# ANNUAL REPORT 2007 2008

msi Marine Science Institute

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# Director's Statement

# Director's Statement

The environmental challenges facing our oceans have never been greater. Melting glaciers and shrinking polar ice caps continue to raise sea level and alter ocean ecosystems. The intensification of ocean acidification threatens coral reefs and many shelled organisms. Fisheries continue to decline. Fortunately, public awareness of the need for better stewardship of the oceans is growing and stewardship of the environment is high on the agenda of presidential candidates for both major parties. This renewal of interest in our planet's oceans is heartening and MSI has been contributing the scientific knowledge that is both fostering public awareness and providing a roadmap to solving these problems. Here are just a few examples: Research into the biological effects of ocean acidification by EEMB faculty member Gretchen Hofmann is revealing how calcifying organisms such as sea urchins, a major local fishery, and pteropods, a major food item for Pacific salmon, are adversely affected by increased ocean acidity. David Lea and James Kennett from Earth Sciences are producing new climate records from the Santa Barbara Basin (California) and the Carico Basin (Venezuela) to test current ideas on greenhouse forcing of climate. The Santa Barbara Coastal and Moorea Coral Reef Long-Term Ecological Research programs continue to reveal how our local kelp forests and tropical coral reefs respond to changes in the environment. Steven Gaines from EEMB and Christopher Costello from the Bren School of Environmental Science & Management are working on new incentive-based models for managing fisheries that will promote responsible stewardship by their very design. These and other projects continue MSI's record of being at the forefront of key issues in marine environmental research.

The vigorous research programs at MSI have resulted in another year of growth at the institute. MSI received a record $25.7 million in extramural awards and managed a record total portfolio $112 million in awards last fiscal year. Accommodating this growth in the face of declining state budgets is a challenge as our administrative staffing levels remain constant despite a 30% growth in the value of extramural awards over the past three years. It is only through the dedication of our staff that MSI continues to provide quality service to its researchers. I want to take this opportunity to thank our staff for their dedication to MSI during difficult times and tell them that their efforts are both noticed and appreciated. My goal of bringing our staffing in line with workload will continue.

There have been some significant changes at MSI this year. The extramural grants administration function of the Department of Ecology Evolution and Marine Biology has been transferred to MSI. I welcome our new colleagues and look forward to facilitating their research. The Cheadle Center for Biodiversity and Ecological Restoration (CCBER) also recently transferred their administrative support needs to MSI. CCBER houses regionally focused collections of terrestrial plants, algae, and vertebrates. It also supports local ecological restoration efforts and contributes to both university and K-12 education. CCBER has had links to MSI for years through partnerships and collaborations with the UC Natural Reserves managed by MSI. These efforts have been extremely successful. This year the "Kids in Nature" program that is run as a joint partnership between CCBER and the Sedgwick Reserve was awarded the 2007 Governor's Environmental and Economic Leadership Award in the category of Children's Environmental Education.

MSI has expanded and improved its computational infrastructure with the construction of a new server room with better cooling and greater capacity. My thanks to our Information Technology Manager, James Woods, for his efforts to make the new server room a reality and for a smooth transition in getting all of the servers and other equipment transferred to the new location with essentially no disruption to computer services.

Planning for the Ocean Science Education Building (OSEB) is in its final phases. This cooperative effort between NOAA and UCSB will house offices for the NOAA Channel Island National Marine Sanctuary (CINMS) and the Ocean Center for Teaching Ocean Science (OCTOS). OCTOS will serve the outreach needs of the CINMS and MSI using technologically state-of-the-art interactive exhibits and classrooms. Last year, MSI and CINMS served nearly 35,000 students through programs in the Channel Islands, the Santa Barbara Harbor and the Research Experience & Education Facility (REEF)

on the UCSB campus. The construction of the OSEB in the near future will provide a spectacular new venue for these joint efforts in ocean education.

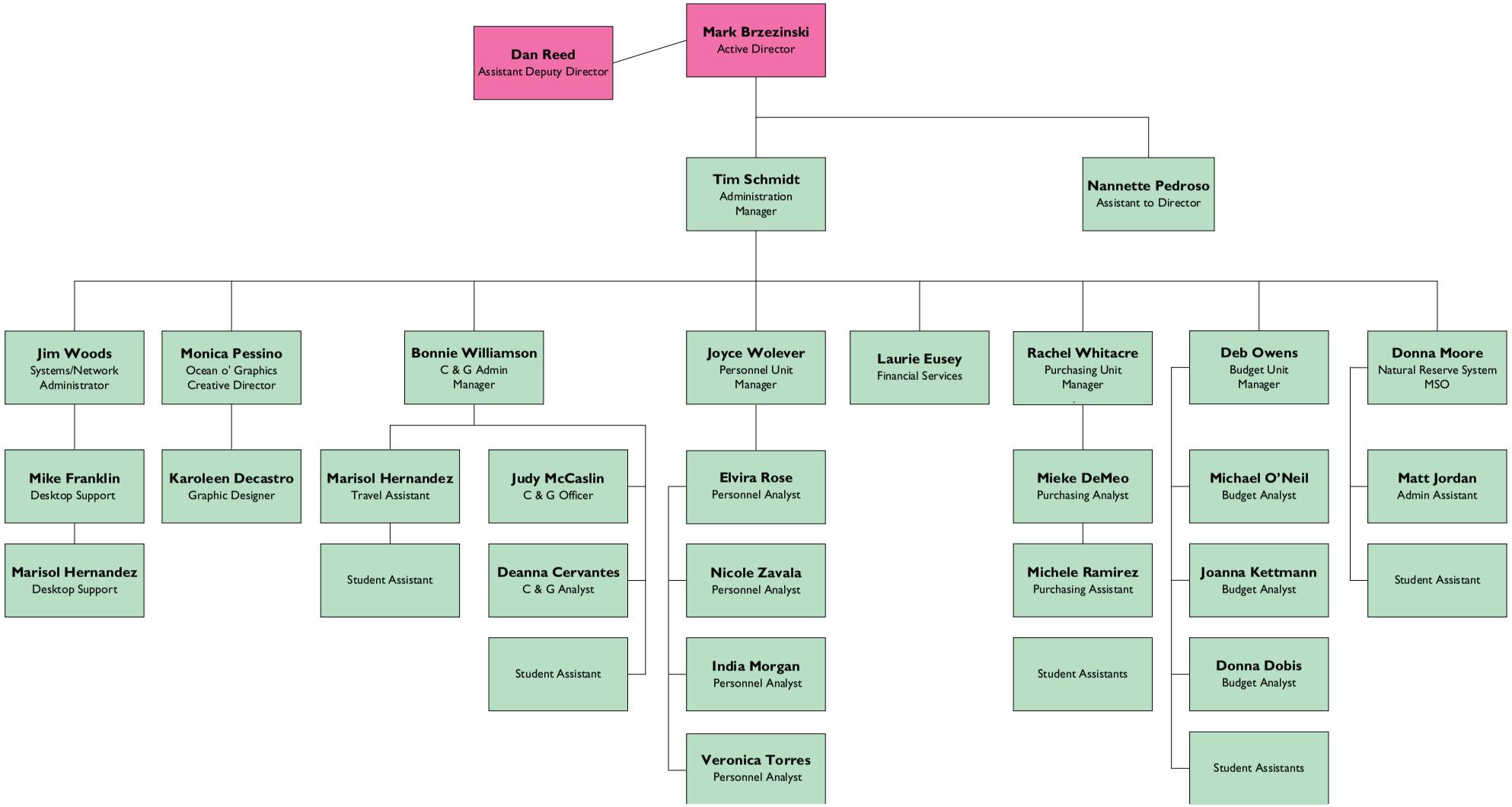
I am proud of the accomplishments of MSI researchers over the past year. It is a pleasure to serve such a fine institution. I look forward to the discoveries that will be made in the coming year.

Mark Brzezinski
Acting Director

# Organizational Charts

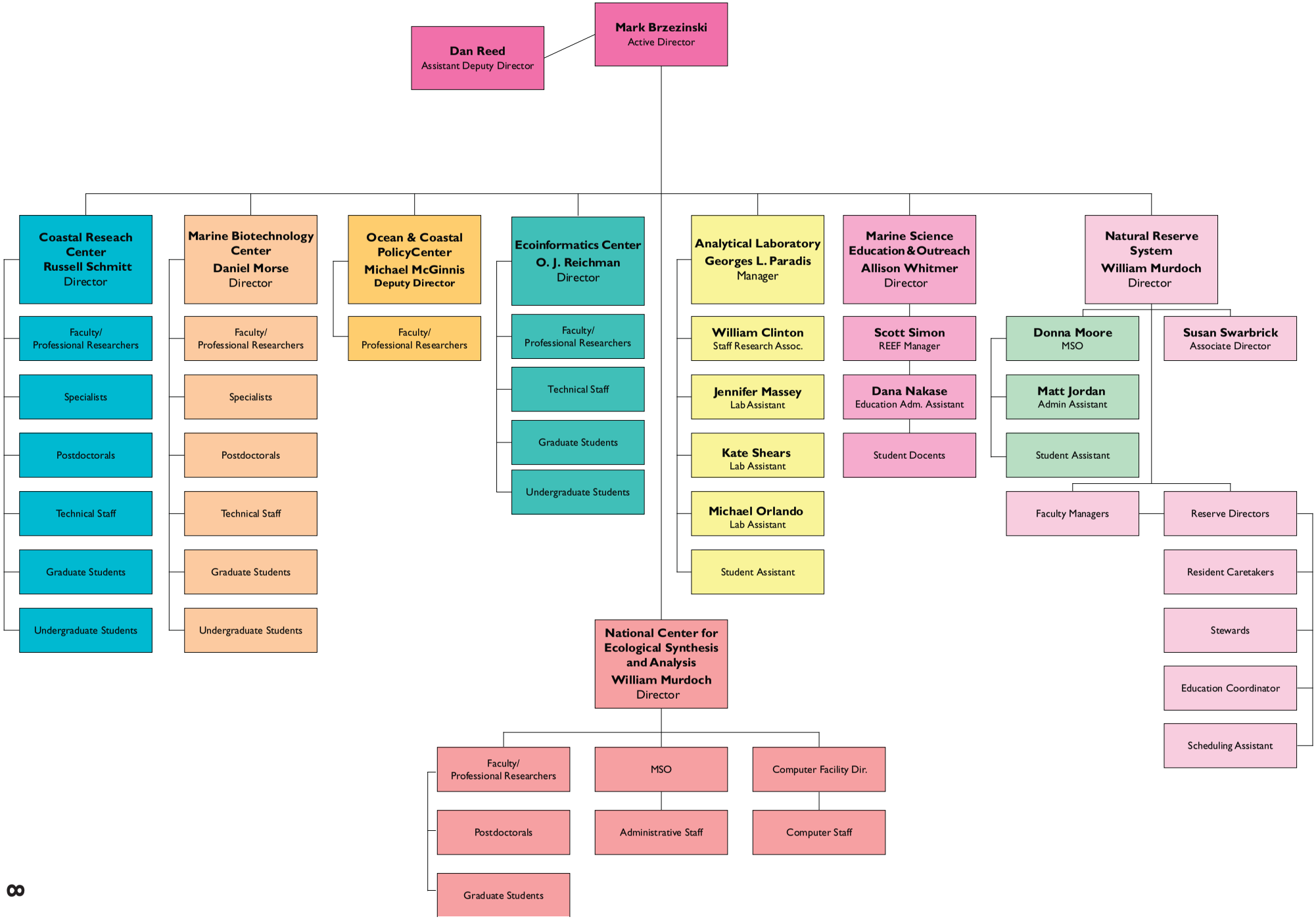
# MARINE SCIENCE INSTITUTE

## 2006–2007 ORGANIZATIONAL CHART



# MARINE SCIENCE INSTITUTE

## 2006–2007 ORGANIZATIONAL CHART



# Other Projects & Activities

# Seminars, Workshops, Conferences, and Meetings 2007-2008

The Marine Science Institute continues to support various seminars, workshops, conferences and meetings. During the 2007-2008 fiscal year 163 events took place, in which a wide range of marine science topics were highlighted.

| Dates | Coordinators | Topic |
|---|---|---|
| June 26 - July 27, 2007 | John Alroy<br>Arnold Miller* | Paleobiology Database (Hosted by NCEAS) (Training Workshop) |
| July 9 -11, 2007 | Matthew Jones<br>Mark Schildhauer<br>Joshua Madin<br>Bowers, Shawn<br>Steve Kelling* | Towards a unified model for describing ecological Bowers, Shawn and environmental observation data (Working Group) |
| July 17 - 19, 2007 | Erica Fleishman<br>Gary Tabor* | Climate change and conservation (WCS) (Working Group) |
| July 23 - 26, 2007 | Matthew Jones<br>Mark Schildhauer<br>Bertram Ludaescher*<br>Deborah Estrin*, Ilkay Altintas*, James Gallagher* | Management and analysis of environmental observatory data using the kepler scientific workflow system (Working Group) |
| July 25 - 27, 2007 | Benjamin Halpern | Ranking and mapping human threats and impacts to marine ecosystems in the California current (Working Group) |
| August 2, 2007 | Christopher Costello<br>Erica Fleishman | Options for reforming the California nearshore finfish fishery (Working Group) |
| August 6, 2007 | Erica Fleishman | Alternative Futures for Great Basin Ecosystems (working group) |
| August 8, 2007 | O.J. Reichman | NCEAS alumni reception |
| August 13 - 15, 2007 | Stephanie Hampton | EBM Governance Group (Hosted by NCEAS) (Meeting) |
| August 20 - 21, 2007 | Margaret Connors | Ocean communications workshop (Meeting) |
| August 21, 2007 | Juliann Aukema | Distributed graduate seminar, Economic impacts of non-native forest pests and pathogens in North America (Meeting) |
| August 30, 2007 | Ecolunch Seminar Series | Peter Mumby, University of Exeter Understanding and managing the resilience of coral reefs |
| September 2 - 8, 2007 | O.J. Reichman<br>Matthew Jones | Data management and analysis tools supporting adaptive management in South African parks (Meeting) |

* Non-UCSB personnel

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|---|---|---|
| September 5 - 6, 2007 | Beverly Rathcke* | Science Advisory Board 2006-2008 |
| September 6, 2007 | Ecolunch Seminar Series | Jim Bever, Indiana University Ecological dynamics and evolutionary maintenance of the mycorrhizal mutualism |
| September 7, 2007 | Jocelyn Ondre | Sustainable Fisheries Group meeting |
| September 10 - 12, 2007 | Steve Gaines, Steven Dov Sax* | Exotic species: A source of insight into ecology, evolution, and biogeography (Working Group) |
| September 10 - 14, 2007 | Richard Condit* | Center for Tropical Forest Science: IT and Research Directions (Hosted by NCEAS) (Meeting) |
| September 13, 2007 | Ecolunch Seminar Series | Andrew Campbell, Triple Helix Consulting, Developments Downunder - current trends in science and policy for managing Australian landscapes |
| September 13 - 17, 2007 | Kevin Lafferty Andrew Dobson* | Parasites and food webs - the ultimate missing links (Working Group) |
| September 14, 2007 | Elizabeth Holmes* Stephanie Hampton | An introduction to the analysis of community time series using Multivariate Autoregressive (MAR) models (Training Workshop) |
| September 17 - 21, 2007 | Elise Granek* David Stoms Edward Barbier* Evamaria Koch* Shankar Aswani-Canela* | Measuring ecological, economic and social values of coastal habitats to inform ecosystem-based management of land-sea (EBM) (Working Group) |
| September 17 - 21, 2007 | Chris Wilcox* C. Josh Donlan* | Exploring compensatory mitigation and markets as mechanisms for resolving fisheries bycatch: Biodiversity conservation conflicts (Working Group) |
| September 20, 2007 | Ecolunch Seminar Series | Brian Silliman, University of Florida Climate change, food webs and new paradigms in marine ecology |
| September 24 - 26, 2007 | Erica Fleishman | Analysis and Conservation Prioritization of Landscape Connectivity in Nevada (Working Group) |
| October 2 - 4, 2007 | Stephanie Hampton | Marine Protected Areas Monitoring Group (Hosted by NCEAS) (Meeting) |
| October 5, 2007 | Ecolunch Seminar Series | Jim Brown: University of New Mexico Productivity and kinetics: the metabolic basis of species diversity |
| October 5, 2007 | Ecolunch Seminar Series | Rob Dunn, North Carolina State University, Climate and global patterns of ant diversity and invasion |

* Non-UCSB personnel

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|---|---|---|
| October 5 - 7, 2007 | Robert Colwell<br>Nicholas Gotelli | Synthetic macroecological models of species diversity (Working Group) |
| October 8, 2007 | Steve Gaines | Alan Hastings, Time: the next frontier in ecology (Seminar) |
| October 9, 2007 | Steve Gaines | Luce Fellows Environmental Science to Solutions Initiative |
| October 11, 2007 | Ecolunch Seminar Series | Marc Cadotte, NCEAS, Species diversity and spatially-dependent mechanisms of coexistence |
| October 11, 2007 | Steve Gaines | Les Real: Integrating the ecologcal and evolutionary dynamics of infectious diseases: from rabies to Ebola (Seminar) |
| October 11 - 14, 2007 | Margaret Connors | SACNAS Annual Meeting |
| October 11 - 12, 2007 | Erica Fleishman | Valuation of marine ecosystem services (Working Group) |
| October 15 - 19, 2007 | Brian McGill*<br>Jessica Green* | Tools and fresh approaches for species abundance distributions (Working Group) |
| October 15 - 19, 2007 | Erica Fleishman | Ecosystem analysis of pelagic organism declines in the Upper San Francisco Estuary (Working Group) |
| October 18, 2007 | Steve Gaines | Peter Hudson: The ecology of natural infections: Individual variation to population dynamics |
| October 18, 2007 | Ecolunch Seminar Series | David Alonso, University of Michigan Randomness, natural selection and physical constraints for a changing world |
| October 22 - 24, 2007 | Benjamin Halpern | Ranking and mapping human threats and impacts to marine ecosystems in the California current (Working Group) |
| October 22 - 24, 2007 | Stephen Hubbell*<br>Pablo Marquet*<br>Andrew Allen | Towards a unified theory of biodiversity (Working Group) |
| October 25, 2007 | Ecolunch Seminar Series | Bill Dennison, University of Maryland Global trajectories of seagrasses, the biological sentinels of coastal ecosystems |
| October 25 - 30, 2007 | Robert Orth*<br>William Dennison* | Global trajectories of seagrasses: Establishing a quantitative basis for seagrass conservation and restoration (Working Group) |
| October 26, 2007 | Jenifer Dugan<br>Dan Reed | SEEDS Field Trip and Meeting |
| October 29 - 31, 2007 | Stephanie Hampton | Marine Protected Areas Monitoring Group (Hosted by NCEAS) (Meeting) |

* Non-UCSB personnel

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|---|---|---|
| November 1, 2007 | Ecolunch Seminar Series | Nick Shears, UCSB, Context dependent effects of fishing on kelp forest ecosystems |
| November 3 - 7, 2007 | Daniel Doak*<br>James Estes*<br>Timothy Wootton*<br>Terrie Williams* | Conservation planning for ecosystem functioning: Testing predictions of ecological effectiveness for marine predators (EBM) (Working Group) |
| November 5, 2007 | Steve Gaines | Future education outreach activities |
| November 6-8, 2007 | Russell Schmitt<br>Sally Holbrook | 4th Annual Moorea Coral Reef LTER Site All Investigators Meeting |
| November 8, 2007 | Ecolunch Seminar Series | Louie Yang, UCSB, Resource pulses, periodical cicadas and the ecology of extreme events |
| November 8, 2007 | Steve Gaines | Nancy Grimm: From desert streams to desert cities: nitrogen transport and retention in heterogeneous landscapes |
| November 8 - 9, 2007 | Benjamin Halpern<br>Erica Fleishman | Synthesis across EBM working groups (EBM) (Meeting) |
| November 9 - 12, 2007 | Ray Hilborn*<br>Boris Worm* | Finding common ground in marine conservation and management (Working Group) |
| November 10 - 13, 2007 | Diane Ebert-May*<br>Matthew Jones<br>Mark Urban-Lurain* | Faculty Institutes for Reforming Science Teaching (FIRST II) (Working Group) |
| November 13 – 17, 2007 | Robert Holt*<br>Lauren Buckley*<br>Joshua Tewksbury* | Mechanistic distribution models: Energetics, fitness, and population dynamics (Working Group) |
| November 14 – 15, 2007 | Scott Collins<br>Elsa Cleland | Ushering in a new era of functional ecology: Dynamics in a changing environment (Distributed Graduate Seminar) |
| November 15, 2007 | Ecolunch Seminar Series | Andrew Allen, NCEAS, Setting the absolute tempo of biodiversity dynamics |
| November 16, 2007 | Daniel Morse | Dr. Angela Belcher, Seminar |
| November 17 - 19, 2007 | Patrick Christie*<br>Richard Pollnac* | Governance feasibility of marine ecosystem-based management: A comparative analysis (EBM) (Working Group) |
| November 26 - 28, 2007 | Stephanie Hampton | Marine Protected Areas Monitoring Group (Hosted by NCEAS) (Meeting) |
| November 27, 2007 | Ecolunch Seminar Series | Astrid Kodric-Brown, University of New Mexico & NCEAS Disturbance is essential for the preservation of desert fish communities |
| November 27 - 28, 2007 | Fiorenza Micheli*<br>Andrew Rosenberg* | A synthetic approach to the science of ecosystem-based management of coastal marine ecosystems (EBM) (Working Group) |

* Non-UCSB personnel

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|---|---|---|
| November 27 - 30, 2007 | O.J. Reichman<br>Stephanie Hampton | Economic impacts of non-native forest pests and pathogens in North America (TNC) (Working Group) |
| November 29, 2007 | Ecolunch Seminar Series | Lawrence McCook, Manager, Great Barrier Reef Marine Park Authority & Pew Fellow in Marine Conservation Science & management of resilience of Great Barrier Reef in context of climate change |
| December 3 - 7, 2007 | Helen Regan*<br>Sahotra Sarkar* | Making decisions on complex environmental problems (Working Group) |
| December 3 - 7, 2007 | Pej Rohani*<br>Aaron King* | Unifying approaches to statistical inference in ecology (Working Group) |
| December 6, 2007 | Ecolunch Seminar Series | Aaron King, University of Michigan New insights into cholera dynamics: asymptomatic infections, rapid loss of immunity, and mode of transmission |
| December 10 - 14, 2007 | Jonathan Shurin<br>Helmut Hillebrand* | Comparing trophic structure across ecosystems (Extended) (Working Group) |
| December 13, 2007 | Ecolunch Seminar Series | Jacob Weiner, University of Copenhagen & NCEAS Applying plant population ecology - increasing the suppression of weeds by cereal crops |
| December 13 - 14, 2007 | Erica Fleishman | Evaluation of declines of pelagic organisms in the upper San Francisco Estuary (Meeting) |
| January 4 - 11, 2008 | Matthew Leibold*<br>Mark Urban* | Evolutionary and ecological sorting in space (Working Group) |
| January 14 - 16, 2008 | Benjamin Halpern | Ranking and mapping human threats and impacts to marine ecosystems in the California current (Working Group) |
| January 4 - 18, 2008 | David Ackerly*<br>Jeannine Cavender-Bares*<br>Peter Reich*<br>Michelle Mack*<br>J. Gordon Burleigh | Linking phylogenetic history, plant traits, and ecological processes at multiple scales (Working Group) |
| January 15 - 17, 2008 | Stephanie Hampton | NBII/GAP (Hosted by NCEAS) (Meeting) |
| January 17, 2008 | Ecolunch Seminar Series | Jeanine Cavender-Bares, University of Minnesota, Linking phylogenetic history, plant traits and environmental gradients |
| January 21 - 25, 2008 | Erica Fleishman | Potential role of contaminants in declines of pelagic organisms in the Upper San Francisco Estuary, California (Working Group) |

* Non-UCSB personnel

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|---|---|---|
| January 22 -24, 2008 | James Randerson*<br>Josep Canadell*<br>Robert Jackson* | Linking carbon storage in terrestrial ecosystems with other climate forcing agents: A synthesis allowing for effective carbon dioxide stabilization policies (Working Group) |
| January 23, 2008 | Ecolunch Seminar Series | Sam Luoma, USGS, Potential role of contaminants in declines of pelagic organisms in the Upper San Francisco Estuary, California |
| January 23 – February 13, 2008 | Bill Langford*<br>John Drake, John | Machine learning for the environment (Working Group) |
| January 23 - 24, 2008 | Mark Schildhauer | Public domain ADMB project (Meeting) |
| January 28 - 29, 2008 | Stephanie Hampton | Marine Protected Areas Monitoring Group (Hosted by NCEAS) (Meeting) |
| January 31, 2008 | Ecolunch Seminar Series | Carlos Melian, NCEAS, Unifying neutral theories of molecular, community and network evolution |
| February 2 - 6, 2008 | Peter Kareiva*<br>Gretchen Daily*<br>Taylor Ricketts | Conservation priorities: Can we have our biodiversity and ecosystem services too? (Hosted by NCEAS) (Meeting) |
| February 2, 2008 | Satie Airame | MPA Monitoring Group – First Five Years of Monitoring the Channel Islands MPA |
| February 2, 2008 | Alisa Hove | EEMB/NCEAS Graduate Student Symposium |
| February 4 - 8, 2008 | Elise Granek*<br>David Stoms<br>Edward Barbier*<br>Evamaria Koch*<br>Shankar Aswani-Canela | Measuring ecological, economic and social values of coastal habitats to inform ecosystem-based management of land-sea (EBM) (Working Group) |
| February 5 -8, 2008 | Juliann Aukema | Economic impacts of non-native forest pests and pathogens in North America (Distributed Graduate Seminar) |
| February 7, 2008 | Ecolunch Seminar Series | Stephen Polasky, University of Minnesota, Valuing ecosystem services: the good, the bad and the ugly |
| February 9 -13, 2008 | Jessica Gurevitch*<br>Julia Koricheva* | Meta-analysis in ecology: Lessons, challenges and future (Working Group) |
| February 12 - 23, 2008 | Peter Walsh | Efficient wildlife disease control: From social network self-organization to optimal vaccination (Working Group) |
| February 14, 2008 | Ecolunch Seminar Series | Christopher Lortie, York University A net interaction based approach to understanding plant community dynamics. |

* Non-UCSB personnel

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| February 15, 2008 | Daniel Morse | Neurobiology & Medical Group researchers Collaborators Meeting |
| February 21, 2008 | Ecolunch Seminar Series | David Atkinson, University of Liverpool & NCEAS, Temperature- and size-dependency of biological rates, and their ecological consequences |
| February 28, 2008 | Ecolunch Seminar Series | John Swaddle, The College of William and Mary & NCEAS Urbanization, mate preference, and public health: the effects of development on avian and human societies |
| March 3 – 8, 2008 | Kevin Lafferty<br>Andrew Dobson* | Parasites and food webs - the ultimate missing links (Working Group) |
| March 5 – 12, 2008 | Chris Wilcox*<br>C. Josh Donlan | Exploring compensatory mitigation and markets as mechanisms for resolving fisheries bycatch: Biodiversity conservation conflicts (Working Group) |
| March 5 – 6, 2008 | Beverly Rathcke* | Science Advisory Board 2006-2008 |
| March 6 - 7, 2008 | Daniel Schindler*<br>Robin Waples | Evolutionary and plastic responses of Pacific salmon to climate change (Working Group) |
| March 6, 2008 | Ecolunch Seminar Series | Chris Wilcox, CSIRO Marine and Atmospheric Research An integrated approach to managing fisheries bycatch |
| March 10 – 14, 2008 | Fred Allendorf*<br>Michael Schwartz* | Genetic monitoring: Development of tools for conservation and management (Working Group) |
| March 10 – 11, 2008 | Randall Peterman* | Monitoring responses of Pacific salmon to climate change (Working Group) |
| March 11-13, 2008 | Jocelyn Ondre, Chuck Cook | Sustainable Fisheries Group Retreat |
| March 13, 2008 | Ecolunch Seminar Series | Raphael Sagarin, Nicholas Institute for Environmental Policy Solutions, Duke University, Darwinian Security: findings from an NCEAS working group on evolution and security |
| March 13 – 14, 2008 | Jerry Melillo*<br>A David McGuire*<br>Ronald Prinn*<br>Qianlai Zhuang* | Toward an adequate quantification of CH4 emissions from land ecosystems: Integrating field and in-situ observations, satellite data, and modeling (Working Group) |
| March 13, 2008 | Satie Airame | Reception for Recipients of Luce Fellows awards |
| March 20, 2008 | Satie Airame | PISCO Policy Retreat |
| March 20, 2008 | Ecolunch Seminar Series | Richard Condit, Smithsonian Tropical Research Institute & NCEAS |

* Non-UCSB personnel

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|---|---|---|
| March 24 - 26, 2008 | Benjamin Halpern | Ranking and mapping human threats and impacts to marine ecosystems in the California current (Working Group) |
| March 25 – 28, 2008 | Matt Jones<br>Mark Schildhauer<br>Bertram Ludaescher*<br>Deborah Estrin*<br>Altintas, Ilkay<br>Gallagher, James | Management and analysis of environmental observatory data using the Kepler Scientific Workflow System (Working Group) |
| March 27 - 31, 2008 | Scott Collins<br>Elsa Cleland | Ushering in a new era of functional ecology: Dynamics in a changing environment (Working Group) |
| March 27 | Ecolunch Seminar Series | Beth Witherell, Editor-in-Chief of The Writings of Henry D. Thoreau An introduction to Henry David Thoreau's phenological data, collected in Concord, Massachusetts, between 1851 and 1861 |
| April 1 - 4, 2008 | James Turner* | Effects of trade policy on management of non-native forest pests and pathogens (Working Group) |
| April 3, 2008 | Ecolunch Seminar Series | Jai Ranganathan, NCEAS Tiger, tiger, burning bright: hope for tiger conservation in the wild |
| April 7, 2008 | Libe Washburn | Seminar, Steve Weisberg, Exec. Dir Southern CA Coastal Observing System |
| April 7 - 11, 2008 | Peter Kareiva*<br>Gretchen Daily*<br>Taylor Ricketts* | Conservation priorities: Can we have our biodiversity and ecosystem services too? (Hosted by NCEAS) (Meeting) |
| April 7 - 11, 2008 | Erica Fleishman | Ecosystem analysis of pelagic organism declines in the Upper San Francisco Estuary (Working Group) |
| April 10, 2008 | Russell Schmitt, Sally Holbrook | UC LTER Network workshop |
| April 10, 2008 | Ecolunch Seminar Series | Andy Sih, University of California, Davis, Behavioral syndromes: evolutionary and ecological issues and implications |
| April 17 - 18, 2008 | Erica Fleishman | Development of a report card for assessing the status and trend of Bay-Delta ecosystems (Working Group) |
| April 17, 2008 | Ecolunch Seminar Series | Nancy Baron, NCEAS & SeaWeb/ COMPASS Communicating Science: Bridging the Worlds between Scientists and Journalists |

* Non-UCSB personnel

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|---|---|---|
| April 19 - 22, 2008 | Ray Hilborn*<br>Boris Worm* | Finding common ground in marine conservation and management (Working Group) |
| April 23 - 25, 2008 | Erica Fleishman | Valuation of marine ecosystem services (Working Group) |
| April 24, 2008 | Ecolunch Seminar Series | Rowan Lockwood, The College of William and Mary & NCEAS Is rarity linked to extinction in the fossil record? A case study using Cenozoic mollusks from the U.S. Coastal Plain |
| April 25, 2008 | Nicholas Shears | The Effect of Marine Reserves on Recruitment, Exploited Species and Fishing meeting |
| April 25 - 29, 2008 | Daniel Doak*<br>James Estes*<br>J Timothy Wootton*<br>Terrie Williams* | Conservation planning for ecosystem functioning: Testing predictions of ecological effectiveness for marine predators (EBM) (Working Group) |
| April 28, 2008 – May 2, 2008 | Reichman, O, Jones, Matthew | Data management and analysis tools supporting adaptive management in South African parks (Training Workshop) |
| April 29-May 1, 2008 | Steve Gaines, John Melack | Digital Oceans Charette |
| April 30, 2008 | Jocelyn Ondre | Program Officers with Paul G. Allen Family Foundation meeting |
| May 1, 2008 | Ecolunch Seminar Series | Stefano Allesina, NCEAS The spider and the web: inference in ecological networks |
| May 5 - 8, 2008 | Connors, Margaret | Kids Do Ecology Poster Day (Meeting) |
| May 6 - 7, 2008 | Erica Fleishman | Advisory Board for Calif. Current EBM (Hosted by NCEAS) (Meeting) |
| May 8, 2008 | Ecolunch Seminar Series | Mark Bradford, University of Georgia Are soil microbial communities functionally equivalent? |
| May 8, 2008 | Jocelyn Ondre | Sustainable Fisheries Project meeting |
| May 8 - 11, 2008 | Moore, John, Dong, Quan | Detritus and dynamics of populations, food webs and communities (Working Group) |
| May 12 - 16, 2008 | Erica Fleishman | Potential role of contaminants in declines of pelagic organisms in the Upper San Francisco Estuary, California (Working Group) |
| May 12 - 15, 2008 | Alan Townsend*<br>Cory Cleveland* | Revisiting nutrient limitation in tropical forests (Working Group) |
| May 15, 2008 | Ecolunch Seminar Series | Kim Schultz, SUNY & NCEAS When "all you can eat" may not be enough: why ecologists should be as concerned with quality as quantity in the aquatic food web buffet |

* Non-UCSB personnel

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|---|---|---|
| May 16, 2008 | Erica Fleishman | Evaluation of declines of pelagic organisms in the upper San Francisco Estuary (Meeting) |
| May 16, 2008 | Steve Gaines | Sustainable Fisheries Meeting |
| May 18 - 22, 2008 | David Ackerly*<br>Jeannine Cavender-Bares*<br>Peter Reich*, Michelle Mack*<br>J Gordon Burleigh* | Linking phylogenetic history, plant traits, and ecological processes at multiple scales (Working Group) |
| May 19 - 20, 2008 | Stephanie Hampton | Large-scale management action experiments and the detection of population-level effects (Meeting) |
| May 21 - 23, 2008 | Erica Fleishman | Analysis and Conservation Prioritization of Landscape Connectivity in Nevada (Working Group) |
| May 21 - 23, 2008 | Stephen Hubbell*<br>Pablo Marquet*<br>Andrew Allen | Towards a unified theory of biodiversity (Working Group) |
| May 22, 2008 | Steve Gaines | Sustainable Fisheries Group meeting |
| May 22, 2008 | Ecolunch Seminar Series | Annette Ostling, University of Michigan, Do tradeoffs lead to neutral communities? |
| May 23 - 24, 2008 | Howard Cornell*,<br>Gary Mittelbach* | Gradients in biodiversity and speciation (Working Group) |
| May 27, 2008 – June 4, 2008 | Christopher Lortie*<br>Lonnie Aarssen*<br>Tom Tregenza* | A quantitative exploration of the role of publication-related biases in ecology (Working Group) |
| May 27, 2008 – June 3, 2008 | Jennifer Balch*<br>David Bowman* | Pyrogeography and climate change (co-sponsored with KITP) (Working Group) |
| May 28 - 30, 2008 | Stephanie Hampton | Sabo: Cadillac Desert (Hosted by NCEAS) (Meeting) |
| May 29, 2008 | Ecolunch Seminar Series | Lonnie Aarssen, Queen's University Death without sex - or how the meek plants have inherited the earth because of evolution |
| May 30, 2008 | Dan Reed | SBC-LTER Annual Undergraduate Student Research meeting |
| June 3, 2008 | Ecolunch Seminar Series | David Bowman, University of Tasmania, Pyrogeography: integrating across the temporal, spatial and cultural dimensions of fire |
| June 4, 2008 | Dan Reed | SBC-LTER Annual Science Meeting |
| June 5 – 6, 2008 | Stephanie Hampton | Meta-analysis (Training Workshop) |
| June 5, 2008 | Erica Fleishman | Meeting with EPA Las Vegas Branch (Hosted by NCEAS) (Meeting) |
| June 5, 2008 | Ecolunch Seminar Series | Tristan Long, UCSB, Evolutionary consequences of sexual conflict |
| June 6, 2008 | Russell Schmitt | UC LTER Network meeting |

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|---|---|---|
| June 8, 2008 | Armand Kuris | Anthropogenic Effects on Host-Trematode Dynamics Retreat |
| June 9 – 13, 2008 | Helen Regan<br>Sahotra Sarkar* | Making decisions on complex environmental problems (Working Group) |
| June 10 – 12, 2008 | Erica Fleishman | Potential role of contaminants in declines of pelagic organisms in the Upper San Francisco Estuary, California (Meeting) |
| June 12 | Ecolunch Seminar Series | Lynn Maguire, Duke University Endangered? threatened? not warranted?: criteria for ESA listing decisions |
| June 16 – 20, 2008 | Pei Rohani*, Aaron King* | Unifying approaches to statistical inference in ecology (Working Group) |
| June 17 – 18, 2008 | Robert Pavia*<br>James Lindholm | Distributed graduate seminar - the role of MPAs in ecosystem-based management: Examining the science and politics of an ocean conservation strategy (Distributed Graduate Seminar) |
| June 19, 2008 | Erica Fleishman | Potential role of contaminants in declines of pelagic organisms in the Upper San Francisco Estuary, California (Meeting) |
| June 23, 2008 –July 28, 2008 | John Alroy<br>Arnold Miller* | Paleobiology Database (Hosted by NCEAS) (Training Workshop) |

# 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: 2006-2007**

**Russell J. Schmitt,** Director and Professor of Biology

**Alice Alldredge,** Professor of Biological Oceanography

**Giacomo Bernardi,** Professor of Molecular Ecology (UCSC)

**Andrew Brooks,** Associate Project Scientist

**Mark Brzezinski,** Professor of Biology

**Alison Butler,** Professor of Chemistry

**Bradley Cardinale,** Assistant Professor of Biology

**Craig Carlson,** Associate Professor of Biology

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

**Joseph H. Connell,** Research Professor of Zoology

**Jenifer E. Dugan,** Associate Research Biologist

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

**John M. Engle,** Associate Research Biologist

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

**Steven D. Gaines,** Professor of Biology

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

**Scott Hodges,** Professor of Biology

**Gretchen Hofmann,** Associate Professor of Biology

**Sally J. Holbrook,** Professor of Biology

**Evelyn Hu,** Professor of Electrical and Computer Engineering

**Ronald Iltis,** Professor of Electrical and Computer Engineering

**Robert Jacobs,** Professor of Biology

**Ryan Kastner,** Assistant Professor of Electrical and Computer Engineering

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

**David Lea,** Professor of Geology

**Hua Lee**, Professor of Electrical and Computer Engineering

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

**Hunter Lenihan,** Associate Professor of Environmental Science

**Milton Love,** Research Biologist

**Sally MacIntyre,** Professor of Limnology and Oceanography

**Stéphane Maritorena,** Associate Researcher

**John Melack,** Professor of Biology

**Daniel Morse,** Professor of Biology

**Erik Muller,** Assistant Research Biologist

**Roger M. Nisbet,** Professor of Biology

**Henry M. Page,** Associate Research Biologist

**Daniel C. Reed,** Research Biologist

**Stephen C. Schroeter,** Research Biologist

**Hannah Stewart,** Postdoctoral Researcher (Un. Washington)

**Allan Stewart-Oaten,** Professor of Biology

**David Valentine,** Assistant Professor of Geological Sciences

**Libe Washburn,** Professor of Geography

**Allison Whitmer,** Assistant Dean (Georgetown University)

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

**Leslie Wilson,** Professor of Biology

# EcoInformatics Center

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

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

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

The Mission of the EIC is to:

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

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

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

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

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

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

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

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

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

**Accomplishments**
Participants in the EIC have been successful on several fronts this year, including advances in software technologies, new awards that will permit continued advances in informatics (see Table 1), and publications raising awareness of informatics issues within the ecological community.

Data and metadata management continues to be a principal emphasis of the software engineering effort at the EIC. Researchers there have created several applications for managing data, including the Metacat metadata and data storage system. This year the EIC has released two new versions of Metacat, which is being used broadly to manage data at UCSB, within the US environmental sciences community, and at international institutions. The Metacat system has become the principal mechanism for data sharing across the 26 sites of the Long Term Ecological Research Network (LTER), and the EIC continues to collaborate with the LTER Network Office to ensure that a national federation of data is available to all researchers. This collaboration is formalized as the Knowledge Network for Biocomplexity (KNB), where a single web-based

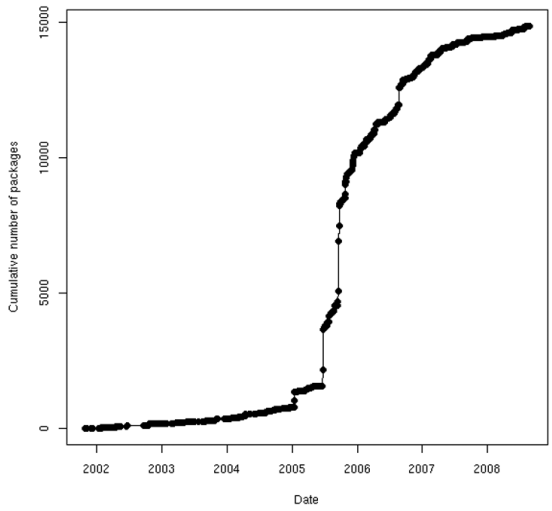


**Figure 1: Cumulative number of data packages available from the Knowledge Network for Biocomplexity (KNB) over time. Each data package contains raw ecological data and descriptive documentation that supports proper interpretation and use of the data. Data are contributed from NCEAS, the LTER Network, PISCO, the Organization of Biological Field Stations (OBFS), the UC Natural Reserve System, and other groups representing more than 200 field stations nationally.**

portal has been established for accessing data from hundreds of ecological field stations throughout the US. The KNB portal grew in 2007 to now contain over 15,000 ecological data sets (Figure 1), many of which are from Metacat systems that have been deployed by two MSI research programs, PISCO and the Santa Barbara Coastal LTER (SBC).

In addition to the US collaborators, the EIC has been working with international partners in South Africa, Taiwan, Denmark, and elsewhere to establish an international network of data providers. The EIC collaboration with Kruger National Park in South Africa has been expanded this year to include other parks in the South African National Parks system and in the South African Environmental Observation Network (SAEON). A new version of Metacat has been written specifically with features that facilitate deployment in these new locations. The new sites will include research focused on both savanna and marine systems. These activities are supported by an award from the Andrew W. Mellon Foundation. This year has also seen us develop a new collaboration with the Global Biodiversity Information Facility (GBIF) to promote the distribution of data globally. GBIF has installed our Metacat system to manage metadata about museum specimen collections worldwide, and we are currently working out the details that would allow GBIF to become a full partner node in the KNB network. We have also begun a partnership with the National Biological Information Infrastructure (NBII) to improve the exchange of metadata and data in the US. Although the growth rate of the KNB has slowed in the past year, we expect these two new initiatives to massively increase the volume of the accessible data in the KNB in the coming year.

