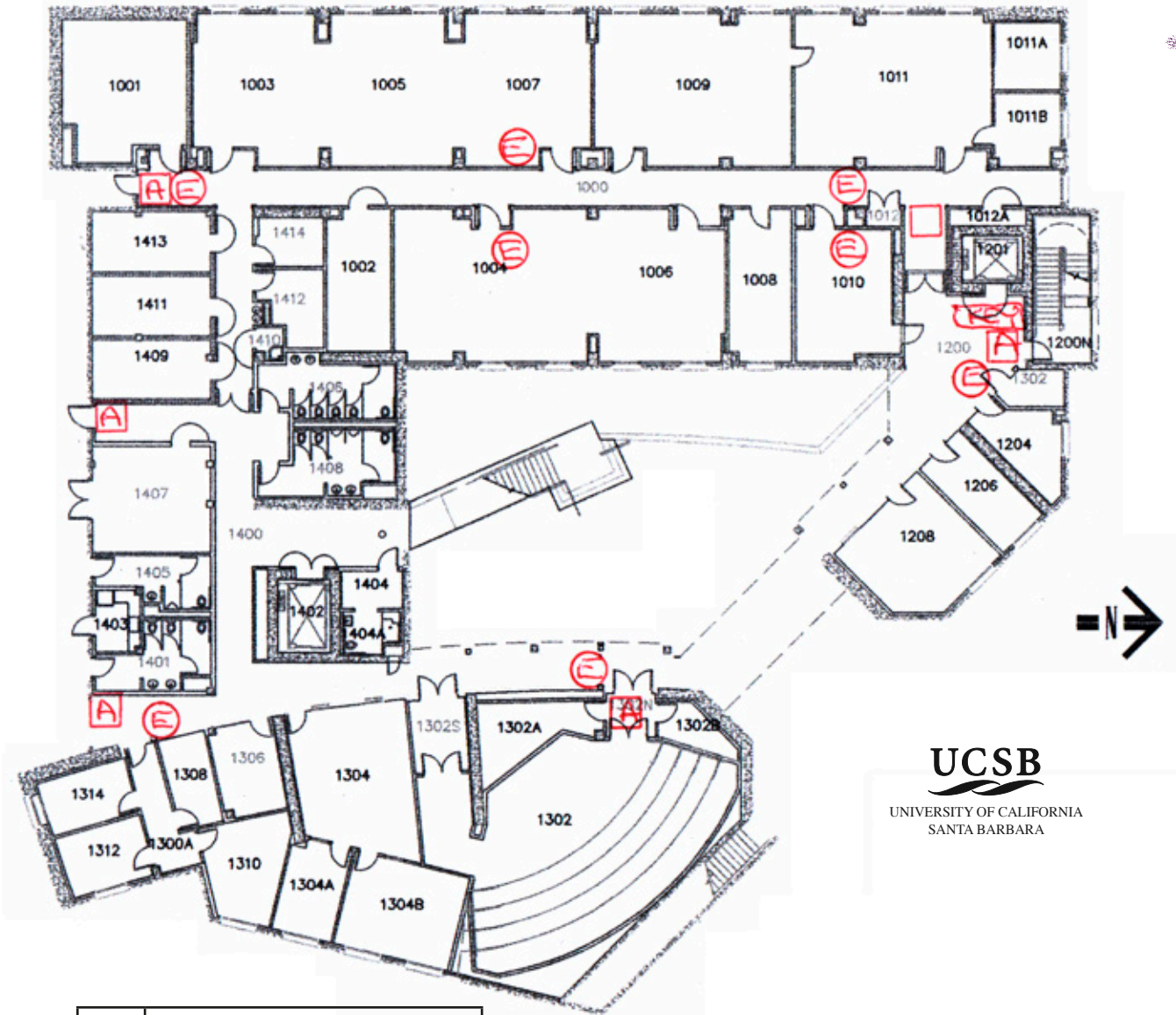
the lipid profile and utilization of developing urchin larvae, and determine how acidification may alter their energetic budget of lipid usage 2) To investigate how metabolism and metabolic enzyme activity are altered under acidification conditions, and 3) To measure changes in protein expression patterns of genes involved in metabolism, development, biomineralization and acid/base-regulation because of lowered pH.





