



National Center for Ecological Analysis and Synthesis

**2009**

**Report to the National Science Foundation**

## NCEAS Annual report 2008-2009

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# 1. Participants

William Murdoch, Interim Director                      PI

Stephanie Hampton, Deputy Director                      Co-PI

Mark Schildhauer, Director of Computing

## ***Partner Organizations***

Matching funds have been provided by the State of California and by the University of California, Santa Barbara.

The Gordon and Betty Moore Foundation has supported a diversity of NCEAS projects. An ongoing project identifying, mapping and comparing the importance of human impacts on the California Current marine ecosystem partners the University of California with non-governmental organizations and federal laboratories. In addition, the Moore Foundation supports multiple Working Groups that have been convened to examine the effects of climate change on wild Pacific salmon and two postdoctoral associates at NCEAS. The Moore Foundation is funding a distributed graduate seminar that complements the NSF-funded working group assembled to reconcile the viewpoints of Fisheries science and Ecology in issues of fisheries management. Finally, the Moore Foundation is supporting a project at NCEAS in which we purchased a proprietary software package (AD Model Builder) common in Fisheries management, moved it into the public domain and have provided free training sessions to extend its usefulness to other fields.

With support from the Andrew W. Mellon Foundation, scientists from NCEAS and Kruger National Park in South Africa are participating in a collaborative effort to develop a unified framework for management and the dissemination of heterogeneous data and metadata from the Park. Approaches developed in this work have had applications throughout NCEAS.

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

The Nature Conservancy supports a graduate student Research Associate and Working Groups assembled to examine the economic impacts of non-native forest pests and pathogens in North America.

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

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

NOAA Fisheries is supporting a working group to address the need for generalizable approaches to detecting species-level responses to large-scale environment management actions.

The California Coastal Conservancy has funded NCEAS and the California Ocean Protection Council to convene working groups to evaluate and synthesize methods for deriving the economic value of ecosystem services in coastal marine systems.

The Henry Luce Foundation founded graduate fellowships at UCSB as part of a program called Environmental Science to Solutions, in which graduate students received training in leadership, communication and ecoinformatics. NCEAS provided ecoinformatics training, gave students experience in existing Working Group collaborations, and then hosted Working Groups that the students themselves have convened.

## ***Other Collaborators***

To facilitate informatics research and to support the informatics needs of the ecological community, NCEAS continued strong research partnerships with a growing group of organizations: San Diego Super Computer Center, University of Kansas and University of New Mexico (LTER Network Office), UC-Davis, Oak Ridge National Laboratories, the National Evolutionary Synthesis Center (NESCent), and the Ecological Society of America (ESA). These partners work together on multiple NSF awards.

Other collaborators are highlighted on the NCEAS web site:  
<http://www.nceas.ucsb.edu/collaborators>

## **2. Activities and Findings**

### ***NCEAS Director Transition***

Dr. Edward McCauley, currently Professor and Canada Research Chair in Population Ecology in the Department of Biological Sciences at the University of Calgary, recently accepted the position as NCEAS Director. Dr. McCauley will begin his new position on 1 January 2010.

Dr. William Murdoch, founding Director of NCEAS, has been Interim Director since January 2008. Dr. Murdoch is the Charles A Storke II Professor of Ecology in the Department of Ecology, Evolution, and Marine Biology at UC Santa Barbara. Dr. Murdoch will remain in the Interim Directorship until Dr. McCauley arrives.

## ***NSF Site Visit – 2-4 February 2009***

NCEAS hosted a site review team 2-4 February, 2009. The team was led by Dr. David Tilman from the University of Minnesota and included 12 additional team members. Some team members were former NCEAS residents and visiting scientists, while others had served on past NCEAS site reviews, or as members of the Scientific Advisory Board. Five reviewers had no previous involvement with NCEAS. The review team highlighted NCEAS achievements and delivered constructive advice for improving future NCEAS activities, captured in a written report to NSF that NCEAS received on 6 March 2009.