Analysis and modeling of ecological data is the second major emphasis area for the EIC. Research on systems for streamlining the analysis and modeling process and integrating national data archives such as the KNB is ongoing at the EIC. As part of the Science Environment for Ecological Knowledge (SEEK) project, researchers at the EIC pioneered a new approach to analysis and modeling based on 'scientific workflows' through the creation of a software tool called Kepler (Figure 2). Kepler simplifies the effort required to analyze and model scientific data by using a visual representation of these processes. These representations, or "scientific workflows," display the flow of data among discrete analysis and modeling components. We released several beta versions of Kepler during 2007 and released the first full version of Kepler (1.0.0) in May 2008. Over 9000 scientists have downloaded Kepler 1.0.0 since its release. Kepler is being used and extended by many science disciplines, including ecology, molecular biology, chemistry, geology, astronomy, and many others. The Kepler Project is a collaboration among many institutions, including UC Santa Barbara, UC Davis, UC San Diego, UC Berkley, University of New Mexico, and many others.



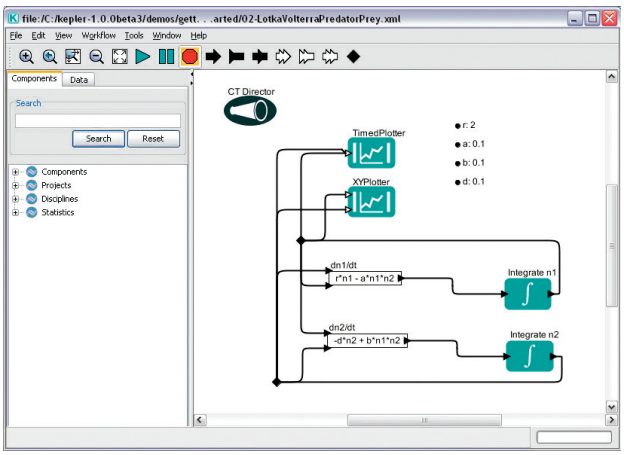


**Figure 2:** The Kepler scientific workflow system showing the Lotka-Volterra predator-prey model. Each component in a scientific workflow is an independent and re-usable analysis or modeling procedure. Kepler supports components written in many prominent analysis environments, such as R and Matlab, and is extensible to support new environments. Kepler workflows can be saved and shared among researchers to facilitate collaboration.

These advances in the software infrastructure available to the environmental sciences community have been accomplished through the existing research grants to participants in the EIC. Five new extramurally funded awards in 2007 and three new awards in 2008 will allow EIC work to continue and to be expanded into new areas (Table 1).

Kepler CORE. One of these awards is for Kepler CORE, an initiative that aims to transform the current Kepler software system from a research prototype to production-grade software. This collaborative

initiative brings together the investigators that are driving development from UC Santa Barbara, UC Davis, and UC San Diego in order to produce a new product that is more robust and stable. This new release of Kepler will be an open-source, non-proprietary product that is easily extensible to support analysis and modeling by different fields of science, including ecology and environmental science.

**Table 1:** Current research awards for informatics at NCEAS and the EIC.

| **Funding Source** | **Year Funded** | **Description** | **Total** Award |
|---|---|---|---|
| NSF | 2002 | Science Environment for Ecological Knowledge (SEEK) | $12.05M |
| SanParks | 2005 | Analysis Tools for Thresholds of Potential Concern | $78K |
| SanParks | 2005 | Spatial Data extensions for Kruger National Park | $39K |
| NSF | 2006 | Management and Analysis of Environmental Observatory Data Using the Kepler Scientific Workflow System (REAP) | $2.75M |
| NSF | 2007 | A Workshop for Advancing a Unified Model for Observational Data in the Ecological and Environmental Sciences | $50K |
| Mellon | 2007 | Data Management and Analysis Tools Supporting Adaptive Management in South African Parks | $256K |
| Mellon | 2007 | Deploying Information Management Tools and Increasing Analytical Capabilities of Scientists | $400K |
| NSF | 2007 | Development of Kepler/CORE – A Comprehensive, Open, Reliable, and Extensible Scientific Workflow Infrastructure | $1.7M |
| NSF | 2007 | Faculty Institutes for Reforming Science Teaching (FIRST) | $132K |
| NSF | 2008 | Semantic Enhancements for Ecological Data Management | $599K |
| NSF | 2008 | Creation of an International Virtual Data Center for the Biodiversity, Ecological and Environmental Sciences (VDC) | $749K |
| NSF | 2008 | A Community-driven Scientific Observations Network to achieve Interoperability of Environmental and Ecological Data (SONet) | $750K |

**REAP.** Another of these awards, the Real-time Environment for Analytical Processing (REAP) project, focuses on the infrastructure needed to integrate emerging sensor networks that are being deployed widely in ecology and environmental science. REAP aims to support the sensor networks deployed in both the National Ecological Observatory Network (NEON) and the Ocean Observing Initiative (OOI) by extending the Kepler system to support direct feeds of sensor data. REAP is being designed as a series of extensions to Kepler that allow scientists to search for sensor data, access the data streams directly within the workflow environment, and then to analyze the sensor data stream in conjunction with data from archives like the Knowledge Network for Biocomplexity. The system is being designed to support

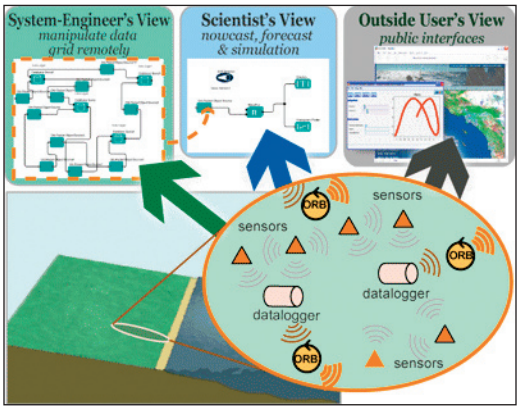


**Figure 3:** The REAP project uses the Kepler system to support a) sensor network management for system engineers, b) analysis and modeling using sensor data for scientists, and c) web-based data summarization targeting the public

a wide variety of common sensor hardware and software, including equipment from vendors such as Campbell Scientific and National Instruments, as well as a variety of open platforms such as TinyOS. In addition to scientific data access, researchers on REAP are developing sensor monitoring and control software that allows a systems engineer to simulate, design, deploy, monitor, and control a sensor network from within the workflow environment. The design of all of these software systems in REAP is being guided by the needs of two use cases. The first focuses on large scale processing and integration of Sea Surface Temperature fields as used in oceanography, and the second on the modeling of terrestrial host-pathogen dynamics within grassland systems.

**Kruger and SANParks.** In addition to these projects that create software for basic research, the EIC obtained new Mellon Foundation support in 2007 to build systems that facilitate adaptive management of South African ecosystems through quantitative analysis and modeling. In these projects, researchers are using the Kepler system as a bridge between scientists that create quantitative models for understanding system function and managers who use those quantitative metrics, termed Thresholds of Potential Concern (TPCs), to make management decisions about South African parks. Thus, the workflow tool represents a communication mechanism between the two worlds of science and management.

**Semantics tools projects.** In addition, the EIC has continued to pursue other informatics projects, including the development of a mechanism for modeling the semantics of scientific observations in order to support improved search capabilities and semi-automated data integration. We ran a national workshop for **'Advancing a Unified Model for Observational Data'.** This emphasis on semantics has led to further work on classifying ecological and environmental concepts for use in improving science teaching (**FIRST project**). This work on semantics is fundamental to continued advances in the informatics field that benefit ecology, and researchers at the EIC have submitted two additional new proposals to extend work in this area.

This initial observational data workshop has led to two new awards in 2008 that focus on data semantics. The first, **SEMTOOLS,** focuses on the use of semantic web technologies in management and analysis of ecological data. In this project we are extending the Metacat and Morpho data management systems to be able to semantically annotate ecological data in order to improve both precision and recall in searching the KNB network. The second award, the **Semantic Observations Network (SONet),** is targeted at achieving community consensus on observational data semantics in order to create an internationally sanctioned observational data model and to engage environmental scientists in the process of creating sub-disciplinary extensions to this general model. We've started this work by convening a Task Group of the international Biodiversity Informatics Standards (TDWG) body that met in Freemantle, Australia in October 2008. This group will shepherd the standards ratification process for the data model produced by SONet.

**Virtual Data Center (VDC) and DataNetONE.** As the KNB network emphasizes the collation of ecological data, we have seen the need for a broader data repository that supports the diverse environmental data needs of synthetic research. In 2008 we are starting a new initiative to design a distributed and virtual data center that includes data from all environmental sciences. Collaborators from ecology, hydrology, atmospheric sciences, and ocean sciences will design a new data system that allows scientists from any environmental science discipline to easily access data from other disciplines. This new project is being conducted with collaborators from University of New Mexico, University of Kansas, the National Evolutionary Synthesis Center, and other environmental science disciplines. It has also led us to propose a new large scale data network based on the virtual data center concept. This new initiative is called the DataNet Observation Network for Earth (DataNetONE), and involves new collaborations with the digital library community. At UCSB, the DataNetONE project has allowed us to bring new collaborators into the EIC, including Larry Carver from the Davidson Library and Patricia Cruze and John Kunze from the California Digital Library. We expect both the VDC and DataNetONE initiatives to be major emphases of our work over the coming decade.

Finally, researchers at the EIC have been active in outreach through publications and scientific conferences. Some of the publications have increased awareness of the need for informatics research and infrastructure that benefits ecology. For example, Jones et al (2006) published a review that broadly

describes the informatics needs within ecology and Madin et al. (in press) published an overview of the needs for semantic data modeling in ecology.

**Future directions**
EIC accomplishments during 2008 have led to significant increases in both the availability of ecological data and the availability of software that is useful for managing and analyzing that data. Nevertheless, significant work is still needed in order to support the needs of researchers. Although we've had some success at building the KNB data archiving network, many scientists still resist sharing data broadly, often due to resource limitations and sometimes due to perceived threats associated with data sharing. The EIC plans to continue promoting the benefits of data sharing to enable scientific advances in ecology while simultaneously improving software systems that lower the effort needed for scientists to share data. One way in which these benefits will be achieved is through advances in analytical systems like Kepler that can directly access data from the KNB and other data networks. We also will be increasing our emphasis on data networking through new data federation initiatives like DataNetONE and on data interoperability through our focus on semantic data integration projects.

## EIC Software Systems

**Ecological Metadata Language (EML).** A standard for representing documentation about ecological and scientific data sets that is utilized broadly within the environmental sciences.

**Morpho.** A data and metadata management application designed to ease the process of preserving data for long term and collaborative use. Morpho creates metadata in EML format and can be used to contribute to the Knowledge Network for Biocomplexity via its link to Metacat.

**Metacat.** A metadata and data storage and search server that forms the backbone of the KNB network. Metacat is used throughout the US and internationally, and supports a variety of useful data and metadata management features.

**Kepler.** A scientific analysis and modeling tool that allows users to create, execute, preserve, and share analytical procedudes using a scientific workflow paradigm.

## Peer-reviewed Publications

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**2006**

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# 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.

One of the main goals of microbial oceanographers is to better understand microbial interactions with larger biogeochemical processes in the ocean. Traditionally, free-living oceanic bacterioplankton have been treated as a "black box" (i.e. all types of heterotrophic bacteria act the same way); however, this approach grossly oversimplifies microbial diversity and their associated processes. Professor Craig

Carlson and his students and colleagues have been actively breaking this black box apart to better understand how specific lineages of bacterioplankton respond to varying biogeochemical patterns in the sea. In their microbial observatory project, focused in the northwestern Sargasso Sea, they have been resolving time-varying trends of members of a major clade of heterotrophic bacterioplankton called SAR11. Recent advances in fluorescent in situ hybridization (FISH) coupled with terminal restriction fragment length polymorphism (T-RFLP) have allowed them to resolve the lineage specific dynamics of SAR11. These findings indicate that at least three of the subclades that comprise SAR11 have specific physiological adaptations that govern the dynamic transitions in time and over depth, indicating that these three SAR11 subclades represent separate SAR11 ecotypes.

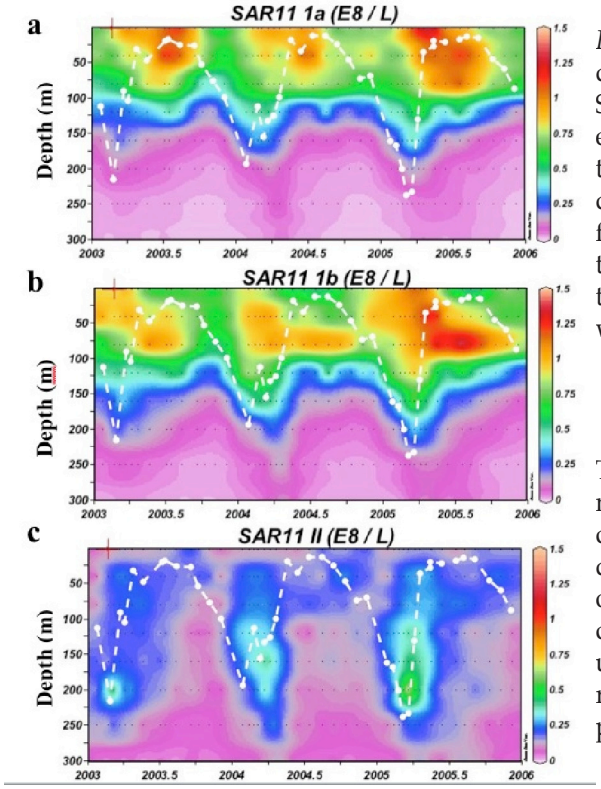



*Figure at left.* Contour plots of SAR11 ecotype cell densities in the surface 300 m in the northwestern Sargasso Sea from 2003 through 2005 for SAR11 ecotype Ia (a), Ib (b) and II (c). The data reported in this figure were modeled from the quantitative FISH data in combination with relative contribution data from T-RFLP patterns. White dashed line represents the dynamics of the mixed layer depth and is used to display the distribution patterns in the context of water column mixing and stratification.

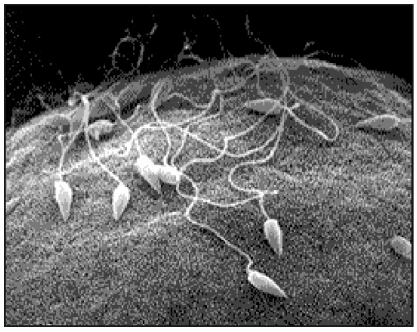
These studies are helping to reveal the influence of microorganisms on global biological and geochemical cycles, and are also providing the tools and baseline data necessary for realistically assessing the impacts of man-made and naturally occurring environmental change. In addition, the recognition of previously unrecognized marine biodiversity is providing a rich resource for new development of biotechnological products and processes.

Extending such efforts to macroscopic ocean flora and fauna, researchers at UCSB are involved in an international effort to annotate the genome of the California purple sea urchin, an organism that serves as an excellent biomedical model system as well as being an integral component of the marine benthic community. These sea urchin genome consortium members at UCSB are helping to develop bioinformatic and functional genomic technologies that can be applied to genomic analyses of other marine organisms as well.

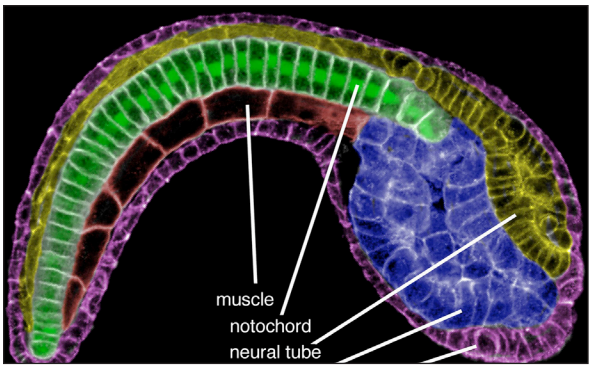
Research at UCSB in the development of new products and industries from marine resources has led to the discovery of promising new diagnostic and therapeutic agents for diseases including cancer, arthritis, epilepsy and Alzheimer's disease, and the development of powerful new enzyme catalysts, novel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

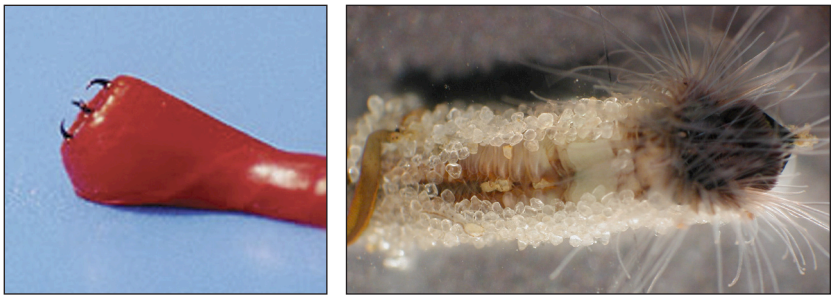



Major tissues of the Ciona tailbud stage embryo, showing the low cell number and simple tissue architecture (false color added for clarity).

Professor William Smith and his students are pioneers in the study of chordate developmental biology using the ascidian ("sea squirt") as a model organism. Ascidians are invertebrate members of the chordate phylum, and are the closest living relatives of the vertebrates. However, despite their kinship with the vertebrates, the ascidians have many features that are more like those found in invertebrate model organisms such as nematodes and insects, including a small genome, and a simple embryo that develops according to an invariant cell lineage. Professor Smith and his group have used two locally abundant species of ascidians

to identify the genes that regulate fundamental process of embryogenesis. To help them with this identification, they've isolated mutants that disrupt the development of various tissues including the nervous system and notochord (a tissue found all chordates that serves as a developmental "scaffold"). These mutants have allowed them identify genes that code for proteins required for the normal development of the brain and other neuronal structures. Within the past year they have mapped one such mutation to a novel gene that is essential for development of the forebrain. This gene, a member of the DMRT family of transcription factors, is expressed from the earliest stages of central nervous system development. A similar gene is found in mammalian genomes, although its function has not been addressed. In a different area, the Smith lab has been collaborating with computer engineers at UCSB to develop advanced image analysis methods for capturing ascidian development in live embryos. The ascidian embryo because of its small size, cellular simplicity, and conserved morphogenesis with vertebrates, is ideal for capturing development in toto from a single living embryo (see figure). Our long-range goal is to fully characterize the range of cell-to-cell interactions, cellular migrations, and force-generating cellular shape-changes that convert the single-cell ascidian embryo into a swimming tadpole larva with 2000 cells.

In addition, marine model systems have shed light on the mechanisms that nerve cells use to produce, store release and respond to chemical messengers and how the resulting regulation of these cells results in information processing, storage and memory. Many of these discoveries have had direct implications for human and other mammalian research. Professor J. Herbert Waite's laboratory studies the specialized teeth, fangs, beaks, spines, and claws of marine invertebrates that equip these animals for feeding, defense, and predation. Their studies in marine polychaetes, squids and snail egg capsules are providing insights into alternative strategies for making robust, tough, lightweight, and self-healing materials.



Close-up photograph of the jaws of a marine worm, discovered to owe their hardness and self-sharpening performance to unique metal constituents (left). Close-up photograph of a sandcastle worm building its tube home by cementing together sandgrains with Dopa containing proteins (right))

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.

## Faculty/Professional Researcher Participants

| | |
|---|---|
| **Mark A. Brzezinski,** | Professor of Marine Biology |
| **Alison Butler,** | Professor of Chemistry and Biochemistry |
| **Craig A. Carlson,** | Associate Professor, Ecology, Evolution and Marine Biology |
| **Bradley F. Chmelka,** | Professor of Chemical Engineering |
| **Steven DenBaars,** | Professor of Electrical and Computer Engineering |
| **Evelyn Hu,** | Director of the California NanoSystems Institute and Professor of Electrical and Computer Engineering |
| **Kathleen R. Foltz,** | Professor of Molecular, Cellular and Developmental Biology |
| **Paul K. Hansma,** | Professor of Physics |
| **Kevin F. Lafferty,** | Research Biologist |
| **Robert Jacobs,** | Professor of Pharmacology |
| **Aileen N.C. Morse,** | Research Biologist |
| **Daniel E. Morse,** | Director, Professor of Molecular Genetics and Biochemistry |
| **William Smith,** | Professor of Molecular, Cellular and Developmental Biology |
| **Galen D. Stucky,** | Professor of Chemistry and Biochemistry; Professor of Materials |
| **Matthew Tirrell,** | Dean of the College of Engineering and Professor of Chemical Engineering |
| **J. Herbert Waite,** | Professor of Molecular, Cellular and Developmental Biology |
| **Leslie Wilson,** | Professor of Molecular, Cellular and Developmental Biology |

# National Center for Ecological Analysis and Synthesis
# July 1, 2007 – June 30, 2008

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 is associated with the Marine Science Institute and is located in downtown Santa Barbara.

NCEAS staffing includes the Interim Director (William Murdoch), Deputy Director (Stephanie Hampton), Director of Computing (Mark Schildhauer), 16 full- and part-time personnel, including eight administrative and eight technical support staff, as well as two student assistants.

The Science Advisory Board (SAB) of 19 eminent ecologists met September 5-6, 2007 and March 5-6, 2008 to review proposals and provide guidance on the Center's mission and research directions. In addition, the Ecosystem-based Management (EBM) Advisory board met on May 6-7, 2008.

Research activities focus on working groups, sabbatical fellows, postdoctoral associates, distributed graduate seminars and graduate student internships. During the 2007-2008 fiscal year, NCEAS hosted 24 meetings, 62 working group meetings, and five training workshops involving a total of 1360 visits by 922 different scientists. In addition, the Center hosted 14 Sabbatical Fellows, 23 Postdoctoral Associates, 4 Center Associates, 7 graduate student interns, 2undergraduate interns, and 1 high school student.

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 Conservation and Resource Management Program at NCEAS has grown. For example, the Packard Foundation's continuing Ecosystem-Based Management (EBM) project involves the analysis and synthesis of existing data and development of new tools to address gaps in knowledge critical to successful implementation of ecosystem-based management. The Moore Foundation has supported several aquatic conservation projects, such as the assessment of salmon response to climate change. The Andrew W. Mellon Foundation continues to support the development and implementation of management and analysis tools supporting adaptive management in South African parks. The Nature Conservancy has supported Working Groups and a Distributed Graduate Seminar focused on non-native pests and pathogens.

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.

Outreach efforts have focused on NCEAS' Kids do Ecology (KDE) classroom program; conducting three distributed graduate student research seminars; sponsorship of an Ecology Award at the annual Santa Barbara County Science Fair; partnership with local organizations in the Santa Barbara Educators' Roundtable to publish a monthly educational page for children in the local Sunday newspaper; and planning proposals for other shared education and outreach projects. During this

reporting period KDE, which is designed to provide an inquiry- based approach for fifth graders to learn about ecology and the scientific method, had five classrooms of 5th graders (approximately 150 students) and their teachers participate in this program. Nine NCEAS scientists and two graduate students provided team teaching for KDE and coached students in presenting their work at NCEAS for scientists, teachers and parents. In addition, the Center hosted 39 Ecolunch seminars this past year, given by resident and visiting scientists, that are open to the 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 World Wide Web URL 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.

# 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.

Academic Participants
Michael McGinnis, Deputy Director
Keith Clarke, Professor of Geography
Gail Osherenko, Research Scientist
Robert Wilkinson, Director, Water Policy Program
Oran Young, Professor of Environmental Science and Management

# 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

This year has seen continued growth and development in MSI's Education and Outreach Programs. The REEF continues it's support of science education, both on and off campus, to over 15,000 children and adults (Figure 1). The Mobile REEF Program, now entering it's third year, has taken marine science and environmental education into the classrooms of over 5,100 G4-8 students and the general public at outreach events. This has been accomplished through the continued development of collaborations with a number of campus departments and local, state and national organizations and institutions, including the Office of Academic Preparation, Cheadle Center for Biodiverstiy and Ecological Restoration (CCBER), the Channel Islands National Marine Sanctuary (CINMS), and the National Science Foundation.

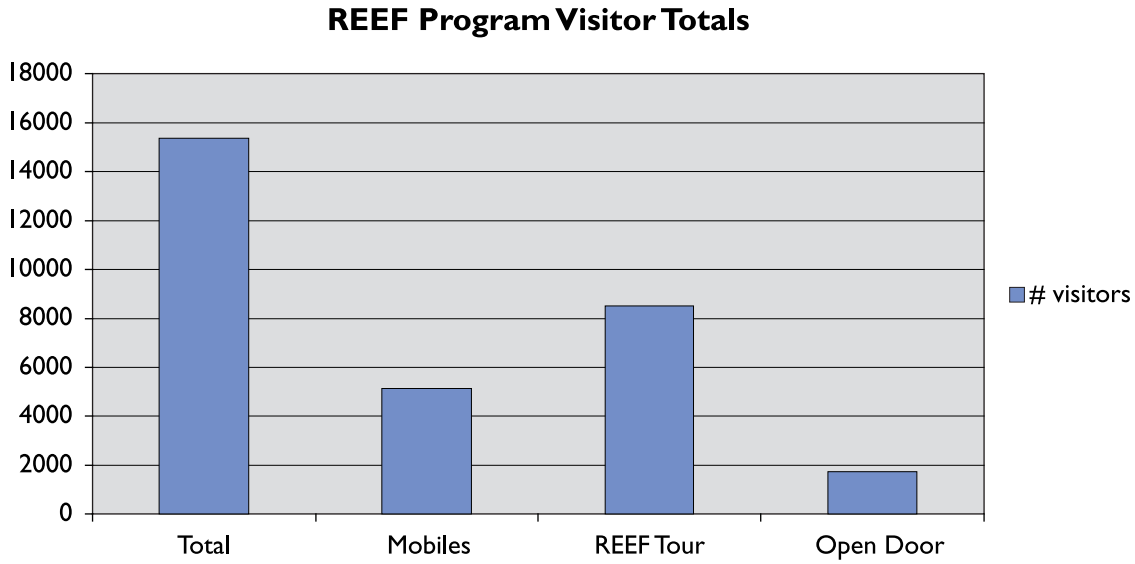



**Figure 1.** Graph of total number of participants served through MSI Education and Outreach at the REEF.

The Research Experience & Education Facility, better known as The REEF has been extremely busy this year. This has included visits from primary and secondary schools from King City in Monterey Co., to San Diego in southern California, and as far east as Las Vegas, Nevada! This year over 3,100 K-12 students visited The REEF (Figure 1). The REEF also serves as a marine lab for many colleges including Cal Lutheran Thousand Oaks, CSU Channel Islands, and UCSB. At UCSB, The REEF serves as an interdisciplinary adjunct lab for Geology 4 (Intro to Oceanography), EEMB 3 (Intro Biology), EEMB 106 (Biology of Fishes), Writing 2 and Writing 109 ST. It also serves UCSB outreach and summer programs. This year had over on-campus 3,400 visitors from over 30 different academic departments and outreach programs.

| REEF visits by Category | # visitors | # groups |
|---|---|---|
| Schools | 3149 | 124 |
| On Campus | 1923 | 78 |
| Outreach | 2529 | 89 |
| UCSB Course | 820 | 36 |
| Other Colleges | 70 | 3 |
| Total | 8491 | 330 |

**Table 1.** Number of REEF visits/visitors by category

During the 2007/2008 academic year,  The REEF once again supported international programs, including middle school students from Taiwan as part of the Yuan-Lin Cultural Exchange Program, students from Croatia and Engineering Graduate students from Osaka University, Japan

Other 2007/2008 collaborations include::

- Continued collaboration and development with the NOAA Channel Islands National Marine Sanctuary (CINMS) on the development of the Outreach Center for Teaching Ocean Sciences (OCTOS), a new, state –of-the-art, marine science education facility.  As well as, the continued implementation LiMPETS Monitoring site at Campus Point that supports CINMS Education and Outreach and will be linked with visits to The REEF.
- The SBC-LTER Watershed Education Program collaborated again with the Office of Academic Preparation and Equal Opportunity (APEO), and Santa Barbara and Goleta Valley Junior Hisgh Schools to bring 20 under-represented middle school students to UCSB for a one-week residential research experience.
- The American Association of University Women (AAUW) *Tech Trek* Program brings 120 girls from around the country to participate in a week-long, immersive, on-campus experience in science and academics. MSI has continued supporting *Tech Trek* by providing real-time, hands-on marine science education and research.

# Awards Administered

# Awards Administered

## Andrew W. Mellon Foundation

S. Gaines
SB080001 6/1/2007-5/31/2009 $200,000
Making Connections: Predicting Variation in Larval Dispersal at Biogeographic Scales

M. Schildhauer, M. Jones, O. Reichman
SB080054 10/1/2007-9/30/2009 $400,000
Data Management and Analysis Tools Supporting Adaptive Management in South African Parks

**Andrew W. Mellon Foundation Subtotal** **$600,000**

## Cal Coastal Conservancy

J. Caselle
07-013 5/15/2007-8/30/2009 $371,187
Filling the Gaps: Marine Protected Area Monitoring in the Channel Islands

**Cal Coastal Conservancy Subtotal** **$371,187**

## Cal Dept of Water Resources

D. Herbst
07-081-256 4/1/2008-3/31/2010 $100,000
Lahontan Region Bioassessment Monitoring and SWAMP Scientific Coordination

**Cal Dept of Water Resources Subtotal** **$100,000**

## Cal RA Department of Fish and Game

I. Leifer
P0775012 7/1/2007-12/31/2008 $21,116
Seeps in Santa Paula Creek

**Cal RA Department of Fish and Game Subtotal** **$21,116**

## California Department of Parks and Recreation

J. Dugan, H. Page
C0753014 1/22/2008-1/31/2009 $49,844
Approaches for Enhancing Prey Resources on Sandy Beaches for Nesting Shorebirds

**California Department of Parks and Recreation Subtotal** **$49,844**

## California Energy Commission

G. Hofmann, C. Osovitz
MR-07-12J 10/19/2007-10/31/2008 $29,700
The Effects of Elevated Atmospheric CO2 on the Physiology of the Purple Sea Urchin

**California Energy Commission Subtotal** **$29,700**

## California Ocean Science Trust

M. Schildhauer
SB080106 2/1/2007-6/30/2007 $10,000
Background Analysis of Metadata Standards Relevant to Baseline and Monitoring Data Collections for MLPA Implementation

**California Ocean Science Trust Subtotal** **$10,000**

## California Regional Water Quality Control Board

S. Cooper
2002-0105 5/1/2008-5/1/2009 $100,000
An Assessment of Numeric Targets for Ventura River Watershed Nutrient TMDLs

D. Herbst
07-125-130 5/15/2008-5/31/2010 $30,000
Characterization of Benthic Communities and Instream Physical Habitat in the San Lorenzo River Watershed

**California Regional Water Quality Control Board Subtotal** **$130,000**

## California Sea Urchin Commission

S. Schroeter
SB070019 1/1/2008-3/31/2008 $4,555
4/1/2008-12/31/2008 $15,000
Studies of Sea Urchins Settlement in Southern and Northern California

**California Sea Urchin Commission Subtotal** **$19,555**

## Channel Islands Marine Resource Institute

H. Lenihan
SB080003 6/4/2007-5/31/2008 $11,384
The effect of environmental conditions on the early life stages of the white abalone (Haliotis sorenseni) and experimental outplanting of larvae at coastal study sites

**Channel Islands Marine Resource Institute Subtotal** **$11,384**

## Coastal Fund (Formerly SPF)

J. Dugan, A. Guerrini
SPR07-16 7/16/2007-12/31/2007 $7,500
Proposal to Save the UCSB Palomar

A. Whitmer
Fall 06-02 4/15/2007-9/30/2007 $6,104
REEF Aquarist and Mobile REEF Internship Program

**Coastal Fund (formerly SPF) Subtotal** **$13,604**

## COM – National Oceanic & Atmospheric Administration

J. Caselle
NCND6000-7-15764 8/25/2007-7/31/2008 $33,001
Maintenance of PISCO-CINMS Moorings in the Channel Islands National Marine Sanctuary

S. Hampton, O. Reichman
AB133F07SE3931 8/12/2007-9/30/2009 $99,855
Design and Implementation Guidance for a Programmatic APproach to Intensively Monitored Watersheds and Similar Large-scale Management Action Experiments

**COM - National Oceanic & Atmospheric Administration Subtotal** **$132,856**

## Commonweal

S. Airame
SB080039 — 9/12/2007-12/31/2007 — $20,219
MPA Monitoring Data Analysis

**Commonweal Subtotal** **$20,219**

## David and Lucile Packard Foundation

E. Fleishman
2007-31848 — 2/1/2008-1/31/2011 — $1,150,000
Development and Application of Scientific Knowledge to Ecosystem-Based Management of Coastal Marine Systems

**David and Lucile Packard Foundation Subtotal** **$1,150,000**

## Dersu & Associates

T. Dudley
SB070110 — 8/16/2007-12/31/2007 — $15,050
1/1/2008-6/30/2008 — $2,100
Nam Theun Wetland Restoration Ecological Study

**Dersu & Associates Subtotal** **$17,150**

## Foundation for Research Science and Technology

N. Shears, S. Gaines
UCAL0601 — 7/1/2007-9/30/2007 — $13,270
10/1/2007-12/31/2007 — $13,270
1/1/2008-3/31/2008 — $13,270
4/1/2008-6/30/2008 — $13,270
The Effect of Marine Reserves on Recruitment, Exploited Species and Fishing

**Foundation for Research Science and Technology Subtotal** **$53,080**

## Gordon and Betty Moore Foundation

S. Airame
1600 — 8/1/2007-7/31/2008 — $20,000
Marine Protected Area (MPA) Monitoring Group: Analysis and Synthesis of Data From 5 Years of Monitoring MPAs in the Channel Islands

E. Fleishman
1454 — 12/7/2007-8/7/2010 — $1,280,807
Prediction of Responses of Wild Pacific Salmon to Climate Change

B. Halpern, O. Reichman
1523 — 6/1/2007-6/1/2008 — $16,475
Ranking and Mapping Human Threats and Impacts to Marine Ecosystems in the California Current

S. Hampton
1673 — 4/29/2008-4/1/2009 — $96,953
Finding Common Ground in Marine Conservation and Management: A Proposal for a Distributed Graduate Seminar

M. Schildhauer
1666 — 12/7/2007-1/7/2009 — $1,036,961
Public Domain ADMB Project

**Gordon and Betty Moore Foundation Subtotal** **$2,451,196**

## Larry Walker Associates, Inc.

K. Klose, S. Cooper
SB080124 4/1/2008-6/30/2008 $8,423
Chlorphyll a Analysis of Stream and Lagoon Algae Samples

**Larry Walker Associates, Inc Subtotal** **$8,423**

## Marine Conservation Biology Institute

D. McArdle, S. Gaines
3675 9/1/2007-8/31/2008 $10,000
A life-history based approach to interpreting and predicting resilience: historical responses of an exploited marine species to fluctuations in fishing an climate.

**Marine Conservation Biology Institute Subtotal** **$10,000**

## Marisla Foundation (Formerly Homeland Foundation)

S. Gaines
3-07-112 9/1/2007-8/31/2008 $1,000,000
The California Fisheries Fund: Investing in Marine Conservation and Fisheries Reform

**Marisla Foundation (formerly Homeland Foundation) Subtotal** **$1,000,000**

## Michigan State University

M. Jones, M. Schildhauer
61-2582CA SB 1/1/2008-12/31/2008 $50,569
Faculty Institutes for Reforming Science Teaching - FIRST III

**Michigan State University Subtotal** **$50,569**

## National Academy of Sciences

M. Heintz, D. Valentine
SB080050 11/1/2007-11/1/2008 $20,000
Biological Control on the Flux of Methane from Marine Hydrates to the Atmosphere: A Research Plan

**National Academy of Sciences Subtotal** **$20,000**

## National Aeronautics and Space Administration

I. Leifer, D. Roberts, B. Luyendyk
0-NACP05-0030 12/1/2007-11/30/2008 $172,061
Remote-Sensing Methane Emissions: Field-Validation with Seepage from Marine, urban, and Submerged City Sources

**National Aeronautics and Space Administration Subtotal** **$172,061**

## National Science Foundation

C. Beucher, M. Brzezinski
OCE-0752264 6/1/2008-5/31/2011 $204,479
Collaborative Research: N and Si dynamics in the glacial Southern Ocean

C. Briggs, R. Knapp
EF-0723563 6/17/2007-8/31/2008 $387,019
Collaborative Research: After the Crash: Factors Allowing Host Persistence Following Outbreaks of a Highly Virulent Disease

B. Cardinale
DEB-0614428 7/1/2007-6/30/2008 $6,000
Effects of Algal Diversity on the Productivity of Streams: Does Diversity Play a Greater Role in Variable vs Constant

C. Carlson
MCB-0237725 4/1/2007-3/31/2009 $5,163
4/1/2008-3/31/2009 $0
Collaborative Research: Linking Microbial Discovery to Biogeochemical Processes in an Oligotrophic Oceanic Microbial Observatory

N. Fangue, G. Hofmann
OISE-0700551 9/1/2007-8/31/2009 $75,000
Postdoctoral Research Fellowship

G. Hofmann
ANT-0808947 12/15/2007-11/30/2008 $20,000
Science of Opportunity: A SGER Proposal to Support the Development of Genomic Resources for Antartic Pteropods.

D. Lea
OCE-0602362 9/1/2007-8/31/2008 $105,833
9/1/2008-8/31/2009 $105,833
Collaborative Research: Establishment of a Climate Type-Section for the Tropical Atlantic from Cariaco Basin Sediments

J. Levine
DEB-0743365 3/15/2008-2/28/2009 $106,262
Collaborative Research: Niches, Neutral Controls Over the Coexistence of California Serpentine Annual Plants

S. MacIntyre
DEB-0640953 4/1/2008-3/31/2009 $49,999
4/1/2008-3/31/2009 $7,000
Turbulent Mixing, Internal Waves, and Intrusions: Temporal and Spatial Variability of Resource Supply and Metabolic Activity in Lakes

P. Miller
0409561 6/1/2007-6/30/2008 $5,000
NSF Minority Postdoctoral Fellowship

W. W. Murdoch, S. Hampton
DEB 0553768 10/1/2007-9/30/2008 $3,681,342
NCEAS: National Center for Ecological Analysis and Synthesis

C. Nicholson, C. Sorlien
EAR-0810278 7/1/2008-6/30/2010 $201,427
Uplift, Subsidence, and Sedimentaion Along the Evolving Pacific-North American Plate Boundary.

C. Nicholson, C. Sorlien, J. Kennett
OCE-0751807 3/1/2008-2/28/2010 $210,269
3/1/2008-2/28/2010 $44,875
Collaborative Research: A Test for Extending the High-resolution Climate Record back to 1.2 Ma & Investigating the Mid-Pleistocene Climate Transition in Santa Barbara Basin

R. Nisbet
DEB-0717259 9/1/2007-8/31/2008 $135,000
QEIB: Modeling Disturbances in Systems with Unidirectional Flow

R. Nisbet, F. Doyle
EF-0742521 4/1/2008-3/31/2011 $555,011
Collaborative Research: Homeostasis, Stoichiometry and Dynamic Energy Budgets at Multiple Levels of Biological Organization

T. Oakley
DEB-0643840 4/1/2008-3/31/2009 $119,999

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

S. Proulx

| | | |
|---|---|---|
| EF-0742582 | 7/1/2008-6/30/2011 | $564,791 |

The Origin of Genetic Interactions by Natural Selection

D. Reed, S. Gaines, J. Melack, D. Siegel, S. Holbrook

| | | |
|---|---|---|
| OCE-0620276 | 6/1/2007-11/30/2007 | $24,000 |
| | 12/1/2006-11/30/2007 | $65,000 |
| | 12/1/2006-11/30/2007 | $10,999 |
| | 12/1/2006-11/30/2007 | $20,000 |
| | 12/1/2007-11/30/2008 | $820,000 |
| | 12/1/2006-11/30/2008 | $50,000 |
| | 12/1/2006-11/30/2008 | $24,000 |

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

O. Reichman, J. Orrock

| | | |
|---|---|---|
| DEB-0444217 | 3/1/2008-2/28/2009 | $65,154 |
| | 3/1/2008-2/28/2010 | $5,586 |

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

M. Schildhauer, M. Jones, J. Madin

| | | |
|---|---|---|
| DBI-07334849 | 5/1/2007-6/30/2008 | $50,000 |

A Workshop for Advancing a Unified Model for Observational Data in the Ecological and Environmental Sciences

R. Schmitt, S. Holbrook

| | | |
|---|---|---|
| OCE-0417412 | 9/1/2006-8/31/2007 | $18,000 |
| | 9/1/2007-8/31/2008 | $20,000 |
| | 9/1/2007-8/31/2008 | $56,000 |
| | 9/1/2007-8/31/2008 | $820,000 |
| | 9/1/2008-8/31/2009 | $820,004 |

LTER: Long-Term Dynamics of a Coral Reef Ecosystem

D. Valentine

| | | |
|---|---|---|
| 0447395 | 4/1/2008-3/31/2009 | $128,043 |
| | 4/1/2007-3/31/2010 | $7,970 |
| | 7/1/2008-3/31/2009 | $7,875 |

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

D. Valentine

| | | |
|---|---|---|
| MCB-0604191 | 9/1/2006-8/31/2009 | $5,906 |

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

K. Whalen, G. Hofmann

| | | |
|---|---|---|
| OISE-0754319 | 9/1/2008-8/31/2010 | $181,660 |

PostDoctoral Research Fellowship

| | |
|---|---|
| **National Science Foundation Subtotal** | **$9,790,499** |

## Oregon State University

S. Airame, S. Gaines
F0570A-A 6/18/2008-3/19/2009 $23,240
Effectively Communicating the Science of Marine Reserves to a Global Audience

S. Gaines, R. Warner, L. Washburn, G. Hofmann
F0395A-C 4/1/2008-3/31/2009 $728,509
4/1/2008-12/31/2008 $890,121
Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO)

**Oregon State University Subtotal** **$1,641,870**

## Paul G. Allen Charitable Foundation

S. Gaines, C. Costello, O. Reichman, J. Melack
8637 5/1/2008-5/1/2009 $1,000,000
Sustainable Fisheries Project

S. Gaines, C. Penley, R. Rice, J. Melack
9991 1/1/2008-9/1/2008 $100,000
Digital Ocean Project

**Paul G. Allen Charitable Foundation Subtotal** **$1,100,000**

## Resources Legacy Fund Foundation

C. Culver, H. Page, J. Dugan, S. Schroeter
2007-0039 6/1/2007-5/31/2008 $46,615
Essential Fishery information for trap-based fisheries: development of a framework for collaborative data collection

W. McClintock, S. Gaines
2007-0056M 7/1/2007-6/30/2008 $203,196
The California Marine Life Protection Act Decision Support System: Recommendations for Development and Maintenance for the North Central Coast Study Region

W. McClintock, S. Gaines
2008-0019M 4/15/2008-3/31/2009 $225,000
MarineMap Decision Support System

**Resources Legacy Fund Foundation Subtotal** **$474,811**

## Santa Clara University

O. Reichman
00282421 11/1/2006-8/31/2007 $14,494
A Workshop on EPA Risk Assessment and Analysis

**Santa Clara University Subtotal** **$14,494**

## Santa Monica Bay Restoration Foundation

W. McClintock, S. Gaines
07-14 12/1/2007-12/31/2008 $75,602
GIS Support for the Analysis of Data Gaps on Habitats and Resources in Santa Monica Bay

**Santa Monica Bay Restoration Foundation Subtotal** **$75,602**

### Seaweb

S. Airame, S. Gaines
SB080121 3/1/2008-12/31/2008 $18,500
Spanish Translation of the Science of Marine Reserves Booklet

**Seaweb Subtotal** **$18,500**

### Simpson and Simpson Business and Personnel Services, Inc.

H. Page, D. Reed, S. Schroeter
SB080067 1/1/2008-12/31/2009 $10,000
San Onofre Nuclear Generating Station Mitigation Project Monitoring Program - SAP

H. Page, D. Reed, S. Schroeter
SB080067 1/1/2008-12/31/2009 $611,835
San Onofre Nuclear Generating Station Mitigation Project Monitoring Program - Wetland

H. Page, D. Reed, S. Schroeter
SB080067 1/1/2008-12/31/2009 $1,456,482
San Onofre Nuclear Generating Station Mitigation Project Monitoring Program - Reef

**Simpson and Simpson Business and Personnel Services, Inc. Subtotal** **$2,078,317**

### Society for Conservation Biology

A. Salomon, S. Gaines
SB080092 3/1/2008-2/28/2009 $78,184
Forecasting the Ecosystem-Level Effects of Marine Reserves to Inform Ecosystem-Based Management

**Society for Conservation Biology Subtotal** **$78,184**

### The Nature Conservancy

S. Hampton, O. Reichman
1980863015-CSD-112007 9/4/2007-9/3/2009 $132,902
Developing a Return on Investment Approach for Conservation Planning in Argentina

O. Reichman
SB070032 8/15/2007-8/14/2008 $151,592
The Economic Impact of Non-native Forest Pests and Pathogens in North America

O. Reichman
64689-0139 4/15/2007-9/30/2007 $25,000
A Workshop on Mapping and Valuing Ecosystem Services

**The Nature Conservancy Subtotal** **$309,494**

### UC Agriculture and Natural Resources

H. Page, J. Dugan
SA7429 12/1/2007-6/30/2010 $102,772
Fouling Dynamics and Control Research and Outreach Assesment to Assist California's Coastal Boaters in Reducing Risks from Hull-Borne Invasive Species

**UC Agriculture and Natural Resources Subtotal** **$102,772**

## UC Davis

M. Jones, M. Schildhauer
SUB0700051 9/1/2007-8/31/2008 $180,000
SDCI NMI Improvement: Development of Kepler CORE - A Comprehensive, Open, Robust, and Extensive Scientific Workflow Infrastructure

**UC Davis Subtotal** **$180,000**

## UC MEXUS

I. Leifer
SB080052 11/1/2007-10/31/2008 $1,500
Developing a UC-Mexico Collaboration on Passive Accoustic Observations of Seabed Bubbles

L. Rodriguez-Villa, C. Blanchette
SB080070 12/1/2007-11/30/2008 $18,000
Biodiversity and Rocky Intertidal Benthic Community Structure in Relation to Coastal Natural Resources in the Southern California Bight

**UC MEXUS Subtotal** **$19,500**

## UC Office of the President

G. Hofmann, P. Matson
08-T-CEQI-08-0007 7/1/2008-6/30/2009 $30,000
The Importance of Source Populations: Does Maternal Temperature and Nutrition Influence the Larval Stress Response in the Red Sea Urchin?