Space

Marine Science Research Building Bldg. No. 520 - 1st floor 06/2012

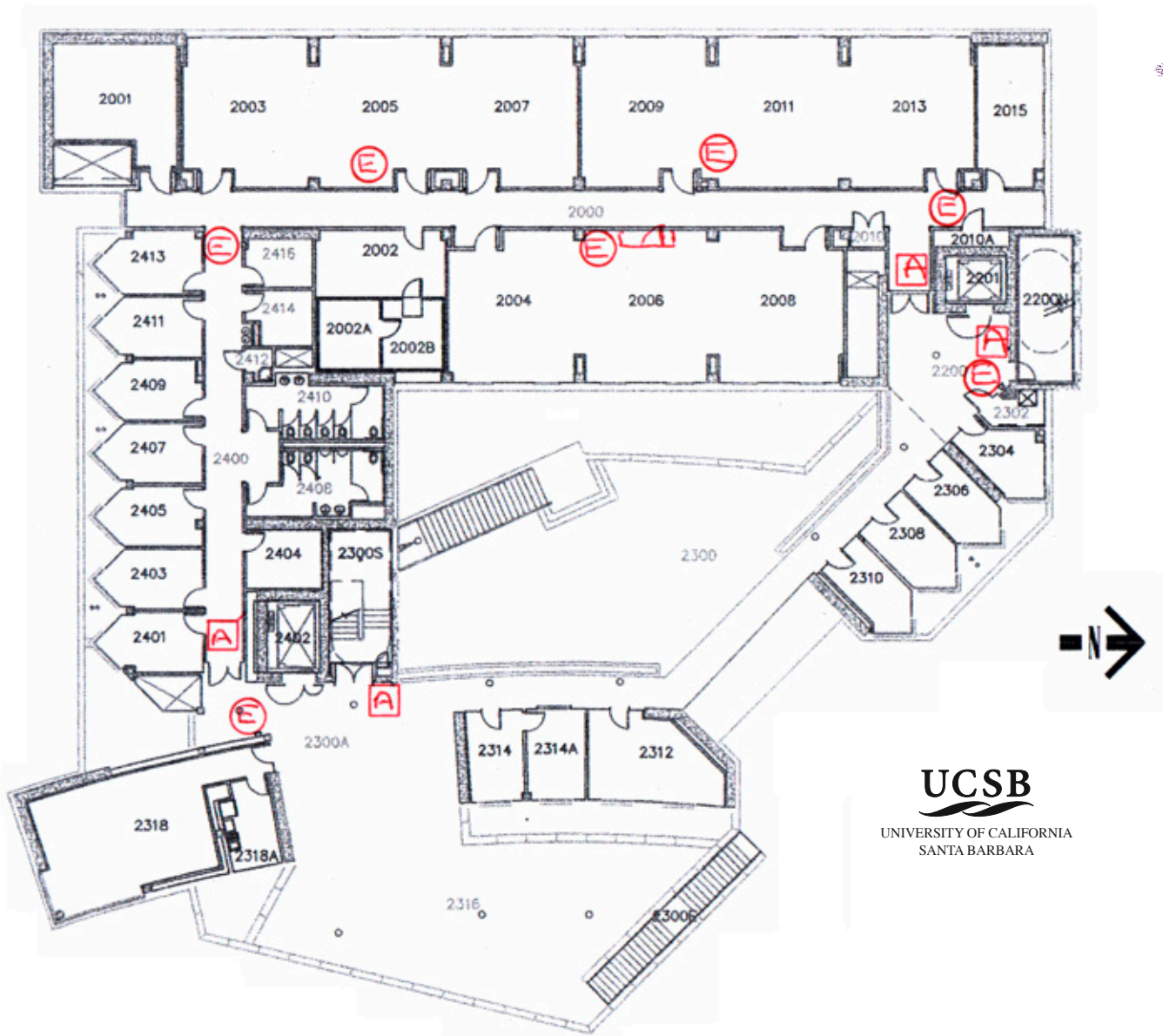


UCSB
UNIVERSITY OF CALIFORNIA
SANTA BARBARA

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 06/2012



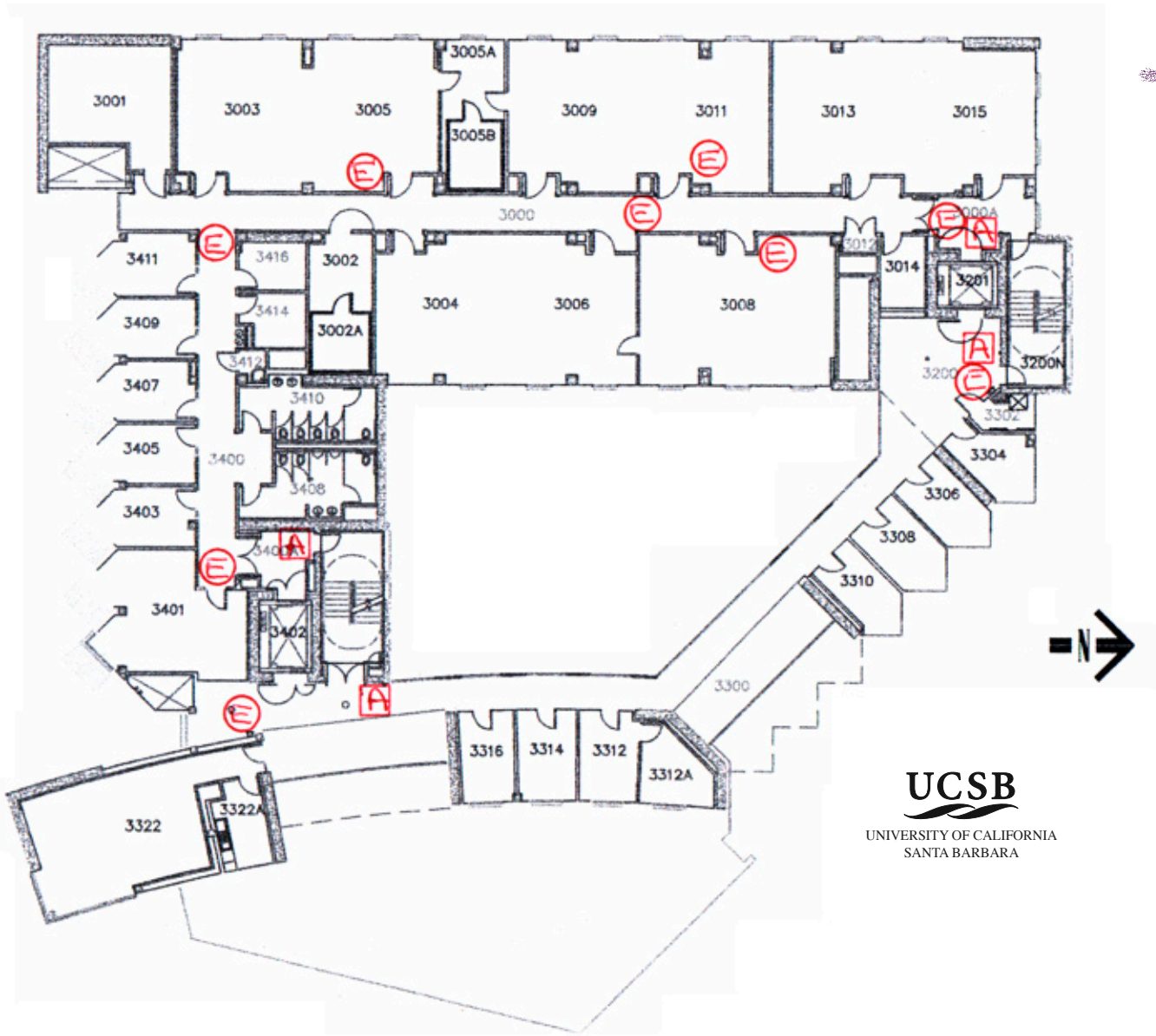
UCSB
UNIVERSITY OF CALIFORNIA
SANTA BARBARA

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 06/2012



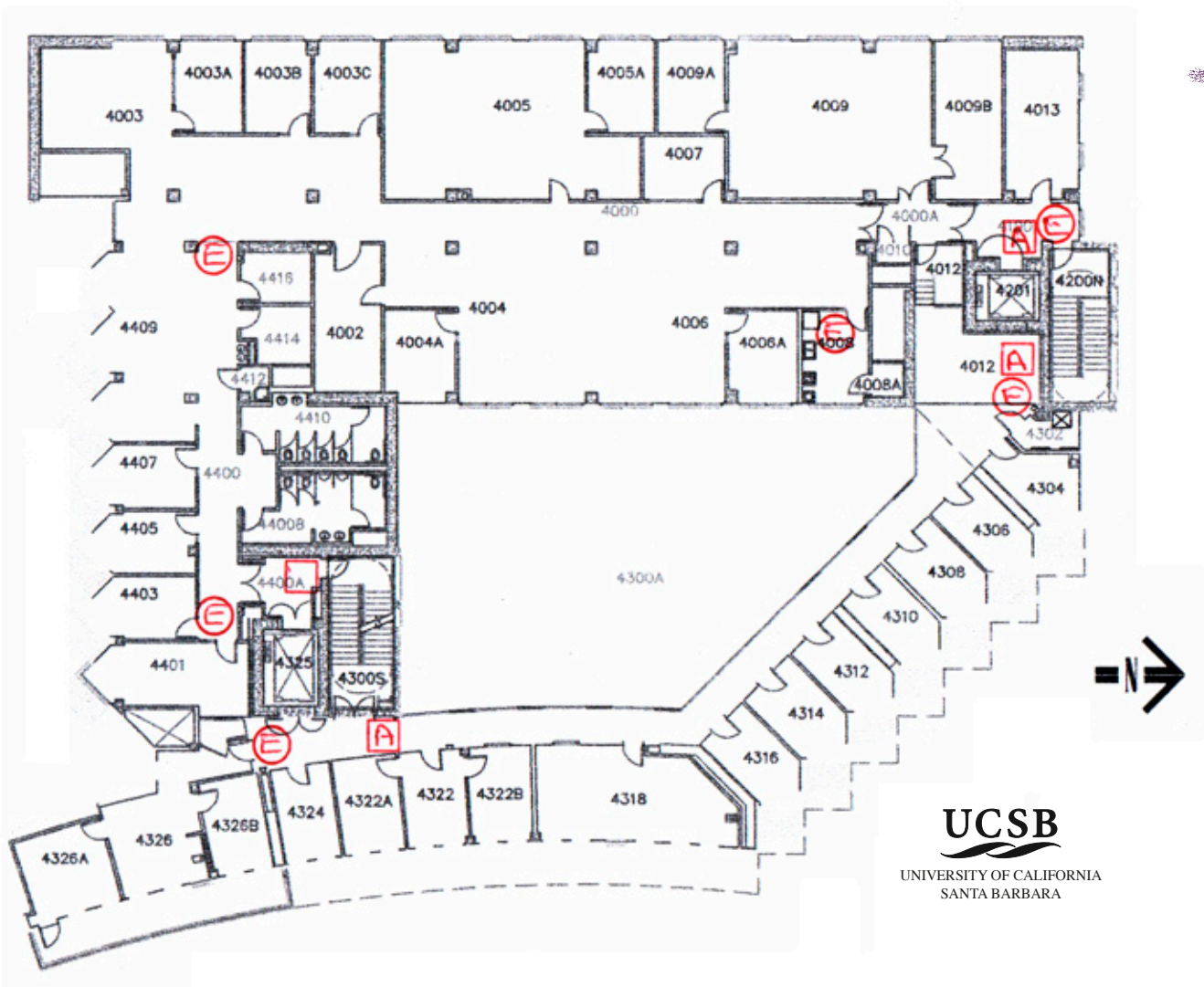
UCSB
UNIVERSITY OF CALIFORNIA
SANTA BARBARA

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 06/2012



UCSB
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SANTA BARBARA

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 2011-2012



	Awards	Percentage of Total
Federal Agencies		
COM National Oceanic and Atmospheric Administration (NOAA)	\$59,996	0.26%
National Aeronautics and Space Administration (NASA)	145,059	0.63%
National Science Foundation-NSF	9,508,264	1.76%
National Institutes of Health (NIH)	1,025,644	4.50%
PHS Centers for Disease Control	108,607	0.48%
USDA Forest Service	3,000	0.01%
USDA National Institute for Food and Agriculture (NIFA)	99,447	0.44%
USDI Bureau of Land Management	12,000	0.05%
USDI Bureau of Ocean Energy Management	1,449,322	6.36%
USDI Fish and Wildlife Service	235,118	1.03%
USDI Geological Survey (Incl Natl Biological Service)	54,263	0.24%
USDI National Park Service	65,420	0.29%
	<hr/>	
Federal Totals	\$ 12,775,821	56.10%
 State		
California Coastal Conservancy\$	250,000	1.10%
Lahontan Regional Water Quality Control Board	40,000	0.18%
Southern California Coastal Water Research Program (SCCWRP)	29,801	0.13%
UC MEXUS	14,230	0.06%