## ***Computing & Informatics Support***

Responding to feedback from reviewers and the ecological community, NCEAS has increased our capabilities for providing informatics education and tools to the scientific community, in addition to maintaining a high level of computing support that facilitates scientific efforts at the Center. For example, NCEAS has increasingly created Plone (open source, free content management software) websites for our supported projects to facilitate collaboration. NCEAS currently has 28 working group and 7 distributed graduate seminar Plone collaboration websites, along with additional Plone sites serving various meetings and special projects. NCEAS has also significantly improved work efficiency and computing capability by increasing internet access speed and adding a new analytical server. Funding from this award supports such informatics education activities as: training workshops targeted to NCEAS resident scientists, one-on-one training for Working Group participants, and the development of undergraduate teaching modules in a new Distributed Seminar.

Many of the training activities highlighted elsewhere in this report are focused on informatics topics, in many cases leveraging Foundation support, e.g. for Luce Fellows, the AD Model Builder software training, and training managers in Kruger National Park. Other NSF awards to our Ecoinformatics team support training and outreach in informatics to the broader ecological community.

## ***Center Ambience***

In an effort to create a more inclusive experience, NCEAS has rapidly become a more “family friendly” environment in recent years, with the addition of a private room for nursing mothers and engagement with the Downtown Santa Barbara Employer Child Care Committee to improve local daycare options. This Committee commissioned a survey and report on downtown child care needs. The section of the report tailored to the NCEAS survey respondents indicated that NCEAS residents - like other downtown workers - saw a need for greater availability of child care options, but that the NCEAS work environment was perceived to provide more support and flexibility for parents than was perceived by other downtown workers in their own work environments.

NCEAS has engaged in a variety of “greening” activities, such as using compostable paper cups, and napkins made with recycled content. Large monitors installed in common spaces to facilitate collaboration are energy-efficient models made of recycled materials.

## ***Science Advisory Board***

NCEAS receives an increasing number of proposals (Figures 1 and 2).

For our July 2008 deadline, we received 55 total proposals. We received proposals for 21 postdoctoral fellowships, 6 sabbatical fellowships, 27 working groups, and 1 distributed graduate seminar. The Science Advisory Board met September 3-4, 2008 to review these proposals; based on their recommendations, decisions were made to support 5 postdoctoral fellowships, 3 sabbatical fellowships, 4 working groups, and 1 distributed graduate seminar.

For our January 2009 deadline, we received 71 proposals: 43 postdoctoral fellowships, 6 sabbatical fellowships, 22 working groups, and no distributed graduate seminars. The Science Advisory Board met on March 4-5, 2009 to review and recommend proposals. Based on their recommendations, decisions were made to support 1 postdoc, 1 sabbatical fellowship, 5 working groups, and no graduate seminars.

Science Advisory Board members during 2008-2009 are listed in Table 1. A complete history of board members is available on the NCEAS web site: <http://www.nceas.ucsb.edu/sab/cumulative>.

## ***Major Research Activities***

Since the beginning of this reporting period, 1 July 2008, NCEAS has supported 7 sabbatical visitors and 20 total postdoctoral researchers. A list of sabbatical and postdoctoral researchers, including descriptions of their projects is provided below. During the past year, NCEAS postdoctoral scientists have accepted faculty or other career positions at Macquarie University, University of California, Davis, Universidad Catolica del Norte, University of North Carolina at Chapel Hill, University of Toronto, University of California, San Diego, The Nature Conservancy, and University of Connecticut.

Since the beginning of the reporting period, 797 different scientists participated in activities at NCEAS. Of these participants, 12% were either residents of NCEAS or scientists at UCSB, and 18% were visiting from foreign institutions. A total of 44 Working Groups and 3 Distributed Graduate Seminars have been active in the reporting period. In addition, there were 2 Working Groups that met during the last reporting period, but were not included in the last report due to the July 2008 submission date.

NCEAS also has hosted Meetings for 11 different collaborative groups and another is scheduled for September 2009. Seven Center Associates and at least 12 Scientific Visitors have been hosted at NCEAS in this reporting period. An additional four Scientific Visitors were here during the last report period, but were not included in the 2007-2008 report due to the July 2008 submission date. These activities are listed below.