A. Kuris
06-000531-01 7/1/2006-6/30/2007 $-4,507
7/1/2007-6/30/2008 $42,185
Establishing Connectivity of Invasive Populations: A Precursor to Prioritization and Implementation of Eradication Efforts

R. Schmitt, S. Holbrook
SB080096 3/1/2008-2/28/2009 $7,500
UC LTER Network Planning Workshops

R. Warner, J. Caselle
06CEQI070034 7/1/2007-8/31/2008 $105,526
Assessing the Assessment: New Models for Informing the Design of Monitoring and Evaluation Programs for Kelp Forest Ecosystems in California's MPAs

L. Yang, J. Levine
SB070021 9/1/2007-9/30/2008 $42,500
10/1/2007-8/31/2008 $5,367
The Ecology of Rare Events: Resource Pulses in Space and Time

**UC Office of the President Subtotal** **$228,571**

## UC San Diego

S. Holbrook
54181A 10/1/2007-9/30/2010 $275,400
Building Community Based, Grass-Roots Networks: The Cases of Global Lake Ecological Observatory Network (GLEON) and of Coral Reef Ecological Observatory Network (CREON)

R. Ross
518607/1247 10/1/2005-9/30/2008 $10,836
1/1/2008-9/30/2008 $14,077
Long-Term Ecological Research on the Antarctic Marine Ecosystem: Climate Migration, Ecosystem Response and Teleconnections in an Ice-Dominated Environment

L. Washburn
0478.01SB 7/1/2007-12/31/2007 $187,541
Short-Medium Range Resolution/Long Range HF Radars-Task A.1

L. Washburn
0478.03SB 7/1/2007-11/15/2007 $10,997
Two Bight-Scale Sections Using an Underway CTD-Task C.1

**UC San Diego Subtotal** **$498,851**

## UC Santa Cruz

J. Engle
M07AC12503 6/19/2007-6/18/2008 $42,000
6/19/2008-6/18/2009 $42,924
The Shoreline Assessment of Changes in Rocky Intertidal Communities in the Southern California Bight

**UC Santa Cruz Subtotal** **$84,924**

## UC Sea Grant

C. Blanchette
R/MPA-2A-S-1/1 6/1/2007-5/31/2008 $41,588
Baseline Data Collection for Rocky Intertidal Marine Protected Areas in the Central Coast of California

J. Caselle
R/OPCFISH-05-S-1/2 4/1/2008-1/31/2009 $38,224
Assessing Changes in Life History Traits and Reproductive Function of CA Sheephead Across its Range: Historical Comparisons and the Effects of Fishing

J. Goddard
R/OPCENV-08-S-1/3 12/1/2007-11/30/2008 $12,900
Long-Term Faunal Changes in California Nudibranchs: Climate Change and Local Ocean Health

G. Hofmann
R/ENV-136PD-F 3/1/2008-2/28/2009 $9,984
How will Calcifying Larval Sea Urchins Respond to Ocean Acidification and Warming in the Future Ocean: Using DNA Microarrays to Screen for Shifts in Expression of Genes Involved in Calcification

G. Hofmann
R/ENV-136{D-TR 3/1/2008-2/28/2009 $19,044
How will Calcifying Larval Sea Urchins Respond to Ocean Acidification and Warming in the Future Ocean: Using DNA Microarrays to Screen for Shifts in Expression of Genes Involved in Calcification

A. Kuris, K. Lafferty, R. F. Hechinger
R/OPCENV-01-S-1/3 2/1/2008-1/31/2009 $66,251
Parasites as Indicators of Coastal Wetland Health

H. Lenihan
R/F-200A-S-2/2 6/1/2007-10/31/2008 $1,000
Assessing Withering Syndrome Resistance in California Black Abalone: Implications for Conservation and Restoration

H. Lenihan, K. Lafferty
R/F-20DA-F-2/2 3/1/2007-6/30/2008 $9,824
Assessing Withering Syndrome Resistance in California Black Abalone: Implications for Conservation and Restoration

M. Love
R/FISH-203-TR-22 2/1/2008-1/31/2009 $26,659
Two Decades of Fishing the Santa Barbara Channel: An Examination of Effort and Catch with Regard to Serial and Localized Depletions of Reef Fishes

M. Love
R/FISH-203-F-1/2 2/1/2007-6/30/2008 $1,560
2/1/2008-1/31/2009 $3,915
Two Decades of Fishing the Santa Barbara Channel: An Examination of Effort and Catch with Regard to Serial and Localized Depletions of Reef Fishes (CORE)

M. Love
R/FISH-203-S-2/2 3/3/2008-2/28/2009 $1,000
Two Decades of Fishing the Santa Barbara Channel: An Examination of Effort and Catch with Regard to Serial and Localized Depletions of Reef Fishes (STATE)

J. Waite
R/MP-97B-F-3/3 3/1/2007-6/30/2008 $49,897
Studies on the Rapid Self-Assembly of Elastic Tensile Fibers from Natural Protein Polymer Found in Marine Snails

J. Waite
R/MP-97B-S-3/3 6/1/2007-10/31/2008 $1,000
Studies on the Rapid Self-Assembly of Elastic Tensile Fibers from a Natural Protein Polymer Found in Marine Snails

O. Young
R/OPCENV-02-S-2/2 4/1/2008-1/31/2009 $6,631
Facilitating Ecosystem-Based Management Through a Quantitative Evaluation of Ocean Management Systems Interplay

O. Young
R/OPCENV-02-TR-2/2 4/1/2008-1/31/2009 $28,757
Facilitating Ecosystem-Based Management Through a Quantitative Evaluation of Ocean Management Systems Interplay

**UC Sea Grant Subtotal** **$318,234**

## UC Toxic Substances Research and Teaching Program

P. Holden
SB070091 10/1/2007-9/30/2008 $19,500
Fate and Effects of TiO2 Nanoparticles on Planktonic, Aerosilized, and Biofilm P. putida Bacteria

**UC Toxic Substances Research and Teaching Program Subtotal** **$19,500**

## University of Miami

C. Carlson
SB080099 4/1/2008-2/28/2009 $73,795
Continuing Measurement of DOC and DON on U.S. Repeat Hydrographic/CO2/ Tracer Surveys

**University of Miami Subtotal** **$73,795**

## University of Southern California

C. Nicholson

| | | |
|---|---|---|
| 119525 | 2/1/2007-1/31/2008 | $25,000 |
| | 2/1/2008-1/31/2009 | $30,000 |

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

**University of Southern California Subtotal** **$55,000**

## US Department of Commerce

J. Caselle

| | | |
|---|---|---|
| NA07NMF4630071 | 5/1/2007-4/30/2008 | $95,141 |
| | 5/1/2008-4/30/2009 | $92,168 |

Interpreting Changes in Community Structure in Marine Reserves in Light of Spatial and Temporal Patterns of Settlement

M. Love

| | | |
|---|---|---|
| AB133F07SE2838 | 6/1/2007-9/30/2008 | $22,443 |

An Assessment of Derelich Fishing Gear and Other Marine Debris in Deepwater Benthic Habitats off California

A. Whitmer

| | | |
|---|---|---|
| NA06NOS4290203 | 9/1/2007-8/31/2008 | $43,379 |

Mobile REEF Program: A Vehicle for Scientific Literacy

**US Department of Commerce Subtotal** **$253,131**

## US Department of the Army

D. Morse

| | | |
|---|---|---|
| W911NF-06-1-0285 | 11/1/2007-11/30/2008 | $79,736 |
| | 12/1/2007-11/30/2008 | $120,264 |

Biomolecular Mechanism, Cloning, Sequencing and Analysis of Adaptive Reflectin cDNAs and Proteins from Squid

**US Department of the Army Subtotal** **$200,000**

## US Environmental Protection Agency

S. Henkel, G. Hofmann

| | | |
|---|---|---|
| FP-91654401 | 9/18/2007-9/18/2008 | $16,107 |

2005 EPA Science to Achieve Results (STAR) Fellowship for Graduate Environmental Study Molecular Techniques for Predicting Invasion Potential: Comparisions Among Native and Invasive Kelp Species

**US Environmental Protection Agency Subtotal** **$16,107**

## US Fish & Wildlife Service

T. Dudley, K. Lafferty, A. Kuris

| | | |
|---|---|---|
| 813327J015 | 10/17/2007-10/31/2012 | $10,000 |

Development of Biological Control for the New Zealand Mud Snail

R. Jellison, D. Herbst

| | | |
|---|---|---|
| 842407J0007 | 4/1/2007-3/31/2008 | $140,163 |
| | 4/1/2008-3/31/2009 | $148,858 |

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

**US Fish & Wildlife Service Subtotal** **$299,021**

## US Forest Service

E. Fleishman
05-JV-11221682-210 5/15/2007-5/30/2008 $94,566
Response of Birds, Butterflies, and their Habitats to Management of Wildland Fuels and Fire Regimes

**US Forest Service Subtotal** **$94,566**

## USDI – Minerals Management Service

M. Love
M07AC13380 8/22/2007-8/31/2010 $670,000
Continuation of Fish Assemblages Associated with Platforms and Natural Reefs in Areas Where Data are Non-Existent or Limited

M. Love
M08AX12732 5/15/2008-5/14/2011 $460,000
Spatial and Seasonal Variation in the Biomass and Size Distribution of Juvenile Fishes Associated with Petroleum Platforms off the California Coast

**USDI - Minerals Management Service Subtotal** **$1,130,000**

## WetLabs, Inc.

J. Case
SB070041 4/1/2008-9/30/2008 $30,000
An Underwater Bioluminescence Assessment Tool (U-BAT), Phase II

**WetLabs, Inc. Subtotal** **$30,000**

## Wilburforce Foundation Subtotal

E. Fleishman
UCSB0703 4/27/2007-4/30/2008 $100,000
Analysis and Conservation Prioritization of Landscape Connectivity in Nevada

**Wilburforce Foundation Subtotal** **$100,000**

## Wildlife Conservation Society Subtotal

E. Fleishman
SB080080 12/1/2007-6/30/2008 $17,000
Climate-change Synthesis for Conservation Action

**Wildlife Conservation Society Subtotal** **$17,000**

# Research Summaries
## (Contracts/Grants Administered)
## July 2006 – June 2007

**Satie Airame** **9/12/2007-12/31/2007** **20,219**
Commonweal, SB080039

**MPA Monitoring Data Analysis**

The Monitoring Data Applications Project and the Marine Protected Areas Monitoring Project are dedicated to advancing sound, ecosystem-based management of ocean resources and science to support that management. This project is aimed at testing the usefulness of nearshore monitoring data for evaluating marine protected areas and for fisheries management. While California is the laboratory, the results could have much wider applicability. The UCSB PI will obtain relevant data for analysis; prepare data for analysis; review options for data analysis with other team members; work with the Monitoring Data Applications Project staff to respond to questions about the data; assist with problem solving and analyses; attend meetings of the MPA Monitoring Group at NCEAS; complete data analysis to address priorities for monitoring in the Channel Islands; work with scientists during the NCEAS meetings to determine the best approaches to analysis of available and relevant data sets; and assist with production of figures, tables and graphics to illustrate results. Priorities are to determine changes in abundance, size, biomass and spawning biomass of species likely to benefit from MPAs; and to determine changes in species composition as it relates to ecosystem function.

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**Satie Airame** **8/1/2007-7/31/2008** **20,000**
Gordon and Betty Moore Foundation, 1600

**Marine Protected Area (MPA) Monitoring Group: Analysis and Synthesis of Data From 5 Years of Monitoring MPAs in the Channel Islands**

Marine Protected Areas (MPAs) were established in the Channel Islands in 2003 to monitor various ecological and socioeconomic variables in this region. To assist the California Department of Fish and Game with preparation of a technical report to summarize results from the first five years of monitoring MPAs in the Channel Islands, UCSB hosted a series of meetings at the National Center for Ecological Analysis and Synthesis (NCEAS). These meetings were designed to promote collaboration and discussion among scientists with complementary data, and to motivate the analysis and synthesis of data in a timely manner. Specific priorities focused on changes in abundance, size, biomass and spawning biomass of species likely to benefit from MPAs; changes in species composition as it relates to ecosystem function; the amount of spillover for fish and invertebrates from MPAs to surrounding areas; and changes in catch per unit effort (CPUE) and total catch. Scientists were encouraged to evaluate habitat changes as they relate to physical alteration (e.g., trawling) and secondary impacts of biological community changes (e.g., habitat forming algae); and to evaluate the distribution of vessels and compliance. The final meeting provided an opportunity for scientists to present their conclusions from data analysis and to receive feedback from other participants.

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**Satie Airame** **3/1/2008-12/31/2008** **18,500**
**Steven Gaines**
Seaweb, SB080121

**Spanish Translation of the Science of Marine Reserves Booklet**

The Principal Investigators will assemble a team to produce an updated Spanish translation of the U.S. version of the *Science of Marine Reserves* booklet. The team will consist of a Translator and a Graphic Designer. The PIs will establish a timeline, supervise the translation and graphic design, and oversee printing and distribution of the booklet. A prior Spanish translation of the booklet was limited to Latin American and Caribbean case studies. The current translation will incorporate Spanish translations of four U.S. case studies from the second edition of the *Science of Marine Reserves*, including translations of the graphics.

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**Satie Airame** **6/18/2008-3/19/2009** **23,240**
**Steven Gaines**
Oregon State University F0570A-A

**Effectively Communicating the Science of Marine Reserves to a Global Audience**

During the first year of this grant, the PIs will oversee the development of a global electronic communication approach to enable audiences around the world to access geospatial information about marine reserves. The information will be accessible via a Google Ocean layer that presents scientific findings from key Science of Marine Reserves case studies around the globe. Each site will include general information as well as specific scientific findings about the effects of marine reserves. This scientific discussion will present the case study information currently compiled in the Science of Marine Reserves booklets and provide opportunity to add additional case studies. Years two and three will focus on development of a Science of Marine Reserves website that is linked to the Google Ocean information. The website will greatly expand the content of the booklet versions by presenting easily accessible, dynamic information to a global audience.

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**John Alroy** **4/15/2006-2/28/2008** **200,000**
National Science Foundation, EAR-0545059

**Collaborative Research: The Paleobiology Database: an International, Web-based Community Project to Assemble, Disseminate, and Analyze Paleontological Data**

The Paleobiology Database is leading the discipline of paleontology into the 21st century by digitizing the global literature on fossils and spearheading research programs that are of broad interest throughout the biological and Earth sciences. Its work over the next five years will document major evolutionary innovations, mass extinctions, and the impact of global change on the biosphere. The Database is an international, distributed effort that covers every taxonomic group, geographic region, and time interval, and brings together 116 Ph.D.s from 73 institutions in 14 countries. It incorporates a wide variety of data types, including taxonomy and both the contents and contexts of fossil collections. The Database is at the forefront of efforts to integrate databases through collaboration with other organizations such as GBIF, MorphoBank, and CHRONOS and use of up-to-date standards and protocols. The Database's effort to translate the literature into digital form will permanently level the playing field for researchers from around the world. The Database has compiled information on 36,923 fossil collections and 66,506 taxa since its inception in 2000, and serves as a repository for multiple independent research consortia. Researchers in six scientific working groups will cover such specific topics as global Phanerozoic diversity and the interplay of diversity and biogeography, local-scale diversity, climate and ecomorphological convergence, and large-scale trends in body size and preservational factors.

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**John Alroy** **9/1/2000-8/31/2006** **$1,520,615**
**Sandy Andelman** **9/1/2005-8/31/2008** **296,549**
National Science Foundation, DEB-0443453

**RCN: Biodiversity Conservation in Dynamic Landscapes (BCDL) Network**

Developing the conceptual foundations for biodiversity conservation in a dynamic and uncertain world requires understanding of the linkages among the dynamics of species, ecological systems, economic activities, and land-use change. Despite recognition of the need for this integration and common objectives, research in each of these areas commonly proceeds independently. This is a three-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 addresses a fundamental limitation of current biodiversity conservation approaches and will bridge the gap between conservation 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.

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**Clarissa Anderson** **9/1/2004-8/31/2007** **72,000**
**David Siegel**
National Aeronautics and Space Administration, NNG04GQ34H

**A Model for Remotely Detecting the Dynamics and Toxicity Of Pseudo-nitzchia Blooms in the Santa Barbara Channel**

Environmental controls of harmful algal blooms are variable at the regional level and not always anthropogenic. In the Santa Barbara Channel the highest concentrations of the toxic diatom group, Pseudo-nitzschia, coincide with periods of strong upwelling and minimal run-off from land. This project addresses bloom dynamics and toxicity of Pseudo-nitschia using the existing framework of the NASA supported Plumes and Blooms project and the SBC-LTER research site. These programs will provide many of the physical, chemical, and biological parameters necessary to parameterize bloom formation and toxin production. In situ data will be incorporated into a predictive model that assesses toxic bloom probabilities for this site. The model will be applied to the remote estimation of blooms using satellite ocean color (MODIS-Aqua & SeaWiFS), sea surface temperature (AVHRR), and high frequency radar determinations of surface currents to develop predictive tools for the onset and toxicity of Pseudo-nitzschia bloom dynamics.

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**Charlotte Beucher** **6/1/2008-5/31/2011** **204,479**
**Mark Brzezinski**
National Science Foundation, OCE-0752264

**Collaborative Research: N and Si dynamics in the glacial Southern Ocean**

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

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**Carol Blanchette** **2/1/2005-1/31/2008** **158,665**
**Alison Whitmer**
The New Media Studio, NNN04AA02A

**Adding Ocean Science Content and Embedded Assessment Tool Capabilities to the Satellite Observations in Science Education (SOSE) REASoN Project**

The investigators will develop a curricular module focusing on ocean science, and a java-based software and learning evaluation tool designed to be integrated into the data access and visualization toolbox of the NASA SOSE REASoN project. The ocean science curricular module (Patterns and Processes in the Ocean) will be designed as a reusable content object (RCO) to be integrated into the SOSE internet-based toolbox. This will provide an incredibly valuable test to the "re-usability" of the RCE framework being developed through the SOSE project. This RCO will be based on NASA ocean-related datasets from several sources and will incorporate data-rich topics that span large scales in time and space. The primary data of interest are ocean temperature (SST), ocean color (chlorophyll), ocean winds and sea surface height. These datasets are perfect for illustrating and exploring physical relationships driving patterns and processes in the oceans across large scales in space ant time. This

module will allow students to explore relationships among many physical and biological variables and begin to understand the physical processes influencing the distribution of organisms throughout the oceans.

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**Carol Blanchette** **6/1/2007-5/31/2008** **41,588**
UC Sea Grant, R/MPA-2A-S-1/1

**Baseline Data Collection for Rocky Intertidal Marine Protected Areas in the Central Coast of California**

The main objective of this research is to collect baseline biological data for rocky intertidal habitats for the Central Coast Marine Protected Areas. Sampling will be coordinated with the two largest rocky intertidal monitoring programs in the state of California, PISCO (Partnership for Interdisciplinary Studies of Coastal Oceans) and MARINe (Multi-Agency Rocky Intertidal Network). This coordination with existing sampling provides an extremely efficient and cost-effective way to ensure that biological sampling meets well-developed monitoring standards and that data are compatible with a larger database of biological and ecological data from the entire west coast of North America. This project will allow the scientists to fill critical gaps in the current sampling programs by adding several new sites. These sites will be sampled using accepted protocols to ensure that adequate baseline data are collected at all of the newly established reserves and at appropriate reference locations so that reserve effectiveness may be evaluated over time.

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**Cherie Briggs** **6/17/2007-8/31/2010** **401,019**
**Roland Knapp**
National Science Foundation, EF-0723563

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

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

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**Mark Brzezinski** **7/1/2007-6/30/2010** **672,641**
National Science Foundation, 0648130

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

This study examines the unique silicon cycle of the North Pacific Subtropical Gyre (NPSG). Most marine silicon cycle studies have focused on the more productive coastal waters or the Southern Ocean where diatoms typically dominate the phytoplankton. Although diatom biomass is much lower in subtropical gyres, silica production is significant in global terms. Silicon cycle studies of the Sargasso Sea in the 1990's implied that subtropical gyres account for 13% of global marine silica production. More recent data from the NPSG show much higher rates of silica production that would increase the contribution of subtropical gyres to as much as 40%. The new estimate is uncertain and

based on few data, but suggests that the contribution of subtropical gyres has been underestimated. Differences in the silicon cycle between the NPSG and the Sargasso Sea go beyond differences in average production rates. The two systems are several months out of phase with each other in terms of their seasonal silica production cycles. Unlike the Sargasso Sea, where diatoms bloom regularly in spring in response to winter convective overturn, permanent stratification prevents spring diatom blooms events in the NPSG, where annual diatom blooms occur in summer, when stratification is strongest and nutrient concentrations are at a seasonal minimum. These enigmatic summer blooms contribute significantly to carbon and nitrogen export in the NPSG and likely dominate the annual silicon cycle. This project will expand understanding of the mechanisms controlling the contribution of diatoms to elemental cycling in open ocean ecosystems.

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**Mark Brzezinski** **4/1/2004-3/31/2009** **594,338**
National Science Foundation, OCE-0350576

**Testing the Utility of Natural Variations in Isotopes of Si as a Proxy for Silica Production in the Sea**

In the mid 1990's it was discovered that diatoms fractionate isotopes of silicon during silicon biomineralization opening the possibility of using natural variations in isotopes of silicon in dissolved Si and in diatom frustules as a tool for assessing silica production in both the past and present day ocean. Diatoms with their silica ballast are key vectors of organic matter out of the euphotic zone. Their obligate need for Si means that their contribution to primary productivity and the biological carbon pump can be controlled by the availability of silicic acid in ocean surface waters. Natural variations in isotopes of Si in diatoms and silicic acid offer a possible means of assessing relative silicic acid use on longer time scales and larger spatial scales than any other technique currently available. This project proposes to continue evaluating and calibrating the ∂30 Si proxy.

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**Mark Brzezinski** **12/1/2003-11/30/2008** **155,755**
Oregon State University, OSU S0793A-G

**Plankton Dynamics and Carbon Cycling in the Equatorial Pacific Ocean: Control by Fe, Si, and Grazing**

In collaboration with investigators at Oregon State University, as part of a grant from the NSF Biocomplexity Program, the UCSB PI will participate on two cruises to the Equatorial Pacific Ocean. Dr. Brzezinski's primary responsibility is to make measurements of silica dissolution rates. UCSB's research team will also assist in measuring silicic acid concentration, biogenic silica concentration and silica production rates. Additionally, the UCSB researchers will participate in K-12 outreach workshops related to this project in Oregon and Maine.

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**Bradley Cardinale** **10/1/2006-9/30/2008** **281,000**
National Science Foundation, DEB-0614428

**Effects of Algal Diversity on the Productivity of Streams: Does Diversity Play a Greater Role in Variable vs Constant**

Ecologists have long studied how the productivity of ecosystems limits species diversity, but the converse question of how diversity controls production has recently emerged as a prominent topic of research. In part, this question has been prompted by accelerating rates of extinction and invasion that reduce and homogenize species pools, requiring a better understanding of the ecological consequences of diversity loss. Studies to date have advanced knowledge of how, when and why species diversity can affect primary production. However, these studies have been limited in scope, focused mostly on randomly assembled communities of grassland species placed together in experimental units that are spatially homogeneous and isolated from external processes such as disturbance and dispersal. In fact, it seems that most studies have worked hard to eliminate forms of spatial and temporal heterogeneity that might increase experimental 'noise'. These forms of heterogeneity are potentially the same ones that maintain diversity in the first place, and theory suggests they are necessary for species to express niche differences that affect resource capture and production. Recent models even argue that diversity per se will only influence productivity in a

variable environment where taxa have full opportunity to express niche differences. The PI seeks to add heterogeneity back into the study of diversity-function relationships by examining how key aspects of spatial and temporal variation moderate the impacts of species diversity on primary production. He will take an empirical approach focusing on stream periphyton (benthic algae) as a model system. Periphyton are useful as a model because the diversity and composition of algae in streams are known to be structured by spatial heterogeneity in flow, and by patchy disturbances that intermittently scour substrates.

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**Craig Carlson** **4/1/2003-3/31/2009** **597,361**
National Science Foundation, MCB-0237725

**Collaborative Research: Linking Microbial Discovery to Biogeochemical Processes in an Oligotrophic Oceanic Microbial Observatory**

This renewal project focuses on microorganisms that live in the ocean surface layer (0-300 m), one of the largest habitats on earth. Microorganisms in the ocean surface layer play an integral role in carbon transport from the atmosphere to the deep ocean. Small perturbations in the metabolism of DOC by microorganisms could strongly impact the balance between oceanic and atmospheric Co2. Thus, the microbial processes that determine DOM production, consumption and distribution in the oceans are important to the global carbon cycle. A relatively small set of microbial groups dominates the ocean surface. Most of these organisms have never been cultured for study in scientific laboratories. The goal of this project is to understand the cell biology and biogeochemical activities of the major bacterioplankton groups by applying new high throughput technologies for cell culturing, and studying the metabolism of these organisms in nature and their interactions with organic matter in the oceans. This effort will be focused on the Bermuda Atlantic Time-series Study (BATS) site, a subtropical gyre characterized by winter time convective overturn, spring phytoplankton blooms, and regular patterns of DOC cycling.

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**Craig Carlson** **7/1/2004-6/30/2008** **342,038**
National Science Foundation, OCE-0425615

**The Effect of Mesoscale Eddy Perturbations on Microbial Processes and Community Structure in the Sargasso Sea**

This is a companion project to the "EDDIES" (EDdy Dynamics, mixing Export, and Species composition) project funded by NSF Biological, Chemical and Physical Oceanography. This interdisciplinary field program was initiated in the Sargasso Sea during the summers of 2004 and 2005. Recent evidence suggests that mesoscale eddies are an important nutrient transport mechanism in the oligotrophic waters of the main subtropical gyres. Numerical simulations and satellite-based statistical estimates indicate that the magnitude of the eddy-driven nutrient flux could be sufficient to balance geochemical estimates of new production. Relatively few direct observations of this process are available, owing to the spatial and temporal intermittency of the events that drive it. Available data demonstrate that isopycnal displacements associated with certain types of eddies can transport nutrients into the euphotic zone, resulting in the accumulation of chlorophyll in overlying waters. Preliminary data indicate that coincident with the passage of a cyclonic eddy at the BATS site, bacterial production rates were significantly enhanced relative to the monthly mean values. However, the extent of the prokaryotic heterotrophic response and their impact on coupled biogeochemical cycles and export has yet to be elucidated. The principal investigator will sample parameters relevant to heterotrophic prokaryotes across mesoscale eddies documenting how these parameters vary inside the eddy through time and space (horizontal and vertical) relative to outside ("control") waters.

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**Craig Carlson** **4/1/2008-2/28/2009** **73,795**
University of Miami, SB080099

**Continuing Measurement of DOC and DON on U.S. Repeat Hydrographic/CO2/Tracer Surveys**

Dr. Carlson will assist D. Hansell, University of Miami, with measurements of dissolved organic matter (DOM) for the U.S. Repeat Hydrography surveys. During a 42-day cruise in the Indian Ocean

sector of the Southern Ocean, the UCSB PI will collect approximately 2,000 samples. The samples will be measured in Carlson's laboratory at UC Santa Barbara. DOC will be measured by high temperature combustion using a Shimadzu TOC-V with auto injection (CV of 1.5-2.5%). DOC and TDN will be measured simultaneously by placing the two detectors (NDIR and chemiluminescences) in series on the Shimadzu. Total nitrogen will be measured via chemiluminescence detection using a Shimadzu TN analyzer attached to the TOC-V. DON is calculated as the difference between total dissolved nitrogen concentrations and dissolved inorganic nitrogen. The Hansell and Carlson laboratories will exchange references and samples for inter-calibration purposes, to ensure the highest quality and comparability between data sets.

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**Craig Carlson** **9/1/2002-8/31/2008** **253,359**
Virginia Institute of Marine Science, 519207/1248

**Quantification and Modeling of DOC and DON Release in Marine Systems: A Study of Increasing Trophic Complexity**

This project complements and expands the PI's ongoing work examining interactions between microbial communities and bioavailability of DOM. He will be responsible for measurements of the microbial dynamics community and selected characterization of the DOM pool. He will provide expertise towards the microbial dynamics and processing of organic matter, and will be responsible for measuring microbial biomass and production in both experimental and field work. Other tasks for the UCSB PI are to oversee the experimental design of the bioavailability study and bacterial growth efficiency experiments; to measure bulk DOM (DOC and DON) concentrations for the oceanic component of the project and for bioavailability studies; to characterize the dissolved combined neutral sugars and dissolved free amino acids in the field and in experimental studies using HPLC technologies; and to participate in data reduction and analysis and publication of papers and reports.

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**James Case** **12/1/2004-4/30/2008** **240,000**
US Department of the Navy, N00014-05-1-0046

**Coastal Bioluminescence: A Collaboration Dealing with Sources, Population Dynamics and Instrumentation**

The goal of this project is to complete a major line of ONR-supported research that received its initial impetus in 1983. As a result of his involvement as a member of the BIDS committee reporting to the Submarine Security Division of the Johns Hopkins Applied Physics Laboratory, the PI developed ideas leading to this line of research. For several years BIDS regularly reviewed ASW/SSN Security field tests dealing with bioluminescence related to submarine security and detection, followed development of an airborne system for detecting submarines at operational depths from their bioluminescence, and evaluated reports of related work by researchers from other sources, primarily the USSR. The PI's work has focused on development of an adequate bioluminescence detector to reliably sample the bioluminescent biota in the open sea to depths relevant to the Navy.

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**James Case** **8/29/2006-9/30/2008** **145,681**
WetLabs, Inc., SB070041

**An Underwater Bioluminescence Assessment Tool (U-BAT), Phase II**

This is part of a Phase II proposal to the Office of Naval Research under the Small Business Technology Transfer Program (STTR) with the lead institution WET Labs, Philomath, OR, a long established developer and manufacturer of oceanographic equipment. WET Labs will lead development of numerous improvements to a profiling bioluminescence sensing instrument developed by Dr. Case's group at UCSB with ONR support. The Case Laboratory at UCSB has developed and extensively field-tested, with ONR support, three generations of a profiling bioluminescence sensing instrument that will be further developed, tested and integrated with WET Labs lead, into a general bio-optics instrument package. UCSB's phase II efforts in the project will include assistance with the following: 1) Final Underwater Bioluminescence Assessment Tool (UBAT)

design. 2) Final prototype design and review. 3) Final design and development of the new combined bioluminescence and IOP sensor and software. 4) Final design review to ensure all technology was transferred accurately and meets MBBP-03 design characteristics. 5) Calibration and validation tests of the combined bioluminescence and IOP sensor in the UCSB laboratory marine optics facility. 6) Review of data collected in laboratory and field, including the efforts of other investigators on prototype tests, with analysis and recommendations. 7) Recommendation toward final UBAT definition.

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**Jennifer Caselle** **5/15/2007-8/30/2009** **371,187**
Cal Coastal Conservancy, 07-013

**Filling the Gaps: Marine Protected Area Monitoring in the Channel Islands**

Biological surveys of near-shore marine communities are needed to fulfill CA Department of Fish and Game management mandates outlined by the MLMA and the MLPA. Characterization of near-shore communities is required to address the goals and objectives outlined by stakeholder groups in CINMS marine reserve working group process. Fishery-independent estimates of density and size structure of commercially and ecologically important species are essential and can, in turn, be used for stock assessment, ecosystem monitoring, and assessment of marine protected area effectiveness. Near-shore biological surveys within the southern California Bight are a high priority management need because: 1) the majority of private recreational fishers, a large CPFV fleet, and an active commercial live/premium finfish fishery all reside in southern California, making this area of considerable importance socio-economically, and 2) the recent establishment of a large network of marine protected areas in the CINMS is an unprecedented management event and therefore subject to a great deal of scrutiny from state, federal, and worldwide communities. Although several programs already conduct surveys of near-shore resources in southern California, additional resources are needed to fill gaps in the current monitoring schemes and coordinate existing programs into an effective large-scale stock assessment and monitoring program. The PI's purpose is to conduct comprehensive near-shore surveys of the CINMS, to expand near-shore SCUBA surveys in the Channel Islands, and to fill gaps in previous monitoring.

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**Jennifer Caselle** **8/25/2007-7/31/2008** **33,001**
COM - National Oceanic & Atmospheric Administration, NCND6000-7-15764

**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.

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**Jennifer Caselle** **2/1/2007-1/31/2009** **87,020**
UC Sea Grant, R/OPCFISH-05-S-1/2

**Assessing Changes in Life History Traits and Reproductive Function of CA Sheephead Across its Range: Historical Comparisons and the Effects of Fishing**

The overall goal of this project is to address many of the data deficiencies identified during the recent stock assessment of California sheephead in order to allow managers to reduce uncertainties in the assessment and to better assist resource management of this key component of the nearshore ecosystem. In addition, the PI will provide a unique test of specific predictions from life history theory on the effects of size- and sex- selective harvesting on a temperate sex-changing fishery species. Specific questions to be addressed are: 1) What are the current levels of life history characteristics (growth rates, age and length at maturity, age and length at sex change, sex ratio) and how do these characteristics vary across the species range? 2) What is the current reproductive output and potential across the species range? 3) How have life history characteristics and reproductive output changed through time, and can this be related to shifts in and types of fishing pressure, shifts in environmental parameters (e.g., ENSO, PDO), and/or changes in population density? The basic approach is to undertake a comprehensive and current examination of spatial variation in age, growth, density and reproductive function.

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**Jennifer Caselle** **5/1/2007-4/30/2009** **187,309**
US Department of Commerce, NA07NMF4630071

**Interpreting Changes in Community Structure in Marine Reserves in Light of Spatial and Temporal Patterns of Settlement**

The primary aim is to understand the spatial and temporal patterns of recruitment of commercially and ecologically important fishes and invertebrates in relation to the system of reserves in the Channel Islands (CI) and Santa Barbara Channel (SBC) mainland, and to identify the potential oceanographic causes of these patterns. An understanding of the spatial and temporal patterns of recruitment into and around marine reserves along with knowledge of potential oceanographic causes will provide an essential context to interpreting any observed changes to populations inside and outside reserves as well as any potential regional and local effects of reserves on recruitment. The study will be accomplished by significantly augmenting an existing array of artificial fish recruitment collectors (Standardized Monitoring Units for the Recruitment of Fishes-SMURFs) in the Northern CI and the SBC through a) the addition of well-tested and newly-designed invertebrate collectors to measure settlement of crabs, urchins and lobsters and b) the addition of sets of collectors (for fishes only) over fine spatial scales at several target reserves in the CI to begin to assess the potential recruitment effects of reserves. All results will be incorporated into the existing marine reserve monitoring programs in the CI. Changes in abundance inside and outside of marine reserves are only interpretable if differences in recruitment to these areas are accounted for. As reserve impacts develop, potential spatial and temporal differences in production can be directly compared to patterns of recruitment, providing for the first time an estimate of the spatial extent of any larval export function of marine reserves.

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**Jennifer Caselle** **9/3/2006-8/31/2007** **14,010**
**Libe Washburn**
US Department of Commerce, NCND6021-6-00021

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

Near-island instrumentation, customized for particular locations, provides information necessary to understand and track water mass movements that affect recruitment of key species to coastal habitats. Inter-annual and shorter-term upwelling and relaxation events have been shown to drive recruitment and movement of certain fish species. It is also likely that these events affect other resources, including 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 and could help explain anomalies. It also allows managers to make informed decisions with regard to placement and size selection of reserves designed to protect or restore particular resources, as well as explain changes in populations, trophic structure, and forcing functions and processes (e.g., seasonal and longer-term cycles of reproduction dispersal,

and recruitment). To provide CINMS with data on water mass movements, six SEA stations were established in 2004 around the Channel Islands and customized to address the information needs of individual areas.

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**Jennifer Caselle** **7/1/2005-6/30/2008** **172,791**
USDI - National Park Service, J8C07050004

**Establish Baseline Ecological Conditions of Newly Established Marine Reserves at the Channel Islands**

The State of California has recently approved a network of marine reserves that closes over 20% of Channel Islands National Park (CINP) waters to harvest. Both commercial and recreational interests have exploited fish, invertebrates and algae for many years; and there is evidence these activities have had large-scale impacts on marine ecosystems. Traditional fisheries management (season, bag, and size limits, permits) has failed to adequately protect marine resources. Establishment of no-harvest zones is a needed action for restoring ecosystem health. This is the largest network of marine reserves in the U.S. and provides the best opportunity to demonstrate the conservation value of no-harvest zones. This project expands the CINP's existing kelp forest monitoring program through establishment of up to sixteen new fixed sites and will monitor existing sites to ensure adequate inside/outside reserve baseline data to properly evaluate the effectiveness of the new marine reserves. The project will be conducted in cooperation with UCSB's Partnership for Integrated Studies for Coastal Oceans (PISCO) subtidal monitoring program to collect fish abundance and size estimates at the monitoring locations.

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**James Childress** **8/15/2003-7/31/2008** **248,007**
National Science Foundation, NSF OCE-0240982

**Collaborative Research: Site Evaluations and Background Studies of Interactions Among Fluid Chemistry, Physiology, and Community Ecology for Ridge 2000 Lau Basin Integrated Studies**

Two cruises to the East Lau Spreading Center (ELSC) are proposed to evaluate sites for selection as the Integrated Study Site (ISS) bull's eye for the Ridge 2000 program and to carry out studies necessary for further interdisciplinary research in this area. In addition to exploration and biological mapping, the sites will be carefully evaluated in terms of the relation between the chemistry of the diffuse flow vents and the macrobiology. This is especially important to do at this time because the only available water chemistry data for this region is from high temperature vents and indicates that Zn is very high and sulfide and methane are very low; this is not consistent with the abundant communities of sulfide and perhaps methane-oxidizing symbioses reported in diffuse flow. This work is complementary to, and will follow upon, the first two major ISS evaluation cruises outlined in the Implementation Plan for the site.

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**Scott Cooper** **5/1/2008-5/1/2009** **100,000**
California Regional Water Quality Control Board, 2002-0105

**An Assessment of Numeric Targets for Ventura River Watershed Nutrient TMDLs**

Section 303(d) of the Clean Water Act requires the State to identify surface water bodies that do not or are not expected to meet water quality standards (comprised of beneficial uses and water quality objectives) with technology-based controls. States must also adopt Total Maximum Daily Loads (TMDLs) for these water bodies when a pollutant causes the impairment. Numeric Targets, which identify the specific in-stream goals or endpoints for the TMDL and equate to attainment of the water quality standard, are a required component of the TMDL. In situations where applicable water quality standards are expressed in narrative terms, it is necessary to develop a quantitative interpretation of narrative standards. Several Reaches and Tributaries of the Ventura River are on the 303(d) list of impaired water bodies for algae, eutrophic effects, low dissolved oxygen, and nitrogen: Ventura River Estuary (algae and eutrophic); Ventura River Reach 1 and 2 (algae); Canada Larga (low dissolved oxygen). These areas exceed the narrative Biostimulatory Substances (phosphorus and nitrogen) objective in the Basin Plan and resultant eutrophic conditions. The goal of this project is to

evaluate different approaches for developing numeric targets for nutrients and eutrophic conditions that attain the biostimulatory substances objective and address the listings of eutrophic, algae, nitrogen and low dissolved oxygen.

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**Carrie Culver** **6/1/2007-5/31/2008** **46,615**
**Henry Page**
**Jenifer Dugan**
**Stephen Schroeter**
Resources Legacy Fund Foundation, 2007-0039

**Essential Fishery information for trap-based fisheries: development of a framework for collaborative data collection**

Large mobile invertebrates, including crabs, shrimp/prawns, and lobsters, are the basis of valuable trap fisheries in the Santa Barbara Channel (SBC) region and elsewhere in California. These animals play an important role in the ecological functioning of near-shore ecosystems. Despite their value and ecological importance, data are lacking for these species largely because they are cryptic, mobile, patchily distributed, and often nocturnal. Because of these traits, traditional visual (e.g., SCUBA, ROV, submersible) techniques do not accurately sample this suite of important invertebrate species, and it is disregarded in existing monitoring programs, as a very different sampling approach is required. The lack of data and methods for collecting information on large, cryptic species hinders the management of California's marine resources. The goal here is to develop the framework for a model program that integrates the knowledge and skills of commercial fishery participants in data collection for cryptic invertebrate species. This study will enhance efforts to develop a scientifically-robust monitoring method using commercial traps. Although the PIs will work specifically with crab fishermen, their approach will be broadly applicable to other trap-based fisheries targeting cryptic species. The SBC's crab fishery will be used as a model system to develop new cooperative strategies for collecting essential fishery information on crabs and other cryptic invertebrates. The project will serve as a model of collaboration among stakeholders, scientists, and managers that can be applied to monitor and assess trap-based fisheries elsewhere in the state.