UC San Diego	201,468	0.88%
UC Santa Cruz	243,959	1.07%
UC Sea Grant College Program	1,173,269	5.15%
	<hr/>	
State Totals	\$ 1,952,727	8.58%

Private

CODAR Ocean Sensors	\$199,992	0.88%
Collaborative Fisheries Research	25,000	0.11%
Colorado State University	321,967	1.41%
Conservation International Foundation	233,294	1.02%
Consortium for Ocean Leadership	45,158	0.20%
David and Lucile Packard Foundation	82,000	0.36%
Ecological Society of America	149,920	0.66%
Gordon And Betty Moore Foundation	141,436	0.62%
Marisla Foundation	175,000	0.77%
Ocean Conservancy	355,488	1.56%
Oregon State University	200,000	0.88%
Prince William Sound Science Center	407,395	1.79%
Resources Legacy Fund Foundation	99,989	0.44%
Simpson & Simpson Business and Personnel Services	\$3,409,092	14.97%
Swiss Federal Institute of Technology	71,718	0.31%
Truckee River Watershed Council	88,200	0.39%
University of Arizona	26,453	0.12%
University of Miami	118,817	0.52%
University of Minnesota	137,317	0.60%
University of Mississippi	348,497	1.53%
University of Nebraska	61,577	0.27%
University Of New Mexico	504,120	2.21%
University of Southern California (So. Calif. Earthquake Center)	40,000	0.18%
University of Tromso, Norway	36,000	0.16%
University Of Washington	546,651	2.40%
Walton Family Foundation	217,665	0.96%

Private Totals	\$ 8,042,746	35.32%
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Total	\$22,771,294	100.00%
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Statistical Summary for the Marine Science Institute 2011-2012



	MSI	NCEAS	NRS	TOTAL
1. Academic personnel on payroll				
a. Faculty	22	1	2	25