## **Sabbatical Fellows**

*Occurred or were scheduled between October 1, 2008 and September 30, 2009  
based on data available as of June 30, 2009*

### **de Roos, Andre**

24-Mar-09- 24-Sep-09

#### ***Population and community ecology of ontogenetic development and growth***

Current ecological theory is to a large extent based on population dynamic models that ignore individual variation within species, in particular the variation that stems from the ontogenetic development that virtually all species go through during life history. The theoretical understanding about the consequences of ontogenetic development for the dynamics and structure of ecological communities has in recent years progressed to a state that a synthesizing book of this theory is urgent, possible and timely. I propose to devote my sabbatical period to writing this synthesis and want to spend this time specifically at NCEAS to take full advantage of the Center's unique data resources for testing the theoretical predictions against as many experimental and empirical data sets as are available.

### **Fagan, William**

4-Sep-08- 30-Sep-09

#### ***Dendritic landscapes: Exploring connectivity and biodiversity in an alternative geometry***

As an NCEAS Sabbatical Fellow, I propose to explore the implications of dendritic (branching) geometries, such as those found in river networks and elsewhere in nature, for ecological complexity through the development of theoretical models.

### **Gerber, Leah**

1-Jun-09- 31-May-10

#### ***Understanding trophic interactions between cetaceans and fisheries: testing modeling approaches***

The goal of my NCEAS sabbatical research is to bridge the gap between marine conservation science and management by providing a transparent and quantitative validation of marine ecosystem models (MEMs). While some attention has been given to predicting the impacts of fishing and model complexity with marine ecosystem models, the systematic understanding of the effects of model structure on model performance is at an early stage. I will characterize the types of MEMs being employed by management agencies that use ecosystem based management. In evaluating the models, I will examine the efficacy of these models in their ability to 1) capture true ecosystem dynamics and 2) apply model results to real-world management. To do this I will create virtual marine ecosystems (VME), complete with ocean currents, exogenous forcings, nutrient cycling, biofeedback, plankton population dynamics and secondary consumers including fish, whales and a fishing fleet. VMEs will provide a known baseline with which to compare predictions from commonly used, but much less detailed MEMs.

I will then use data extracted from the VMEs to parameterize a suite of MEMs and quantify the relative accuracy of these models in relevant management scenarios. Ultimately I hope that this work will provide guidance about the use of MEMs models for different management agencies.

**Mack, Michelle**

16-Aug-09- 15-May-10

***Climate warming and fire in a naïve biome: Using insights from boreal forest to understand causes and consequences of fire intensification in arctic tundra***

Human-caused warming of climate at high northern latitudes appears to be increasing the intensity, frequency and size of wildfires in boreal and arctic tundra biomes. Because >40% of the world's biological carbon stocks reside in these biomes, intensification of fire could be a strong, positive feedback to climate warming. Although fire has been part of the natural disturbance regime in many regions of the boreal forest, arctic tundra has experienced relatively little fire disturbance in the Holocene. Intensification of fire in arctic tundra represents the introduction of a novel disturbance regime that could reshape the structure and function of arctic ecosystems. The goal of my proposed sabbatical research is to synthesize data from my lab and others to examine controls over an important aspect of fire intensification—fire severity—and identify its consequences for ecosystem structure and function in both boreal and arctic Alaska. I propose to use statistical modeling techniques to address the following questions: (1) What are the important environmental and structural predictors of fire severity at the landscape-scale? (2) What are the consequences of fire severity for emissions of C and N, residual ecosystem C and N pools, organic layer thickness, and mineral soil exposure? (3) How do controls over and consequences of fire severity differ between boreal forest and a naïve biome, arctic tundra? Anticipated products include a publicly available dataset, a peer reviewed manuscript and a workbook for land and fire managers that provides step-by-step instructions for quantifying belowground fire severity in boreal forest and arctic tundra. This research will contribute to the mechanistic understanding of fire severity in high northern latitude systems important for predicting the net feedback of terrestrial ecosystems to a warming climate.