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**Ellen Damschen** **11/1/2005-10/31/2007** **10,000**
**Steven Gaines**
National Science Foundation, SB060070

**Biological Informatics Postdoctoral Fellowship**

The purpose of this project is to conduct a first test of large-scale habitat configuration effects on species diversity and composition over time in kelp forests using rare long-term datasets from the Santa Barbara Channel. The investigator seeks to determine the effects of the spatial arrangement of habitat in kelp forests on community composition and species abundances and distributions in order to provide a differential tool that can be used to assess the importance of connectivity and patch shape for species with different life history traits at two different scales. Objectives include: determining if the degree of patchiness at two different spatial scales has increased over time due to human-induced impacts (e.g., urchins, pollution, climate variability); quantifying suitable habitat for kelp and determining if the area, isolation, and shape of available substrate affects kelp colonization and turnover; and determining if kelp forest patchiness affects the distribution and abundance of marine species and whether life history traits (reproductive mode, planktonic larval duration, vagility) can predict species responses.

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**Tom Dudley** **3/1/2007-12/31/2007** **7,261**
Coastal Fund (formerly SPF), WIN07-04

**Sustainable Control of Invasive Arundo donax Along the UCSB Coastal Zone**

A student researcher, Yoshi Tamagawa, will evaluate the distribution of the invasive reed, Arundo donax, in riparian and shoreline habitats adjacent to the UCSB campus. He will also evaluate the distribution of an herbivorous wasp in these areas - this wasp has potential to reduce the growth and invasiveness of Arundo. In common garden experiments at the UCSB greenhouses at More Mesa, the student will evaluate the damage to Arundo caused by wasp feeding relative to uninfested plants.

Information from this study will directly benefit the UCSB community by identifying populations of Arundo around campus that may interfere with current campus restoration projects. Evaluating the impact of wasps on Arundo will enable researchers to determine whether these wasps will be effective for permanent control of Arundo populations in this area.

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**Tom Dudley** **4/1/2007-6/30/2008** **32,900**
Dersu & Associates, SB070110

**Nam Theun Wetland Restoration Ecological Study**

A large hydropower dam will be constructed on one of the main tributaries to the Mekong River, the Nam Theun River, on the Nakai Plateau in central Laos. The Nam Theun 2 dam project is projected to flood approximately 340 km2 of the plateau. This region has an incredibly high biodiversity, and habitat in the reservoir footprint is used by many endangered and rare animals. Very little is known about the ecology of wetlands in this region, although it has been identified as an area of international significance. The primary objectives of this initial stage of the study are to document natural wetland ecosystem biodiversity, processes, and functions before the dam is built, help guide development of a conceptual wetland restoration plan to be implemented as part of the dam construction, and establish long-term monitoring sites for evaluation of restoration success.

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**Tom Dudley** **9/1/2006-8/31/2008** **60,012**
UC Davis, 2006-34439-17024

**Ecological Basis for Biological Control of giant reed (Arundo donax) in California**

Giant reed (Arundo donax) may be the most destructive invader of California riparian areas. Classical biological control is a cost-effective and environmentally benign alternative to traditional control methods. Candidate agents have been identified, but their eventual release is predicated upon evidence that damage is substantial, and greater than that potentially caused by herbivores already present in North America. It is also important to establish monitoring programs so that efficacy can be evaluated when and if releases take place. The PI and postdoc will characterize vegetation at two spatial scales for the Santa Clara River riparian ecosystem as a baseline for future evaluation of field effectiveness of Arundo biocontrol, and recovery of desired vegetation and associated wildlife. Associated woody and understory plants will be surveyed, and plant growth parameters will be compared with those found in the European range of origin. They will also characterize the herbivore complex already present on giant reed in North America, in particular a recently discovered stem-boring wasp in Ventura County, to evaluate the potential for augmentation biocontrol as an alternative to introduction of non-native natural enemies. They will create an internet-based outreach program for the dissemination of information critical for the control and management of Arundo populations, both regionally and nationally.

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**Tom Dudley** **12/15/2005-12/14/2008** **305,000**
US Department of Agriculture, 2006-35302-16641

**Regional Targeting of Biological Control Agents Against Saltcedar (Tamarix spp.) in North America**

This research is designed to enhance the effectiveness of biological control of saltcedar (Tamarix spp.) where this noxious weed infests floodplain ecosystems throughout the western U.S. An approved biological control agent from north-central Asia (Chrysomelidae: Diorhabda elongata from 44.1°N) has been released in experimental sites in eight western states, but establishment in most has been weak or absent. Poor establishment appears to be related to developmental asynchrony with environmental conditions, especially photoperiod, and secondarily to host plant genotype, across the wide range of latitudes where it has been tested. A second biotype or genetic form of Diorhabda from the Mediterranean region (35.1°N) has now been released at four sites, with moderate to poor establishment. Eight biotypes of Diorhabda are currently maintained from other latitudes in Eurasia and northern Africa, and these have been tested to ensure safety for subsequent release. However, before widespread releases of these insects can take place, the responses of the geographical biotypes to field conditions must be tested, including host genotype, climate, and especially photoperiod,

across a representative range of infested ecosystems. The PI will conduct field tests across three North-South latitudinal gradients in Pacific western, arid interior and mid-continent locations, and will simultaneously characterize the full range of developmental responses of the Diorhabda biotypes to photoperiod and temperature under controlled conditions.

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**Tom Dudley** **10/17/2007-10/31/2012** **10,000**
**Kevin Lafferty**
**Armand Kuris**
US Fish & Wildlife Service, 813327J015

**Development of Biological Control for the New Zealand Mud Snail**

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

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**Tom Dudley** **11/30/2005-9/30/2010** **100,000**
US Fish & Wildlife Service, 81440-5-G021

**Biological Control of Invasive Giant Reed (Arundo donax) in the Santa Clara River Watershed**

Giant reed (Arundo donax) may be the most destructive invasive plant infesting southern California riparian areas, including the Santa Clara River. Because traditional control methods are very costly and incur substantial collateral damage, the PI seeks to develop biological control as a cost-effective and environmentally benign means to reduce Arundo infestations using imported natural enemies that specialize on these plants in their Eurasian regions of origin. The ultimate objective of this project is to suppress the growth and reduce the abundance of Arundo in infested riparian ecosystems, thereby eliminating competition with native woody and understory species and facilitating ecological recovery of the Santa Clara River ecosystem and riparian associated wildlife. This ecosystem provides an excellent test location, but the program is directed towards subsequent implementation throughout southern California and other infested ecosystems of North America. The overall objective is to identify and evaluate herbivorous insects and plant-infecting fungi with the following specific goals: 1) quantify level of damage to the target plant, including plant mortality; 2) verify that agents do not feed on nor infect native and economically important plants; 3) evaluate potential for large-scale rearing, transport and introduction into infested field locations.

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**Jenifer Dugan** **7/1/2006-12/31/2007** **29,999**
**Henry Page**
Cal RA Department of Fish and Game, P0675003

**Restoration Approach for Sandy Beaches Impacted by an Oil Spill and Cleanup Activities**

Exposed sandy beaches comprise three-quarters of the world's open coast shorelines and are valued for human recreation and as habitat and resources for wildlife. This prevalence means beaches are often the primary coastal habitats affected by oil spills and cleanup activities. Agencies, such as the

OSPR and the National Oceanic and Atmospheric Administration, are under increasing pressure to develop environmentally sensitive, cost-effective strategies to respond to, clean up and restore beaches impacted by an oil spill. Macroinvertebrate communities inhabiting sandy beaches depend almost entirely upon allocthonous inputs of carbon and organic material. For California beaches, stranded marine macrophytes (macroalgae, sea grasses) from rocky reefs represent a major subsidy that supports a diverse and productive portion of beach food webs. Changes in the supply and accumulation of macrophyte wrack have significant bottom-up effects on this ecosystem, altering the biodiversity, structure, composition and dynamics of the macroinvertebrate community, and consequently the availability of prey to higher trophic levels, such as shorebirds and fishes. Results from groomed beaches suggest that removal of rack significantly reduces not only wrack cover, but the species richness, abundance and biomass of intertidal macroinvertebrates, prey availability to shorebirds and the cover of dune vegetation on sandy beaches. This study will provide the first experimental investigation of the potential ecological recovery of a beach affected by an oil spill and cleanup activities.

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**Jenifer Dugan** **1/22/2008-1/31/2009** **49,844**
**Henry Page**
California Department of Parks and Recreation, C0753014

**Approaches for Enhancing Prey Resources on Sandy Beaches for Nesting Shorebirds**

Sandy beaches are highly valued as aesthetic and recreational resources for humans. Beaches are also vitally important as ecosystems that support wildlife by providing habitat and prey for nesting, migrating and wintering shorebirds and other wildlife. There is increasing pressure to develop environmentally sensitive, cost-effective strategies for managing beaches for both humans and wildlife. The motivation for this study comes from the need to improve approaches for enhancing beach ecosystem function for wildlife support. The results will provide information on potential techniques for enhancement of resources for endangered and threatened bird species, particularly the Western Snowy Plover, a shorebird that depends on beach prey resources during the nesting season. The PIs will investigate approaches that could potentially be applied by resource managers to enhance sandy beach ecosystems for support of higher trophic levels, particularly nesting shorebirds. Specifically they will experimentally examine effects of the addition of 1) macrophyte wrack (e.g., kelps) and 2) selected flightless invertebrate prey (e.g., talitrid amphipods) on the diversity, abundance and composition of the wrack-associated invertebrate community.

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**Jenifer Dugan** **7/16/2007-5/31/2008** **7,500**
**Anita Guerrini**
Coastal Fund (formerly SPF), SPR07-16

**Proposal to Save the UCSB Palomar**

The Palomar is an iconic little building that has been a part of the coastal experience and local landscape for generations of students and local residents. After decades of facing the ocean elements at Coal Oil Point, this charming historic element of UCSB's beautiful coastal landscape is in urgent need of preservation and restoration due to safety concerns. The building has been known by many names over the years, the beehive, the oven, the pigeon house and no doubt others. It provides a daily link to local coastal history and the history of UCSB's West Campus. The design is an unusual "Spanish colonial revival" palomar style, but the architect and the exact historic use of this little building unknown. This award provides for support of two complementary actions needed to initiate the process of preservation and lay the foundation for preservation and restoration of UCSB's historic Palomar: 1) Historical architectural assessment by a qualified architectural historian, and 2) Structural evaluation by a qualified engineer.

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**Jenifer Dugan** **4/15/2007-12/31/2007** **10,500**
Coastal Fund (formerly SPF), WIN07-10

**Developing and Testing Invasive Plant Control for Isla Vista's Vernal Pools**

The goal of this project is to develop and implement a control strategy for invasive plants in and around Isla Vista's vernal pools, and to develop an interpretive program that will increase awareness

of local natural resources for students and the greater Isla Vista community. The project will develop a series of interpretive bilingual signs to be installed along the trail systems in these open spaces, develop web content to describe the importance of the natural resources and provide material for self-guided educational tours of these sites.

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**Jenifer Dugan** **4/1/2006-11/30/2007** **9,999**
UC Sea Grant, R/CZ-PD121-F-1/1

**Balancing Human Health Needs with Sustainable Harvest of Marine Resources for Biomedical Use: The Case of the Giant Keyhole Limpet**

This study represents the first step in a proactive approach to a unique resource management issue: sustainable harvest of a marine animal that is the only source of a natural product important to the pharmaceutical industry. Basic information on the life history and population biology of this species does not exist and is critically needed for development of an effective management program that addresses the need for a sustainable harvest for biomedical use. The Investigators will gather and analyze basic information on the distribution, abundance and size structure of an important and potentially valuable marine species, Megathura crenulata, in a variety of habitats, both natural and artificial. They will also investigate key aspects of the reproductive biology of M. crenulata from selected habitats. This study will provide resource managers with information that will aid in the development of strategies for sustainable use and management of a marine species that is the only known source of potentially valuable biomedical products for human health, yet has life history characteristics that confer high vulnerability to overfishing. The study results will also support the pharmaceutical industry by providing information critically needed to achieve continued availability of a natural product important for development and commercialization of several promising pharmaceutical drugs with the potential to improve human health.

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**Jessica Dutton** **7/1/2004-6/30/2008** **50,000**
**Gretchen Hofmann**
UC Toxic Substances Research and Teaching Program, SB040104

**Interspecific Stress Expression in a Native/Invasive Pair: Independent and Additive Effects of Temperature and Chemical Exposure in the Invasive Mussel Mytilus galloprovincialis and its native Cogener Mytilus trossulus**

Chemical pollution has become a significant characteristic shaping many coastal habitats and communities and likely exerts a selective force upon organisms therein by redefining the parameters of physiological stress for those areas. It has been suggested that invasive organisms may be successful at infiltrating new environments in some part due to relatively robust stress tolerance capabilities. This suggestion can be tested by comparing the relative physiological responses to cumulative environmental stressors in a native and invasive species pair, the bay mussels Mytilus trossulus and M. galloprovincialis respectively. By examining field and laboratory relationships between contaminant exposure, biological uptake, thermotolerance capabilities and physiological stress in the two species, this study will elucidate some of the physiological differences that may have helped M. galloprovincialis successfully invade the west coast of the United States and elsewhere. This research should contribute to our understanding about the role of environmental pollution in biological invasions, and will also reveal much about the relative merits of the two study organisms as sentinel species for monitoring purposes.

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**John Engle** **6/19/2007-6/18/2009** **84,924**
UC Santa Cruz, M07AC12503

**The Shoreline Assessment of Changes in Rocky Intertidal Communities in the Southern California Bight**

The UCSB portion of the MMS Rocky Intertidal Program 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 new field, laboratory, and data management procedures. The primary goal of this project is coordination and facilitation of activities to produce and update a variety of products including a standardized data management system, private and public internet sites, reports, publications, and oral presentations.

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**John Engle** **5/30/2002-12/31/2008** **160,957**
UC Santa Cruz, UCSC 14350102CA85144

**Coordination of Database Development, Protocol Standardization, and Regional Activities Between Minerals Management Service and Others in the Multi-Agency Rocky Intertidal Monitoring Network**

The UCSB portion of the multi-campus Minerals Management Service (MMS) program, "Shoreline Assessment of Changes in the Rocky Intertidal in the Southern California Bight," consists of coordination of database development and maintenance, protocol standardization, and other regional activities between MMS and the additional agency members of the Multi-Agency Rocky Intertidal Network (MARINE). The program includes principal investigators from UC Santa Cruz, UC Los Angeles, UC Santa Barbara, and California State University, Fullerton. The primary Cooperative Agreement is arranged between MMS and UCSC, with subcontracts extended to the other California institutions.

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**John Engle** **9/29/2006-3/1/2008** **9,976**
USDI - National Park Service, J807060010

**Interim Funding of Four San Diego County Rocky Intertidal Monitoring Sites**

Limited field data entry (slide scoring, data entry with no analysis) is needed for the results from the spring 2006 rocky intertidal monitoring event for sites near and within Cabrillo National Monument. Dr. John Engle and his staff will provide the slide scoring and data entry at UCSB's laboratories from October through December 2006 for four sites. Park staff will provide the slide scoring and data entry at Cabrillo NM for the three sites within the park's administration. The electronic format of this data is critical in order for UCSB, the National Park Service, and other regional members of the Multi-Agency Rocky Intertidal Network (MARINe) to use this information and compare local data within a regional context. Data will be contributed to the MARINe database by both groups by June 2007. Data will be reviewed and included in park management documents following the entry into the MARINe database.

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**Nann Fangue** **9/1/2007-8/31/2009** **75,000**
**Gretchen Hofmann**
National Science Foundation, OISE-0700551

**Postdoctoral Research Fellowship**

The aim of this project is to investigate the potential affects of climate change on the physiological performance of a marine invertebrate. Implicit with global climate predictions is the notion that climate change does not respect geographic boundaries. To assess and predict the response of organisms and communities, there is a need for the facilitation of cross-border investigations, particularly for organisms distributed across a wide, international biogeographic range. In the coming decades, scientists expect increasing numbers of species invasions and shifts in species range distributions in response to global climate change. It is critical to determine the processes and mechanisms that set species range boundaries and influence performance in novel environments presented by climate change. Because of the poor linkage between biological and political arenas, it is important to unite the study of species whose distributions span political borders. This study examines physiological ecology of the purple sea urchin, *Strongylocentrotus purpuratus* without borders. The postdoctoral fellow will test the overall hypothesis that sea urchin physiological performance will be affected by ecologically relevant (based on current climate change predictions)

temperature and acidification stressors. This project is being conducted at the Universidad Autonòma de Baja California in Ensenada, Mexico, where the urchin culturing expertise is located, and at UC Santa Barbara, where samples will be analyzed using the readily available resources for high throughput molecular biology.

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**Erica Fleishman** **5/1/2007-3/15/2009** **78,738**
**O. James Reichman**
Cal Coastal Conservancy, 06-135

**Non-market Ecological Valuation of Coastal Marine Resources in California**

The National Center for Ecological Analysis and Synthesis (NCEAS) will evaluate and synthesize methods for deriving the value of ecosystem services that are provided by coastal marine resources in California. The working groups convened by NCEAS will

- compile a lexicon related to valuation of ecosystem services
- create a preliminary list of services in coastal marine California that are expedient and tractable to value
- evaluate and synthesize methods for deriving the value of ecosystem services
- consider the extent to which surrogate measures of market or non-market values can be developed and implemented
- assess the uncertainty in direct or indirect measurements of ecosystem services and discuss how those uncertainties might affect management options or decisions
- calculate the value of at least one of the services provided and define the potential uncertainties associated with that value

To accomplish these tasks, NCEAS will convene approximately three workshops and working groups of economists and ecologists with appropriate expertise. Tasks will be supported by a graduate assistant and by NCEAS staff. NCEAS will work closely with OPC to ensure that deliverables include not only complete documentation of activities conducted at NCEAS and associated inferences, but summary products that are suitable for decision-makers and the educated public.

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**Erica Fleishman** **2/1/2008-1/31/2011** **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.

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**Erica Fleishman** **12/7/2007-8/7/2010** **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.

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**Erica Fleishman** **6/6/2007-6/5/2008** **385,781**
US Fish & Wildlife Service, 813327J002

**Integration analysis, and synthesis of results from Evaluation of a Pelagic Organism Decline (POD) in the Upper San Francisco Estuary**

The Interagency Ecological Program (IEP) for the San Francisco Bay/Sacramento-San Joaquin Estuary consists of nine member agencies: three State (Department of Water Resources, Department of Fish and Game, and State Water Resources Control Board), and six Federal (Fish and Wildlife Service, Bureau of Reclamation, Geological Survey, Army Corps of Engineers, National Marine Fisheries Service, and Environmental Protection Agency) and also includes a non-government organization (The San Francisco Estuarine Institute) among its program partners. Working together, the mission of the IEP partners is to develop a better understanding of the estuary's ecology and the effects of the State Water Project (SWP) and Federal Central Valley Project (CVP) operations on the physical, chemical, and biological conditions of the San Francisco Bay - Delta estuary. To accomplish its goals, IEP members conduct and sponsor a large number of long-term monitoring surveys as well as shorter term studies. The overall goal for the proposed work with NCEAS (including but not limited to working groups) is to conduct and/or guide the integration, analysis, and synthesis of Pelagic Organism Decline (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) is 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 will also be clearly identified.

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**Erica Fleishman** **5/15/2007-9/30/2009** **94,566**
US Forest Service, 05-JV-11221682-210

**Response of Birds, Butterflies, and their Habitats to Management of Wildland Fuels and Fire Regimes**

Resource agencies in the Intermountain West are concerned with the response of bird communities and individual species of birds to fire and fire management. For example, potential violations of the Migratory Bird Treaty Act can constrain implementation of prescribed fire during the spring. The PI will examine whether potential loss of individual birds is likely to have an impact on regional

population persistence. Understanding the response of cavity-nesting birds is important because fire affects the quality of habitat for many species. Further, cavity-nesting species often are designated as Management Indicator Species or Sensitive Species. Of the 109 species of birds from the study area, one (Northern Goshawk) is considered Sensitive by USFS, and an additional 23 have been identified as priorities. Among these, Pinyon Jay has been identified as a local concern. Butterflies also tend to respond rapidly to fuels management because their population viability is linked closely to availability of larval host plants and adult nectar sources. This study will address local data gaps on the distribution and abundance of birds, including species identified as Sensitive or priorities, and the response of those species and their habitats to management of wildland fuels and fire regimes.

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**Erica Fleishman** **4/27/2007-12/31/2008** **100,000**
Wilburforce Foundation, UCSB0703

**Analysis and Conservation Prioritization of Landscape Connectivity in Nevada**

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

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**Erica Fleishman** **12/1/2006-11/30/2008** **25,000**
**O. James Reichman**
Wilburforce Foundation, UNIVE0611

**New Tools for Incorporating Landscape and Population Connectivity into Conservation Planning**

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

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**Erica Fleishman** **2/1/2007-10/31/2007** **103,673**
Wildlife Conservation Society, SB07121

**Linking Packard's Regional EBM Initiatives**

Seven Regional Initiatives (RIs) supported by the David and Lucile Packard Foundation are working to integrate physical, natural, and social science activities to help design practical, transparent, and politically feasible management frameworks that advance coastal-marine sustainability - a process that has been termed "ecosystem-based management" (EBM). NCEAS and FOS will work with these seven projects to help them both define and improve the EBM work at their specific sites, and to

bring them together to learn from one another in a learning network. There also is an opportunity to build capacity for data analysis, synthesis, and sharing into the individual projects and the network. As a first stage in this process, investigators will hold an initial meeting of the projects that can serve as a pilot test to see if a long-term learning network makes sense. NCEAS will help to introduce the project teams to concepts and tools related to data documentation, access, analysis, and synthesis and to determine what support and training in these areas would be required as part of the longer-term work.

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**Erica Fleishman** **12/1/2007-6/30/2008** **17,000**
Wildlife Conservation Society, SB080080

**Climate-change Synthesis for Conservation Action**

There is increasingly compelling evidence that human activities are affecting the global climate, that biological systems are responding to climate change, and that future climate change will continue to alter patterns of biological diversity at multiple scales worldwide. As a result, scientists and managers are grappling with how current and future conservation strategies might be revised to maximize resilience and potential for adaptation by wildlife and their resources. The Wildlife Conservation Society (WCS) and the National Center for Ecological Analysis and Synthesis (NCEAS) aim to develop a strategy to incorporate climate change science into on-the-ground wildlife conservation practices in the Intermountain West of North America. During a preliminary meeting of a Climate and Conservation working group at NCEAS in July, 2007, participants outlined a four-step strategy for integrating climate change impacts into wildlife conservation planning: 1) select conservation targets, 2) assess impacts more thoroughly, 3) modify generic adaptation strategies for the case-study regions, and 4) develop adaptation scenarios. The PI will compile and summarize existing literature on potential impacts of and adaptations to climate change.

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**Kathleen Foltz** **9/1/2004-8/31/2007** **375,000**
National Science Foundation, IOB-0415581

**Understanding the Fertilization Signalsome**

The activation of the quiescent egg during fertilization is the remarkable first step in the development of a new organism. Despite a long history of descriptions of the process, surprisingly little is known about the molecular details of fertilization in any system. In the eggs of all multicellular animals studied to date, a rise in intracellular calcium plays a key role in egg activation. The PI will conduct experiments designed to test hypotheses about the molecular mechanisms of the very early events of egg activation to examine how the rise in calcium is mediated and what triggers opening of calcium gates in the egg's endoplasmic reticulum. These studies are conducted on echinoderms (sea urchin and starfish), the best-understood model system currently in place for dissecting the egg activation pathway. Eggs (especially the highly synchronous echinoderm eggs) offer an exciting example of digital signaling, based on protein-protein interactions, that toggle the cell from "off" to "on" in seconds. Understanding the details of fertilization will provide insight into the general phenomenon of signal transduction as well.

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**Steven Gaines** **6/20/2003-12/31/2007** **360,000**
Andrew W. Mellon Foundation, SB030115

**Linking Community Ecology and Biogeography: The Causes of Large-scale Variation in Marine Ecosystems**

This continuation of previous research funded by the Mellon Foundation will focus on the biogeography of species interactions. Three complementary types of studies will examine the issues of how multispecies interactions are altered by oceanographic and geographic processes. 1. New models of species interactions targeted specifically at the large life history variation in the ocean: predator prey, competition, facilitation, parasitism and disease. 2. Coordinated experiments on the dynamics and consequences of species interactions at geographical scales, with repeated experiments at strategic locations to test hypotheses derived from modeling efforts. 3. Geographical sampling of the abundance and dynamics of key interacting pairs to examine if the large scale patterns are

consistent with model and experimental predictions. These types of studies are especially crucial to make any thoughtful advances in the design of marine reserve networks as effective means of ecosystem wide management.

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**Steven Gaines** **6/1/2007-5/31/2009** **200,000**
Andrew W. Mellon Foundation, SB080001

**Making Connections: Predicting Variation in Larval Dispersal at Biogeographic Scales**

In the last decade, the combined research efforts of the iCORUMBA teams in Chile, Oregon and Santa Barbara have documented important sources of variation in recruitment rates, including abrupt changes in geographical patterns of larval settlement associated with abrupt shifts in the intensity and frequency of upwelling. These patterns create distinct regions of the shore with contrasting patterns of community structure. Within these large geographic regions, however, the sources of variation in recruitment are much more poorly understood. Moreover, even in situations where the pattern of recruitment is predictable, the source of the recruits is largely unknown. The goal of this work is to combine a number of distinct research efforts from recent years into a synthetic and predictive look at population connectivity in coastal upwelling ecosystems.

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**Steven Gaines** **7/14/2006-6/30/2008** **22,400**
COM - National Oceanic & Atmospheric Administration, NCNS3000-6-00546

**Graduate Training Support**

This award provides graduate student support for Christine Addison, a graduate student working with Drs. Steven Gaines and Carol Blanchette.

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**Steven Gaines** **7/1/2007-6/30/2011** **450,000**
**John Melack**
**O. James Reichman**
**Alice Alldredge**
**Oliver Chadwick**
**Bruce Luyendyk**
Luce Foundation, SB070105

**The Luce Environmental Science to Solutions Initiative**

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

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**Steven Gaines** **9/1/2007-8/31/2008** **1,000,000**
Marisla Foundation (formerly Homeland Foundation), 3-07-112

**The California Fisheries Fund: Investing in Marine Conservation and Fisheries Reform**

Human activities have reached the limits of ocean productivity and have reduced productivity in some cases. Overfishing, bycatch, and habitat damage associated with fishing have impacted the fundamental drivers of ocean productivity and diversity. Many NGOs are working hard, with considerable success, to put into place policies and regulations intended to result in more sustainable fisheries. Several factors are coming together to facilitate the transformation of California fisheries and ocean ecosystem protection, including the implementation of the Marine Life Management Act, the Marine Life Protection Act and the California Ocean Protection Act. However, conservation prescriptions embedded in these policies and regulations are being undercut by strong opposition by fishermen because they are perceived as threats to livelihood and economic health. In addition, fisheries management and research are chronically underfunded by government agencies. Fishermen feel disenfranchised and resentful of conservation actions because they perceive conservation as an added jeopardy rather than a benefit to their livelihoods. Two critical ingredients are needed to complement ongoing fishery reform efforts: capital to finance change, and governance reform that results in incentives for stewardship. The California Fisheries Fund is designed to fill these gaps, and in concert with policy and regulatory reforms, transform fisheries to sustainability and reduce opposition to MPAs and other conservation measures.

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**Steven Gaines** **1/1/2005-3/31/2009** **6,836,629**
**Robert Warner**
**Libe Washburn**
**Gretchen Hofmann**
Oregon State University, F0395A-C

**Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO)**

The Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) is a collaboration of scientists at four universities - Oregon State University, University of California at Santa Cruz, University of California at Santa Barbara, and Stanford University - with the goals of understanding the dynamics of the ocean ecosystem along the U.S. west coast, producing a new generation of scientists trained in interdisciplinary collaborative approaches, and sharing knowledge for science-based decisions regarding coastal and marine management and stewardship. Over the next five years, PISCO will address major scientific, technological, and cultural challenges to provide the information and tools that are essential for effective management and conservation of the ocean. Ultimately, PISCO will help society to enjoy the many benefits of intact, functioning marine ecosystems, including abundant ocean wildlife, sustainable commercial and recreational fisheries, and vibrant coastal economies.

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**Steven Gaines** **8/22/2006-9/30/2008** **136,241**
**Satie Airame**
Oregon State University, F0468A-A

**New Advances in the Science of Marine Reserves, second editions of: The Science of Marine Reserves**

The investigators will update the scientific information and expand the distribution and effective use of "The Science of Marine Reserves" booklet that was originally produced in 2002. The first edition was intended for use within the United States and has been very effective in sharing information about marine reserves with non-technical audiences. The booklets have contributed directly to the establishment of marine reserves in the U.S. However, since 2001 over 300 new papers on the science of marine reserves have been published. There is now a need to update the booklet. Two updated versions will be produced, one for U.S. audiences and a second (in English) for the international community. In addition to the two booklets, the processes used to develop the new materials will result in a stronger community of scientists that is familiar with the latest findings, ready to share that knowledge with users and decision-makers, and primed to advance the science of marine reserves through further research. The use of scientific advisors in intended to provide rigorous peer review in the development of content and to entrain a broad group of scientists in the distribution and use of the booklet.

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**Steven Gaines** **5/1/2006-5/1/2009** **5,000,000**
**Christopher Costello**
**O. James Reichman**
**John Melack**
Paul G. Allen Charitable Foundation, 8637

**Sustainable Fisheries Project**

Confidence in our ability to manage ocean fisheries is at an all-time low. Over-fishing has been determined to be the most important alteration of the oceans in the past millennium. The range of causes for the declines in US marine fisheries is large and diverse, but the global breadth of the problem points to a widespread failure of management systems as the critical root of the problem. Fishery dynamics result from the interplay among physical oceanography, biological interactions, economic activities, and regulatory decisions. Yet, the standard management framework for fisheries meshes poorly with this inherent complexity. One of the largest problems is that market incentives create behaviors that are typically at odds with sustainable practices. Open access to fisheries favors overcapitalization and a race to fish that serves neither fish nor fishermen well. In many cases, more effective management strategies involving dedicated access privileges are known, but the pathway to implementation is unclear. In collaboration with Environmental Defense, three entities at the University of California, Santa Barbara will catalyze the reform of fisheries by coupling ecological analysis, economic models, and investment tools to help align positive ecological outcomes with fishermen's incentives. A Sustainable Fisheries Fund will be developed to support reform efforts. The UCSB entities include the Donald Bren School of Environmental Science and Management, the Marine Science Institute, and the National Center for Ecological Analysis and Synthesis. The project will implement these tools and strategies with significant investment from public and private sources.

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**Steven Gaines** **1/1/2008-9/1/2008** **100,000**
**Constance Penley**
**Ronald Rice**
**John Melack**
Paul G. Allen Charitable Foundation, 9991

**Digital Ocean Project**

The *Digital Ocean* (DO) project will use collaborative digital technologies to inspire public engagement in preserving the world's oceans. The goal is to create an open-source social learning environment using new and existing technologies, software and networking processes that will allow a broad range of users/producers to interact with valid scientific data about human impacts on the oceans in a way that is fun, engaging, intellectually challenging, and rooted in social interaction. *DO* will serve as a platform for building multi-disciplinary, multi-generational communities. Participants may include scientists, educators, students, communicators, policy makers, and the general public. Given that the kinds of outreach needed for each of these groups is very different, the Planning Process will develop a Strategic and Business Plan to identify possible pilot projects that prioritize different participant groups. Increases in human coastal populations and widespread ignorance of the oceans' crucial roles in maintaining the ecosphere and providing food have led to crisis conditions that, if not reversed quickly, threaten the future of life on earth. The developing interactive, social networking and multi-media capabilities of the Internet and the world-wide web (Web 2.0) offer unprecedented opportunities to establish a fan base for ocean conservation by creating online communities for virtually experiencing undersea life forms and processes that few people will otherwise ever encounter. This project will develop a strategic plan for moving *DO* from concept to pilot development and testing.

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**Steven Gaines** **12/1/2005-10/31/2008** **326,372**
Resources Legacy Fund Foundation, 20050137M

**MLPA Initiative Evaluation Tool**

The purpose of this project is to develop a decision support tool for use by the Science Advisory Team for the Marine Life Protection Act (MLPA) Initiative, a public-private partnership between the Resources Agency, the Department of Fish and Game and the Resources Legacy Fund Foundation.

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**Steven Gaines** **7/1/2005-8/31/2007** **369,391**
UC Office of the President, 05 T CEQI 08 0076

**Population Connectivity of Coastal Fishery Species across the California-Mexico International Border**

This project focuses on understanding the interconnections between populations of fishery species on either side of the international border with Mexico. Despite the fact that California is moving quickly toward promoting sustainable harvest through ecosystem-based management approaches in its own waters, there has been little consideration of the role of other regions in supplying individuals. Fish and invertebrates do not recognize international borders. Past research suggests that many southern California species peak in abundance south of the Mexican border, and indirect evidence suggests that ocean currents may cause a significant number of marine communities in California to depend on larval re-seeding from Baja, Mexico. Without consideration of the role of cross-border connectivity, the State of California's efforts to create sustainable harvests will be misinformed and likely unsuccessful. In order to understand the extent of larval exchange between California and Mexico, the PI will use new advances in genetic technology on a suite of model species to determine the rates and direction of gene flow across the international border, the spatial scales of larval dispersal along the coastline, and, when possible, the source locations of individuals recruiting to populations in California. Synthesis of these results will enable the research group to test and quantify the hypothesized dependence of California on breeding populations in Mexico for new recruits. The research covers a broad taxonomic assemblage of five fish and invertebrate fishery species having similar biogeographic and life history traits that suggest population connectivity across the international border. These species also represent a host of other sub-tropically associated species in California, thereby extending the implications of the results to cover a wide array of species of economic and conservation importance to California.

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**Steven Gaines** **5/1/2005-4/30/2010** **6,495,699**
COM - National Oceanic & Atmospheric Administration, 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 Ocean Science Education Center will be a state-of-the-art educational facility that connects invited participants to the CINMS and the Marine Science Institute at UCSB through compelling, hands-on programming. The facility 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. 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.

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**Jeffrey Goddard** **12/1/2007-11/30/2008** **12,900**
UC Sea Grant, R/OPCENV-08-S-1/3

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

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

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**Benjamin Halpern** **12/13/2006-6/1/2008** **207,091**
**O. James Reichman**
Gordon and Betty Moore Foundation, 1314

**Ranking and Mapping Human Threats and Impacts to Marine Ecosystems in the California Current**

Coastal and nearshore marine ecosystems are heavily threatened by human activities on land and at sea, yet surprisingly little is known about the distribution of threats and their differential impacts among ecosystems. The California Current has received a large amount of attention from conservationists and resource managers trying to develop spatial management plans, and recent political developments linking state-level efforts will only increase this interest, creating an urgent need for rigorous, comprehensive, and spatially-explicit threat and impact assessment for marine ecosystems. This research will produce a high-resolution map of human impacts to marine ecosystems for the California Current and will leverage the large amount of experience and resources developed over the past two years to produce similar maps at a global scale, based on higher-quality regional data. The PI will 1) use an expert survey tool developed and vetted for the global threats process to survey traditional and non-traditional experts from Baja to Washington, 2) gather and synthesize high-quality, high-resolution data for the Current that will supplement or replace the global data for the region, 3) use a variety of novel modeling approaches to combine these data into synthetic threat impact maps, and then 4) bring together decision theory experts to develop approaches for translating our results into decision support tools. All of these products will be made available for free on an interactive mapping website, and ongoing involvement in and connection to existing outreach efforts and policy processes will be used to help translate the products into future policy and management decision-making.

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**Stephanie Hampton** **8/12/2007-9/30/2009** **99,855**
**O. James Reichman**
COM - National Oceanic & Atmospheric Administration, AB133F07SE3931

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

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

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**Stephanie Hampton** **6/20/2004-12/31/2008** **1,859,855**
David and Lucile Packard Foundation, 2004-27169

**Knowledge and Capacity-Building to Support Ecosystem-Based Management for Sustainable Coastal-Marine Systems**

This is a partnership between the National Center for Ecological Analysis and Synthesis (NCEAS) at UC Santa Barbara and the Packard Foundation that focuses the attention of innovative scientists of

the highest caliber on generating the knowledge needed to support an ecosystem-based approach to managing coastal-marine systems. Coastal systems are heterogeneous and dynamic. They also are frequently chaotic, corruptible by invasion of exotic species, and strongly influenced by both nearby and remote processes, including human activities. The current global population and associated activities of more than 6 billion people are generating unprecedented rates of change in these systems. Thus they cannot be managed successfully by existing approaches. In this context, perhaps the greatest challenge for today's scientific, conservation, and policy communities is to develop ways to ensure new knowledge is relevant and of high quality. A related challenge involves delivering this information in a timely fashion and making the results accessible to managers and decision makers so that scientific information is considered in making environmental policy.

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**Stephanie Hampton** **4/29/2008-4/1/2009** **96,953**
Gordon and Betty Moore Foundation, 1673

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

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

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**Stephanie Hampton** **9/4/2007-9/3/2009** **132,902**
**O. James Reichman**
The Nature Conservancy, 1980863015-CSD-112007

**Developing a Return on Investment Approach for Conservation Planning in Argentina**

The budgets of even the largest conservation organizations will never be large enough to fully address the many threats to global biodiversity and surrounding natural systems. Consequently, the fundamental challenge is determining how to prioritize. Traditionally, the two considerations weighed most strongly by conservation organizations in priority setting have been biological value and threat. Indeed, these two priorities form the strategic core of many leading organizations. However, this approach misses an opportunity by ignoring the costs associated with particular conservation choices. Economic theory indicates that the greatest gains are achieved by choosing options that provide the greatest return on investment, an especially important consideration for typically resource-strapped conservation organizations. This return on investment (ROI) approach could greatly improve conservation planning by providing information about the benefit per unit cost for all options under consideration. The purpose of this post-doctoral fellowship is to explore how ROI can improve the quality of environmental decision-making, focusing on the Nature Conservancy's strategic planning for conserving Argentinean grasslands.

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**Rachel Haymon** **5/1/2004-4/30/2008** **436,815**
**Ken Macdonald**
COM - National Oceanic & Atmospheric Administration, NA04OAR600049

**Exploring Hydrothermal System Response to Magma Supply & Crustal Thickness Gradients Along the Galapagos Spreading Center, 89.5°-94°W**

A field experiment is proposed along the Galapagos Spreading Center (GSC) to explore the response of the hydrothermal-geological-biological system along the ridge crest to large, hotspot-induced, along-strike gradients in magma supply and crustal thickness/structure. Unlike the East Pacific Rise (EPR) and other mid-ocean ridges (MOR's) where variations in magma supply along strike are much debated, the GSC is known to exhibit increases in magma supply and crustal thickness/structure toward the center of the Galapagos mantle plume (GMP) influence at 91.5°W. However, almost no hydrothermal exploration of the GSC has been done. The GSC is thus an ideal natural experiment, for which the observations have yet to be made, on how magma supply and crustal thickness affect the nature, abundance, and distribution of ridge crest hydrothermal activity, and interactions between hydrothermal, volcanic, tectonic, and biological processes.

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**Rachel Haymon** **5/1/2004-4/30/2009** **229,028**
**Ken Macdonald**
National Science Foundation, 0324668

**Collaborative Research: Hydrothermal System Response to Magma Supply and Crustal Thickness Gradients along the Galapagos Spreading Center, 89.5°-94° W**

A field experiment is proposed along the Galapagos Spreading Center (GSC) to investigate the response of the hydrothermal-geological-biological system along the ridge crest to large, hotspot-induced, along-strike gradients in magma supply and crustal thickness/structure. Unlike the East Pacific Rise (EPR) and other mid-ocean ridges (MOR's) where variations in magma supply along strike are much debated, the GSC is known to exhibit increases in magma supply and crustal thickness toward the center of the Galapagos mantle plume (GMP) influence at 91.5°W. The GSC is thus an ideal natural experiment for which the observations have yet to be made, on how magma supply and crustal thickness affect the nature, abundance, and distribution of ridge crest hydrothermal activity, and interactions between hydrothermal, volcanic, tectonic, and biological processes.

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**Monica Heintz** **11/1/2007-11/1/2008** **20,000**
**David Valentine**
National Academy of Sciences, SB080050

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

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

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**Sarah Henkel** **9/19/2005-9/18/2008** **47,423**
**Gretchen Hofmann**
US Environmental Protection Agency, FP-91654401

**2005 EPA Science to Achieve Results (STAR) Fellowship for Graduate Environmental Study Molecular Techniques for Predicting Invasion Potential: Comparisons Among Native and Invasive Kelp Species**

Kelps, an important group of seaweeds, are significant members of marine communities, holding scenic, recreational, economic, and environmental value. This research focuses on the invasive Asian kelp, Undaria pinnatifida, and how it is capable of spreading. Invasive species can disrupt food webs and have economic impacts. The fellow will examine how temperature tolerance play a role in invasions and range expansions. An established measure of temperature tolerance is the production of heat shock proteins (Hsps). This project will study Hsps and how they are involved in invasion and spread. Knowledge of the potential for Undaria to spread is important for prevention as well as control of this invader.

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**David Herbst** **4/1/2008-3/31/2010** **100,000**
Cal Dept of Water Resources, 07-081-256

**Lahontan Region Bioassessment Monitoring and SWAMP Scientific Coordination**

The California Regional Water Quality Control Board, Lahontan Region (RWQCB), is the State agency responsible for protection of water quality within the Lahontan Region of California. Its jurisdiction extends from the Oregon border to the northern Mojave Desert and includes all of California east of the Sierra crest. The RWQCB needs modern tools to better protect and regulate aquatic life beneficial uses for surface waters. Aquatic habitat quality may be evaluated by sampling in-stream invertebrate and periphyton communities and calculating composite measures of community structure (such as diversity, biotic index, and taxonomic indicator groups), and through multivariate methods that consider physical habitat parameters as well as community structure. The collection of such information is called "biomonitoring" and the assessment of biological integrity using the biomonitoring data is called "bioassessment." The objectives of this project are to implement existing tools for assessing the quality of wadeable streams and rivers, and to develop and advance new such tools. The project will: a) characterize benthic communities and instream physical habitat at selected stream reaches; and b) provide technical assistance to the Lahontan Water Board to assist it in implementing existing bioassessment tools and develop new tools for the future.

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**David Herbst** **12/1/2005-3/31/2009** **484,000**
California Regional Water Quality Control Board, 05-179-160-0

**Assessment of the Influence of Sediment on Benthic Stream Communities and Development of Guidance for Sediment TMDLs: Proposed Research Outline for TMDL Study**

Sediment is one of the most prevalent, non-point source pollutants impacting water quality in streams nationwide and in California. Statewide, 30.5 percent of stream miles listed as impaired under the Clean Water Act in 2002 were listed for sediment, and sediment was cited more than any other pollutant impairing streams. Assessing, managing, and restoring water bodies affected by a non-point source pollutant such as sediment is one of the most difficult challenges faced by researchers and water quality managers. The Principal Investigator will develop and refine tools to assist Regional Water Boards throughout the State of California in developing TMDLs for sediment. His work will consist of: a) characterizing benthic communities and instream physical habitat in watersheds representing a range of sediment loading, including those with excessive sedimentation from anthropogenic sources and those representing a minimally-disturbed or "reference" condition; b) conducting sediment dose experiments on benthic communities using stream mesocosms; c) conducting sediment dose experiments on selected macroinvertebrate taxa using laboratory microcosms; and d) integrating the findings to create new tools to assist the Regional Water Boards in developing sediment TMDLs.