b. Professional Researchers (including Visiting)	31	3	0	34
c. Project Scientists	10	3	0	13
d. Specialists	35	2	4	41
e. Postdoctoral Scholars	30	17	0	47
f. Postgraduate Researchers	0	0	0	0
g. Academic Coordinators	5	1	1	7
TOTAL	133	27	7	167

2. Graduate Students on payroll				
a. Employed on contracts and grants	44	1	0	45
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	44	1	0	45

3. Undergraduate Students on payroll				
a. Employed on contracts and grants	133	8	6	147
b. Employed on other funds	0	0	0	0
c. Number of volunteers, & unpaid interns	0	0	0	0
TOTAL	133	8	0	147

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	146	13	8	167
b. Administrative/Clerical	24	11	23	58
TOTAL	170	24	31	225

6. Seminars, symposia, workshops sponsored	-	-	-	0
7. Proposals submitted	183	4	0	187
8. Number of different awarding agencies dealt with*	-	-	-	111
9. Number of extramural awards administered	228	23	-	251
10. Dollar value of extramural awards administered during year**	\$ 76,775,168	\$27,713,344	-	\$104,488,512
11. Number of Principal Investigators***	-	-	-	150
12. Dollar value of other project awards ****	\$1,788,999	\$264,467	\$2,425,619	\$4,479,085
13. Number of other projects administered	64	7	28	99
14. Total base budget for the year (as of June 30, 2010)	\$1,085,010	\$818,733	\$1,238,391	\$3,142,134
15. Dollar value of intramural support	\$556,502	-	\$67,423	\$623,925
16. Total assigned square footage in ORU	38,807	-	-	38,807
17. Dollar value of awards for year (2010 Total)	\$21,910,558	\$836,750	\$0	\$22,747,308

* Count each agency only once (include agencies to which proposals have been submitted).