**Sabo, John**

1-Jun-09- 31-May-10

***Dams, River Networks and the Distribution of Native and Non-Native Freshwater Fauna in the United States***

Dams are ubiquitous in riverscapes and implicated in 'biotic homogenization' of river ecosystems. Biotic homogenization (BH) is defined as a reduction in biogeographic variation in species composition and caused by extinction of native fauna and invasion of non-indigenous species. The goal of my proposed Sabbatical Fellow research is to define a quantitative approach to conservation biogeography of rivers rooted in drainage network theory. I will use seven georeferenced databases to quantify the effects of river network structure, the quantity and size of dams and nature of dam placement within the context of river networks on flow-related



changes in river biota across the US. In contrast to previous work on this topic I will tackle this question using a structural equation modeling approach that accounts for spatially autocorrelated errors in these datasets while simultaneously modeling complex cause-effect relationships. This will allow me to quantify the cumulative (serial) effects of multiple dams in drainage networks and the interactive effects of dam and network properties on BH. This work should provide general rules of thumb about where in watersheds dam removal and experimental release strategies would work best.

**Schuur, Ted**

16-Aug-09- 15-May-10

***Permafrost and the Global Carbon Cycle: A Research and Education Synthesis Towards Understanding Terrestrial Feedbacks to Climate Change***

At present, increasing greenhouse gases responsible for climate change are largely a result of human activities. However, climate change may alter the natural cycling of carbon (C) in ecosystems far from direct human influence. Because of the size and nature of the permafrost C pool, decomposition of previously frozen, old organic C is one of the most likely positive feedbacks from terrestrial ecosystems to climate change. Sustained transfers of C to the atmosphere that could cause a significant positive feedback from permafrost to climate change must come from 'old' C, which forms the bulk of the permafrost C pool. Radiocarbon measurements of ecosystem respiration losses provide the definitive proof of old C mobilization in natural ecosystems undergoing change. Two synthesis activities relating to this topic will be carried out as a sabbatical fellow at the National Center for Ecological Analysis and Synthesis. The first activity consists of compiling and analyzing soil incubation data from the published literature to understand the relative climate forcing effect of methane and carbon dioxide released from decomposing permafrost C. The second activity is the organization and writing of an isotope textbook focused on the use radiocarbon in ecology and earth system science. This activity will synthesize 5 years of materials developed for a short course taught at the Keck Carbon Cycle Accelerator Mass Spectrometer facility at UC Irvine. Together these research and education synthesis activities will advance understanding of terrestrial ecosystem feedbacks to climate change.

**Woods, Kerry**

10-Nov-08- 30-Apr-09

***Slow systems and complex data-sets: Multi-decade permanent plots permit address of recalcitrant questions about late-successional forests***

Long-standing (and often conflicting) hypotheses about processes in late-successional forest communities remain effectively untested because existing data-sets are inadequate for analysis of very slow processes. Usual approaches are of limited power because they employ assumption laden indirect methods or data-sets of low precision and resolution. Large, multi-decade, spatially explicit data from systems of permanent plots in old-growth forests in Michigan afford the potential for rigorous address of a range of important but recalcitrant questions. Are community and population processes stabilizing and convergent, or non-equilibrium and

historically contingent? Is diversity maintained by equilibrational or non-equibrational processes? How do frequency and scale of different types of disturbance interact with population dynamics and interactions? Are tree growth and biomass accumulation related to diversity? How do spatial and temporal scale and resolution affect answers to these questions? The data-set, while uniquely appropriate for assessing these questions, is also very complex - irregular in structure and complexly stratified in time and space - posing daunting methodological challenges. This project has two general goals that will make use of the distinctive resources and mission of NEASC. First, I hope to collaborate with NEASC staff and guests in developing and applying models and analytic approaches appropriate to these research questions and commensurate with the properties of the data set (I particularly hope to establish ongoing collaborations). Second, I hope to make this data-set available to the larger community of researchers by archiving it in the NCEAS data repository and developing structures for continual updating as new layers of data are acquired.