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**David Herbst** **5/1/2006-3/31/2009** **420,111**
California Regional Water Quality Control Board, 05-280-160-0

**Bioassessment Comparability within Watershed Networks: Spatial and Temporal Components of Variation, and Development of Reference Site Selection Criteria**

The objectives of this project are to develop and refine tools to assist the Regional Water Quality Control Board, Lahontan Region (RWQCB) and the State Water Resources Control Board (SWRCB)

in assessing the quality of wadeable streams and rivers. The project will consist of: 1) characterizing benthic communities and instream physical habitat at selected stream reaches, and developing/refining tools for the application of bioassessments; 2) integrating historic bioassessment data into a format compatible with the SWRCB's Surface Water Ambient Monitoring Program (SWAMP) database; 3) working with SWAMP staff to promote consistency in bioassessment methods and to develop and refine quality assurance procedures for bioassessment in California; and 4) preparing results (manuscripts) for submittal to peer-reviewed scientific journals.

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**David Herbst** **5/15/2008-5/31/2010** **30,000**
California Regional Water Quality Control Board, 07-125-130

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

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

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**David Herbst** **9/14/2005-9/14/2010** **120,000**
**Scott Cooper**
US Department of Agriculture, 05-JV-11272164-082

**Aquatic Invertebrate Research for Kings River Experimental Watershed**

Headwater streams provide the strongest connection between the landscape and networks of flowing water. This is where flows originate and where the interface of earth and water, and biogeochemical processes influence the entire watershed. The objective of this research study is to set a multi-year baseline for future studies of integrated watershed effects of fire and logging practices in the Kings River Experimental Watershed (Sierra National Forest). This component of that baseline is to establish annual, seasonal, and habitat-specific conditions describing the diversity and structure of benthic invertebrate communities in ten separate headwater catchments that will serve as treatment and control groups for future project activities, and for two additional study sites below confluences of the treatment headwater drainages where the integrative changes associated with the upstream watershed may be discerned. This continues the development of a data set that the investigators have established over the period from 1999 to 2004.

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**Gretchen Hofmann** **10/19/2007-10/31/2008** **29,700**
**Christopher Osovitz**
California Energy Commission, MR-07-12J

**The Effects of Elevated Atmospheric CO2 on the Physiology of the Purple Sea Urchin**

The central aim of this project is to employ emerging molecular tools to strengthen our understanding of the biological consequences of ocean acidification on California's reef system by investigating the physiology of an important biological member of California's coastal ecosystem, the purple sea urchin, in response to elevated levels of CO2. The current trajectory of global climate change has generated an urgent need to understand the ecological consequences of such change. In particular,

marine systems face the threat of ocean acidification due to increasing atmospheric CO2 levels. The most recent Intergovernmental Panel on Climate Change (IPCC) report projects global CO2 levels to reach 540-970 parts per million (ppm) by the year 2100, up from the current level of 370 ppm. This increase in CO2 could in turn decrease ocean pH (currently 80-8.3) as much as 0.3 pH units, a degree which has already been shown to slow the rate of calcification in the skeletons of calcareous marine organisms. However, the impact of such changes on the physiological ecology of California reef species remains unclear. In order to assess the physiological effects of ocean acidification, skeletal growth and hardness and gene expression will be measured in the calcareous purple sea urchin, *Strongylocentrotus purpuratus* in response to artificially elevated levels of CO2 under laboratory conditions.

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**Gretchen Hofmann** **5/1/2005-4/30/2009** **535,623**
National Science Foundation, ANT-0440799

**Towards an Understanding of Protein Homeostatis in Cold-adapted Antarctic Fish**

The central objective of this project is to examine the process of protein homeostasis in the cells of Antarctic notothenioid fishes. Prior results suggested that proteins in Antarctic fish may be subject to a great deal of misfolding at the subzero temperatures typical of Antarctic coastal waters. The two main observations that will define this new set of experiments are: 1) the observation that a normally stress-inducible molecular chaperone, Hsp70, has been recruited into constitutive expression, and 2) in pilot experiments, high levels of ubiquitinated proteins have been measured in tissue of two Antarctic species. The planned experiments will continue with a comparative approach using temperate New Zealand notothenioid fishes to highlight the differences in Antarctic fish physiology. Specific aims include use of ubiquitin conjugate analysis to measure the levels of damaged proteins in cells of Antarctic fishes; estimation of the efficiency of protein synthesis in cold-adapted Antarctic fish cells by measuring the levels of defective ribosomal products (DRiPs); measurement of relative 26S proteasome activity in cells of Antarctic fishes; and assessment of the nature of cold-adapted gene expression in Antarctic fish as compared to their temperate New Zealand relatives.

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**Gretchen Hofmann** **12/15/2007-11/30/2008** **20,000**
National Science Foundation, ANT-0808947

**Science of Opportunity: A SGER Proposal to Support the Development of Genomic Resources for Antarctic Pteropods.**

This grant supports the rapid acquisition of DNA sequence for the Antarctic pteropod *Limacina helicina*, a resource that would allow the development of a cDNA microarray to profile gene expression in this critical marine invertebrate in response to ocean acidification. This acquisition facilitates the collaboration of the PI, a marine molecular ecologist, with Professor Victoria Fabry, an expert in pteropod calcification biology, and a leader in the ocean acidification research community. The resources developed here will be shared with the polar research community, and all DNA sequence data and protocols will be available via web databases. Notably, the genomic tool developed here will be most likely useful for pteropods from Antarctic and Arctic waters.

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**Gretchen Hofmann** **7/15/2004-6/30/2008** **368,534**
National Science Foundation, OCE-0425107

**Finding the Genes that Matter: Profiling Gene Expression in Strongylocentrotid Sea Urchins with Different Biogeographic and Temperature Distributions**

The goal of this project is: 1) to test the hypothesis that temperature contributes to setting species distribution patterns in marine ecosystems and 2) to employ genomic approaches and other molecular techniques to assess changes in gene expression in congeneric sea urchins that are adapted to different temperatures and have different biogeographical distributions in nature. The project uses four congeneric species of temperate sea urchin (genus Strongylocentrotus) as study organisms: S. purpuratus, S. droebachiensis, S. franciscanus, and S. pallidus. Gene expression profiles will be assessed in order to address how the differentially thermally adapted sea urchin species respond to ecologically relevant temperatures at the genomic level. The strategy for the genomics approach

entails using DNA macroarrays to screen for differentially expressed genes that will then be analyzed using other genomics techniques -- DNA microarrays and real time PCR.

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**Gretchen Hofmann** **9/1/2006-2/28/2009** **15,500**
UC MEXUS, SB070049

**Stress Temperatures and Sea Urchin Metamorphosis Along Latitudinal and Depth Gradients**

The goal of this project is to combine the expertise of two science groups - one at UABC (Dr. E. Carpizo) and another at UCSB (Dr. G. Hofmann) - in order to assess the survival of larvae and embryos of marine invertebrates in the context of global climate change. Combining invertebrate zoology, marine ecology and genomics, these studies will contribute to an understanding of how economically important marine organisms may respond to changes in ocean temperature, and further how these impacts might be distributed across the natural range of these organisms that spans the border of the Pacific coast from the U.S. to Mexico. Finally, this project will have an elevated training profile as students and postdocs will play a primary role in conducting and communicating the resulting science. It is hoped that this initial collaboration will become the platform for long-term collaborations, and that the UC-MEXUS funds awarded will serve as "seed" funding to obtain additional external grant support for applied marine ecology between the U.S. and Mexico.

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**Gretchen Hofmann** **12/31/2099-00/00/00** **32,092**
**Paul Matson**
UC Office of the President, 08-T-CEQI-08-0007

**The Importance of Source Populations: Does Maternal Temperature and Nutrition Influence the Larval Stress Response in the Red Sea Urchin?**

This project will examine whether larval stress tolerance is influenced by the maternal environment in the red sea urchin (*Strongylocentrotus franciscanus*) distributed across the Santa Barbara Channel. The graduate student will use genomic tools to study how both habitat temperature and nutritional condition of adult red sea urchins may affect the physiological performance of larvae in response to thermal stress. In addition, he will explore possible effects of climate change by culturing adult urchins from different habitats in the laboratory under increased temperatures. The red sea urchin is an excellent study organism to explore this question because of its large spatial distribution, ease of laboratory culturing, accessibility of genomic information, and ecological and commercial importance.

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**Gretchen Hofmann** **7/1/2007-6/30/2008** **30,000**
**Mackenzie Zippay**
UC Office of the President, SB07129

**Examining the Impacts of Climate Change on Marine Organisms: Effects of Ocean Acidification on Larval Marine Snails of Coastal California**

This project examines the impacts of global climate change on California's coastline with an emphasis on understanding the effects of climate change on populations of marine invertebrates. The graduate student will study embryos and larvae of *Nucella*, an intertidal snail, and will test their tolerance of elevated temperatures and changing CO2 levels (ocean acidification) that might be expected in predicted climate change scenarios. Although this species is not of central economic importance to California, it serves as an excellent study organism; *Nucella* has a biogeographical distribution that covers the entire coast of California, and the embryos are exposed to conditions in nature that would capture changes in climate. The focus of this research addresses the environmental situation of temperature and pH changes that occur simultaneously. A central goal is to determine the calcification response to elevated CO2 in benthic calcifiers, such as snails, since estimates suggest that a drop in pH to 7.9 could decrease calcification rates of many marine organisms up to 60% by the end of the century.

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**Gretchen Hofmann** **3/1/2008-2/28/2009** **29,028**
UC Sea Grant, R/ENV-136PD-F

**How will Calcifying Larval Sea Urchins Respond to Ocean Acidification and Warming in the Future Ocean: Using DNA Microarrays to Screen for Shifts in Expression of Genes Involved in Calcification**

The goal is to determine the impact of ocean acidification and temperature changes on the development and physiology of early life history stages of the red sea urchin, *Strongylocentrotus franciscanus*, using genomics tools. The method is to raise cultures of red urchin at three levels of CO2 and three different temperatures, then to collect larvae to screen for variation in gene expression using an oligonucleotide microarray designed in the PI's lab. This microarray has a perfect match with purple sea urchins, and preliminary screenings demonstrate that the red sea urchin will also hybridize with the microarray. Resulting data will facilitate understanding of the impact of ocean acidification on economically important marine calcifying organisms. A great deal of information from laboratory experiments shows that a more acidic ocean will reduce calcification and growth rates. However, the mechanisms involved in compensation for the lower saturation states in future oceans are unknown. A genomics approach, whereby we can observe gene expression changes in multiple pathways, allows insight into a "physiological fingerprint" of how the larvae respond to these changes in the ecosystem and will show whether they are capable of calcifying in the future high CO2 ocean, which holds many unknowns for marine ecosystems. The experiments will: examine how CO2 impacts calcification and other processes, explore whether there is plasticity/compensation, reveal mechanism, examine and reveal the synergistic actions of ocean acidification and increased temperature.

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**Sally Holbrook** **10/1/2007-9/30/2010** **275,400**
UC San Diego, 54181A

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

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

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**Patricia Holden** **6/15/2004-8/31/2007** **338,938**
City of Santa Barbara, 21429

**DNA-Based Source Tracking of Human Fecal Material: A Proposal to the City of Santa Barbara**

The overarching goal of this research is to determine the presence and potential origins of human waste in creaks, extending into the surf zone at the coastal ocean, in Santa Barbara. The geographical focus of this study will be in three areas: 1) old Mission creak from Bohnett Park into the new Mission Creek concretized channel, 2) mid and lower Mission Creek extending to the ocean and including the lagoon, 3) lower Arroyo Burro Creek with an emphasis on lagoon and beach processes. The work will be conducted in two phases. Phase I will determine the efficacy of two DNA-based tests

for discerning human from animal fecal material in environmental matrices. Phase II will apply the demonstrated assays to understanding the origins and fates of human fecal material in the study areas.

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**Patricia Holden** **11/1/2006-9/30/2008** **45,500**
UC Toxic Substances Research and Teaching Program, SB070091

**Fate and Effects of TiO2 Nanoparticles on Planktonic, Aerosilized, and Biofilm P. putida Bacteria**

Bacteria are the most abundant organisms on earth and are the major catalysts for reactions in nuclear cycling and biodegradation. Most bacteria grow as biofilms which consist of cells and surrounding exopolymeric substance (EPS) made of polysaccharides, DNA, protein, and sorbed exogenous materials including metals. However, bacteria are also free-living in planktonic systems, and they can be aerosolized and transported long distances in the atmosphere. Currently, there is little understanding of the effects of nanoparticulate metals to bacteria. This research is aimed towards gaining new insights into interactions between bacteria and engineered nanoparticles, with an overall goal of providing fundamental insights into this new area of research. The project will involve gathering baseline information concerning the fate and effects of nanoparticles to bacteria. Because it is most relevant to the ecological performance of bacteria in the environment, the research will focus initially on physiological, dose-response assays that, coupled with the knowledge of nanoparticle characteristics, will reveal relationships between toxicity responses and particle type, size and other characteristics such as charge or functionalization. First, physiological responses will be catalogued and measured, and other experiments at the level of protein production and gene transcription will follow.

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**Patricia Holden** **11/15/2004-11/14/2007** **250,648**
US Department of Energy, DE-FG02-05ER63949

**Stabilization of Plutonium in Subsurface Environments via Microbial Reduction and Biofilm Formation**

Actinide contamination of subsurface sediments and groundwaters at DOE sites that have varying geochemistry and hydrology is a long-term problem. The investigator's hypothesis is that plutonium (Pu) solubility, speciation and resultant (im)mobilization are susceptible to both metal reduction and biofilm formation by common, well-studied subsurface bacteria. To prove this hypothesis, the PI will study enzymatic metal reduction, bacterial accumulation, and mineral sorption/desorption processes by examining the Pu-bacteria and Pu-mineral-bacteria interactions. Because Pu has complicated geochemistry and a range of oxidation states that are relevant to subsurface and vadose environments, this research will focus on both anaerobic and aerobic mechanisms. The objective of the project is to understand how biotransformation and biogeochemical processes known to affect the behavior of major redox-active transition metals, Fe and Mn, can affect the mobility of Pu in the environment. Results will fill significant gaps in the scientific basis for monitored natural attenuation and in situ stabilization of widespread and problematic radionuclide contamination.

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**Patricia Holden** **7/1/2004-12/31/2007** **332,099**
US Environmental Protection Agency, RD-83171201

**Transformation of Biologically-Conjugated CdSe Quantum Dots Released into Water and Biofilms**

Semiconductor nanocrystals (quantum dots) differ in important ways from bulk semiconductor materials. Their increased band gap means that they function as strong oxidizing and/or reducing agents, and their small size allows them to pass into living cells. Conjugation of biomolecules to the crystal surface can alter any or all of these properties. In preliminary experiments, the investigators have observed that nucleobase-conjugated CdSe quantum dots were actively taken up by soil and water bacteria (for example, Bacillus subtilis and Escherichia coli). Effects on microbial viability attributed to the presence of the quantum dots included slower doubling times, heavy metal sequestration, and "blebbing" of metals into the environment. The PIs aim to quantify these effects using a variety of biologically-conjugated quantum dots and an assortment of microbial species, monitoring the process of quantum dot uptake and breakdown and characterizing the breakdown products that result from bacterial metabolism of these particles.

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**Robert Jellison** **1/15/1997-6/30/2008** **1,397,427**
**John Melack**
Los Angeles Department of Water and Power, LADWP 8062

**Monitoring of Limnology and Plankton in Mono Lake**

Mono Lake is a large, hypersaline, highly productive alkaline lake lying just east of the Sierra Nevada. In addition to its recreational, scenic, and water resource values, it contains large populations of an endemic brine shrimp and the alkali fly, which are important food sources for migrating birds. Although saline lakes are common throughout the world and provide important ecological resources for many species, they are much less studied than freshwater ecosystems. Limnological monitoring conducted from 1982-1996 represents one of the longest continuous studies of any hypersaline lake. Rapid lake level rise in 1995 resulted in the onset of meromixis (persistent salinity stratification) and disruption of internal nutrient cycles. This monitoring program will assess whether long-term changes are occurring and if the hypothesized benefits of higher lake levels will take place.

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**Robert Jellison** **4/1/2007-3/31/2009** **289,021**
**David Herbst**
US Fish & Wildlife Service, 842407J0007

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

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

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**Matthew B. Jones** **1/1/2007-12/31/2008** **132,651**
**Mark Schildhauer**
Michigan State University, 61-2582CA SB

**Faculty Institutes for Reforming Science Teaching - FIRST III**

The National Center for Ecological Analysis and Synthesis (NCEAS) will participate in this construction of the Faculty Institutes for Reforming Science Teaching (FIRST) database. NCEAS personnel have nearly a decade of experience developing formal metadata standards for ecological data and implementing software applications and database servers for distributed storage and querying of ecological data and metadata. Rather than embark on a completely independent development effort, the FIRST project will adopt existing technological approaches where these are relevant, thereby gaining compatibility with the generic solutions developed within the Knowledge Network for Biocomplexity (KNB) and the emerging approaches from the Science Environment for Ecological Knowledge (SEEK). UCSB's PIs and staff will work with other project scientists with the definition and construction of the appropriate extensions of the Ecological Metadata Language (EML) to create an "Educational Metadata Language" that will powerfully describe a variety of assessment instruments for the sciences.

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**Matthew B. Jones** **10/1/2006-5/31/2009** **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. This four-year project will advance cyberinfrastructure by combining, for the first time, scientific workflow systems with dynamic real-time data grids associated with multiple sensor networks. The project goal is to provide scientists with an analysis and modeling tool that can easily integrate distributed heterogeneous data streams for use in simulation and forecast models. This near real-time environment for analytical processing will provide an open-source, extensible and customizable framework for designing and executing scientific models that consume data streams from sensor networks. Project investigators will combine the real-time data grid being constructed through other projects (ROADNet, CENS ESS, OPeNDAP, EcoGrid) with the scientific workflow system Kepler. These open-source software frameworks represent considerable prior investments. Kepler will be extended to meet the needs of scientists that analyze and model observatory data, systems engineers that create and maintain observatory sensor networks, and the public that accesses data and results from observatories.

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**Matthew B. Jones** **8/28/2006-7/31/2008** **78,900**
South African National Parks, SB070033

**Analysis Tools for Thresholds of Potential Concern**

UCSB will perform software engineering activities to create software products to be used by Kruger National Park for the management of scientific data. One software engineer will be devoted to this project. The engineers at the National Center for Ecological Analysis and Synthesis will elicit software specifications from personnel at Kruger National Par, design and prototype the following software products: 1) creation of R scripts for Threshold of Potential Concern (TPC) Analyses; 2) creation of Scientific workflow for TPC Analyses; and 3) a Web-based interface for executing these TPC analyses.

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**Matthew B. Jones** **9/1/2007-8/31/2008** **180,000**
**Mark Schildhauer**
UC Davis, SUB0700051

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

The UC Santa Barbara work on this project will include participation in project meetings, interaction with the broader scientific community about requirements for Kepler, and contributions to the development of the Kepler Core software. Specifically, Matthew Jones will oversee and manage the UCS project; Mark Schildhauer will engage with domain scientists to elicit project requirements; the software engineer will participate in the design and re-factoring of Kepler core for maintainability, extensibility, and new core features; and the build and support engineer will re-factor the build system to be NMI compliant, build the test system and write tests, as well as solicit test cases from the project developers and the broader community, and will create and maintain the collaboration infrastructure (web site, wiki, CVS, bug tracking, etc.).

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**James Kennett** **3/15/2007-8/31/2008** **53,073**
**Luann Becker**
National Science Foundation, ATM-0713769

**SGER: Investigations of a Likely Extraterrestrial Impact at 12.9 ka: Possible Cause of Younger Dryas Cooling, North American Mammal Mass Extinction and Demise of Clovis People**

This research will investigate the untested and novel hypothesis of a major extraterrestrial impact (comet) over North America at ~12.9 ka near the end of the Pleistocene. The principal investigators are working with several scientists (notably Richard Firestone of Lawrence Berkeley Laboratory and Alan West, consulting earth scientist, Scottsdale, Arizona) on developing and testing a potentially important and far-reaching hypothesis that a major extraterrestrial (ET) impact event over North America triggered the abrupt onset of Younger Dryas cooling, caused the well-known massive extinction of North American mammals (such as mammoths, camels, horses, groundsloths, etc.), and terminated the Paleolithic Clovis culture. The initial evidence suggests that all of these events occurred together abruptly, thus challenging popular existing hypotheses for the Younger Dryas cooling and the massive extinction event by human overkill. Remarkably, this major ET impact event has remained undiscovered until now; yet this singular event may explain several outstanding and unexplained problems: the abrupt triggering of Younger Dryas cooling, the massive megafaunal extinctions and a critical early human cultural change throughout North America. The new hypothesis for testing posits that Younger Dryas cooling was triggered by an impact on or near the Laurentide Ice Sheet causing destabilization, melting and resulting massive flooding to the northern Atlantic and Arctic that in turn affected ocean circulation and climate change.

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**James Kennett** **2/15/2003-12/31/2007** **330,000**
National Science Foundation, NSF OCE-0242041

**Abrupt Climatic Transitions: Surface to Deep-water Response from High-resolution Sediment Records, Santa Barbara, California**

Understanding mechanisms behind abrupt climate change during the late Quaternary remains a major challenge in Earth Sciences. The oceans clearly have played a major role in such change, although specific components of the ocean system have responded and contributed differently. While differences in timing between these responses appear to be small (as brief as decades), the sequencing of change is key in understanding processes and forcing mechanisms of climate change. Unfortunately, few areas in the world contain records of sufficient temporal resolution to resolve such change on the short time scales at which these remarkable climatic shifts occurred. One such area is Santa Barbara Basin, providing one of the highest resolution marine records of late Quaternary climate change at the required decadal resolution.

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**James Kennett** **7/1/2006-6/30/2008** **132,326**
**Dorothy Pak**
**Craig Nicholson**
**Christopher Sorlien**
National Science Foundation, OCE-0623148

**Extending the High-Resolution Global Climate Record in Santa Barbara Basin: Evaluating Climate Change Potential**

The investigators will conduct a series of pilot investigations to determine the effective potential of recovered piston cores for ultra high-resolution paleoceanographic and paleoclimatic investigations of the late Quaternary. They will refine the integrative stratigraphy and conduct orbital and millennial-scale stable isotopic and Mg/Ca investigations of selected intervals (windows) to establish the utility of these proxies in the sequence. This work will further the understanding of abrupt climate change and millennial-scale late Quaternary climate behavior prior to 160 ka, and of factors that can destabilize climate and potentially cause abrupt climate change, a current societal concern given global warming and possible future climatic instability. Ongoing development of the integrative stratigraphy will provide a quantitative basis for modeling the basin-wide response to climate change, and the interaction between climate, tectonics and sea-level fluctuations. The dated high-resolution seismic stratigraphy and development of 3D structure models will also provide input into the history of crustal deformation, structural models for oblique faulting and folding, and earthquake, submarine slope-stability and tsunami hazards along coastal California.

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**James Kennett** **10/1/2003-9/14/2007** **450,826**
US Department of Energy, DE-FG02-03ER63696

**Effects of Oceanic Disposal of Carbon Dioxide on Benthic Microfauna: Foraminfera as Indicators of Dissolution and Ecosystem Health**

Carbon dioxide (CO2) sequestration is currently being considered as a mechanism for reducing the release of carbon dioxide to the atmosphere. Because direct infection of CO2 at the seafloor provides certain advantages to other disposal venues, a crucial part of investigating oceanic CO2 sequestration is to determine the biological and geochemical effects on the benthic realm. Work is ongoing to determine the effects of dissolving carbon dioxide hydrate on benthic megafauna. However, little work has been conducted to quantify the effects of CO2 sequestration on microorganisms in surface sediments. The investigator will conduct a number of studies on foraminifera, a well-known group of diverse protists that are typically abundant, and sometimes dominant, in marine sediments. Many foraminifera precipitate shells composed of calcium carbonate, making them an ideal indicator to assess the effects of dissolving CO2 hydrate, which increases pCO2 levels and also decreases pH in the surrounding waters. Because of their shell composition, significant proportions of foraminifera are dependent on a stable, relatively high pH. Foraminifera live both epifaunally at the sediment/water interface as well as burrowing infaunally, and thus can be used to determine the extent of environmental change both on and within the sediments.

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**Kristie Klose** **4/1/2008-6/30/2008** **8,423**
**Scott Cooper**
Larry Walker Associates, Inc, SB080124

**Chlorphyll a Analysis of Stream and Lagoon Algae Samples**

UCSB PI Kristie Klose will perform analyses for chlorophyll a on samples of stream and lagoon algae collected by Larry Walker Associates (LWA) staff. Dr. Klose will process samples, extract pigments in acetone, conduct fluorometric analysis of extracts, calculate chlorophyll a, and report results to LWA.

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**Roland Knapp** **7/1/2005-6/30/2008** **102,551**
USDI - National Park Service, J8C07050005

**Reintroduce Yellow-legged Frogs to Fishless Lakes in Yosemite National Park**

Yosemite National Park recently proposed reintroductions of the declining mountain yellow-legged frog (Rana muscosa) into lakes in six basins. Eight lakes were chosen for reintroduction based on the results of a recent survey of amphibian populations in all lentic water bodies in the park. These lakes currently lack R. muscosa and nonnative trout populations, contain suitable habitat for R. muscosa, and have remnant R. muscosa populations within 5 km that are large enough to serve as source populations for the reintroductions. The lack of R. muscosa at the reintroduction sites is likely a consequence of historic populations going extinct, perhaps because of trout introductions or disease outbreaks. The effect of predation by introduced trout in causing the extinction of R. muscosa populations in the Sierra Nevada is well-documented. The amphibian disease, chytridiomycosis, is caused by the fungal pathogen, Batrachochytrium dendrobatidis, and was recently implicated as a major cause of R. muscosa population extinctions in the southern Sierra Nevada. Recent evidence indicates that B. dendrobatidis is widespread in R. muscosa populations in Yosemite National Park. The objective of this research is to: 1) determine the presence/absence of B. dendrobatidis in all proposed R. muscosa source populations and in alternative source populations located nearby, 2) use source populations free of B. dendrobatidis to conduct as many of the eight originally-proposed reintroductions as possible, and 3) monitor population sizes and disease status of the R. muscosa populations for at least two years following reintroduction.

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**Armand Kuris** **6/1/2002-5/31/2009** **2,238,400**
**Kevin Lafferty**
National Science Foundation, NSF EF-0224565

**Anthropogenic Effects on Host-Trematode Dynamics**

Disease interacts with the environment in a variety of ways. This is particularly true for diseases with complex life cycles. A basic understanding of the way that parasites with complex life cycles interact with man-made changes to the environment will help to anticipate future changes in such diseases. This project will use a variety of experimental, observational and theoretical approaches to develop a comprehensive and synthetic understanding of the interactions between man-made environmental change, parasite communities, and the extent to which these changes affect host communities. Salt marshes are a useful model ecosystem to address the role of diseases, since these wetlands are subject to a wide range of man-made impacts and support a diverse community of trematode worm parasites. Examples of changes that can affect parasite communities include losses to biodiversity, pollution, introduced species and climate change. The effects of these impacts are not likely to be the same for all diseases. Because some parasitic diseases can alter the community of hosts that they infect (such as by altering the flow of energy through an ecosystem or by changing predator-prey relationships) there may be complex feedback between changes in the environment, diseases and ecosystems.

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**Armand Kuris** **7/1/2006-6/30/2008** **82,751**
UC Office of the President, 06-000531-01

**Establishing Connectivity of Invasive Populations: A Precursor to Prioritization and Implementation of Eradication Efforts**

The UCSB PI will direct the parasitological component of this collaborative project and play a major role in the coordination of the policies deriving from the synthesis of this research. He will also supervise the UCSB graduate student and the parasitological components of the workshops and tutorials.

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**Armand Kuris** **2/1/2007-1/31/2009** **132,432**
**Kevin Lafferty**
**Ryan Hechinger**
UC Sea Grant, R/OPCENV-01-S-1/3

**Parasites as Indicators of Coastal Wetland Health**

The overall objective of this project is to complete the development and assessment of the use of larval trematode parasites in snails as a cost-effective and integrative tool for characterizing wetland biodiversity and ecosystem function. To finish the development of these parasites as a tool for managers to assess wetlands, it is necessary to take several more steps to validate the basic science of the approach and transfer the technique to end-users. The specific objectives are: 1) To determine how well trematodes indicate assemblages of fishes and benthic invertebrates (at the scale of entire habitats and wetlands); 2) To confirm which animals are indicated by trematodes (i.e., which hosts are used by the trematodes) throughout their geographic range; 3) To examine the extent the trematode tool integrates time to provide information on longer-term trends in wetland condition (compared to the information provided by standard surveys); 4) To establish the most efficient sampling strategy to calibrate the tool and combine it with standard assessment techniques to characterize a wetland; 5) To communicate to and instruct managers and stake-holders in the use of the trematode bioindicator tool; 6) To work with established wetland educational programs to incorporate the knowledge and study of the ecologically important trematode parasites into their educational endeavors.

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**David Lea** **6/15/2005-5/31/2008** **304,003**
National Science Foundation, OCE-0502609

**Testing the Tropical Greenhouse Forcing Hypothesis Using a Halmahera Proxy SST Record**

This project will test a new hypothesis: tropical ocean temperature variability over the last several hundred thousand years is dominantly driven by changes in greenhouse forcing (the tropical greenhouse forcing hypothesis). This hypothesis will be tested by developing a new proxy sea surface temperature (SST) record from a site in the western equatorial Pacific warm pool lying just east of Halmahera, Indonesia. A high sedimentation rate core (~15 cm/ky) from this site taken by collaborators from Tongji University in Shanghai, China will be targeted for development of a ~30-140 y resolution proxy SST record. SSTs will be reconstructed using the Mg content of the surface-

dwelling planktonic foraminifera Globigerinoides ruber, a methodology that has been validated in many different settings and timescales throughout the tropics. Results from this study will advance independent determinations of climate sensitivity from paleoclimatic data. Climate sensitivity is considered the most significant uncertainty in global climate change predictions.

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**David Lea** **9/1/2006-8/31/2008** **211,666**
National Science Foundation, OCE-0602362

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

Scientists' understanding of the nature of late Pleistocene climate variability has changed dramatically during the last decade. It is now known that the climate system can undergo large amplitude fluctuations on much shorter timescales than previously thought, an observation that has important implications for future climate change. The systematic and methodic examination of polar ice cores serves as a model for interdisciplinary studies of past climate change. The investigators for this project seek to emulate the strategies used by their ice core colleagues, although there are few marine sediment sections that can be sampled at a comparable resolution. The high deposition rate, frequently varved sediments accumulating in Cariaco Basin, a deep depression along the northern margin of Venezuela, represent a climate archive that can be sampled at a resolution similar to that employed in ice core studies. This project is a multidiciplinary study involving individuals from the University of Miami (L. Peterson), the University of Akron (D. Black), the University of South Carolina (R. Thunell) and the UC Santa Barbara PI, David Lea. The PIs will make paired planktonic foraminiferal Mg/Ca and d16O measurements in order to reconstruct climate variability on multiple time scales. The climate records produced from this study will serve as a template for late Pleistocene tropical climate variability, and thus provide a low latitude counterpart for the ice core climate records.

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**Ira Leifer** **4/1/2004-8/31/2008** **80,000**
American Chemical Society, PRF 40726-AC8

**A Turbine Seep-Tent Network to Study Hydrocarbon Migration**

Hydrocarbon migration in a fracture network presents an extremely challenging problem with significant implications to issues such as reservoir recharge and seep contribution to global climate. Since non-destructive, in-situ studies are difficult, great uncertainties remain. Marine seeps provide a unique opportunity to study this migration process as the seabed is a transecting surface through the network, and measuring gas flux is simpler as bubbles locate seepage. Close to UCSB lies one of the most active seep fields in the world. Thanks to numerous current and past research projects, a historical picture of seepage has been built up over the last decade. Deployment of a 40-unit turbine-seep tent network will measure spatio-temporal variations in seep flux in two disparate active seepage areas. Turbines are spun by rising bubbles; measuring flux and calibration showed insensitivity to bubble size and a fast (0.25s) response. Data analysis will discriminate between factors controlling hydrocarbon flux, including temperature, hydrostatic (tides, swell, barometric), and tar in the fractures. Deployment at two separate seeps will test the hypothesis that seeps respond to small earthquakes. Also tested is whether larger seeps are less oily, a conclusion based on a limited data set from the Gulf of Mexico. This research will also allow discrimination between the mechanisms behind ejections and blowouts.

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**Ira Leifer** **7/1/2007-12/31/2008** **21,116**
Cal RA Department of Fish and Game, P0775012

**Seeps in Santa Paula Creek**

This project tests the hypothesis that hydrological factors and topography strongly affect the emission and transport of riverine seep oil to coastal waters. The PI will investigate several of the largest seeps in Santa Paula Creek near its confluence with Sisar Creek and identify hydrological factors that could allow oil transport to coastal waters. He will develop methods to quantify oil emissions from these seeps and quantify emissions with respect to rainy season and aquifer pressure. Results will be compiled of oil sampling investigations in coastal and inland areas, which led to the implication of

natural seeps in Santa Paula Creek Watershed as the source(s) of oil that affected coastal and inland resources and their habitats. Finally, the PI will document the locations of capture and species of oiled birds affected by the 2005 VBOI and summarize the outcome of rehabilitation efforts.

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**Ira Leifer** **4/1/2006-9/30/2007** **200,000**
**Bruce Luyendyk**
Cal State Lands Commission, C2005-041

**UCSB Coal Oil Point Seep Studies**

This 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. Results of this study are key towards the larger goal of developing appropriate and cost-effective mitigation strategies. A multi-pronged approach includes seasonal and inter-annual sonar seepage mapping studies; turbine tent deployment and flux monitoring; sea-surface oil slick capture study, seabed oil-tent deployment and flux monitoring; and oil slick trajectory study.

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**Ira Leifer** **7/10/2006-9/30/2007** **10,000**
Cal State Lands Commission, C2006-050

**Goleta Slough Seep Study**

The project goal is to determine the source of the gas emissions from the Goleta slough (gas reservoir, biological, natural seepage, air) in order to ensure that mitigation efforts will not lead to increased gas emissions and/or present a hazard. Gas samples will be collected from other seeps in the vicinity of the slough for comparison. Samples will be analyzed for relevant gases including CO and CO2, He, H2, Ar, O2, N2, and the n-alkanes methane through pentane. Del C13 will also be measured for CH4 and ethane. Other analysis may be requested depending upon a review of the storage field gas and well-head gas compositions.

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**Ira Leifer** **12/1/2006-11/30/2008** **361,606**
**Dar Roberts**
**Bruce Luyendyk**
National Aeronautics and Space Administration, 0-NACP05-0030

**Remote-Sensing Methane Emissions: Field-Validation with Seepage from Marine, urban, and Submerged City Sources**

Although CH4 is at least 20 times more potent to greenhouse warming than CO2, its sources are poorly constrained. Remote sensing can improve atmospheric CH4 budgets by allowing measurements at multiple scales with standardized measures and repeat sampling. However, improvements in spatial resolution are necessary to validate satellite-derived CH4 measurements of sources with sub-regional scale variability. Equally important, is the lack of ground-referenced data. The PIs propose that marine hydrocarbon seeps can ground reference remote sensing CH4 data determining limitations and abilities of current and next generation remote sensing platforms. Marine hydrocarbon seeps provide an ideal natural laboratory for this validation, due to the sea surface's relative spectral uniformity, the locality of the seeps, their clear identification (visual and sonar), the wide diversity of source strengths and intensity, and the freedom of movement (no obstacles) on the sea surface. The goal of this project is to identify the feasibility and limitations of current (AVIRIS) and next generation, remote-sensing technology for detection and quantification of CH4 fluxes. This study uses the wide range of seep strengths and intensities in the Coal Oil Point (COP) seep field as ground-reference data. The technique will be ground-referenced in an urban aqueous seep, the La Brea Tar Pits, and then applied to AVIRIS images acquired during the flooding of New Orleans.

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**Ira Leifer** **11/1/2007-10/31/2008** **1,500**
UC MEXUS, SB080052

**Developing a UC-Mexico Collaboration on Passive Acoustic Observations of Seabed Bubbles**

Measurement of the bubble size distribution is of widespread importance and has long challenged researchers. Although optical approaches are most common, passive acoustics is highly promising with several advantages over optics. Specifically, passive acoustics could allow long-term monitoring of seabed and wetland bubble emissions, which present enormous challenges for optical approaches and remain poorly quantified. Concern for greenhouse gas emissions and the need for data for model initialization provides the impetus to develop new approaches to measure these fluxes. This project supports the PI to travel to Mexico to discuss preliminary data and develop a collaborative research program with Mexican scientists at UNAM-Iztapalapa. Dr. Leifer has extensive experience in field and laboratory optical bubble measurements, including a first effort to passively observe seep bubbles. The Mexican collaborators have extensive experience in bubble hydrodynamics, both experimental and theoretical.

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**Ira Leifer** **2/5/2007-9/30/2009** **72,157**
**Bruce Luyendyk**
USDI - Minerals Management Service, M07AC13149

**Volume and Chemistry of Natural Petroleum Seeps in the Santa Barbara Channel and Southern Santa Maria Basin**

Understanding the impact of oil slicks on coastal communities requires quantitative evaluation of tar on the beaches, the most visible impact of oil from the Coal Oil Point seeps on human activities, as well as protected environmental areas. The PIs will conduct a series of slick tracking studies, spanning a range of seasons, weather and oceanographic conditions, and water temperatures. Studies will be in conjunction with beach tar surveys, and oil samples will be collected from the tracked slicks and the beach for analysis by USGS. Surveys will also focus on slicks from a range of seeps in the seep field, and any spill of opportunity. For each daylong slick study, data analysis will include numerical GNOME modeling to improve modeling of slick advection and chemical evolution. Beach tar surveys will be conducted weekly throughout the study, with additional studies before and after rain events, and with several periods of daily surveys spanning one week at several times during the year. These surveys will have as their core, the existing detailed survey grid centered at Coal Oil Point, but will also survey a larger length of beach (~ 2 km) through a coarse grid focused on the swash zone. For these studies, image-processing techniques to evaluate beach tar will be developed.

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**Hunter Lenihan** **6/4/2007-5/31/2008** **11,384**
Channel Islands Marine Resource Institute, SB080003

**The effect of environmental conditions on the early life stages of the white abalone *(Haliotis sorenseni)* and experimental outplanting of larvae at coastal study sites**

The white abalone is an endangered species throughout its range, from Point Conception, California, USA to Punta Abreojos, Baja California, Mexico, based on a comprehensive status review of the species. Its decline has been attributed to over-exploitation by commercial and recreational fisheries in the absence of adequate regulatory mechanisms. There is an urgent need for human intervention in the recovery of the species, in large part because sub-threshold abalone densities in nature, resulting in repeated recruitment failure, make it unlikely that the species will recover on its own. In 2001, a spawn of captive white abalone resulted in the first large-scale cultivation of this species. Most of the animals were cultivated at the Channel Islands Marine Resource Institute (CIMRI) in Oxnard, but some were retained at UC Santa Barbara (UCSB). At this time, about 75 animals remain at UCSB. Recently, these animals spawned spontaneously, creating at least three million larvae. Since this event was unanticipated, very few of the larvae reached settlement stage. The PI will utilize the pool of apparently healthy hatchery-raised adult white abalone at UCSB to produce additional larvae and possibly juveniles for research and experimental out-planting. UCSB will house larvae in a sabellid free environment safe for future out-planting scenarios. The primary goals are: 1) To equip and set up a hatchery at UCSB; 2) To determine the effect of environmental conditions on larval settlement and

the susceptibility of early juveniles to predation; 3) To conduct experimental out-planting of larvae and possibly juvenile abalone; 4) To conduct developmental, ws-RLP, OTC baths, and shell disease studies.

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**Hunter Lenihan** **3/1/2006-3/31/2008** **82,685**
**Kevin Lafferty**
UC Sea Grant, R/F-200A

**Assessing Withering Syndrome Resistance in California Black Abalone: Implications for Conservation and Restoration**

Black abalones were once abundant in California (CA) where they played important ecological, social and economic roles. Withering Syndrome (WS) and overfishing have caused catastrophic declines in black abalone populations, especially in southern California. Some (~1%) of black abalones survive WS infections. It is crucial for restoration and management efforts in CA to determine whether remaining subpopulations are WS resistant and if resistance is heritable. In addition, black abalone spawning methods have not been well developed. Poor spawning success to date impedes research and conservation because populations are so depressed in the wild that only very few individuals can be collected from the field so as to avoid species extinction. To advance restoration and enhancement programs for this species, the PIs will assess the role of WS in the survival of wild populations and advance spawning techniques. They will address the following research questions: 1) What are the best methods to spawn WS-resistant black abalone? 2) Is it possible to quantify more effectively bacterial loads in infected individuals using real-time PCR (Q-PCR; relative to traditional histology)? 3) Are abalones that survive in the wild resistant to WS? Resistance may be conferred by a reduced prevalence or intensity of bacterial infection and or reduced disease in infected individuals, questions that will be addressed by a Q-PCR test.

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**Jonathan Levine** **10/21/2004-10/20/2009** **625,000**
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 project will undertake a research program applying principles of population, community, and ecosystem ecology to understand the factors controlling the success and impacts of biological invasions. The research couples mathematical models with field experiments to understand such fundamental questions as how many new invaders can be expected 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, this research aggressively pursues a rigorous understanding of the entire invasion process.

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**Jonathan Levine** **7/1/2007-12/31/2008** **48,655**
National Science Foundation, DEB-035608

**Environmental Variation, Dormancy, and Rare Plant Persistence in Invaded Habitats**

The goal of this project is to examine how rare annual plants persist in the highly variable, exotic grass dominated habitats of the California Channel Islands. With tenfold annual variation in rainfall, and over fifteen rare and endangered annual plants, the island system provides a unique opportunity to examine how germination biology, environmental variation, and surrounding community dynamics influence persistence. To accomplish this, a powerful combination of single and multispecies models, experimental manipulations of environmental variation, and analysis of natural population dynamics will be undertaken. Stochastic single species population models and their multispecies counterparts will be developed for seven rare island annual plants and their exotic grass competitors. Models will be parameterized with demographic rates of plants sown into experimentally imposed rainfall environments in the presence and absence of exotic grass competitors. Sensitivity and elasticity analyses will quantify the importance of dormancy for the ability of populations to increase when rare. Whether environmental variation favors or inhibits

persistence will be tested by examining model systems varying in the probability of different patterns of annual rainfall. Single and multispecies models parameterized in the presence and absence of exotic grasses will quantify invader influences on persistence and the predicted effects of environmental variation. These predictions will be tested by experimentally manipulating the sequence of high and low rainfall years through the three years of the project. Lastly, the natural population dynamics of the focal island annuals will be used to test whether multispecies models better predict temporal patterns of abundance than their single species counterparts.