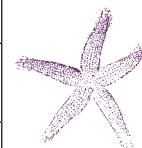
** If the award was open during the year, even if for only one month, please include in total.

*** 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.



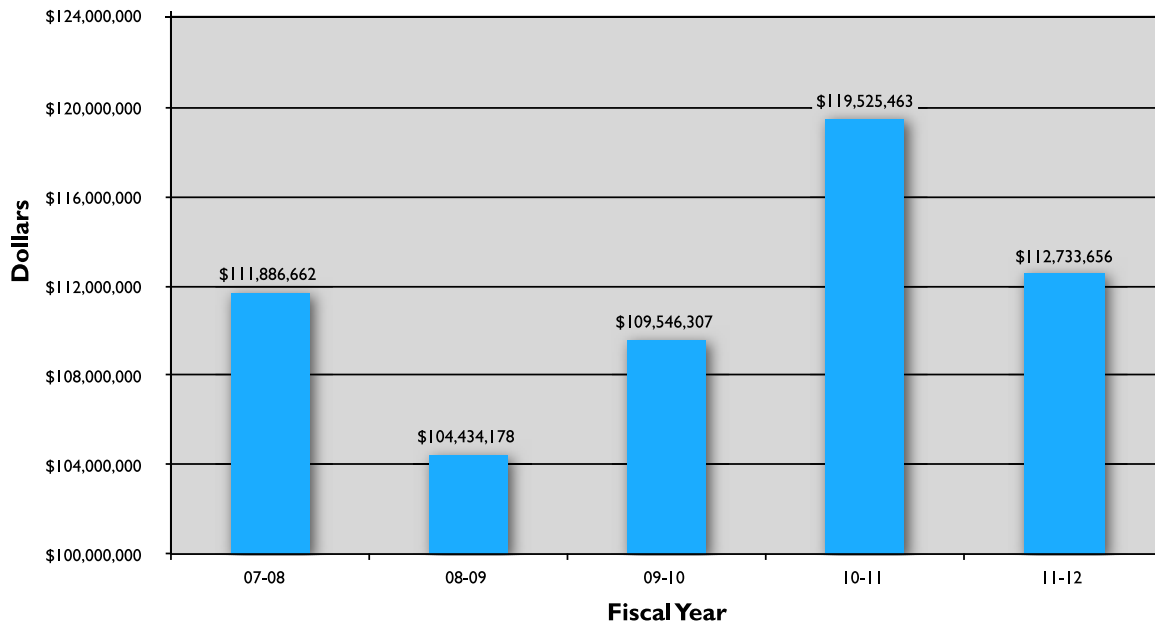
Five-Year Statistical Summary 2008-2012



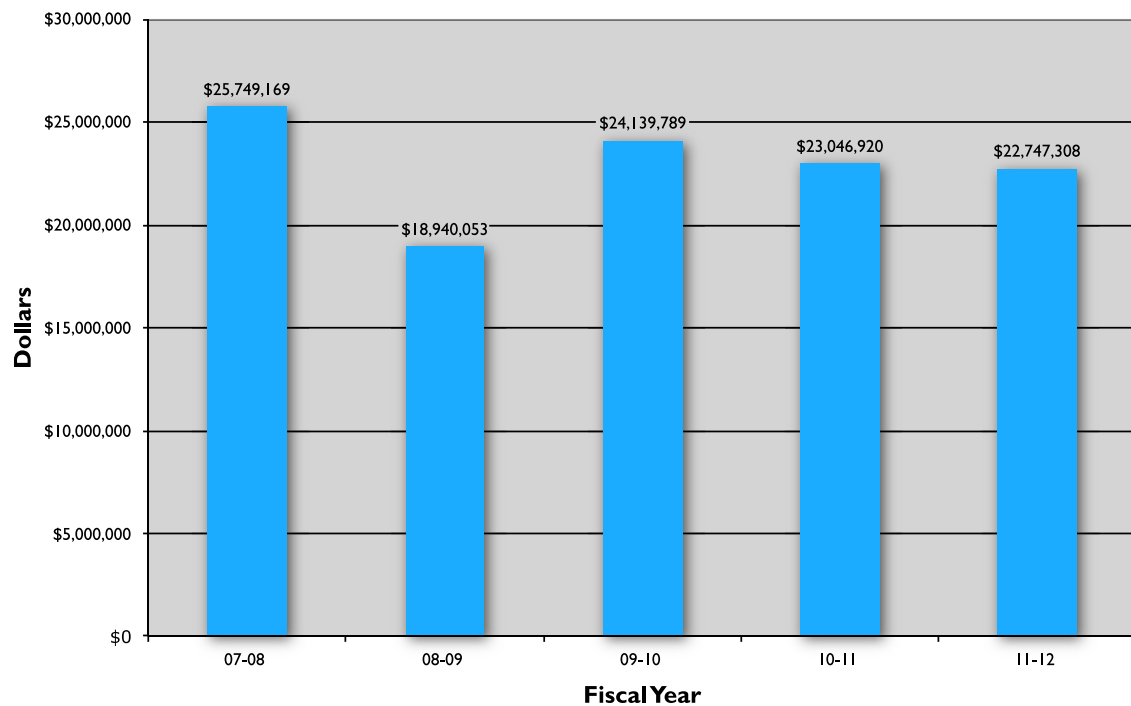
	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
1. Academic personnel engaged in research					
a. Faculty	56	59	38	24	25
b. Researchers/Project Scientists	42	42	45	52	47
c. Visiting Researchers	8				
d. Specialists/Academic Coord/Academic Admin.	35	35	41	49	48
e. Postdoctorals/Postgraduates	85	54	56	50	47
Total	226	190	180	175	167
2. Staff (Univ. & Non-Univ. Funds)					
a. Technical	218	197	207	174	167
b. Administrative/Clerical	54	56	64	68	58
Total	272	253	271	242	225
3. Graduate students employed by MSI	99	61	67	53	45
4. Undergraduate students employed by MSI	179	211	175	154	147
5. Publications	1**	1**	1**	1**	1**
6. Seminars, symposia, workshops, etc., sponsored by MSI	163				
7. Proposals submitted	199	171	204	181	187
8. Annual extramural awards	\$25,749,169	\$18,940,053	\$24,139,789	\$23,046,920	\$22,747,308
9. Extramural awards administered	300	290	278	257	251
10. Other project awards	\$1,283,705	\$1,437,240	\$4,175,455	\$3,156,683	\$4,479,085
11. Other projects administered	61	107	121	95	99
12. MSI base budget	\$1,011,541	\$1,626,165	\$1,084,520	\$1,238,532	\$1,085,010
13. Intramural support	\$1,710,775	\$1,009,091	\$331,430	\$993,488	\$623,925
14. Total Funds Administered	\$111,886,662	\$104,434,178	\$109,546,307	\$119,525,463	\$112,733,656