## **Postdoctoral Fellows**

*Occurred or were scheduled between October 1, 2008 and September 30, 2009  
based on data available as of June 30, 2009*

### **Adair, Carol**

6-Apr-09 - 5-Apr-11

***Do microbes matter? Using global data to test implicit versus explicit representation of microbial activity in litter decomposition models***

Despite the major contribution of decomposition to global carbon and nitrogen cycles, it remains poorly understood. This uncertainty is reflected in the diversity of approaches used to depict decomposition in ecosystem models and in debate regarding if, or how, microbes should be explicitly represented. I propose to compile a large-scale, long-term database of litter decomposition data, which I will use to compare two sets of decomposition models: the first varies only in how microbial activity is modeled; the second compares the best model(s) from the first set to a range of published models. Conducting a sophisticated model comparison using spatially and temporally extensive data will allow me to evaluate the relevance of explicitly incorporating microbial activity into large-scale decomposition models and compare the ability of published models to accurately describe global decomposition.

### **Allesina, Stefano**

1-Sep-07- 31-Aug-09

***Reverse engineering of ecological networks: From the disassembly to the construction of robust networks***

Molecular biologists study how a gene works in an organism by switching it off, engineers try to replicate the functioning of a device by taking it apart and studying how its components are wired together, archaeologists reconstruct ancient machinery by examining fragments buried for centuries: these are all examples of reverse engineering. This

approach is usually precluded to ecologists given the potentially dramatic consequences of disturbing ecosystems, except in mathematical models and ‘in silico’ simulations of scenarios. I intend to study the patterns of secondary extinctions in ecological networks using mathematical and simulation models. In particular, I will try to identify which building blocks or network motifs confer robustness to ecological systems. The research on networks robustness has been so far dominated by the study of ‘hubs’ or most connected species, and has typically included only static analyses. I will focus not only on predator-prey interactions, but also on other major constituents of ecological networks, such as parasitism, pollination and mutualism in a dynamic context, with the ultimate goal of understanding how to assemble robust networks. The ‘hubs’ based approach will be substituted by a functional approach in which the relative importance of the components of a network is explicitly evaluated.

**Balch, Jennifer**

1-Jan-09- 31-Dec-10

***Relative influence of fuels, climate, and ignition on fire frequency across earth's ecosystems***

Fire is a critical catalyst of climate and vegetation change across the globe. Future shifts in fire regimes—associated with anthropogenic change—may alter ecosystems and biogeochemical cycles on a global scale. Yet, modeling efforts largely ignore fire in global vegetation and climate projections. Therefore, I propose to synthesize published data on fuel production, climate, and ignition sources with reconstructed fire histories in order to investigate the determinants of fire frequency across scales and ecosystems. Rather than gauge how fire influences the biosphere, I plan to assess the factors that control the global fire cycle. This fire-centric approach will illuminate the biotic and abiotic factors that increase fire frequency. Moreover, the results will provide mechanistic insights into historical fire patterns and bolster predictions of future fire regimes in an era of accelerating global land-cover and climate change.

**Broitman, Bernardo**

15-Jan-06- 1-Oct-08

***Bottom-up ecosystem-based management of coastal systems: Social drivers of ecological and economic factors in EBM (EBM, Packard Foundation)***

Ecosystem-based management call for the adoption of management practices that explicitly account for the cross-linkages between ecological, economic and social components. I propose an approach to determine the goals of EBM in coastal temperate oceans through a literature review of initiatives where a social process has advanced research priorities for scientists and economists. By examining and compiling these research priorities I will to compile large datasets of the environmental, ecological and economic variables singled out by the social process. Going one step further, I will generate uncertainty estimates through simulations that I will incorporate into simple bioeconomic models. This formal approach will allow for a clearer definition and examination of EBM in coastal systems.