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**Jonathan Levine** **3/15/2008-2/28/2009** **106,262**
National Science Foundation, DEB-0743365

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

One of the most enduring mysteries in ecology is how multiple plant species coexist. For almost a century, efforts to answer this question almost invariably invoked niche differences between species. This changed, however, with the recent rise of neutral models suggesting that species similarities, rather than differences, drive their coexistence. Apparent conflict between the role of species differences in neutral and niche theories has spurred interest in a new framework for coexistence. In this framework, species coexist when niche differences, called stabilizing processes, overcome fitness differences between species. This theoretical insight, however, has identified new gaps in the understanding of coexistence. Most importantly, ecologists have little understanding of overcoming large fitness differences among species versus weak stabilization combined with small fitness differences. Where real communities fall along this continuum reveals the importance of niche differences for coexistence, and goes to the heart of debate between niche and neutral theory. This research combines field experiments with population dynamic and statistical models to ask how niche differences and fitness inequality shape the coexistence of California serpentine annual plants.

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**Jonathan Levine** **8/1/2005-7/31/2008** **214,734**
US Department of Agriculture, 2005-35320-16273

**Plant-soil feedbacks and the regulations of native shrub recolonization of exotic grasslands**

The goal of this project is to understand how plant-soil feedbacks regulate plant invasion dynamics in natural ecosystems. Research will be conducted on Santa Cruz Island, California, where livestock grazing coupled with the introduction of European annual grasses in the early part of the last century converted habitats from native coastal sage scrub to non-native grasslands. Although grazing has been removed, native coastal sage scrub species such as Eriogonum arborescens and Artemisia californica have not recolonized into areas dominated by exotic annual grasses, such as Avena fatua. The PI will investigate how native shrub effects on a) nutrient cycling and b) how soil biota differ from the dominant exotic grass. He will assess how these differences affect native shrub and exotic grass performance. Finally, he will address how plant-soil feedbacks combine with competitive interactions to influence shrub reinvasion of exotic annual grasslands on the islands.

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**Milton Love** **6/1/2001-12/31/2008** **1,333,269**
California Artificial Reef Enhancement, SB020084

**The Ecological Role of Natural Reefs and Oil and Gas Production Platforms on Rocky Reef Fishes in Southern California**

In response to a recognized need for the development of scientific understanding of the biology and ecology of fish assemblages living around offshore oil/gas platforms, the PI is involved in a regional approach to research addressing questions about how fishery productivity at the platforms and natural reefs has contributed to key reef fish populations in southern California. A major focus is on determining the relative habitat values of oil/gas platforms and reefs and how ocean influences affect survival and recruitment in the study area. MMS is using the results for environmental assessments associated with oil/gas exploration on existing offshore leases and platform decommissioning in the Santa Barbara Channel and Santa Maria Basin (e.g., oil spill risk assessments and effects of habitat modifications). Other federal, state and private agencies are using the data to assist in decision-

making on issues pertaining to fishery management, conservation biology, marine refuges, and artificial reefs. The study addresses the relative contribution of Platforms in supplying hard substrate to reef fish populations, length of time fishes reside at offshore platforms, comparison of daily growth rates of rockfishes from platforms and natural reefs, habitat value of offshore platforms, description of associated biological communities, and role of oil/gas pipelines as fish habitat.

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**Milton Love** **2/1/2007-1/31/2009** **62,853**
UC Sea Grant, R/FISH-203-TR-22

**Two Decades of Fishing the Santa Barbara Channel: An Examination of Effort and Catch with Regard to Serial and Localized Depletions of Reef Fishes**

Historically, rockfishes (genus Sebastes) and lingcod (Ophiodon elongatus) have been of great recreational and commercial importance on the Pacific Coast. A number of these species have been listed as overfished by NOAA Fisheries. Stock assessments have not been conducted on most species, and arguably some of these species have also been overharvested. Despite evidence that many reef fishes are relatively sedentary, management has traditionally focused on large geographic scales. Because this process has not proven effective, there is now some support for regional or even port-by-port fisheries management (often called local-area management). One of the issues inherent in this management debate is the extent to which localized depletion of stocks takes place. Indeed, some elements in the fishing community have claimed that no such depletion exists. Thus, what is needed is a study that examines evidence of whether or not localized and relatively long-standing depletion of reef fishes has occurred. The Graduate Student Trainee will extract and examine the data contained within his vessel daily logs and associated Fish and Game log book entries covering more than twenty years of CPFV activity. He will apply a standardized system for classifying fishing site locations with respect to distance from port, exposure to weather and other values inherent to a site. He will then construct a computer database set of these values and others contained within the log form or deduced from text entries (mined from log notes). This database will be manipulated, summarized and tested with respect to two hypotheses. The hypotheses are: 1) Serial depletions of rockfish (genus Sebastes) availability that followed an initially expanding return/opportunity cost maxima have occurred within the study area; and 2) There exist sustained depletions of rockfish availability and therefore populations on relatively fine-grained spatial scales (varying sharply over a few miles or less). These are correlated with a site's accessibility to fishers. (This accessibility is equivalent to what is termed "opportunity-cost" within environmental economics literature.)

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**Milton Love** **6/1/2007-9/30/2008** **22,443**
US Department of Commerce, AB133F07SE2838

**An Assessment of Derelict Fishing Gear and Other Marine Debris in Deepwater Benthic Habitats off California**

Dr. Love will provide data and video archives from southern California underwater surveys. He will then be involved in the production of a report and a website detailing marine debris pollution in southern California water.

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**Milton Love** **8/5/2005-8/4/2009** **426,278**
USDI - Minerals Management Service, 1435-01-05-CA-39315

**Reproductive Ecology and Body Burden of Resident Fish Prior to Decommissioning**

The primary goal of this study is to fill gaps in information about the reproductive ecology and body burden of resident fish prior to decommissioning. This goal will be met through three separate work tasks or phases. The first phase will determine whether otolith or "ear bone" microchemistry can identify intrinsic markers associated with juvenile rockfish and adult flatfish residing at platforms. Unique signatures of elements (including heavy metals) incorporated in otoliths potentially can be used to measure the extent to which platforms function as nurseries, particularly for rockfishes, and contribute to the replenishment of regional populations in natural areas. If once a platform "fingerprint" is identified, otolith microchemistry can also be useful for identifying adult fish that have moved between platforms and natural areas. The second phase is a survey of levels of heavy

metal contaminants present in fishes from platforms and natural areas. The results will begin to establish the relative importance of such contaminants at platforms given the background load in the regional populations.

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**Milton Love** **8/3/2005-8/31/2008** **670,000**
USDI - Minerals Management Service, 1435-01-05-CA-39322

**Fish Assemblages Associated with Platforms and Natural Reefs in Areas Where Data Are Non-Existent or Limited**

The MMS defines decommissioning as the process of ending oil, gas, or sulfur operations and returning the lease or pipeline right-of-way to a condition that meets regulation requirements. The MMS works to ensure that wells are plugged to prevent pollution; that pipelines are decommissioned and sometimes removed to prevent seepage of hydrocarbons and to resolve conflicts with other uses of the OCS; and that all sites are cleared of obstructions to minimize use conflicts. The MMS will conduct detailed environmental reviews of any proposed decommissioning projects to evaluate the impacts from platform removal on regional fish populations. When a platform is disassembled, habitat is removed, and numerous fishes and invertebrates are killed. However, the impacts of platform removal on regional populations of coastal organisms are not yet known, particularly on the economically important rockfish species, on the Pacific OCS. Assessment of the effects of platform activities and of the habitat created by the structure of platforms on marine populations greatly bears upon decommissioning issues, as questions about Essential Fish Habitat and the ecological role of Pacific OCS platforms are still unresolved. In order to understand the environmental consequences of decommissioning platforms on local and regional fish populations, there is a need to know the importance of platforms as fish habitat when compared to adjacent natural reefs. The UCSB PI will conduct research aimed at collecting data necessary for making the comparisons, including: 1) density and size structure of the fishes inhabiting both platforms and natural reefs, and 2) location, area and number of natural reefs.

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**Milton Love** **8/22/2007-8/31/2010** **670,000**
USDI - Minerals Management Service, M07AC13380

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

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

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**Milton Love** **5/15/2008-5/14/2011** **460,000**
USDI - Minerals Management Service, M08AX12732

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

Although hundreds of thousands of juvenile rockfishes sometimes inhabit POCS platform midwaters, the role that platforms play as nursery grounds for these badly depleted fishes is not well understood and will be of critical importance to the MMS in assessing the ramifications of different platform decommissioning options. It will also be of great interest to Federal and State agencies concerned with rebuilding overfished stocks and to nongovernmental organizations involved in the decommissioning process. Because fish populations are usually limited by available habitat, energy, or recruitment, it is essential to know the role of each platform as habitat for early life stages, particularly as compared to the natural reefs in the vicinity of platforms. In this study, SCUBA

surveys at platforms and natural reefs that are at depths of at least 25 m will provide comparative data on which species settle (i.e., recruit), their densities, size distributions at platforms and natural reefs, as well as the depth at which they recruit at platforms throughout the Santa Barbara Channel region and off central California. Further, a novel experiment employing fish attraction devices (FADs), is designed to evaluate the importance of the shallow portion of platforms (<25 m) for recruitment. The SCUBA survey and FAD experiment build upon previous research to assess the importance of depth for fish recruitment at the platforms. This is particularly crucial in order to analyze the environmental consequences of decommissioning alternatives on local and regional fish populations.

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**Sally MacIntyre** **3/1/2007-3/31/2009** **478,623**
National Science Foundation, DEB-0640953

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

The long term goal of this research is to develop a predictive understanding of how physical forcings in lakes effect and control ecosystem function. The PI is using insights gained in the last decade into hydrodynamic processes in lakes along with state-of-the-art instrumentation to identify key physical processes and their links to ecosystem function. During storm events, the investigator is able to envision hot spots where solute fluxes and metabolic activity are intensified and cold spots where change is only possible if currents transport water from hot spots. This phase of the study involves the design of experiments to locate hot and cold spots and quantify the bacterial and primary productivity. Via time series arrays, collaborative modeling efforts, and adaptive sampling based on real time data on the physical state of the lakes, researchers will be positioned to more accurately quantify lacustrine bacterial and primary productivity than ever before.

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**Sally MacIntyre** **8/1/2001-7/31/2007** **439,956**
National Science Foundation, NSF DEB 0108572

**Turbulent Mixing: Effects on Resource Supply and Primary Production in Lakes**

The long term goal is to develop a predictive understanding of how physical forcings in lakes affect and control ecosystem function. Knowledge of hydrodynamic processes in lakes has increased dramatically in the last decade, and linking these processes to biological ones on the same temporal and spatial scales is essential for fully understanding controls of ecosystem function. Previous studies have correlated turbulence production with the destabilization of basin scale internal waves due to wind forcing and have linked turbulence production to lake size and bathymetry. This knowledge will be used in the current work to design experiments on spatial/temporal variation of turbulent mixing and its consequences for nutrient fluxes, primary productivity, and spatial heterogeneity of community structure in lakes ranging from 0.1 to 100 km2. The PI will conduct experiments on time scales relevant to changes in bacterial and phytoplankton physiology and growth over several seasons to determine the effect of natural variability on responses. New insights at the process level will allow scientists to make better predictions of changes in lacustrine ecosystems due to physical forcing. Extrapolation based on the new understandings of the relation of turbulent mixing to the internal wave field will allow predictions to longer time scales and to other lakes.

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**Susan Mau** **5/1/2006-6/5/2009** **33,900**
**David Valentine**
University of Kiel, MOIF-CT-2006-02164

**The Role of Water Column Methane Oxidation in the Global Carbon Budget - Marine CH4 Oxidation**

The release of large amounts of the greenhouse gas methane from shallow marine gas reservoirs and dissociating gas hydrates at continental margins is said to have advanced warming episodes in Earth's history. However, methane emitted at the seafloor is consumed partly in the ocean by microbial oxidation reducing the portion reaching the atmosphere. It is the main purpose of this project to quantify the fraction of CH4 oxidized in the water column in relation to the amount discharging, dispersed in the water column and escaping into the atmosphere at different seep

settings. In the outgoing phase, Dr. Susan Mau will learn the 14C/3H-tracer technique including the synthesis of the tracers at the University of California, Santa Barbara, to measure oxidation rates of CH4 in the water column. This will allow integrated investigation of several vent sites situated in 10-100 m water depth in the Santa Barbara Basin. The area is ideally suited as it is one of the most active areas of natural marine hydrocarbon seepage in the world. The comparison of the results from distinct settings will provide new insight to the buffer system of the ocean with regard to hydrocarbon seepage. This is of great value for the assessment of the climatological response of a sudden release of CH4 from shallow marine gas resources and gas hydrates.

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**Deborah McArdle** **9/1/2007-8/31/2008** **10,000**
**Steven Gaines**
Marine Conservation Biology Institute, 3675

**A life-history based approach to interpreting and predicting resilience: historical responses of an exploited marine species to fluctuations in fishing an climate.**

This project will analyze an extended fishery time series using historical and biological data spanning over a century to determine: 1) the California spiny lobster's historical baseline population, 2) how that population has changed over time, 3) the long-term natural and human causes for those fluctuations, and 4) whether the historical baseline is an appropriate conservation target. It will employ both classical fisheries models and heirarchichal Bayesian methods, and capitalize on the length of the time series, to disentangle signatures of fishing, environmental variation, and population dynamics. Synthesizing historical data and population models, the PIs will seek to identify whether and the extent to which specific life history traits underlie California spiny lobster's historical responses to fluctuations in fishing intensity and climate. The focus on life history traits will contribute to an improved framework for setting robust, long-term sustainable conservation targets for lobster fisheries and other exploited marine populations with similar relevant traits.

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**William McClintock** **7/1/2005-9/30/2007** **83,664**
**Steven Gaines**
Resources Legacy Fund Foundation, 2005-0072M

**Hardware and Support Enhancements to the Marine Life Protection Act Initiative Geographic Information System**

According to the separate memorandum of understanding between the Resources Agency, the Department of Fish and Game and Resources Legacy Fund Foundation (RLFF), RLFF has agreed to fund GIS hardware and support enhancements for the Marine Life Protection Act (MLPA) Initiative, a public-private partnership.

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**William McClintock** **7/1/2007-6/30/2008** **203,196**
**Steven Gaines**
Resources Legacy Fund Foundation, 2007-0056M

**The California Marine Life Protection Act Decision Support System: Recommendations for Development and Maintenance for the North Central Coast Study Region**

This award funds GIS hardware and support enhancements for the Marine Life Protection Act (MLPA) initiative, a public-private partnership between the agency, the department, and RLFF.

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**William McClintock** **4/15/2008-3/31/2009** **225,000**
**Steven Gaines**
Resources Legacy Fund Foundation, 2008-0019M

**MarineMap Decision Support System**

The Marine Life Protection Act Initiative (MLPAI) is in dire need of an updated, web-based decision support system (DSS) for designing marine protected areas (MPAs) and communicating proposed designs to stakeholders, the Science Advisory Team (SAT), and Blue Ribbon Task Force (BRTF). Previously, the MarineMap consortium based at UCSB outlined specifications for a proper DSS for the

upcoming, South Coast phase of the MLPAI. This system would allow stakeholders to: 1) manipulate interactive maps to view all of the spatial data layers in the MLPAI geodatabase, 2) visualize the results of ongoing monitoring efforts, 3) draw prospective MPA boundaries, perform a variety of analyses using these boundaries that support SAT guidelines, including spacing, habitat calculations, and economic impacts, 4) save and post maps, analytical results and MPA proposals to discussion forums, and 5) participate in online discussions and Wikis (a web page in which users edit content collectively) about these proposals. UCSB is leading the effort to build and manage the MLPAI DSS, providing expertise, guidance and coordination among the entities involved in developing these tools. This project supports the development of the system prototype that, with continued efforts, will ultimately lead to a dramatically improved DSS. UCSB will coordinate efforts among Ecotrust, Farallon Geographics and subcontractors to develop the proposed decision support system.

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**William McClintock** **12/1/2007-12/31/2008** **75,602**
**Steven Gaines**
Santa Monica Bay Restoration Foundation, 07-14

**GIS Support for the Analysis of Data Gaps on Habitats and Resources in Santa Monica Bay**

The UCSB PIs will provide geographic information systems (GIS) support for the Santa Monica Bay Restoration Commission (SMBRC) to facilitate the analysis of data gaps on habitats and resources in Santa Monica Bay. In particular, a full-time GIS analyst will work under supervision of Dr. Will McClintock at the UCSB Marine Science Institute (MSI). The GIS analyst is to work in close collaboration with a second individual (to be hired by the SMBRC) who will be primarily responsible for providing data to the analyst for compilation, uploading to the MLPA geospatial database, and displaying and distributing via an ArcIMS web site. The data, database schema, and ArcIMS formats will match comparable and existing data, schemas and formats used by the MLPA Initiative to facilitate use by interested parties once the MLPA Initiative moves to the Southern California Bight.

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**Paige Miller** **6/1/05-6/30/08** **15,000**
National Science Foundation, DBI-0409561

**NSF Minority Postdoctoral Fellowship**

Theory on the evolution of sex chromosomes has focused on XY systems, neglecting ZW systems despite their importance in nature and the fundamental differences between the two systems, which may have profound evolutionary consequences. The ZW sex determination system fundamentally differs from the XY in two ways: A) in ZW systems, there is colinear transmission of both the W chromosome and the cytoplasmic DNA, and B) both sex chromosomes reside in females, thus potentially affecting the early development of offspring via maternal effect genes. This project investigates the consequences of the unique characteristics of a ZW system via three major approaches: 1) The development of theory concerning the genetic conflict that arises during the evolution of a ZW sex determination system, 2) The creation of a new female limited sex chromosome (neo-W) in a line of Drosophila melanogaster, and monitoring of subsequent sex-specific fitness changes, and 3) A genomic comparison of the distribution (X vs. autosomes) of maternal effect genes in G. domesticus (chicken) ZQ genome with the XY systems of D. melanogaster (fly), C. elegans (nematode), and H. sapiens (mammal).

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**Aileen Morse** **1/27/2006-11/30/2009** **142,171**
University of Queensland, SB060101

**Coral Reef Targeted Research and Capacity Building for Management**

Coral reefs worldwide are suffering degradation from a number of disparate natural and man-induced causes. Tackling the root-causes of degradation through effective coastal management measures is likely the best way both to reduce further damage and to allow reefs to return to viable healthy states. Nevertheless, there can also be opportunities for direct intervention to actively restore injured coral reefs. As part of an international research effort, the UCSB investigator seeks to answer the following question: Does the use of "larval flypapers" to effect controlled settlement and metamorphosis of larvae of selected coral species in a lab-based hatchery facility contribute to

enhanced growth and survival of recruits out-planted to the field for purposes of restoration? The research objectives are as follows: 1) To design a low-cost land-based hatchery operated at local level to provide reliable sources of coral larvae, and for the intermediate grow-out of young coral polyps for use in restoration/remediation projects. 2) To investigate the success of collecting gametes from individual coral colonies from nearby healthy sites for rearing under hatchery conditions to provide a supply of young recruits for out-planting into damaged areas. 3) To investigate what is likely to be the most cost-effective size to out-plant juveniles to field. 4) To investigate the effect on reef restoration of out-planting young polyps, derived from hatchery-produced larvae that have been newly settled on "larval flypapers" onto standardized artificial modules (SMs) and natural reef substrate.

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**Daniel Morse** **8/1/2005-8/31/2007** **238,970**
Marine Biological Laboratory, 27343

**Biomolecular Mechanism, Cloning, Sequencing and Analysis of Adaptive Reflectin cDNAs and Proteins**

The dynamically adaptive optical properties of cephalopod skin are driven by unique biomolecular mechanisms that change skin color, reflectance and texture. While the mechanisms responsible for the changes in color and texture are largely understood, it is the dynamic changes in reflectance that are most poorly understood. Our specific focus in this 12-month Phase-One project is to clone and sequence the cDNAs coding for the dynamically adaptive reflectin proteins from squid (genus Loligo), and determine from the deduced sequences, molecular models and experimental analyses of the adaptive reflectin proteins the molecular domains and mechanisms that govern the dynamically adaptive changes in reflectance.

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**Daniel Morse** **8/19/2002-8/18/2008** **2,971,750**
**Paul Hansma**
**Galen Stucky**
**J. Herbert Waite**
Princeton University, 00000532

**Synthetic Self-Healing Structural Materials**

This research will develop generic, robust rules and design tools governing synthesis and performance of self-healing structural materials, based on exemplars from biological systems that combine some of the desirable properties of Kevlar and silicones. New routes to synthesis of these multifunctional materials will be developed, together with a robust and generalizable understanding of the fundamental physics and design principles underlying their assembly and behavior. Practical uses include self-healing fibers, solids, armors and protectants, coatings, resins, adhesives and packaging materials. Robust and generalizable rules and design tools governing the physical properties and synthesis of self-healing structural materials should find wide application in extensions to predictive property design in other multifunctional materials as well. This project aims to develop fundamental design principles and new routes to synthesis for manufacture of self-healing fibers, resins, solids and composites based on lessons extracted from the biological protein models. The UCSB team will develop, test and optimize synthetic analogs of the natural self-healing proteins and protein-based composites on which their approaches are based, and then translate the results of these studies to second generation synthetic materials that are thermally robust, resilient, processible and economically manufacturable.

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**Daniel Morse** **7/1/2006-11/30/2008** **485,000**
US Department of the Army, W911NF-06-1-0285

**Biomolecular Mechanism, Cloning, Sequencing and Analysis of Adaptive Reflectin cDNAs and Proteins from Squid**

The dynamically adaptive optical properties of cephalopod (octopus, squid and cuttlefish) skin are driven by unique biomolecular mechanisms that change skin color, reflectance and texture. While the mechanisms responsible for the changes in color and texture are largely understood, it is the dynamic changes in reflectance that are most poorly understood. The specific objectives of this project are to

clone and sequence the cDNAs coding for the dynamically adaptive reflectin proteins from squid (genus Loligo), and determine from the deduced sequences, molecular models and experimental analyses of the adaptive reflectin proteins, genetically engineered mutants and synthetic peptide analogs of these proteins the molecular domains and mechanisms that govern the dynamically adaptive changes in reflectance. Results of this study will enable the subsequent design and synthesis of a new generation of electro-optically active materials for new means of optoelectronic communication.

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**William Murdoch** **10/1/2006-9/30/2011** **7,099,618**
**Stephanie Hampton**
National Science Foundation, DEB 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.

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**Craig Nicholson** **8/1/2005-7/31/2007** **150,748**
**Christopher Sorlien**
National Science Foundation, EAR-0439859

**Accommodating Oblique Plate Motion in the California Continental Borderland: The Interaction Between Rotating and Non-Rotating Domains**

Understanding continental structure and the dynamics of plate boundary deformation is a major initiative in earth science. This project is part of a coordinated effort to conduct integrated, multi-disciplinary studies of the crust and mantle structure and evolving plate boundary deformation both onshore in southern California and offshore in the California Continental Borderland. The Borderland was the locus of Pacific-North America plate motion for about 70% of its displacement history, and recent GPS data suggest that up to 20% of current plate motion is still located offshore. This project will make use of extensive grids of existing high-quality industry multi-channel seismic (MCS) data that have recently become available to investigate the crustal deformation and tectonic evolution of the offshore portion of the PAC-NAM plate boundary. A prime objective is to document how the crustal architecture accommodates plate boundary transpression, differential rotation, spatial variations in fault slip and the termination of faults. Project results will be incorporated into regional community fault, structure and velocity models for southern California that form the basis for estimating earthquake hazards, interpreting geodetic strain data, understanding plate boundary evolution, and other aspects of continental deformation, including fault interaction and fault system dynamics.

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**Craig Nicholson** **7/1/08-6/30/10** **201,427**
**Christopher Sorlien**
National Science Foundation, EAR-0810278

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

The offshore California Continental Borderland is an ideal natural laboratory to investigate many aspects of continental deformation and plate boundary evolution, including oblique rifting and transform initiation. The Borderland was the locus of Pacific-North America plate motion for about

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

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**Craig Nicholson** **3/1/2008-2/28/2010** **255,144**
**Christopher Sorlien**
**James Kennett**
National Science Foundation, OCE-0751807

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

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

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**Craig Nicholson** **2/1/2007-1/31/2009** **55,000**
University of Southern California, 119525

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

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

and focal mechanisms, which based on kinematic consistency and other independent data sets can be used to define the orientation and position of active subsurface fault segments.

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**Roger Nisbet** **9/1/2007-8/31/2008** **135,000**
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.

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**Roger Nisbet** **4/1/2008-3/31/2011** **555,011**
**Frank Doyle**
National Science Foundation, EF-0742521

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

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

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**Todd Oakley** **1/1/2004-12/31/2007** **271,300**
**Nikolaos Schizas**
National Science Foundation, 0316330

**A Multi-Gene Phylogeny of Maxillopod Crustaceans to Facilitate Comparative Study of Eye Evolution**

As benefactors of a detailed stratigraphic record, riotous diversity, and cosmopolitan distribution, the Maxillopoda (ostracods, copepods, barnacles, and others) have enormous potential to provide

information about evolution, biodiversity, ecology and global change. However, a major obstacle to utilizing this potential is the lack of reliable phylogenetic hypotheses for the group. This project has two major goals: 1) to provide a large-scale molecular phylogeny of maxillopod crustaceans and; 2) to use the phylogeny to test hypotheses about maxillopod eye evolution. A selected team of researchers and collaborators with complementary expertise in the major maxillopod groups will sample a taxonomically diverse array of about 100 maxillopod species that is nearly comprehensive at the level of family to order. They will obtain DNA sequence from four different nuclear genes that will allow not only resolution of maxillopod relationships, but also integration with other studies in arthropod phylogeny. With regard to maxillopod eye evolution, a preliminary phylogeny based on extensive preliminary strongly supports independent origins of compound eyes in both myodocopid ostracods and branchiuran fish lice. The PI's will examine statistically the alternative hypothesis that compound eyes were lost multiple times rather than gained.

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**Todd Oakley** **4/1/2007-3/31/2008** **120,000**
National Science Foundation, DEB-0643840

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

This is 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 (who is trained in molecular phylogeny and molecular evolution) will 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.

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**Todd Oakley** **1/1/2004-12/31/2007** **271,300**
**Todd Oakley** **7/1/2007-6/30/2009** **12,000**
**David Plachetzki**
National Science Foundation, DEB-0710406

**DISSERTATION RESEARCH: Tracing the Origins and History of Animal Phototransduction using Phylogenetic Approaches**

This study seeks to shed light on the problem of the evolutionary origins of diversity and complexity using the animal phototransduction protein network as a model. These phototransduction protein networks are implicated in primary vision in all animal eyes and represent ancient evolutionary modules, amenable to phylogenetic study. The primary question explored by this research is: how have the evolutionary mechanisms of duplication, co-option and loss shaped animal phototransduction protein network history? A central hypothesis is that duplication of phototransduction protein networks (via gene duplication) has been a driving force in the diversification of animal visual systems. Opsin proteins mediate animal phototransduction, and a comprehensive, metazoan-wide phylogenetic treatment of their relationships has already been completed. Phylogenies for each of the remaining members of the phototransduciton protein network are underway. This project will be able to vastly improve the quality of its findings by allowing experimental confirmation or our phylogenetic results and predictions. As a test case for the implementation of common phylogenetic tools to a novel problem, this study is poised to yield important contributions that extend beyond the problem of photoreceptor evolution.

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**Gail Osherenko** **3/1/2006-5/31/2008** **13,238**
**Keith Clarke**
University of Southern California, 112446

**California's Coastal Zone Management Program: Retaining Agricultural Land in the Face of Urban Growth**

Nearly all of California's coastal communities are facing a serious shortage of housing for low- and moderate- income workers and looking to remaining agricultural land and open space for land to build high density housing developments. The California Coastal Act, promulgated in 1976 to protect the beauty of the Coast, is now being tested in a new time of housing shortages and astronomical price increases. The Act identifies retention of important farm- and rangeland as one of the top three priorities for land use in the coastal zone, yet the rate of population growth in coastal communities coupled with patterns of development that foster sprawl threaten conversion of agricultural land both within and outside the coastal zone. Even when planners promote "smart growth" alternatives to sprawl, remaining agricultural land in and close to urban areas provides tempting sites for location of development. California employs a complex of economic, regulatory and legal tools to protect agricultural land: regulatory restrictions (command and control mechanisms), tax incentives, and purchase of property rights. This project examines and evaluates the role of each of these policy instruments in preventing the conversion of agricultural land. The researcher and graduate student will explore the interplay among the three approaches to agricultural land retention.

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**Christopher Osovitz** **7/1/2005-9/30/2007** **12,000**
**Gretchen Hofmann**
UC Mexus, SB060030

**Investigating the role of physiological tolerances in setting marine species' biogeographic boundaries**

This is a dissertation project investigating the physiological underpinnings of the biogeographic ranges of two sea urchin species whose southern range boundaries are located near Punta Eugenia, Baja MX. The purple sea urchin (Strongylocentrotus purpuratus), the red sea urchin (S. franciscanus) and many other marine species share this point as a southern range boundary. It is widely thought that this point is a thermal barrier for these species because a relatively large thermal cline exists there. Since physiological thermal tolerances are thought to limit species ranges at such locations, many studies suggest that species' distributions may shift pole-ward in response to global ocean warming. However, these hypotheses are largely based on hypothetical data, and physiological states of marine species near their southern range boundaries have rarely been investigated. In order to investigate this phenomenon, the investigator will compare gene expression among natural populations of S. purpuratus and S. franciscanus from the center of their biogeographic range (Oregon, USA) toward their southern range boundary (Punta Eugenia, Baja, Mexico). This project will aim to answer two questions: 1) What are the general trends of S. purpuratus' gene expression along the southern portion of its biogeographic range? 2) Does S. purpuratus' sister species S. franciscanus utilize similar differential expression trends across its biogeographic range? Using this twofold approach will allow the PI to make conclusions regarding a species' general physiological response to environmental variation (#1) as well as specific responses to what extent such responses are universal to other species (#2). Such an endeavor would benefit understanding of marine community structure as well as offer insight to species responses to future climate change.

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**Henry Page** **9/18/2006-6/30/2008** **9,999**
**Jenifer Dugan**
Channel Islands National Park, J8C07060004

**An Investigation of the Responses of Benthic Invertebrate Species to Marine Protected Areas in the Channel Islands National Park**

Shallow rocky reefs are a critically important nearshore coastal ecosystem of the California Mediterranean region. Populations of commercially (e.g., red sea urchins, rock crabs), recreationally (rock scallops), and ecologically (e.g., purple sea urchins, keyhole limpets) important invertebrate species occur on shallow rocky reefs located inside and outside of Marine Protected Areas (MPAs) within the Channel Islands National Park (CINP). Populations inside and outside of MPAs are potentially linked through the passive transport of planktonic larvae by ocean currents. The PIs are deploying 12 temporary moorings as part of another study to monitor larval recruitment of

key invertebrate species inside and outside of MPAs within the CINP. The proposed project will complement the larval monitoring by: 1) analyzing NPS data collected during the Kelp Forest Monitoring Program on the composition and density of selected benthic invertebrates, including sea urchins, scallops, crabs, and keyhole limpets, at the locations of larval monitoring sites located at CINPS sites at Santa Cruz and Santa Rosa Islands, and 2) conducting quantitative field surveys on the composition and density of benthic invertebrates at larval monitoring sites at these islands where CINPS data are not available.

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**Henry Page** **1/1/2008-12/31/2009** **2,078,317**
**Daniel Reed**
**Stephen Schroeter**
Simpson and Simpson Business and Personnel Services, Inc., SB080067

**San Onofre Nuclear Generating Station Mitigation Project Monitoring Program**

In 1974, the California Coastal Commission (CCC) issued a coastal development permit to Southern California Edison Company (SCE) for Units 2 and 3 of the San Onofre Nuclear Generating Station. A condition of the permit required studying the impacts of the operation of the units on the marine environment offshore from San Onofre, and mitigation of any adverse impacts. As a result of the impact studies, the Coastal Commission added new conditions requiring restoration of southern California wetlands, construction of a kelp reef, installation of fish barrier devices at the power plant, and provision of funds for a marine fish hatchery. The new conditions also require SCE to fund a program for monitoring the implementation of the mitigation effort to be carried out by appropriate and independent scientific and technical personnel and consultants under the direction of the Executive Director of the Coastal Commission. The UCSB investigators will work with CCC officials on implementation and monitoring of the Wetland Restoration and the Mitigation Artificial Reef projects. Their activities will include entering, organizing and managing data, as well as preparation of reports to the CCC on the progress of these projects.

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**Henry Page** **12/1/2007-6/30/2010** **102,772**
**Jenifer Dugan**
UC Agriculture and Natural Resources, SA7429

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

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

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**Steven Proulx** **7/1/08-6/30/11** **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.

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**Langdon Quetin** **10/15/2002-9/30/2008** **596,520**
**Robin Ross**
Virginia Institute of Marine Science, 518606/1247

**LTER: Palmer Antarctica LTER: Climate Change, Ecosystem Migration and Teleconnections in an Ice-Dominated Environment**

The UCSB investigators are responsible for the Zooplankton and Micronekton component of the PAL LTER study of the pelagic ecosystem west of the Antarctic Peninsula. The work consists of three major areas, core data sets, process experiments, and synthesis and modeling. The core data sets constitute the time series that is the legacy of the LTER, and that allows the investigators to test hypotheses about processes that occur on time scales of decades. UCSB's investigators are responsible for: 1) collection of core data sets during the spring and summer season, primarily during the annual research cruise in January/February; and 2) documentation of data collection methods, quality control/quality assurance of the core data sets, and placement of the core data sets and documentation into the PAL LTER database within two years of collection. Shorter-term process studies on such questions as grazing rates of larval krill on surfaces or factors driving the documented seasonal decrease in biomass of krill in the area will be undertaken in one- or two-year sequences. They will also participate in synthetic and modeling activities, including continuation of the EOF analysis begun during the 1996-2002 period of the project, and analysis of the abundance and distribution of the five major macro-zooplankton species in the PAL LTER study region with the ten-year time series.

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**Daniel Reed** **4/1/2000-3/31/2008** **5,037,911**
**Scott Cooper**
**Steven Gaines**
**Sally Holbrook**
**John Melack**
National Science Foundation, NSF OCE 9982105

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

This LTER (Long-Term Ecological Research) site in the Santa Barbara region is focused on ecological systems at the land/ocean-margin. The location is typical of many semi-arid regions in that it includes a large number of watersheds with episodic stream flow that vary in size and land use. The focal coastal ecosystem of this research will be giant kelp (Macrocystis pyrifera) forests, which are extremely important to the ecology and economy of coastal areas along the west coast of North and South America. Kelp forests occur on shallow coastal reefs and are affected in both positive and negative ways by land and the open ocean through the movement of water carrying constituents (e.g., sediments, nutrients, larvae, pollutants) from these different sources. Kelp forests have a unique trophic structure in which producers (macroalgae) and consumers (sessile invertebrates that filter plankton) compete for space. Competition between macroalgae and sessile invertebrates can be mediated by the relative supply of nutrients and particulate organic matter to the reef.

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**Daniel Reed** **12/1/2006-11/30/2008** **1,833,999**
**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 established in April, 2000 to investigate the relative importance of land and ocean processes in structuring ecosystems at the land-sea margin. The principal study area is the Santa Barbara Channel and the coastal watersheds that drain into it, and the focal ecosystem is giant kelp forests, which occur on shallow rocky reefs at the interface of the land-sea margin throughout the study area and other temperate coasts throughout the world. The major focus of this work is to develop 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. The overarching question of this research is: How do abiotic drivers acting over different spatial and temporal scales interact to influence kelp forest structure and function?

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**Daniel Reed** **7/1/2004-8/31/2007** **354,967**
**Sally MacIntyre**
**Mark Brzezinski**
**Sally Holbrook**
UC Office of the President, UCOP 012856-01

**Ecosystem Functioning in Giant Kelp Forests: Linking Hydrodynamics to an Essential Forage Species and its Benthos**

Giant kelp (Macrocystis pyrifera) is heavily harvested and is a critical forage species for numerous other marine organisms, many of strong commercial value to fisheries. The subtidal forests formed by this kelp may also have the capacity to function as natural filters to improve coastal water quality. However, despite the clear economic and ecological importance of giant kelp forests, their relationship to surrounding waters and the linked responses of organisms within the community to forest-flow processes have not been explored in any detail. The investigators aim to examine mechanistically 1) the degree of connection of this vital system to its surrounding waters, 2) rates of consumption or production of waterborne subsidies by kelp forests, 3) the interplay of nutrients, light, and flow in determining kelp growth, and 4) the implications of forest-flow interactions for benthic inhabitants of the forest. The experimental efforts will employ extensive flow measurements, geochemical and biochemical analyses, and traditional ecological methods in exploiting a breadth of expertise in hydrodynamics, marine ecology, biological oceanography, and algal physiology. As such, this work will address pressing problems in coastal water quality, it will increase knowledge of the ecosystem role of a critical forage species, and it will outline the nature of cascading ecological processes that impact fisheries.

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**O. James Reichman** **3/23/2005-3/31/2009** **300,000**
**Sandy Andelman**
Andrew W. Mellon Foundation, SB050085

**Deploying Information Management Tools and Increasing Analytical Capabilities of Scientists Through the National Center for Ecological Analysis and Synthesis**

The National Center for Ecological Analysis and Synthesis (NCEAS) was established to use existing data to address important ecological questions. Accordingly, its research and training activities (including Working Groups, Postdoctoral Associates, and Center Fellows, totaling more than 3,500 individuals in 10 years) focus on the acquisition and access to distributed and heterogeneous

ecological information. NCEAS has been engaged in extensive research projects to develop generic data access tools for ecology and allied disciplines. Concurrently, the Andrew W. Mellon Foundation has provided unique support to help deploy the tools, a crucial activity that is not supported by more traditional entities. With this support, the Principal Investigators have discovered that a distinctive opportunity exists at NCEAS to develop informatics tools and train hundreds of scientists in their use. Specifically, while at the Center, scientists are fully engaged in accessing, integrating, and sharing information to conduct their projects and thus are primed to employ new informatics tools. This award from the Andrew W. Mellon Foundation provides support for one person for informatics training and three analytically adept postdoctoral associates to significantly strengthen informatics training for hundreds of scientists who visit the Center each year.

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**O. James Reichman** **10/1/2006-8/15/2007** **85,826**
Gordon and Betty Moore Foundation, 1203

**Wild Salmon Ecosystems**

Climate is a major driver of the geographic distribution and abundance of salmon. Climate change is occurring globally, but there has been no organized effort to evaluate the potential effects of climate change on populations of salmon and the ecosystems they inhabit. Sufficient data and expertise exist to conduct such an assessment. Developing and implementing a process to synthesize the data is the critical step toward achieving this evaluation. This project will initiate the process of synthesizing existing data on the potential effects of climate change on salmon. In collaboration with a Steering Committee assembled by the Moore Foundation, the National Center for Ecological Analysis and Synthesis will convene a multidisciplinary group of approximately forty-five scientists and practitioners with relevant expertise. The experts will identify the most important topics related to the potential effects of climate change on salmon and their ecosystems, and develop a strategic framework for conducting targeted analyses and syntheses of existing data.

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**O. James Reichman** **3/15/2005-2/28/2010** **281,068**
**John Orrock**
National Science Foundation, DEB-0444217

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

Biological invasions are a leading cause of extinction that imperil the structure and function of ecological communities. Consumers can play an integral role in the outcome of invasions, as evidenced by classical biological control whereby exotic plants are controlled by the introduction of exotic consumers. However, the role of native consumers in affecting biological invasions remains unclear. This project evaluates an untested hypothesis with direct implications for biological invasions: exotic plants can subsidize native consumers, leading to stronger impacts of native consumers on native plants (i.e. apparent competition). Furthermore, this study examines how differences in resources and protective cover between native and exotic patches of vegetation affect the spatial extent of apparent competition by influencing consumer behavior. When consumer incursions limit the spatial extent and pattern of apparent competition, the size and shape of native patches determines what areas, if any, are free of apparent competition. By measuring consumer abundance, activity, and impact in patches of varying geometry, a second untested hypothesis is examined: differences in native and exotic habitats alter consumer behavior, changing the spatial extent of apparent competition and setting geometric thresholds at which patches of native plants are too small or too narrow to persist.

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**O. James Reichman** **8/1/2000-7/31/2007** **16,664,400**
National Science Foundation, NSF DEB 0072909

**National Center for Ecological Analysis and Synthesis**

The Center for Ecological Analysis and Synthesis is located in downtown Santa Barbara. The Center provides an outstanding physical and intellectual setting for visiting scientists who conduct collaborative research on major fundamental and applied problems in ecology. The Center's high

performance computing facilities and skilled technical staff enable resident and remote researchers to tackle complex and computationally challenging problems. The results of the Center's research, both data and publications, are disseminated widely to the scientific community, as well as to other user groups, such as resource managers and policy makers.

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**O. James Reichman** **10/1/2002-9/30/2008** **2,910,756**
**Mark Schildhauer**
**Matthew B. Jones**
National Science Foundation, NSF EF-0225676

**ITR Collaborative Research: Enabling the Science Environment for Ecological Knowledge**

Continuing advances in computation and communication are transforming the scientific process. Biodiversity research, like the fields of molecular, structural and proteomic biology, is re-inventing itself with new technology applications, and is evolving into an increasingly predictive and integrative science focused on important research and policy issues. This international ITR collaboration takes on key challenges for biodiversity researchers by modeling, designing and implementing the data discovery, integration and visualization components for a semantic web in environmental science. The initiative stands on the foundation of substantial and productive NSF investment in ecological and biodiversity informatics and it brings together four highly collaborative, forward-looking institutions in a partnership committed to inventing and supporting a global computing infrastructure for environmental biology. The project involves a multidisciplinary team of computer scientists, ecologists and technologists collaborating in complementary IT R&D and working group units.

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**O. James Reichman** **11/1/2006-8/31/2007** **14,494**
Santa Clara University, 00282421

**A Workshop on EPA Risk Assessment and Analysis**

A workshop will be conducted at the National Center for Ecological Analysis and Synthesis (NCEAS) on EPA risk assessment and analysis. From the perspective of EPA with its regulatory and risk assessment responsibilities, there are three over-arching questions: 1) What kinds of data should be collected and generated to support risk assessment of PIPs? 2) What approaches have been taken to date and how well do these approaches match up with the questions that must be addressed? 3) How robust are the data gathered from different types of risk assessments, and how can we best quantify the residual uncertainty?

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**O. James Reichman** **4/15/2007-9/30/2007** **25,000**
The Nature Conservancy, 64689-0139

**A Workshop on Mapping and Valuing Ecosystem Services**

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

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**O. James Reichman** **10/1/2005-12/31/2008** **50,000**
The Nature Conservancy, CR0002-64689

**A Workshop on Global Climate Change and Adaptation of Conservation Priorities**

Climate change is broadly recognized as a threat to global biodiversity. The Nature Conservancy, along with many major conservation NGOs, has recognized climate change as a threat to its conservation investments and the long-term success of its mission. The broad spectrum of responses to this threat have included efforts to change national energy policy, promote new technologies, manage carbon stocks through mitigation and sequestration, and to reduce greenhouse gas emissions through meaningful implementation of the Kyoto Protocol and other policy instruments. These activities are essential, but not sufficient responses if we are to maintain biodiversity in the face of certain climatic change to which we have already committed ourselves due to past and present industrial activities. Moreover, responses have not adequately provided an active role for land stewards, resource managers, and conservation planners. The goal of Climate Change Impacts and Adaptation Tools Workshop is to review and advance simple and effective methodologies for incorporating climate change impacts into conservation planning assessments for more resilient and adaptable conservation blueprints. The vision for success of a climate methodology would be one that allows for explicit interpretation of direct and indirect ecological responses to the climate changes and provides guidance in strategic planning for an uncertain future.