**Only Departmental Publications

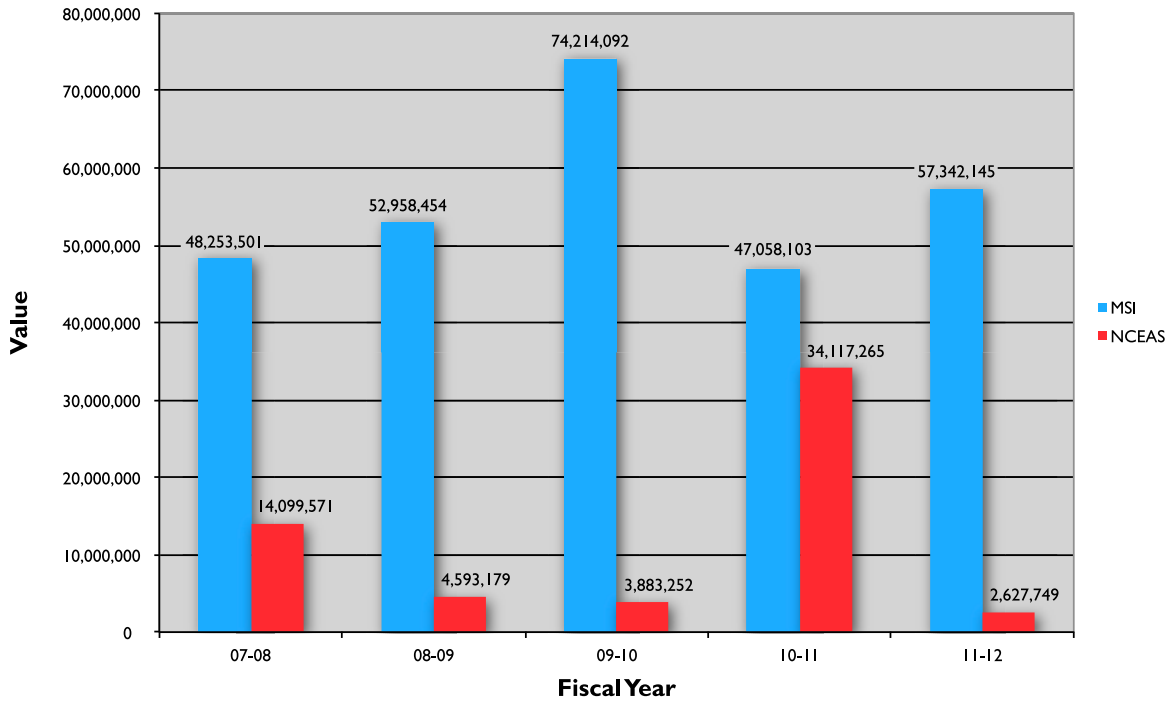
Marine Science Institute – Total Value of Awards Administered