**Buckley, Lauren**

7-Nov-07- 31-Dec-08

***Distribution dynamics in changing environments: Geographic trait variation and the potential for future adaptation***

Mechanistic models that link individual energetics and population dynamics offer improved predictions of species' distribution dynamics in changing environments. Including population dynamics enables addressing the distribution implications of physiological adaptation (both plastic and evolutionary), species interactions, and dispersal limitations. I propose to first generalize an energetic optimization model across foraging strategies for ectothermic vertebrates. I will then examine current geographic trait variation for North American lizards to understand the potential for adaptation to moderate climate induced range shifts. This analysis will enable using performance optimization models and genetic models of thermal evolution to predict potential thermal adaptation following climate change. The potential for species to respond to changing climates through adaptation will be an important and little understood determinant of the biodiversity implications of environmental change.

**Budden, Amber**

1-May-07- 30-Apr-10

***Occurrence of publication bias in ecology***

Metrics associated with publications such as citation rates and impact factors are widely used in the evaluation of academics, departments and institutions. However, factors other than the intrinsic quality of a manuscript can affect its publication and dissemination. Publication bias can be perceived as the extent to which the relative perceived merit of work predicts the relative actual merit of the work and such biases can affect both the publications available to the community, funding allocation, and potentially the career trajectories of researchers. General biases previously detected include the file drawer problem, over-interpretation of data, dissemination bias, institutional or individual status bias, and gender bias. However, the degree or prevalence of these factors has not been extensively explored within the discipline of ecology. Using survey data from multiple sources, online databases and bibliometric methods I aim to evaluate the utility of current metrics, explore the incidence of biases associated with publication and dissemination of material and determine the potential impact of publication bias with respect to the composition of the working and publishing ecological community. I also intend to develop and advocate for best practices to be used by journals, editors, reviewers and authors. For example, preliminary research has demonstrated that the process of double-blind review may serve to reduce non-conscious bias against female authors. This review method is not widely practiced in ecology and I am currently examining community response to double-blind review and evaluating both the benefits and challenges associated with implementing double-blind review practices.

**Cadotte, Marc**

15-Jun-07- 14-Jun-09

***Using phylogenetic information to predict the relative importance of equalizing versus stabilizing mechanisms on species coexistence***

Understanding species coexistence is crucial to understanding the processes that structure communities. Niche mechanisms that promote coexistence result from trait differences that

reduce niche overlap and thus reduce competitive interactions allowing stable coexistence. The relative importance of niche differentiation versus neutral mechanisms for driving community patterns is hotly debated in ecology. It is likely that in natural communities, coexistence mechanisms include both processes, which are determined by how similar or different two species are to one another. The degree of differentiation, or perhaps evolutionary distance, may be a surrogate to understand which species can coexist and under what mechanism. In this research project I will be analyzing published competition experiments to see if phylogenetic relatedness can predict which species are able to coexist and the mechanism of coexistence.

**Davies, T. Jonathan**

1-Feb-07- 31-Jan-10

***Coexistence, competition, and character evolution in carnivores and primates***

Explaining species coexistence is one of the principal goals of ecology. Competition is thought to inhibit coexistence among species occupying the same ecological niche. Hence species sharing similar ecological traits are predicted to overlap less in their geographical range. However, the lack of robust null models and the scarcity of appropriate data have meant that the importance of competition in structuring ecological communities has proven hard to evaluate and remains controversial. In addition, other factors may dominate patterns of species overlap and trait similarity; for example, sympatric species might be similar due to convergent evolution as a consequence of sharing a similar environment or they may have only recently diverged, and therefore be similar by descent. Phylogenetic approaches enable the confounding influence of evolutionary history to be controlled for, and provide a simple null model for evaluating the relationship between coexistence and character divergence. This project uses new species-level phylogenetic trees along with extensive databases on species traits and distributions within mammals, to perform global analyses of species overlap and divergence across multiple carnivore and primate communities. Specifically, this project aims to evaluate whether divergence in ecological traits facilitates coexistence in these clades.