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**O. James Reichman** **8/15/2006-8/14/2008** **391,969**
The Nature Conservancy, SB070032

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

The intent of this project is to quantify the economic impact of non-native forest pests and pathogens in North America. Although there are well-documented examples of non-native forest pests and pathogens altering forest composition (e.g., hemlock woolly adelgid, chestnut blight), the economic costs of these impacts have not been credibly estimated. There is a sense, however, that the economic threats are substantial, and rising because additional non-native pests and pathogens continue to establish in the United States at a rate of approximately one potentially significant introduction per year. Examples of these recent invaders include sudden oak death, emerald ash borer, and Asian longhorn beetle. Using postdoctoral fellows, graduate student research assistants, working groups, distributed graduate seminars, and other techniques of interdisciplinary research and data analysis, the National Center for Ecological Analysis and Synthesis will assess non-native forest pests and pathogens from both ecological and economic perspectives. Researchers will consider the effects of economic activities such as importation of goods using solid wood packaging, shipment of logs and lumber, and importation of live plant material. Effective use of limited public funds to control invasions of non-native forest pests and pathogens depends on an understanding of the full extent of economic impacts of invasive pests over a time period of decades to centuries.

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**William Rice** **2/1/2002-7/31/2008** **605,000**
National Science Foundation, NSF DEB-0128780

**Gender-Specific Fitness and Intersexual Developmental Conflict in a Drosophila Model System**

Males and females express overlapping sets of genes. This shared hereditary material can be selected toward different gender-specific optima and produce sexually antagonistic selection. Intersexual genetic conflict occurs during development when an allele moves one sex toward its gender-specific optimal phenotype, but has the opposite effect in the other sex. A recent pilot experiment in the PI's lab using a Drosophila melanogaster model system, provides preliminary evidence that the genome of this species contains substantial sexually antagonistic fitness variation and suggests that a large fraction of the genome-wide genetic variation for fitness is divergently selected between sexes. Building on the pilot study, the investigator will quantify the extent to which the genome-wide standing genetic variation for fitness is concordantly vs. discordantly selected between the sexes.

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**William Rice** **8/1/2003-7/31/2007** **303,906**
University of Washington, UW 806099

**IRCEB: The Origin of Barriers to Fertilization and Their Role in Speciation: From Populations to Proteins**

The UCSB investigator will clone a sample of fifty genomic haplotypes and assay these genomes for 1) their fitness (total, adult, juvenile, and sperm competition) when expressed in males, 2) their fitness (total, adult, and juvenile) when expressed in females, and 3) the harm to a male's mate (both through behavior and through seminal fluid) when these genomes are expressed in males. In collaboration with D. Howard and R. Harrison, the UCSB investigator will assay five pairs of populations which have adapted to the same laboratory environment for ~ 1,000 generations but that experienced independent intersexual coevolution (parallel populations). Males will be assayed with females from their population of origin (con-population females) and with females from the parallel population that was derived from the same ancestral population (hetero-population females). The PI will characterize both the defense phenotype of the males (in the context of sperm competition) and the degree to which they harm their mates via seminal fluid proteins.

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**William R. Rice** **4/4/08-5/31/09** **136,350**
**University of Washington**
**Drosophillia Seminal Fluid: Proteomic Discovery and Functional Variation Analyses**

The seminal fluid proteins of *Drosophila melanogaster* have been extensively studied. Most fly seminal fluid proteins are accessory proteins (Acps), produced in a paired set of secretory organs called the accessory glands. Upon mating, these proteins are mixed with sperm and several other proteins to produce seminal fluid, which is then transferred to the female. These transferred proteins are responsible for several changes in female physiology and behavior; they induce ovulation and egg-laying, reduce female receptivity to re-mating, stimulate an immune response, and up-regulate feeding behavior. Acps are implicated in mediating sperm competition between males and causing an overall cost of mating in females. In spite of two decades of study, only a handful of seminal fluid proteins have been conclusively demonstrated to be transferred at mating to females, and specific functions have been assigned to even fewer. This research seeks to comprehensively identify the set of seminal fluid proteins present in mated females. These proteins will then be examined for their patterns of molecular evolution and their effects on male reproductive success. The PI hypothesizes that for certain Acps, both coding sequence variation and levels of protein expression will affect male and female fitness.

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**Luz Rodriguez-Villa** **12/1/2007-11/30/2008** **18,000**
**Carol Blanchette**
UC MEXUS, SB080070

**Biodiversity and Rocky Intertidal Benthic Community Structure in Relation to Coastal Natural Resources in the Southern California Bight**

Information on the influence of environmental, biological and anthropogenic factors on coastal natural resources is important for adequate management. An ecological analysis of seafloor (benthic) community resources is essential for understanding natural ecosystems. Biodiversity studies provide a fundamental link in developing advantageous strategies, through conservation research and management of the economic sustainability of coastal zones, where exploitation and commercialization of these natural resources and their use for fishing, industry, tourist-recreational and urban interests generate an important source of revenue. Rocky intertidal habitats are extensive zones of great ecological importance, often with high species diversity. Their accessibility facilitates constant anthropogenic alterations, including destruction of habitat and pollution. However, current knowledge of the biodiversity of these communities is inconsistent. Some groups in rocky intertidal habitats are well known and well understood, mainly those with larger organisms and north of the US-Mexico border. For other important groups, such as benthic macrofauna, awareness is poor, especially south of the US-Mexico border. This project will generate the first large-scale data on benthic macroinvertebrate community structure of rocky intertidal habitats in the southernmost

portion of the Southern California Bight (SSCB), spanning from the US-Mexico border in the north to Cabo Colonet, in Baja California, Mexico, in the south. The end-product will expand knowledge of the species richness of macroinvertebrates, serving as a reference frame for future ecological studies.

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**Robin Ross** **1/1/2006-12/31/2008** **241,951**
**Langdon Quetin**
National Science Foundation, ANT-0529087

**Collaborative Research: US SO GLOBEC Synthesis and Modeling: Timing is Everything: The dynamic coupling among Phytoplankton, Ice, Ice Algae and Krill (PIIAK)**

The annual advance and retreat of sea ice (from a summer minimum of approximately 4 million km2 to a winter maximum of 20 million km2) play a dominant role in the Southern Ocean (SO) ecosystem and have been called the largest seasonal process on Earth. The life history of Euphausia superba, Antarctic krill and a key species in the food web of the Southern Ocean ecosystem, is intricately involved with seasonal sea ice dynamics. Recent results from the U.S. SO GLOBEC field program as well as historical information on sea ice dynamics and Antarctic krill recruitment suggest a shift in the paradigm that all pack ice is equally good habitat (i.e., that sea ice varies in its habitat quality for larval krill). Through this data synthesis and modeling program, historical records of krill condition factor, larval growth, and recruitment will be linked to variability in sea ice dynamics via its coupling to phytoplankton incorporation and sea ice algal biomass. The project has two main goals: 1) Develop, refine, and link diagnostic datasets and models of phytoplankton decreases in the fall, phytoplankton biomass incorporation into sea ice, sea ice growth dynamics, sea ice algal production and biomass accumulation, and larval krill energetics, condition, and survival. 2) Hindcast variability (spatially within a season as well as interannually) in the quality of pack ice habitat and larval krill condition west of the Antarctic Peninsula (WAP) from present back to 1979 by linking mechanistic data sets and models in a two-dimensional model.

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**Robin Ross** **3/1/2005-9/30/2008** **41,045**
UC San Diego, 518607/1247

**Long-Term Ecological Research on the Antarctic Marine Ecosystem: Climate Migration, Ecosystem Response and Teleconnections in an Ice-Dominated Environment**

The UCSB investigator will conduct chemical analyses of samples jointly collected in Antarctica by the LTER team.

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**Anne Salomon** **3/1/2008-2/28/2009** **78,184**
**Steven Gaines**
Society for Conservation Biology, SB080092

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

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

range of oceanographic conditions. This research project has been designed to explicitly inform ecosystem-based management, one of the foremost challenges facing conservation and management practitioners today.

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**Cristina Sandoval** **2/15/2007-4/15/2010** **261,000**
**Susan Swarbrick**
Wildlife Conservation Board, WC-6046PP

**Restoration of the Devereux Slough margin on Coal Oil Point Reserve**

The restoration of the Devereux Slough ecosystem is on the Wetlands Recovery Project Work Plan, and is considered a priority project (Tier 1). Devereux Slough received global recognition as an Important Bird Area by the National Audubon Society for its diversity and abundance of birds, and in particular, the presence of several rare and endangered species. The Coal Oil Point Reserve contains 170 acres, 50 of which are degraded from past agricultural practices. The Work Plan for this project includes restoration of all 50 acres, to be completed in several phases over 2-year periods. This first phase will restore and enhance the biological functions of approximately seven acres of the Devereux Slough margin, a critical habitat to many of the species that live there. The western margin and a portion of the eastern margin of Devereux Slough are presently degraded from invasion of exotic plants including large trees, shrubs and annual weeds. Restoration of the margins of Devereux Slough will directly benefit several rare plants, butterflies and endangered and threatened species of birds. Restoration will greatly enhance habitat value for bird species such as the Western Snowy Plover, the California Least Tern, and the Belding's Savannah Sparrow; estuarine fish such as the Tidewater Goby; butterflies such as the Western Pygmy Blue and the Wandering Skipper, and a number of sensitive plants.

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**Mark Schildhauer** **9/22/2006-9/22/2009** **250,000**
**Matthew B. Jones**
**O. James Reichman**
Andrew W. Mellon Foundation, SB070042

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

Kruger National Park is faced with a challenge common to many research stations where dozens of loosely coordinated monitoring and experimental projects are underway at any time. The main challenge is how to effectively collect, present, and preserve this highly variable collection of scientific data for collaborative and integrative analyses. The Andrew W. Mellon Foundation has supported a partnership between Kruger National Park and the National Center for Ecological Analysis and Synthesis (NCEAS) over the past two years to address this informatics challenge by implementing and refining an approach for archiving KNP's scientific field data using methods developed and tested by NCEAS, the Long Term Ecological Research program, and other partners. The successful deployment of a metadata archive (Metacat) at KNP, along with two successful training workshops in its use, have validated the power and viability of this approach. Kruger National Park is now part of a global "Knowledge Network for Biocomplexity" (KNB), which is based on the use of metadata standards in ecology, particularly Ecological Metadata Language, or "EML" documents that are stored in Metacat database servers. The EML metadata specification is also being used by NCEAS, LTER, the Organization of Biological Field Stations, and the Ecological Society of America, all of which are examples of other major ecological research institutions that are committed to using a common metadata standard for documenting their data. At Kruger, staff and scientists have been trained to use the Morpho metadata and data management application to document their data holdings and upload these to the Kruger data repository (Metacat). This project will expand the data system to the broader collection of parks and research stations in South Africa and create the additional analysis infrastructure needed to effectively use these data in adaptive management approaches in the parks. This phase of the research will simplify the data management infrastructure to make it much easier to deploy in the parks in South Africa. In addition, the research will allow the quantitative results to be made available on the Web for use by resource managers and scientists.

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**Mark Schildhauer** **10/1/2007-9/30/2009** **400,000**
**Matthew B. Jones**
**O. James Reichman**
Andrew W. Mellon Foundation, SB080054

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

Kruger National Park (KNP) is faced with a challenge common to many research stations where dozens of loosely coordinated monitoring and experimental projects are underway at any time. The main challenge is how to effectively collect, present, and preserve this highly variable collection of scientific data for collaborative and integrative analyses. The Andrew W. Mellon Foundation has supported a partnership between Kruger National Park and the National Center for Ecological Analysis and Synthesis (NCEAS) over the past two years to address this informatics challenge by implementing and refining an approach for archiving KNP's scientific field data using methods developed and tested by NCEAS, the Long Term Ecological Research program, and other partners. The successful deployment of a metadata archive (Metacat) at KNP, along with two successful training workshops in its use, has validated the power and viability of this approach. Kruger National Park is now part of a global "Knowledge Network for Biocomplexity" (KNB), which is based on the use of metadata standards in ecology, particularly Ecological Metadata Language, or "EML" documents that are stored in Metacat database servers. This phase of the project entails the expansion of the data system to the broader collection of parks and research stations in South Africa, and the creation of the additional analysis infrastructure needed to effectively use these data in adaptive management approaches in the parks.

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**Mark Schildhauer** **2/1/2007-6/30/2007** **10,000**
California Ocean Science Trust, SB080106

**Background Analysis of Metadata Standards Relevant to Baseline and Monitoring Data Collections for MLPA Implementation**

A long-term need exists to facilitate integration and synthetic analyses of baseline and monitoring data collected in support of MLPA implementation to inform adaptive management of the state's MPA system and improved coastal stewardship more generally. Benefits also will accrue from making the MPA data broadly accessible to the research community. Metadata standards are a key tool that can aid in these processes. Increasingly, government programs that develop data in support of ecosystem and biodiversity management and assessment have adopted specific metadata standards. Guidance on metadata standards is under development for the nation's ocean observing systems. Several efforts are underway to gain broader adoption of metadata standards by individual investigators and programs across the research and museum communities. Various metadata standards now exist that might be applied to MLPS-related data collections. The practical challenge at hand is how to select a particular metadata standard for the baseline data that will soon be collected at the newly-designated MPAs in the Central Coast region. The results from this project will aid decision-makers in selecting the technical standard for baseline data collections for the Central Coast Region under MLPA by providing a balanced assessment of the strengths and weaknesses of various candidate metadata standards. Further, this analysis will usefully inform subsequent deliberation and decisions about metadata standards to be adopted for long-term monitoring of the statewide MLPA system.

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**Mark Schildhauer** **12/7/2007-1/7/2009** **1,036,961**
Gordon and Betty Moore Foundation, 1666

**Public Domain ADMB Project**

AD Model Builder (ADMB) is a tool for developing integrated statistical models of complex systems. The principal advantages of the ADMB software suite over other approaches are rapid model development, numerical stability, computational speed, precision of model estimates, and the capacity to accommodate relatively large numbers of parameters and data points. The ADMB software has earned acceptance by researchers working on all aspects of resource management.

Population models based on the ADMB software are used to monitor more than 150 different sensitive endangered species and commercially valuable fish stocks around the world. ADMB applications extend beyond stock assessment. This software is used for applications critical to the development of place-based management policies and is an essential building block of the methods used to reconstruct movements of many species of animals tracked with electronic tags. ADMB applications are critical to the missions of fishery management agencies in the United States and abroad. A group of world-renowned resource scientists have established a non-profit charitable organization, the ADMB Foundation, to acquire the ADMB software and establish a system for maintaining and distributing it. As part of this project, the PI's will establish a partnership between the ADMB Foundation and the National Center for Ecological Analysis and Synthesis (NCEAS), with the goal of placing the ADMB software in the pubic domain so that it can be freely distributed via the world wide web.

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**Mark Schildhauer** **5/1/2007-6/30/2008** **50,000**
**Matthew B. Jones**
**Joshua Madin**
National Science Foundation, DBI-07334849

**A Workshop for Advancing a Unified Model for Observational Data in the Ecological and Environmental Sciences**

Broad-scale ecological studies often require information assembled from multiple disciplines including biology (e.g., genetics, physiology, and paleontology), the physical sciences (e.g., geography, meteorology, and hydrology), and increasingly the social sciences (e.g., economics and sociology). In such studies, data heterogeneity creates major informatics challenges that include the need to better discover, access, interpret, and integrate relevant data collected by others. Despite advances made using metadata and community-wide data networks, science needs robust, open, and generic software systems that address the semantic ambiguities of heterogeneous data. New strategies for managing observational data are needed so that systems can better interpret the semantics of observations to resolve issues impending synthesis. For these systems to interoperate effectively, however, the scientific community must first unify the various existing approaches for representing observational data. A community-sanctioned data model for ecological and environmental observational data will provide an important mechanism for informatics efforts to enable interoperability among existing data resources, ultimately leading to improved, comprehensive, cross-disciplinary synthetic research. This workshop will engage a diverse and representative group of researchers to address issues of observational data modeling. The outcomes will help standardize existing and future information management systems that will significantly improve the ability of scientists to utilize ecological and environmental data archives, and for accessing any scientific data of an "observational" nature.

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**Russell Schmitt** **9/1/2004-8/31/2009** **4,334,460**
**Sally Holbrook**
National Science Foundation, OCE-0417412

**LTER: Long-Term Dynamics of a Coral Reef Ecosystem**

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

scientific community and the public have tremendous interest in and concern about conservation of coral reef ecosystems. This project will greatly increase understanding of these systems, and as such, will inform government officials, resource managers and others charged with conservation and management of coral reefs.

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**Russell Schmitt** **5/1/2007-6/30/2008** **15,000**
**Sally Holbrook**
UC Office of the President, SB070122

**The Conservation Technology Initiative**

Conservation science is in its infancy, yet there is a critical and growing need for more effective science-based conservation actions. A major hindrance to obtaining critical scientific information is the failure to develop and harness potentially powerful technologies. The investigators believe that quantum advances in the ability to manage and conserve critical living resources can result from a better coupling of technology and science where the technology infrastructure development is driven by the science. This project involves a model for such a "Conservation Technology" approach that has great potential for enabling revolutionary advances in conservation science and radically altering the ability to manage and conserve effectively the natural world. Achieving this vision requires a novel integration of disciplines, many of which traditionally have not worked together (e.g., ecology and engineering). The strategy is to tap appropriate expertise from several UC campuses (UCSB, UC San Diego, UC Santa Cruz and UC Davis) to focus initial developmental efforts around a common model ecosystem (coral reefs) and base of field operations (UCB's Gump Research Station). The science program that motivates this research has two inter-related goals, both of which require technological innovation and infrastructure. The first is to advance fundamental scientific understanding on issues relevant to conservation (e.g., What is the functional significance of biodiversity and hence, what are the most important aspects to conserve?). The second goal is to address the universally appreciated need for new - and more effective - conservation tools to resolve such urgent problems as the maintenance of biodiversity, the control of exotic species, the enhancement of depleted populations and the restoration of degraded habitats.

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**Russell Schmitt** **3/1/2008-2/28/2009** **7,500**
**Sally Holbrook**
UC Office of the President, SB080096

**UC LTER Network Planning Workshops**

The LTER program is the flagship of the environmental sciences at NSF, designed to explore ecological phenomena that occur over many decades. Hence, a core research theme concerns the responses of the focal ecosystem to climate forcing. UC administers three of the 26 LTER sites, all with a coastal marine focus: the Santa Barbara Coastal (SBC), California Current Ecosystem (CCE) and Moorea Coral Reef (MCR ) LTERs. Collectively, these three LTERs involve researchers and research facilities from 5 UC campuses as well as scientists from two California State Universities. The UC LTERs represent the most productive and economically important coastal marine ecosystems of the Pacific Rim: forests of giant kelp (SBC), coral reefs (MCR) and the coastal pelagic upwelling biome (CCE). This project is designed to capitalize on NSF's long term investment in research and information management infrastructures of the UC LTERs, to enhance the range of issues UC scientists can address and to implement a new model for cross-disciplinary training of graduate students across UC campuses. Such a framework would greatly improve our ability to advance knowledge by facilitating research on major issues that cannot be answered by studying at a single LTER site or ecosystem, but could be addressed effectively using a network - level approach.

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**Russell Schmitt** **7/1/2001-6/30/2008** **1,540,000**
UC Toxic Substances Research and Teaching Program, SB020063

**Coastal Toxicology Component of the UC TSR &TP**

The overall objective of the Coastal Toxicology Program is to help resolve pollution-related environmental problems in California's aquatic ecosystems. This is accomplished by facilitating

faculty research on appropriate issues, and by providing students with research and training opportunities in environmental toxicology. The resolution of environmental problems requires interdisciplinary efforts and accordingly, the Coastal Toxicology Program is comprised of a network of UC scientists from the Santa Barbara, Santa Cruz, Davis and Los Angeles campuses as well as Scripps Institution of Oceanography, Bodega Marine Lab and Lawrence Berkeley Lab.

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**Stephen Schroeter** **7/1/2006-12/31/2008** **40,000**
California Sea Urchin Commission, SB070019

**Studies of Sea Urchins Settlement in Southern and Northern California**

The patterns of settlement of red (Strongylocentrotus franciscanus) and purple (S. purpuratus) sea urchins may have important impacts on the commercial fishery and provide an important fishery-independent measure of stock health. The investigators have monitored weekly to bi-weekly sea urchin settlement at multiple sites in southern and northern California since February 1990. Studies to date have identified spatial and temporal patterns in sea urchin settlement (including the effects of periodic El Niños and La Niñas) and have identified some of the likely mechanisms responsible for these patterns. They have added value to their work by volunteering their time and collaborating with University researchers and private industry. In particular, work done in collaboration with Jan Svejkovsky of Ocean Imaging has given important insights into the effects of large-scale oceanographic forcing on sea urchin settlement patterns, while collaborative work on population genetics with Dr. Ron Burton has shed light on the structure of parental source populations during a heavy settlement event. Perhaps most importantly, their long-term and geographically extensive record of sea urchin settlement continues to provide the only integrated, fishery independent index of the condition of the breeding stock, since larval supply and settlement are a function of the effective breeding population. The value of this inexpensive tool for monitoring the health of the sea urchin resource in California increases each year the study is continued.

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**Stephen Schroeter** **1/1/2006-12/31/2007** **1,617,689**
**Daniel Reed**
**Henry Page**
Simpson and Simpson Business and Personnel Services, Inc., SB060076

**San Onofre Nuclear Generating Station Mitigation Project Monitoring Program - Wetland**

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

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**Nicholas Shears** **10/1/2006-6/30/2008** **106,160**
**Steven Gaines**
Foundation for Research Science and Technology, UCAL0601

**The Effect of Marine Reserves on Recruitment, Exploited Species and Fishing**

There is a need for sound scientific information on the ecological and socio-economic impacts of Marine Protected Area (MPA) networks. While MPAs are predicted to benefit local fisheries through "spillover" of adults and increased larval output from MPAs (recruitment effects), they may also have negative effects on fishing through reducing the available fishing area and displacing fishing effort. Demonstrating and understanding the potential recruitment effects of MPAs and determining whether they can compensate for increased fishing effort in fished areas requires a detailed

understanding of the interactions between physical oceanography, recruitment, target populations and fishing effort. The PI will use numerical modeling and empirical field studies to investigate the interaction between MPA networks and fishing. His work will form part of an ongoing large-scale interdisciplinary project investigating the relationship between physical oceanography, larval dispersal, fishing and the effects of MPAs in the California Channel Islands marine reserve network.

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**Mark Steele** **10/1/2002-9/30/2007** **120,264**
University of Rhode Island, 030603/532577

**A Test for Shelter Limitation of Reef Fish Populations at Large Spatial Scales: An Integrated Empirical and Theoretical Approach**

Overall, this project includes monitoring of reef fish population dynamics, a large-scale field experiment, and mathematical modeling of reef fish population dynamics. It includes three investigators: Dr. Graham Forrester, the principal investigator at the University of Rhode Island; Dr. Mark Steel, who was originally the co-PI at URI, but who has now moved to UC Santa Barbara where he will be the PI on the UCSB subcontract; and associate investigator Dr. Rick Vance who is the PI on the subcontract to UCLA. All three investigators collaborated on the prior award from NSF for which the present project is a renewal. The three investigators will collaborate in most aspects of the current award. At UCSB, Dr. Steele will be responsible for directing fieldwork, managing and analyzing data, preparing reports and publications. Dr. Steele will be involved with field research and will recruit and train UCSB students to analyze otolith growth increments and assist the research as necessary.

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**David Valentine** **9/1/2006-8/31/2008** **80,000**
American Chemical Society, 44969-AC2

**Community Succession and Hydrocarbon Oxidation in Marine Microbial Mats: An In-situ Time Series Experiment**

Microbial mats develop and thrive at the oxic-anoxic interface in marine environments, acquiring energy by oxidizing sulfide to elemental sulfur and sulfate. Microbial mats are abundant in areas of petroleum seepage and are thought to be fueled by sulfide produced in the subsurface during anaerobic petroleum oxidation; a direct role for microbial mats in petroleum oxidation has not been established. This research investigates the development of microbial mat communities and their role in petroleum oxidation through a series of in-situ experiments at a marine hydrocarbon seep field located in shallow water off the coast of Central California. The PI will fabricate and deploy benthic devices over natural petroleum seeps to serve as modular surfaces for the development of microbial mat communities. Devices will be deployed overlying seeps of distinct gas and oil composition, and samples from the modular surface will be collected regularly to provide for a time series of biological and geochemical analyses. Changes in the bacterial community will be followed using molecular biological tools including automated ribosomal intergenic spacer analysis and 16SrDNA sequencing. Growth of the overall community will be tracked by carbon and nitrogen abundance. Development of petroleum-oxidizing activity will be tracked through the abundance and isotopic composition of lipid biomarkers. This work will be the first to quantify the rates and patterns of mat development in natural petroleum seeps and is important because mats are one natural mechanism by which marine bacteria detoxify harmful chemicals such as sulfide and petroleum.

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**David Valentine** **4/1/2007-3/31/2008** **270,000**
Methanogenesis Corporation (Canada), SB070096

**Methane from Deep Coal: Enrichment, Isolation and Characterization of Subsurface Methanogenic Communities**

The goals of this project are to isolate, identify and characterize microbes active in coalbed methanogenesis with the ultimate goal of using this knowledge to develop strategies to accelerate in situ biogas production within deep coal deposits. Using samples collected from deep coal deposits, the investigator will isolate the most active and important members of the microbial community, including both fermentative and methanogenic organisms. The physiological characteristics of the isolates will be investigated for their suitability toward in situ gas production. Isolates will also be

combined to allow for investigation of defined consortia, which are expected to have the greatest capacity for methane generation at natural subsurface conditions.

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**David Valentine** **4/15/2005-3/31/2010** **516,399**
National Science Foundation, 0447395

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

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

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**David Valentine** **8/31/2003-7/31/2007** **299,670**
National Science Foundation, EAR-0311894

**Collaborative Research: Hydrogen Isotope Biogeochemistry of Anoxic Environments - Field and Laboratory Studies**

The goal of this project is to develop compound-specific hydrogen isotope analyses as a tool for process-oriented biogeochemical studies of anoxic environments. Analytical techniques are now well established, and the next major hurdle is to understand the biochemical controls on isotopic distributions in these environments. This study will seek such understanding through a combination of field and laboratory studies, implemented as a collaboration between PI's at Caltech and UC Santa Barbara. Research will focus on sulfate-reducing bacteria (SRB) due to their quantitative importance for carbon cycling in marine settings. The results of this research are potentially important for a wide range of scientific disciplines, including microbial ecology (novel approaches for quantifying the importance of interspecies hydrogen transfer in microbial communities), carbon cycling (isotopic mass-balance estimates of organic matter remineralization by anaerobic processes), organic geochemistry (identification of lipids produced by H2-consuming microbes), paleoclimatology (improved understanding of the preservation of organic D/H ratios during diagenesis), Earth system history (novel tools to study redox conditions of the geologic past) and biochemistry (methods for identifying the cellular location of hydrogenase enzymes).

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**David Valentine** **9/1/2006-8/31/2009** **334,398**
National Science Foundation, MCB-0604191

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

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

microbes of this environment. Furthermore, this work will lead to an understanding of the microbial ecosystem present in the sediments of the Salton Sea, which may become useful to policy makers as this lake begins to dry.

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**J. Herbert Waite** **7/1/2007-6/30/2008** **50,000**
UC Biotechnology Research and Education Program, 2007-02

**Self-Healing Bio-Inspired Polymers: Structure and Mechanics**

Self-healing materials are a group of materials that, when extreme stresses break internal bonds and deform it, the material can reform the broken bonds and regain its original shape and mechanical properties after the stress is removed, with no outside aid. There are numerous uses for self-healing materials including, but not limited to, biomedical applications, construction, aerospace, and robotics. Many naturally occurring materials show self-healing properties, some that are more impressive than what is currently synthesized in labs. An example of this is WECB (whelk egg capsule biopolymer), produced by a group of sea snails, genus Busycon (the whelks), to protect their eggs. This material is composed of protein, but does not contain cells, is elastic, and shows remarkable self-healing properties. By studying the chemistry of the individual molecular components, and how they are processed and arranged into the macroscopic material, it will be possible to create novel materials that have similar mechanical properties, but will be better suited for use in industry. A variety of techniques from different fields will be used to study this material including biochemistry, molecular biology, materials science, and engineering. Research of this kind will lead to the next generation of high-performance materials.

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**J. Herbert Waite** **3/1/2007-2/28/2009** **159,902**
UC Sea Grant, R/MP-97

**Studies on the Rapid Self-Assembly of Elastic Tensile Fibers from Natural Protein Polymer Found in Marine Snails**

The development and fabrication of new tensile materials based on biomimetics is of broad industrial and biomedical interest. Because biological materials are synthesized in aqueous conditions and at ambient temperatures with highly specialized molecules, they offer considerable potential for design of new materials. Additionally, the synthesis of novel materials now emphasizes the use of molecules that organize spontaneously into hierarchically complex structures in differing environments. With self-assembly, materials can be produced with lower energy cost and reduced dependence on fabrication machinery or environmentally damaging processing. Marine organisms synthesize many structural materials that withstand repeated tensile stresses or protracted periods of time in the harsh marine environment. Recently, the PI and collaborators characterized an elastomeric protein polymer comprising the egg capsules of marine snails and found that it is a highly extensible elastic material with unusual mechanical behavior they termed "recoverable-yield". The goal of this part of the project is to complete biochemical characterization and to study the mechanism of self-assembly in this natural polymer in order to elucidate the molecular basis for its novel elastic properties, and to mimic these properties in fibers produced experimentally in vitro.

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**Robert Warner** **9/8/2007-9/7/2008** **18,000**
National Geographic Society, 8079-06

**Unexpected Indirect Consequences of Predator Removal on Coral Reef Community Structure**

The objectives of this research are twofold and will draw on collective expertise in the fields of population and community ecology, behavioral ecology and marine biogeography. The first goal is to understand the patterns of spatial abundance and distribution of key reef organisms and reef features as they relate to one another. This will serve to verify the differences in community structure between the two areas and allow an estimate of relative risk of predation. To do so, it will be necessary to quantify the abundance and distribution of a subset of species in key trophic levels (i.e., predatory and herbivorous fishes and algal biomass) as well as the distribution of different habitat types in a fine-resolution (to the nearest 5cm) spatially-explicit framework. Using this grid-based approach will allow the identity and location of focal species within each trophic group to be spatially 'mapped'

onto one another and onto habitat type. The second objective will be to quantify behavioral responses of herbivorous fishes (prey) to the risk imposed by the presence of their predators (i.e., piscivorous fishes). This will be accomplished by measuring behavioral characteristics relevant to the risk-reward trade-off imposed by predation risk on herbivorous fish species. For example, researchers will quantify variables such as duration and distance of herbivore foraging excursions from refuge areas and density of foraging and spawning aggregations in order to compare behaviors of prey species between the two islands with different levels of predation risk. For this purpose, two divers will descend and allow a short period of 'habituation' to diver presence to occur. For each of the focal behaviors and for each focal herbivore group (e.g., territorial, roving, etc.), one 30-minute survey will be done.

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**Robert Warner** **4/1/2004-3/31/2009** **268,137**
**Steven Gaines**
National Science Foundation, OCE-0351843

**Collaborative Research: Tracking Larval Invertebrate Dispersal Trajectories Using Calcified Structures**

Many marine species produce pelagic larvae that can be advected away from their natal source by oceanic currents. Predicting their destination has been one of the foremost challenges for marine biologists. The potential interactions among larval swimming behaviors, complex ocean circulation dynamics, and variability in pelagic duration make it difficult to predict the sources of larvae settling into adult habitat. Yet, identification of the natal source of incoming recruits has tremendous consequences for understanding population dynamics as well as for the design of effective marine reserve networks. Fish biologists have successfully exploited otoliths as environmentally induced natural tags to examine exchange among fish populations in some systems. Despite pressing needs to also understand the dispersal trajectories of invertebrate larvae, ecologists have paid less attention to analogous environmentally induced tags in larval invertebrate hard parts. Invertebrate ecologists only recently demonstrated the potential to use the elemental composition of molluscan statoliths and protoconchs as tags of natal origin. However, to date, no study has effectively used this tool to identify the natal source of any marine invertebrate recruit. This research will use environmentally induced tags in the statoliths of recently recruited Kelletia kelletii whelks to examine exchange of larvae among distinct regions of this species' range.

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**Robert Warner** **7/1/2006-8/31/2008** **211,838**
**Jennifer Caselle**
UC Office of the President, 06CEQI070034

**Assessing the Assessment: New Models for Informing the Design of Monitoring and Evaluation Programs for Kelp Forest Ecosystems in California's MPAs**

Through this collaboration of researchers at UC Santa Cruz and UC Santa Barbara, the investigators are conducting critical and timely studies required of a monitoring and evaluation program for Marine Protected Areas (MPAs) designed to protect kelp forest ecosystems in California's Channel Islands and central coast. This research is being designed and conducted so as to provide managers with baseline monitoring at a time when it is most critical to the success of a long-term monitoring program for the evaluation of the existing (Channel Islands) and proposed (central California) MPA networks. The studies are aimed at developing optimal, cost-effective monitoring programs for kelp forest ecosystems in the recently implemented Channel Islands Marine Reserves (CIMR) and the existing and impending MPA network in the Central Coast Study Region (CCSR). The basis of this research includes three key components: 1) analysis of the PIs' and other historical kelp forest monitoring data sets, 2) specific studies conducted by PIs, post-docs, collaborators and graduate students intended to produce a well-documented baseline and to evaluate components of monitoring and evaluation design, and 3) conducting these studies at sites in order to expand existing monitoring to key locations in response to recently implemented (CIMR) and proposed (CCSR) MPAs.

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**Libe Washburn** **2/1/2005-1/15/2009** **1,191,380**
UC San Diego, 0478.01SB

**Short-Medium Range Resolution/Long Range HF Radars-Task A.1**

As part of the Southern California Coastal Observing System (SCCOOS)m UCSB will collaborate with other institutions in the Southern California Bight, including Scripps Institution of Oceanography, USC and CalPoly San Luis Obispo to operate an array of HF radars for mapping surface currents. This portion of the project involves purchase, installation, calibration and operation of approximately twenty-one HF Radar installations. The installation consists of the placement of HF radar mast, antenna and associated computer hardware and shelter.

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**Libe Washburn** **2/1/2005-1/15/2009** **43,650**
UC San Diego, 0478.03SB

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

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

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**Kristen Whalen** **12/31/2099-00/00/00** **181,660**
**Gretchen Hofmann**
National Science Foundation, OISE-0754319

**PostDoctoral Research Fellowship**

Body

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**Corwith White** **10/13/2005-10/12/2008** **78,000**
**Bruce Kendall**
American Assn for the Advancement of Science, SB060039

**Population Connectivity and the Management of Coastal Fishery Species across the California-Mexico International Border**

This project focuses on the interconnections between populations of fish and invertebrate species on either side of the California-Mexico international border. Despite the fact that California is moving quickly toward promoting sustainable harvest through ecosystem-based management approaches in its own waters, there has been little consideration of the role of other regions in supplying individuals. Indirect evidence suggests that ocean currents may cause a significant number of marine communities in California to depend on larval re-seeding from Baja, Mexico, with populations in Channel Islands National Park being particularly susceptible to fluctuations in recruitment from southern source locations. Without consideration of the role of cross-border connectivity, California and National Park Service efforts to safeguard their populations and create sustainable harvests will be misinformed and likely unsuccessful. The graduate student researcher will estimate the frequency, direction, and magnitude of larval exchange across the US-Mexico border using oceanographic and state-of-the-art genetic tools, and will evaluate using a modeling framework for implications of cross-border connectivity on conservation and management of fishery resource populations shared by both countries. Current and novel management strategies will be explored to identify practical solutions providing for successful management of an ensemble of valuable fishery species along the west coast of North America.

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**Allison Whitmer** **12/1/2006-9/30/2007** **12,224**
Coastal Fund (formerly SPF), Fall 06-02

**REEF Aquarist and Mobile REEF Internship Program**

This program offers UCSB undergraduates an opportunity to extend their learning outside of the lecture hall through experiential education in marine and environmental science. Aquarist interns learn about aquarium facility operation, exhibit design and construction, and husbandry, as well as research support. Aquarists serve as techs for the Blue Water Task Force. Mobile REEF interns learn to coordinate and operate the Mobile REEF Unit (van and mobile touch tank) for transport to local schools and public events to teach about local coastal ecosystems and natural history. REEF interns also assist the REEF manager in training volunteer undergraduates in conducting the REEF Tour Program. There is a strong public education component, as volunteers and interns conduct tours for the public and K-12 classes at the REEF and through visits to tri-county classrooms.

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**Allison Whitmer** **9/1/2006-8/31/2008** **93,379**
COM-National Oceanographic & Atmospheric Administration, NA06NOS4290203

**Mobile REEF Program: A Vehicle for Scientific Literacy**

Trained staff will take the Mobile REEF, a specially designed van, to classrooms in Santa Barbara and Ventura Counties to provide a hands-on, inquiry based program. This program will provide students with an introduction to organisms, habitats and ecosystems occurring in regional watersheds and extending out to the Santa Barbara Channel Islands. The focus will be on on-going research conducted by researchers from the Channel Islands National Marine Sanctuary, the Santa Barbara Coastal Long-Term Ecological Research project, and the Partnership for Interdisciplinary Studies of Coastal Oceans. Materials will include stream, estuarine, sandy beach, rocky intertidal and oceanographic studies. Use of the Magic Planet (a multimedia digital imagery sphere) will allow program staff to connect local ecosystems with global ocean systems and issues. This Meaningful Watershed experience includes classroom group-based activities, mobile touch tanks and guided field trips. It will empower students with the critical thinking skills necessary to excel in education and make informed decisions about the policies that will affect their environment..

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**Robert Wilkinson** **12/2/2005-9/30/2007** **114,560**
UC Santa Cruz, SB060086

**Developing a Tool to Guide State and Local Desalination Planning: A Comprehensive Economic and Environmental Framework to Fully Assess the Benefits and Costs of Desalination**

This research involves: 1) undertaking a literature review of desalination cost and benefit research; 2) identifying, securing, reviewing, and analyzing the cost and benefit analyses of existing and proposed desal plants; and 3) reviewing and analyzing the documents provided by agency participants as in-kind contributions. The core of the work is a series of workshops designed to help develop a thorough understanding of the potential costs and benefits of desalination as an urban water supply strategy.

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**Michael Williams** **12/15/2003-11/30/2008** **225,757**
**Joshua Schimel**
**William Murdoch**
**Susan Swarbrick**
National Science Foundation, NSF DBI 0330442

**Sedgwick Reserve Infrastructure Development**

Sedgwick Reserve is one of the largest reserves in the University of California's Natural Reserve System. It is exceptional for its biological diversity and landscape heterogeneity. The Reserve is available for use as a research site and outdoor classroom by researchers, teachers and students from any institution of higher learning, government agency or scientific organization. Located about 50 km northwest of the UC Santa Barbara campus, on the slopes of the San Rafael Mountains, Sedgwick Reserve has become a site for both important ecological research and for major outreach activities in environmental education. This grant provides support to upgrade the Reserve's existing infrastructure in preparation for a new multipurpose building funded by UC. The University's

long-term goal is to provide facilities that would support world-class environmental research and university-level instruction, as well as K-12 environmental education, while restoring and preserving Sedgwick's natural resources.

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**Douglas Wilson** **7/10/2005-6/28/2008** **40,012**
Joint Oceanographic Institutions, Inc., JSA-44 T309A44

**Integrated Ocean Drilling Program Scientific Cruise 309**

In contrast to mid-latitude sites, the formation of ODP Site 1256 at the Miocene equator does not allow unambiguous absolute orientation using paleomagnetic remnant directions. Additionally, many paleomagnetic basement samples from Site 1256 have proven to be unreliable in the presence of drilling overprint. Most Hole 1256D samples of length greater than 10 cm have been optically scanned prior to splitting, both for ODP Leg 206 and IODP Expedition 309. This project will integrate the scanned images of core pieces with logging images from the FMS and UBI tools, with the primary goal being to provide unambiguous piece orientation for structural and paleomagnetic purposes. Benefits of the work will include determination of magnetic polarity, a critical component of the Expedition's objectives on constraining the source of marine magnetic anomalies, and providing orientation for structures such as microfaults, where information on sense of shear from the core will provide much more information than just interpretation of the logging images.

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**Douglas Wilson** **11/12/2005-8/31/2007** **43,991**
Joint Oceanographic Institutions, Inc., T312A44

**Integrated Ocean Drilling Program Scientific Cruise 312**

Shipboard paleomagnetic measurements during Expedition 312 were limited by conservative sampling strategy in low recovery, intended to preserve material for shore-based sampling, and also by the limitations of the shipboard magnetics lab. Samples in general showed incomplete removal of drilling overprint. Thermal demagnetization, important for estimating blocking temperature at which intrusive rocks acquired their magnetization, was done on only eight samples due to recovery and time constraints. New measurements in a shore-based lab will offer significantly better characterization of the magnetization prior to drilling overprint. Integration of sample data with downhole magnetic field data provides the best chance of determining in situ magnetization direction and intensity. Characterization of in situ magnetization will address fundamental questions on the source layer of marine magnetic anomalies.

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**Louie Yang** **9/1/2006-9/30/2008** **92,243**
**Jonathan Levine**
UC Office of the President, SB070021

**The Ecology of Rare Events: Resource Pulses in Space and Time**

The Postdoctoral Fellow's research focuses on the consequences of spatial and temporal variability in natural communities, and, in particular, the influence of rare events of large magnitude on ecological systems. Resource pulses are uncommon events of resource superabundance that occur in many natural systems; for example, post-spawning salmon mortality and seed masting. These events are of broad interest because they represent extreme examples of spatiotemporal variability found in all natural systems. This phase of the postdoctoral study will have four parts: 1) Continued gathering of broader insights into resource pulses and spatial subsidies through review, meta-analysis and theoretical approaches; 2) Continued study of periodical cicadas as resource pulses during the cicada emergences of 2007 and 2008, with specific questions investigating indirect effects of cicada fertilization on other herbivores, and the integrated effects of cicada fertilization and herbivory; 3) Study of the effects of variable resource dynamics in other systems, including ongoing work investigating the effects of hurricane-driven seaweed pulses on small islands in the Bahamas; 4) Development of similar questions in a California field system, possibly to study the effects of windblown detritus in alpine habitats.