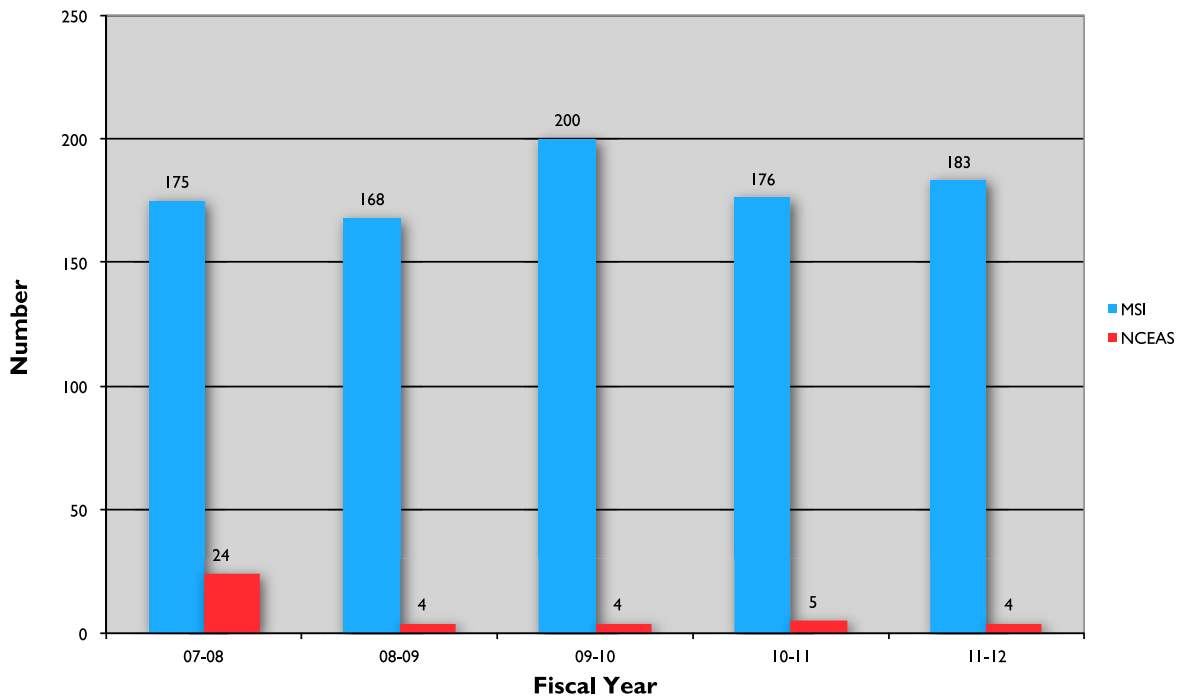
Marine Science Institute - Value of Extramural Awards Received Annually



Value of Proposals Submitted Annually by MSI & NCEAS



Number of Proposals Submitted Annually by MSI & NCEAS



Funding Agencies 2011-2012

Andrew W. Mellon Foundation
Arizona State University, Tempe
Bonefish & Tarpon Trust
Boston University
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 Landscape Contractors Association
California Ocean Science Trust (Calost)
California Sea Urchin Commission
California State Lands Commission
Clark County, Nevada
Coastal Fund (formerly Shoreline Preservation Fund)
CODAR Ocean Sensors
Collaborative Fisheries Research
Colorado State University
Conservation International Foundation
Consortium for Ocean Leadership
Consolidated Safety Services
Consortium for Ocean Leadership
Cornell University
David And Lucile Packard Foundation (The)
Desert Research Institute
Ecological Society of America (ESA)
Ecotrust
Gordon and Betty Moore Foundation
Gulf of Mexico Research Initiative
Heal The Ocean Inc.
H.T. Harvey & Associates Ecological Consultants
Human Frontier Science Program In'tl
Japan Aerospace Exploration Agency (JAXA)
(Frmly NASDAa)(Japan)
Lockheed Martin Corporation
Los Angeles Dept Of Water And Power
Louisiana State University
Luce Foundation
Marisla Foundation (Frmly Homeland Foundation)
National Aeronautics and Space Administration
National Coastal Resources Research & Development Institute (NCRI)
National Institutes of Health, Public Health Services
National Science Foundation-NSF
Nature Conservancy, The
National Institutes of Health, NIH Research
National Institutes of Health, NIH General Medical Sciences
National Institutes of Health, NIH Allergy & Infectious Diseases
Nautica Windpower, LLC
NEONinc
NYS DOS Division of Coastal Resources
New Zealand Department of Conservation
North Pacific Research Board (NPRB)
Ocean Conservancy
Oregon State University
PHS Centers for Disease Control
Prince William Sound Science Center (Incl Oil Spill Recovery Inst)
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.

Southern California Coastal Water Research Project Auth, A Public Agency

Southern California Wetlands Recovery Project

Swiss Federal Inst Of Technology-DbA Eth (Switzerland)

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 Cancer Research Coordinating Committee

UC Davis

UC Discovery Research & Training Grant

UC Hansen Trust Fund

UC Lab Fees Research Program

UC MEXUS

UC Office Of The President

UC San Diego

UC Santa Cruz

UC Sea Grant College Program

United Soybean Board /Smith Bucklin & Assoc., L.L.C.