**Lancaster, Lesley**

1-Mar-09- 28-Feb-11

***What Community Characteristics Promote Recent and Current Bio-Diversification? An Investigation of Community-Level, Ecological Correlates of Rapid Diversification in Replicate, Temperate Angiosperm Genera***

Processes behind patterns of angiosperm biodiversity in temperate regions are little understood. Further, we do not know whether particular communities that currently support relatively high temperate biodiversity are the same communities that promote the evolutionary process of diversification (i.e. speciation). I propose to compare diversification rates within selected angiosperm genera that inhabit a range of temperate communities using published phylogenies and sequence data, focusing on clades in which nodes can be or have been dated. I will then map habitat and community characteristics that have been hypothesized to be general factors

promoting rapid diversification. I will apply method-of-moments estimators of diversification rates (using a stochastic birth-and- death model of diversification) both within and between selected genera to look for correlations between recent rapid divergence within clades and characteristics of habitat or community type occupied by those clades. Previous studies of diversification processes have targeted particularly diverse clades or communities and then attempted to draw conclusions about which factors led to their respective high species numbers. However, my proposed method will allow for more rigorous hypothesis testing and generalization of conditions promoting diversification by starting with a phylogenetically diverse array of genera and ecological conditions within which to compare habitat characteristics and diversification rates. Furthermore, recent advances in estimating diversification rates will allow me to disentangle the relative effects of speciation vs. extinction on diversification rates. These methods have seldom been applied to diversification rates within less inclusive crown clades, which may be the most relevant for understanding the processes of speciation and conservation of habitat features or communities that are most likely to be sites of current speciation and/or extinction.

**Madrinan, Luis Francisco**

2-Jun-08- 1-Jun-10

*Investigating responses of riverine habitats and Pacific salmon to climate change (Moore Foundation)*

Pacific salmon play an important ecological role by interacting with other species in the rivers where they are born, in the ocean where they spend most of their life, and later again in the river where they return to breed. As a result of their very complex life history, salmonid species have been affected by human activities such as harvest, hydropower, hatcheries and habitat destruction.

Climate controls fish metabolic rates, influences habitat use, and regulates behavioral responses to a variety of environmental stimuli. For this reason climate change shapes not only fish distribution patterns but fish community composition, because it influences the differential survival and reproduction of species across watersheds.

The objective of my work will be to identify salmon populations that are especially resilient or sensitive to climate change across their range from California to Alaska. A state-of-the-art climate model developed at the University of Washington combined with fine and coarse-scale hydrological drainage maps, abundance time-series and other datasets will be used to consider several possible scenarios.

In collaboration with other postdoctoral fellows at NCEAS and the University of Washington, we aim to develop a novel approach by increasing our understanding of likely selective or plastic responses due to climate change. We hope to estimate the likelihood of populations reaching a quasi- extinction threshold resulting in range shifts of the different species, as well as to identify management strategies helping to enhance the resilience of populations to likely habitat changes.

**Melian, Carlos**

22-Apr-08- 20-Apr-10

*Unifying niche-neutral theories of molecular, community and network evolution (Microsoft)*

A long discussed and unresolved question in ecology and evolution is to determine the mechanisms that originate and set an upper limit to diversity in ecosystems. Ecological and evolutionary views have focused on the mechanisms that enable or constraint species coexistence, genetic variation and the genetics of speciation respectively, but a unified theory of biodiversity linking those approaches in the same framework is still missing. Classic and current models of diversity have recently opened and reinvigorated the search for evolutionary and ecological patterns in a unified framework. At NCEAS, I intend to work towards a unified theory of biodiversity by modeling multiple biological levels and spatial scales using novel computational and analytic approaches. I will also test these models with the huge amount of data on multiple levels and scales, collected and meticulously catalogued, that is becoming available for scientific analysis. In particular, I will integrate neutral theories of molecular and species diversity by linking ecological interactions to explicit mechanisms of speciation by implementing models of evolving graphs at molecular and ecological levels. This will allow me to study how interacting graphs at multiple biological levels generate and alter diversity and better understand the evolution of diversity at different biological levels under neutral or natural selection. Finally, these models will allow the linking of the origin, evolution and coexistence of diversity to molecular, sexual and trophic behavior at ecological and evolutionary scales.