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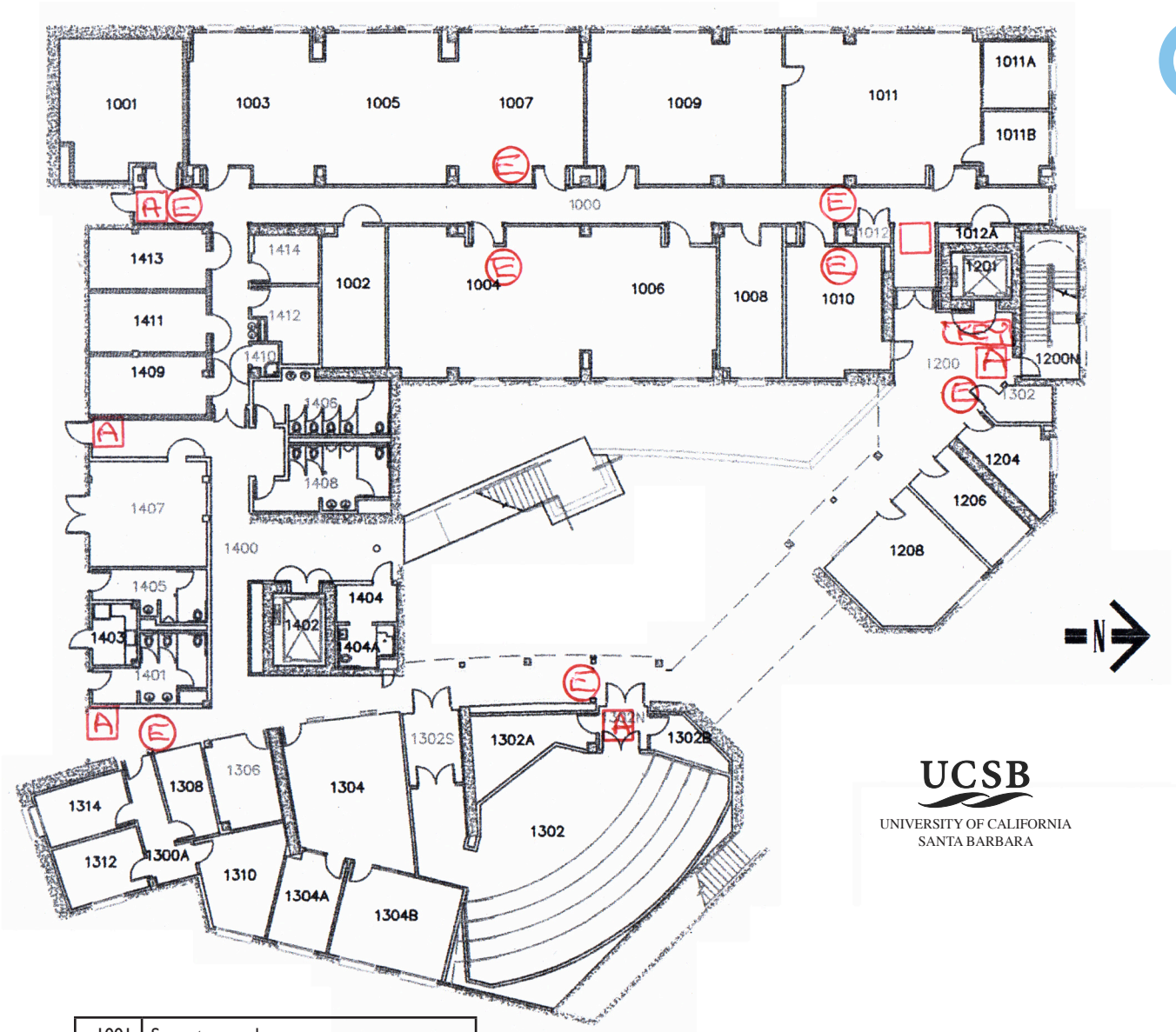
**Oran Young** **2/1/2007-1/31/2009** **61,941**
UC Sea Grant, R/OPCENV-02

**Facilitating Ecosystem-Based Management Through a Quantitative Evaluation of Ocean Management Systems Interplay**

Fragmented sector-based management is a source of today's problems with ocean health. Ocean management traditionally has been divided into individual sectors, such as transportation, mining, and fishing. Due to increased coastal populations and improved technology, uses affecting the ocean have increased, resulting in overlapping laws that regulate different activities. Inconsistent management and lack of coordination across political jurisdictions between sectors has resulted in sector-based management. When one sector makes a decision, it can result in unintended consequences for other sectors. The goal of this project is to facilitate implementation of Ecosystem-Based Management (EBM) for California's coastal and marine ecosystems. Because ecosystems span across political borders, this study focuses on the entire California Current Large Marine Ecosystem, extending from Washington to south of Baja, Mexico and seaward approximately 500 nautical miles. This large marine ecosystem, bounded by bathymetry and current systems, is one of the most productive marine regions in the world and is heavily populated. This project will assess uncoordinated and conflicting marine management between California and other jurisdictions (Oregon, Washington, Baja, and Mexico) quantitatively and comprehensively, which has never been done before.

# Space

# Marine Science Research Building
# Bldg. No. 520 - 1st floor
# 06/2008

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|---|---|
| 1001 | Seawater workroom |
| 1002 | Common support laboratory |
| 1003 | Valentine laboratory |
| 1004 | Page/Dugan laboratory |
| 1005 | Valentine laboratory |
| 1006 | EPA laboratory |
| 1007 | Siegel laboratory |
| 1008 | Postdoc/Visiting Scholar office |
| 1009 | Analytical Laboratory |
| 1010 | Hazardous Materials Storage |
| 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 |

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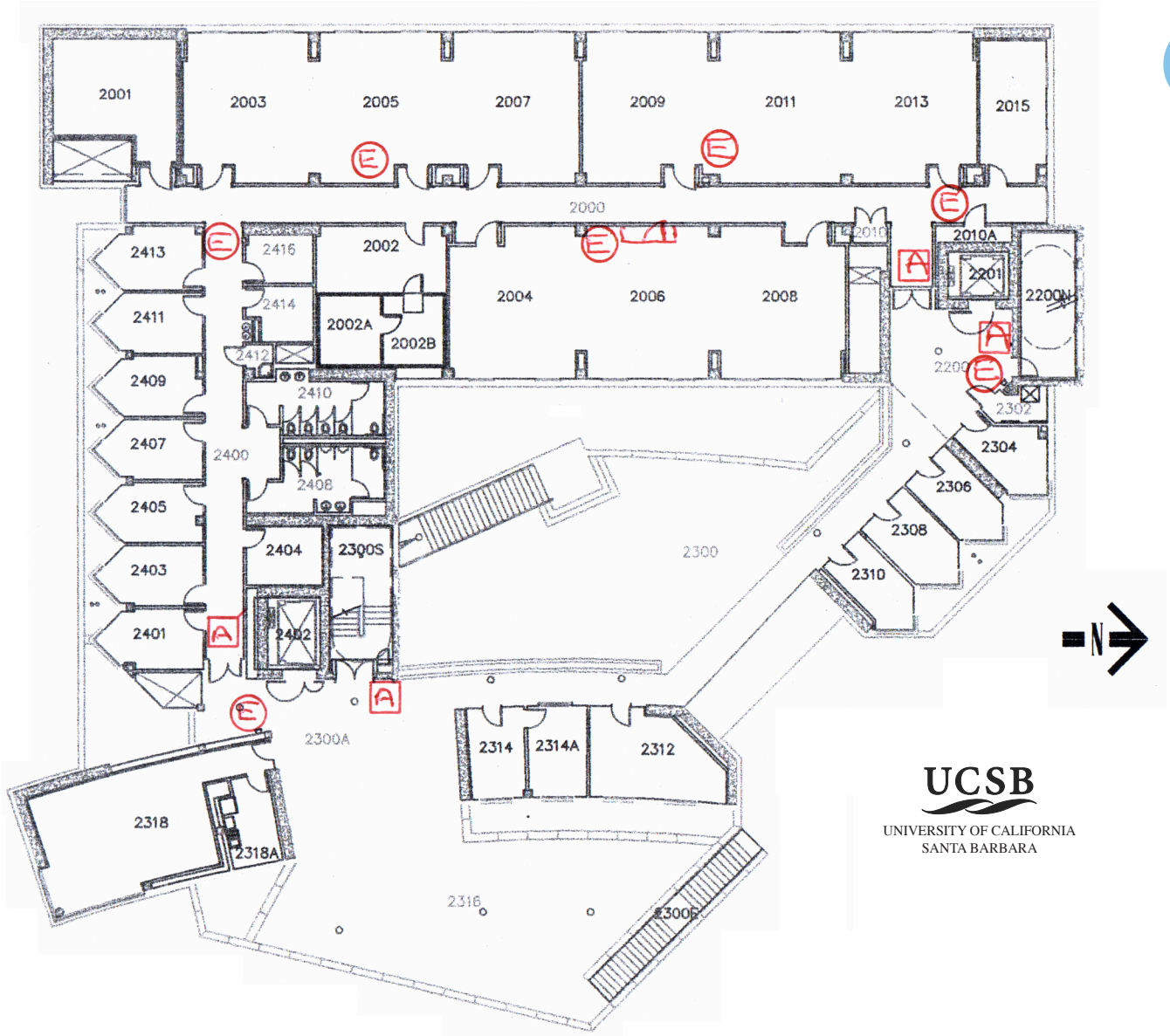
# Marine Science Research Building
# Bldg. No. 520 - 2nd floor
# 06/2008

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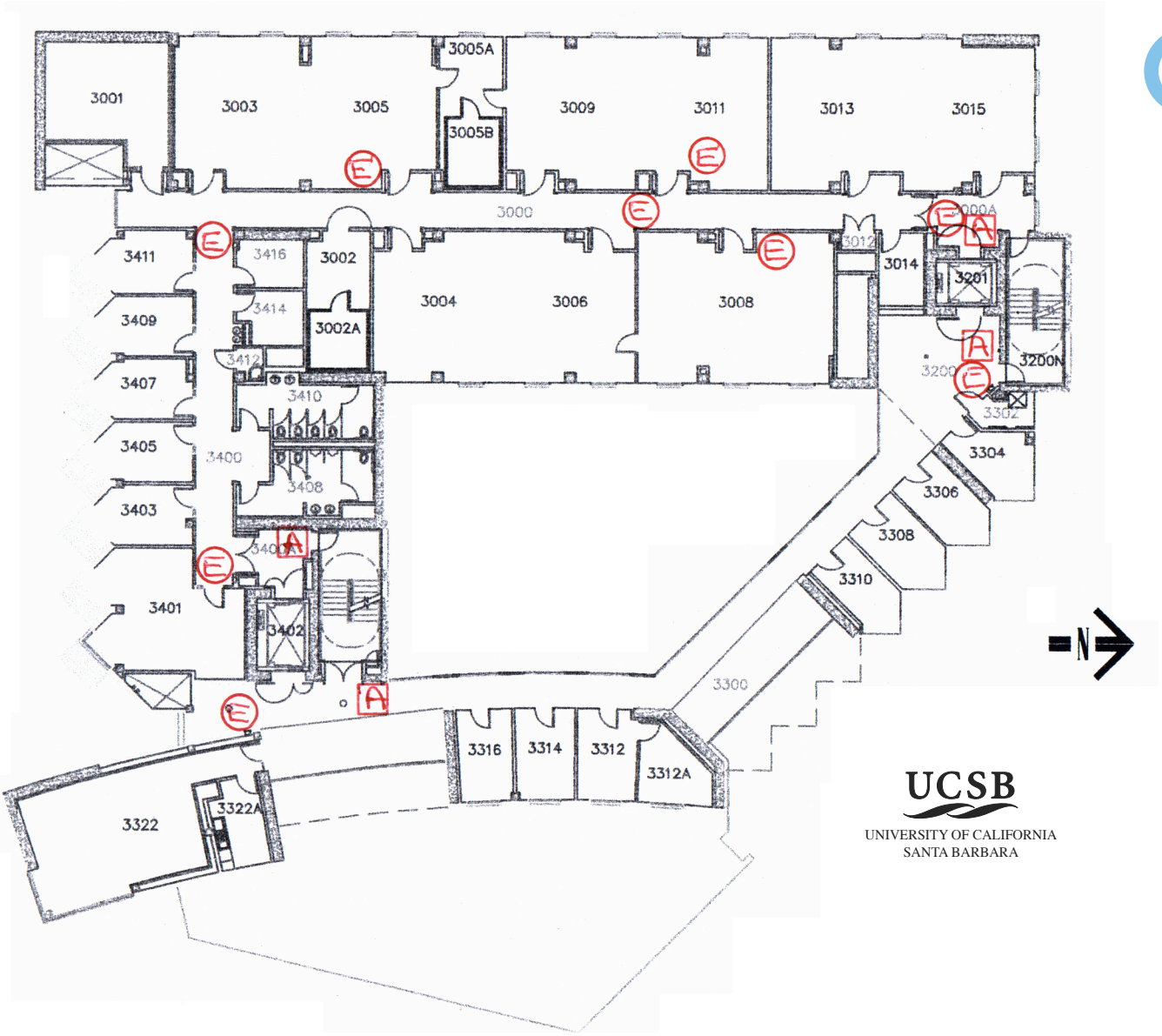
| | |
|---|---|
| 2001 | Seawater workroom |
| 2002 | Common support laboratory |
| 2002a | Environmental room |
| 2002b | Environmental room |
| 2003 | Hofmann laboratory |
| 2004 | Quetin/Ross laboratory |
| 2005 | Hofmann laboratory |
| 2006 | Quetin/Ross laboratory |
| 2007 | Hofmann laboratory |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

| | |
|---|---|
| 2013 | Gaines laboratory |
| 2015 | Will McClintock |
| 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
# 06/2008

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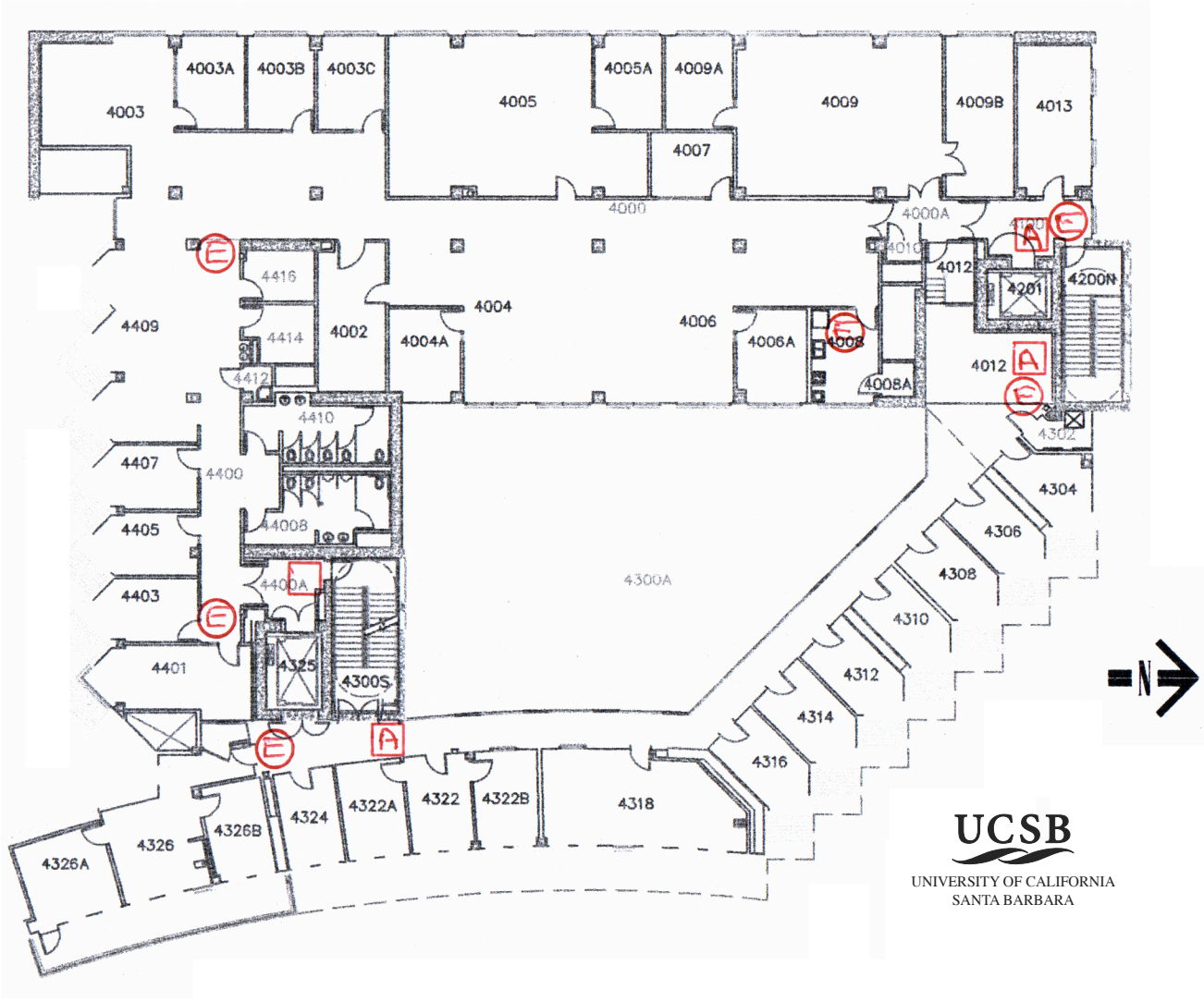
| | |
|---|---|
| 3001 | Seawater workroom |
| 3002 | Common support laboratory |
| 3003 | Reed laboratory |
| 3004 | Holbrook laboratory |
| 3005 | Reed laboratory |
| 3005a | Common support laboratory |
| 3006 | Schmitt laboratory |
| 3008 | Gaines laboratory |
| 3009 | Warner laboratory |
| 3011 | 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 | Margaret O'Brien/Jordan Morris/ Sabine Grabner |
| 3403 | Econinformatics – Kevin Drury |
| 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
# 06/2008




| | |
|---|---|
| 4002 | Copier/mail room |
| 4003a | Ocean O'Graphics – Monica Pessino |
| 4003b | Storage |
| 4003c | Joyce Wolever |
| 4004A | Rachel Whitacre |
| 4004d | Mieke DeMeo |
| 4005A | Elvira Rose |
| 4005a | India Morgan |
| 4005b | Veronica Torres |
| 4005c | Nicole Zavala |
| 4005e | vacant |
| 4006A | |
| 4006a | Donna Dobis |
| 4006b | Joanna Kettmann |
| 4006e | Mike O'Neil |

| | |
|---|---|
| 4007 | Conference room |
| 4008 | Break room |
| 4009B | Server room |
| 4009b | Jim Woods |
| 4009d | Mike Franklin |
| 4012 | IT storage |
| 4013 | Shipping/receiving |
| 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 |
| 4324 | 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 | Miriam Polne-Fuller |
| 325-e | Jack Engle |
| | |
| 334-a | Scott Simon |
| 334-b | REEF |
| 334-c | REEF |

# Statistical Summary

# Research Support Summary

| | | Awards | Percentage of Total |
|---|---|---|---|
| **Federal Agencies** | | | |
| National Oceanic & Atmospheric Administration | $ | 132,856 | 0.52% |
| National Aeronautics and Space Administration | | 172,061 | 0.67% |
| National Science Foundation | | 9,790,499 | 38.02% |
| UC Sea Grant | | 149,640 | 0.58% |
| US Department of Commerce | | 253,131 | 0.98% |
| US Department of the Army | | 200,000 | 0.78% |
| US Environmental Protection Agency | | 16,107 | 0.06% |
| US Fish & Wildlife Service | | 299,021 | 1.16% |
| US Forest Service | | 94,566 | 0.37% |
| USDI - Minerals Management Service | | 1,130,000 | 4.39% |
| **Federal Totals** | | **$ 12,237,881** | **47.53%** |
| **State** | | | |
| California Coastal Conservancy | $ | 371,187 | 1.44% |
| California Dept of Water Resources | | 100,000 | 0.39% |
| California Department of Fish and Game | | 21,116 | 0.08% |
| California Department of Parks and Recreation | | 49,844 | 0.19% |
| California Energy Commission | | 29,700 | 0.12% |
| California Regional Water Quality Control Board | | 130,000 | 0.50% |
| Coastal Fund (formerly SPF) | | 13,604 | 0.05% |
| Santa Monica Bay Restoration Foundation | | 75,602 | 0.29% |
| UC Agriculture and Natural Resources | | 102,772 | 0.40% |
| UC Davis | | 180,000 | 0.70% |
| UC MEXUS | | 19,500 | 0.08% |
| UC Office of the President | | 233,078 | 0.91% |
| UC San Diego | | 498,851 | 1.94% |
| UC Santa Cruz | | 84,924 | 0.33% |
| UC Sea Grant | | 168,594 | 0.65% |
| UC Toxic Substances Research and Teaching Program | | 19,500 | 0.08% |
| **State Totals** | | **$ 2,222,636** | **8.14%** |

## Private

| | | | |
|---|---|---|---|
| Andrew W. Mellon Foundation | $ | 600,000 | 2.33% |
| California Ocean Science Trust | | 10,000 | 0.04% |
| California Sea Urchin Commission | | 19,555 | 0.08% |
| Channel Islands Marine Resource Institute | | 11,384 | 0.04% |
| Commonweal | | 20,219 | 0.08% |
| David and Lucile Packard Foundation | | 1,150,000 | 4.47% |
| Dersu & Associates | | 17,150 | 0.07% |
| Foundation for Research Science and Technology | | 53,080 | 0.21% |
| Gordon and Betty Moore Foundation | | 2,451,196 | 9.52% |
| Larry Walker Associates, Inc | | 8,423 | 0.03% |
| Marine Conservation Biology Institute | | 10,000 | 0.04% |
| Marisla Foundation (formerly Homeland Foundation) | | 1,000,000 | 3.88% |
| Michigan State University | | 50,569 | 0.20% |
| National Academy of Sciences | | 20,000 | 0.08% |
| Oregon State University | | 1,641,870 | 6.38% |
| Paul G. Allen Charitable Foundation | | 1,100,000 | 4.27% |
| Resources Legacy Fund Foundation | | 474,811 | 1.84% |
| Santa Clara University | | 14,494 | 0.06% |
| Seaweb | | 18,500 | 0.07% |
| Simpson and Simpson Business and Personnel Services, Inc. | | 2,078,317 | 8.07% |
| Society for Conservation Biology | | 78,184 | 0.30% |
| The Nature Conservancy | | 309,494 | 1.20% |
| University of Miami | | 73,795 | 0.29% |
| University of Southern California | | 55,000 | 0.21% |
| WetLabs, Inc. | | 30,000 | 0.12% |
| Wilburforce Foundation | | 100,000 | 0.39% |
| Wildlife Conservation Society | | 17,000 | 0.07% |
| **Private Totals** | | **$ 11,288,677** | **44.33%** |
| **Total** | | **$ 25,749,194** | **100.00%** |

# Budget Summary
# 2007-2008

| Permanent Funds | FTE | Appropriation | Expense | Balance |
|---|---|---|---|---|
| Academic Salaries | | | | 0 |
| Director | | | | 0 |
| Stipend—Director | | 18,000 | 0 | 18,000 |
| Stipend—Acting Director | | 0 | 18,000 | -18,000 |
| Other | 0.75 | 31,014 | 38,866 | -7,852 |
| Staff Salaries | 13.65 | 897,701 | 817,035 | 80,666 |
| General Assistance | | 30,523 | 362,483 | -331,960 |
| Employee Benefits | | 336,939 | 334,225 | 2,714 |
| Supplies & Expense | | 31,589 | 0 | 31,589 |
| Travel & Equipment | | | | 0 |
| Other | | | | 0 |
| **Total** | | **1,345,766** | **1,570,609** | **-224,843** |
| Less budgetary savings target | | | 24,130 | -24,130 |
| **Adjusted 2007-08** | | **1,345,766** | **1,546,479** | **-248,973** |

| Temporary Funds | Appropriation | Expense | Balance |
|---|---|---|---|
| A-21 Return/General Operations | 512,483 | 200,222 | 312,261 |
| MSI Development Support | -55,423 | 16,027 | -71,450 |
| MSB Equipment - Pre-occupancy IDC | 153,252 | 87,008 | 66,245 |
| Research Support - Dudley Salary | 28,807 | 28,807 | 0 |
| Research Support - Osherenko Salary | 19,567 | 19,567 | 0 |
| Research Support - Lafferty | 197 | 197 | 0 |
| Research Support - Osherenko | 1,285 | 629 | 656 |
| Research Support - Lea | 31,162 | 3,663 | 27,499 |
| Research Support - Wilson | 1,389 | 9 | 1,380 |
| Research Support - Brzezinski | 6,288 | 0 | 6,288 |
| Research Support - Kennett | 416 | 359 | 57 |
| Research Support - Love | 15,000 | 0 | 15,000 |
| Research Support - Simon | 75,000 | 0 | 75,000 |
| GUS Support | 43,483 | 43,483 | 0 |
| Insurance Claim - Cormorant | 0 | -40,117 | 40,117 |
| Sale of Surplus Equipment - PISCO | 2,365 | 0 | 2,365 |
| Outreach | -94,292 | 39,024 | -133,316 |

| | | | |
|---|---|---|---|
| Outreach Public Service - APEO Support | 10,000 | 8,331 | 1,669 |
| Outreach Coastal Fund Award - Floating Lab | 8,100 | 8,100 | 0 |
| Outreach Coastal Fund Award - Interns | 8,800 | 6,500 | 2,300 |
| Dean's Relief Funds - Gaines | 75,000 | 58,266 | 16,734 |
| EEMB Chair's Funds - Warner | 20,000 | 6,667 | 13,333 |
| Grant Match - Morse NASA/URETI | 4,949 | 4,164 | 785 |
| Grant Match - NASA/URETI on hold | 15,990 | 0 | 15,990 |
| Grant Match - Reed SBC-LTER | 65,930 | 27,898 | 38,032 |
| Grant Match - Quetin/Ross | 15,190 | 11,188 | 4,002 |
| Grant Match - Schmitt MCR-LTER | 166,620 | 46,858 | 119,762 |
| Grant Match - NCEAS State | 604,421 | 599,672 | 4,748 |
| Grant Match - NCEAS Campus | 147,260 | 40,769 | 106,491 |
| Grant Match - NCEAS ITR | 145,612 | 122,695 | 22,917 |
| NCEAS Discretionary | 4,830 | 4,680 | 150 |

| **Recharges** | **Income** | **Expense** | **Balance** |
|---|---|---|---|
| MSI Revenue | 98,327 | 129,596 | -31,269 |
| Analytical Lab | 360,589 | 326,560 | 34,030 |
| GUS Revenue | 13,307 | 13,307 | 0 |
| Mass Spectrometer - Brzezinski | 16,716 | 21,673 | -4,957 |
| CRC copier (discarded Spring '06) | 1,879 | 0 | 1,879 |
| Mass Spectrometer - Lea | 2,639 | 1,885 | 754 |
| MSI Graphics revenue | 69,140 | 50,249 | 18,891 |
| Kennett - DOE funds | 1,518 | 1,321 | 197 |
| Culver - Santa Clara Water District Work | 1,066 | 0 | 1,066 |
| HP Wide Format Printer | 139 | 823 | -685 |
| DOC - Carlson | 6,940 | 2,888 | 4,052 |
| Boats | 7,812 | 0 | 7,812 |
| Mt. Holyoke Fellowship - Dutton | 501 | 501 | 0 |
| Sale of Wearables | -156 | 0 | -156 |
| Software Site License | 0 | 361 | -361 |
| Outreach Revenue | 276 | 276 | 0 |
| NCAR Conference - Osherenko | 140 | 140 | 0 |
| Kruger National Park - ECP07/ECP15 | 14,916 | 14,916 | 0 |
| Melack Chemical Analysis | 979 | 0 | 979 |
| Alroy - Summer Course | 5,991.00 | 5,991.00 | 0 |
| NCEAS Mugs & T-Shirt Sales | 2,279.64 | 1,770.84 | 509 |

| Equipment Reserves | Balance |
|---|---|
| Analytical Lab Maintenance Reserve | 10,906 |
| Analytical Lab Depreciation Reserve | -64,867 |

# Statistical Summary for the Marine Science Institute

| | | |
|---|---|---|
| 1. | Academic personnel engaged in research: | |
| | a. Faculty | 56 |
| | b. Professional Researchers (including Visiting) | 36 |
| | c. Project Scientists | 14 |
| | d. Specialists | 28 |
| | e Postdoctoral Scholars | 64 |
| | f Postgraduate Researchers | 21 |
| | g Academic Coordinators | 7 |
| | TOTAL | 226 |
| 2. | Graduate Students: | |
| | a Employed on contracts and grants | 99 |
| | b. Employed on other sources of funds | |
| | c. Participating through assistantships | |
| | d. Participating through traineeships | |
| | e Other- students at other campuses | |
| | TOTAL | 99 |
| 3. | Undergraduate Students: | |
| | a. Employed on contracts and grants | 179 |
| | b. Employed on other funds | |
| | c. Number of volunteers, & unpaid interns | 197 |
| | TOTAL | 376 |
| 4. | Participation from outside UCSB: (optional) | |
| | a. Academics (without Salary Academic Visitors) | |
| | b. Other (specify) | |
| 5. | Staff (Univ. & Non-Univ. Funds): | |
| | a. Technical | 218 |
| | b. Administrative/Clerical | 54 |
| 6. | Seminars, symposia, workshops sponsored | 163 |
| 7. | Proposals submitted | 199 |
| 8. | Number of different awarding agencies dealt with* | 103 |
| 9. | Number of extramural awards administered | 300 |
| 10. | Dollar value of extramural awards administered during year** | $111,886,662 |
| 11. | Number of Principal Investigators*** | 141 |
| 12. | Dollar value of other project awards **** | $1,283,705 |
| 13. | Number of other projects administered | 61 |
| 14. | Total base budget for the year (as of June 30, 2006) | $1,011,541 |

| | | |
|---|---|---|
| 15. | Dollar value of intramural support | $1,710,775 |
| 16. | Total assigned square footage in ORU | 35,000 |
| 17. | Dollar value of awards for year (08 Total) | $25,749,169 |

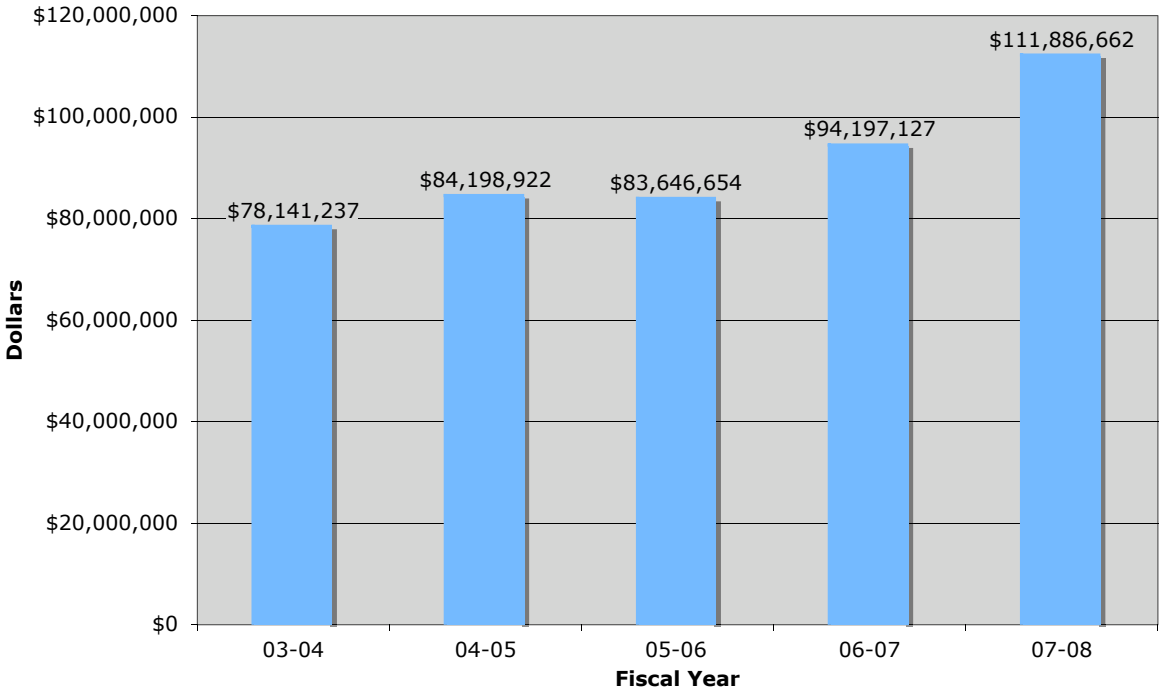
* Count each agency only once (include agencies to which proposals have been submitted).
** If the award was open during the year, even if for only one month, please include in total.
*** Number of PIs, Co-PIs and Proposed PIs (count each person only once.)
**** Other projects - such as donation, presidential awards, fellowships, anything that isn't core budget, extramural, or intramural.

# Five-Year Statistical Summary 2004-2008

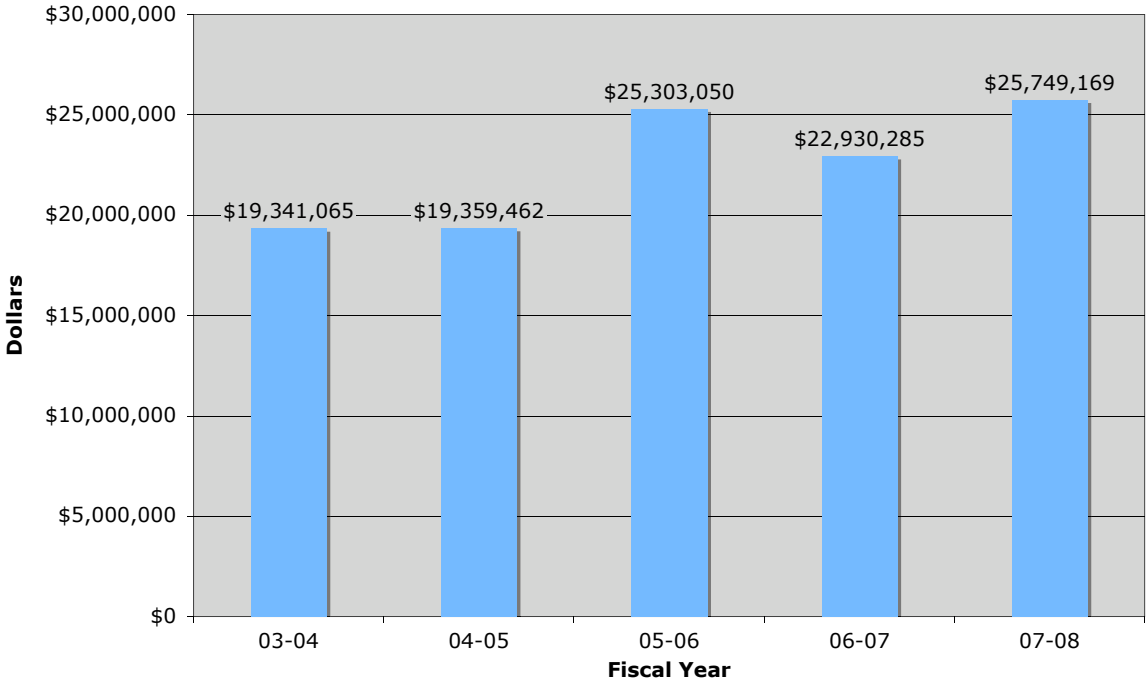
| | 2003-2004 | 2004-2005 | 2005-2006 | 2006-2007 | 2007-2008 |
|---|---|---|---|---|---|
| 1. Academic personnel engaged in research | | | | | |
| a. Faculty | 58 | 63 | 59 | 54 | 56 |
| b. Researchers / Project Scientists | 50 | 39 | 30 | 29 | 42 |
| c. Visiting Researchers | 7 | 8 | 7 | 8 | 8 |
| d. Specialists / Academic Coord / Academic Admin. | 18 | 13 | 26 | 32 | 35 |
| e. Postdoctorals / Postgraduates | 60 | 54 | 59 | 63 | 85 |
| **Total** | **193** | **177** | **174** | **186** | **226** |
| 2. Staff (Univ. & Non-Univ. Funds) | | | | | |
| a. Technical | 200 | 168 | 182 | 205 | 218 |
| b. Administrative / Clerical | 28 | 64 | 49 | 48 | 54 |
| **Total** | **228** | **232** | **231** | **253** | **272** |
| 3 Graduate students employed by MSI | 110 | 97 | 82 | 105 | 99 |
| 4. Undergraduate students employed by MSI | 216 | 257 | 155 | 164 | 179 |
| 5. Publications | 2** | 1** | 1** | 1** | 1** |
| 6. Seminars, symposia, workshops, etc., sponsored by MSI | 109 | 115 | 125 | 141 | 163 |
| 7. Proposals submitted | 182 | 164 | 205 | 213 | 199 |
| 8. Annual extramural awards | $19,341,065 | $19,359,462 | $25,303,050 | $22,930,285 | $25,749,169 |
| 9. Extramural awards administered | 246 | 239 | 260 | 289 | 300 |
| 10. Other project awards | $1,145,713 | $1,420,623 | $878,572 | $1,175,674 | $1,283,705 |
| 11. Other projects administered | 55 | 68 | 60 | 57 | 61 |
| 12. MSI base budget | $857,373 | $846,304 | $868,379 | $974,238 | $1,011,541 |
| 13. Intramural support | $1,552,076 | $1,631,875 | $2,016,623 | $1,596,833 | $1,710,775 |
| 14. Total Funds Administered | $78,141,237 | $84,198,922 | $83,646,654 | $94,197,127 | $111,886,662 |

**Only Departmental Publications

**Marine Science Institute - Total Value of Awards Administered**




**Marine Science Institute - Value of Extramural Awards Received Annually**



# Funding Agencies

Alfred P. Sloan Foundation
American Assn for the Advancement of Science
American Chemical Society
Anchor Environmental, LLC
Andrew W. Mellon Foundation
Burroughs Wellcome Fund
California Artificial Reef Enhancement
California Coastal Conservancy
California Department of Fish and Game
California Department of Parks and Recreation
California Department of Water Resources
California Energy Commission
California Ocean Science Trust
California State Lands Commission
California Regional Water Quality Control Board
California Sea Urchin Commission
Channel Islands Marine Resource Institute
Channel Islands National Park
City of Santa Barbara
Coastal Fund (formerly SPF)
Commonweal
David and Lucile Packard Foundation
Dersu & Associates
Foundation for Research Science and Technology
Gordon and Betty Moore Foundation
Joint Oceanographic Institutions, Inc.
Kern Community Foundation
Larry Walker Associates, Inc
Los Angeles Department of Water and Power
Luce Foundation
Marine Biological Laboratory
Marine Conservation Biology Institute
Marisla Foundation (formerly Homeland Foundation)
Methanogenesis Corporation (Canada)
Michigan State University
Microsoft
Mineral Science Company
National Academy of Sciences
National Aeronautics and Space Administration
National Fish and Wildlife Foundation
National Geographic Society
National Institutes of Health, Public Health Service
National Marine Fisheries Service
National Oceanic & Atmospheric Administration
National Science Foundation
Oregon State University
Paul G. Allen Charitable Foundation
Princeton University
Resources Legacy Fund Foundation
San Francisco Estuary Institute
Santa Clara University
Santa Monica Bay Restoration Foundation
Seaweb
Simpson and Simpson Business and Personnel Services, Inc.
Smithsonian Tropical Research Institute
Society for Conservation Biology, Smith Fellows Program
South African National Parks
Stanford University
The Nature Conservancy
The New Media Studio
UC Agriculture and Natural Resources
UC Berkeley
UC Biotechnology Research and Education Program

UC Center for Water Resources

UC Davis

UC Genetic Resources Conservation Program

UC Institute for Energy Efficiency

UC MEXUS

UC Office of the President

UC San Diego

UC Santa Cruz

UC Sea Grant

UC Toxic Substances Research and Teaching Program

University of Central Florida

University of Colorado

University of Georgia

University of Kiel

University of Miami

University of Mississippi

University of New Mexico

University of Queensland

University of Rhode Island

University of Southern California

University of Washington

US Department of Agriculture

US Department of Commerce

USDA Pacific Southwest Forest and Range Experiment Station

US Department of the Army

US Department of Energy

US Department of the Navy

US Environmental Protection Agency

US Fish & Wildlife Service

US Forest Service

US Geological Survey

USC Sea Grant

USDI - Minerals Management Service

USDI - National Park Service

Virginia Institute of Marine Science

WetLabs, Inc.

Wilburforce Foundation

Wildlife Conservation Board

Wildlife Conservation Society

# MSI Advisory Committee, Administrative, Professional & Technical Staff

# Marine Science Institute
# 2007-2008

| | |
|---|---|
| Chancellor | Henry T. Yang |
| Executive Vice Chancellor | Gene Lucas |
| Vice Chancellor for Research | Michael Witherell |
| Director | Steven D. Gaines |
| Deputy Director | Mark A. Brzezinski |

## Advisory Committee

**David Clarke**, Professor, Materials
**Christopher Costello**, Associate Professor, Bren School of Environmental Science & Management
**Rachel Haymon,** Professor, Earth Sciences
**Gretchen Hofmann**, Associate Professor, Ecology, Evolution & Marine Biology, Committee Chair
**Kevin Lafferty**, Assistant Researcher, Marine Science Institute
**Ira Leifer**, Associate Researcher, Marine Science Institute
**Hunter Lenihan**, Assistant Professor, Bren School of Environmental Science & Management
**Bruce Luyendyk**, Professor, Earth Sciences
**Langdon Quetin,** Researcher, Marine Science Institute
**David Valentine,** Assistant Professor, Earth Sciences
**Oran Young,** Professor, Bren School of Environmental Science & Management

Ex-Officio members -

**Mark Brzezinski**, Deputy Director of Marine Science Institute, Professor, Ecology, Evolution & Marine Biology
**Steven Gaines**, Director of Marine Science Institute, Professor, Ecology, Evolution & Marine Biology
**Daniel Morse**, Director of Marine Biotech Center, Professor, Molecular, Cellular & Developmental Biology
**William Murdoch**, Director of Natural Reserve System, Professor, Ecology, Evolution & Marine Biology
**Omer Reichman**, Director of National Center for Ecological Analysis & Synthesis, Professor, Ecology, Evolution & Marine Biology
**Tim Schmidt**, ex-officio, Manager, Marine Science Institute
**Russell Schmitt**, Director of Coastal Research Center, Professor, Ecology, Evolution & Marine Biology

# Marine Science Institute
# Administrative, Professional and Technical Staff

Deanna Cervantes, Contracts & Grants Analyst
Marie Ciluaga, Analyst
William Clinton, Staff Research Associate, Analytical Laboratory
Karoleen Decastro, Artist
Donna Dobis, Budget Analyst
Mieke DeMeo, Purchasing Analyst
Laurie Eusey, Financial Services Manager
Mike Franklin, Desktop Support
Marisol Hernandez, Desktop Support/Travel Analyst
Jenn Massey, Analytical Lab
Judy McCaslin, Contracts & Grants Officer
India Morgan, Personnel Analyst
Mike O'Neil, Budget Analyst
Michael Orlando, Analytical Lab
Georges Paradis, Manager, Analytical Lab
Nanette Pedroso, Development Analyst
Monica Pessino, Publication Manager
Michele Ramirez, Purchasing Assistant
Elvira Rose, Personnel Unit Coordinator
Tim Schmidt, Manager
Scott Simon, Outreach Coordinator
Kate Steger, Anlytical Lab
Veronica Torres, Personnel Analyst
Rachel Whitacre, Purchasing Unit Manager
Bonnie Williamson, Contracts & Grants Administration Manager
Joyce Wolever, Payroll & Personnel Unit Manager
James Woods, Information Technology
Joanna Kettmann, Budget Analyst
Nicole Zavala, Personnel Analyst

# Marine Science Institute Principal Investigators 2007-2008

# Marine Science Institute
# Principal Investigators
# 2007-2008

| | | |
|---|---|---|
| Airame, Satie | Academic Coordinator | Marine Science Institute |
| Alldredge, Alice | Professor of Marine Science | Ecology, Evolution & Marine Biology |
| Allesina, Stefano | Postdoctoral Researcher | Nat'l Ctr for Ecol. Analysis & Synthesis |
| Alroy, John | Associate Researcher | Nat'l Ctr for Ecol. Analysis & Synthesis |
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