United States Intelligence Community

University of Arizona

University of Colorado

University of Florida

University of Miami

University of Minnesota

University Of Mississippi

University Of Nebraska

University of New Mexico

University of Rochester

University of St. Thomas

University of Southern California

University of Southern Mississippi

University of Tromso, Norway

University of Washington

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

USDA National Institute for Food and Agriculture

USDI Bureau Of Land Management

USDI Bureau of Ocean Energy Management, Regulation and Enforcement (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

Woods Hole Oceangraphic Institution

World Wildlife Fund





**MSI Advisory Committee,
Administrative,
Professional
& Technical Staff**

Marine Science Institute 2011-2012

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HENRY T. YANG

EXECUTIVE VICE CHANCELLOR

GENE LUCAS

VICE CHANCELLOR FOR RESEARCH

MICHAEL WITHERELL

DIRECTOR

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Carol Blanchette, MSI
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Eckhart Meiburg, Mechanical Engineering
Mark Page, MSI
Russell Schmitt, Chair, EEMB
Syee Weldeab, Earth Science
Doug Wilson, MSI

Ex-Officio Members –

Mark Brzezinski, Director, MSI
Frank Davis, Director, NCEAS
Gretchen Hofmann, EEMB
Patricia Holden, Director, NRS
Daniel Morse, Director, Marine Biotech Center
Dan Reed, Deputy Director, MSI
Tim Schmidt, Manager, MSI
Russell Schmitt, Director, Coastal Research Center

Marine Science Institute

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Deputy Director, Dan Reed
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Budget Analyst, Joanna Kettmann
Budget Analyst, Michael O'Neil
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Contracts & Grants Officer, Judy McCaslin
Contracts & Grants Officer, Deanna Cervantes
Development Officer, Gay Larsen
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Graphics Assistant, Molly Thomson
IT Manager, Jim Woods
Desktop Support, Mike Franklin
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Personnel Unit Coordinator, Elvira Rose
Personnel Analyst, India Morgan
Personnel Analyst, Veronica Perez
Purchasing Analyst, Kayla Jackson
Purchasing Analyst, Nicole Zavala
Travel Coordinator, Marisol Hernandez





**Marine Science Institute
Principal Investigators
2011-2012**

Marine Science Institute

Principal Investigators

2011-2012

Ahn, Kolbe	Assistant Project Scientist	Marine Science Institute
Airame, Satie	Academic Coordinator	Marine Science Institute
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Allredge, Alice	Professor of Marine Science	Ecology, Evolution & Marine Biology
Andelman, Sandy	Specialist	Nat'l Ctr for Ecol. Analysis & Synthesis
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Briggs, Cheryl	Professor	Ecology, Evolution & Marine Biology
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Brzezinski, Mark	Professor	Ecology, Evolution & Marine Biology
Cardinale, Bradley	Associate Professor	Ecology, Evolution & Marine Biology
Carlson, Craig	Professor	Ecology, Evolution & Marine Biology
Caselle, Jennifer	Associate Project Scientist	Marine Science Institute
Cavanaugh, Kyle	Postdoctoral Researcher	Marine Science Institute
Chadwick, Oliver	Professor	Geography
Cooper, Scott	Professor	Ecology, Evolution & Marine Biology
Costello, Christopher	Associate Professor	Bren School of Envir. Sci. & Management
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Damuth, John	Researcher	Marine Science Institute
D'Antonio, Carla	Professor	Environmental Studies



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Hofmann, Gretchen	Professor	Ecology, Evolution & Marine Biology



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Lopez-Carr, David	Associate Professor	Geography
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Max, Lisa	Graduate Student Researcher	Ecology, Evolution & Marine Biology



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McCauley, Edward	Professor	Nat'l Ctr for Ecol. Analysis & Synthesis
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Quetin, Langdon	Researcher	Marine Science Institute
Rassweiler, Andrew	Associate Project Scientist	Marine Science Institute



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Ross, Robin	Researcher	Marine Science Institute
Rothstein, Stephen	Professor	Ecology, Evolution & Marine Biology
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Selkoe, Kim	Assistant Research Biologist	Marine Science Institute
Siegel, David	Professor	Geography
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Sokolow, Susanne	Postdoctoral Researcher	Marine Science Institute
Sorlien, Christopher	Associate Researcher	Earth Research Institute
Speiser, Daniel	Postdoctoral Researcher	Marine Science Institute
Stahlheber, Karen	Graduate Student Researcher	Marine Science Institute
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Toothman, Mary	Staff Research Associate	Marine Science Institute
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Valentine, David	Professor	Earth Sciences
Waite, J. Herbert	Professor	Molecular, Cellular & Devel. Biology
Walker, Barbara	Academic Coordinator III	Office of Research



Warner, Robert	Professor of Biology	Ecology, Evolution & Marine Biology
Washburn, Libe	Professor	Geography
Wear, Emma	Graduate Student Researcher	Marine Science Institute
Weldaeb, Syee	Assistant Professor	Earth Sciences
Wenner, Adrian	Professor Emeritus	College of Creative Studies
White, Crow	Postdoctoral Researcher	Marine Science Institute
Whitmer, Allison	Academic Coordinator	Marine Science Institute
Wilson, Douglas	Research Geologist	Earth Sciences
Wood, Chelsea	Postdoctoral Researcher	Marine Science Institute
Yanchukov, Oleksiy	Postdoctoral Researcher	Marine Science Institute
Yu, Pauline	Postdoctoral Researcher	Marine Science Institute