**Menge, Duncan**

11-Aug-08- 10-Aug-10

*Synthesizing ecosystem development data in a theoretical framework to understand transitions from nitrogen limitation to colimitation to phosphorus limitation*

The ability of ecosystems to sequester carbon (C) and help mitigate climate change depends on which factors limit C uptake into vegetation. It is increasingly clear that nitrogen (N) and phosphorus (P) play critical roles in regulating C uptake, and forests tend to transition from N limitation to colimitation to P limitation as they develop from bare ground. However, at present there is no theoretical framework that determines the conditions under which each resource limits production, or when transitions between the different states should occur. At NCEAS I will build such a theoretical framework, synthesize existing data from forest chronosequences worldwide, and combine theory with data to analyze transitions between the alternate ecosystem states of limitation by N, P, or both.

**Kappel, Carrie**

25-Jan-06- 7-Feb-09

*A synthetic approach to the science of ecosystem-based management of coastal marine ecosystems (EBM, Packard Foundation)*

We will develop a modeling and data integration framework for EBM and apply that framework to a case study from coastal California. By bringing experts in the modeling of natural and human systems together with policy specialists, the working group will develop a policy relevant modeling approach that includes the dynamics of social, biophysical and economic components of the ecosystem and critical feedbacks among them, and an explicit risk assessment component.

Then, in collaboration with scientists and managers knowledgeable about the coastal California system, we will develop a detailed case study using this modeling approach as a basis. Key questions about how to cope with uncertainty, how to define ecosystem boundaries, and what constitute appropriate and effective indicators of ecosystem health and performance, will be addressed through the case study. The result will be a tool that scientists and policy makers use to develop an ecosystem-based approach to management of this system, and by extension others.

**O'Connor, Mary**

7-Jan-09- 6-Jan-11

***Linking Physiological Rates and Community Ecology: Effects of Temperature on Food Web Dynamics and Population Connectivity***

Fisheries productivity and population connectivity are two complex ecological processes that are relevant to effective management of ocean resources but are very difficult to study directly. Developing a quantitative understanding of how these processes vary with environmental conditions will provide insight into the mechanisms governing each process, as well as how the processes change geographically or with climate change. I will use a general theory of metabolic responses to temperature to determine the role of temperature in driving variation in food web productivity and larval dispersal and survival in marine systems. This research will produce marine food web and larval dispersal databases, along with models, simulations and maps of how these processes are affected by ocean temperature under specific climate change scenarios.

**Parker, John**

11-Aug-08- 10-Aug-10

***Disciplinary synthesis and collaboration in ecology: Organizations, research groups, and work lives***

This is a proposal to extend and develop an ongoing investigation of current attempts to synthesize research in ecology and the social sciences. Ecology is undergoing a rapid transformation, a major component of which is the increasingly interdisciplinary scope of ecological research. Among the most salient attempts to bridge disciplines are occurring between ecology and the social sciences. Driven by the complexity of social-ecological interactions and pressing environmental concerns, attempts to merge these disciplines have become institutionalized in research centers, funding initiatives, scholarly journals and conferences. Because change has been rapid, little is known about the character of these efforts and their impact on science. These issues will be explored through a comparative, multi-method investigation of the practice and outcomes of synthetic social-ecological research. Expected outcomes include: 1) enhancing understanding of the most effective means by which to catalyze disciplinary synthesis, 2) advancing knowledge about the social and technical processes characteristic of synthetic collaborations, 3) increasing insight regarding the effect of synthetic participation on researchers' careers, and 4) providing information on disciplinary synthesis as an agent of scientific change.



**Petersen, Christine**

15-Apr-08- 14-Apr-10

***Assessing sensitivity of salmon species to river modifications and climate change (Moore Foundation)***

The salmonids are particularly predisposed to local adaptation to habitat and climate conditions due to their trait of returning to the natal stream for adult-stage reproduction. With ranges from California to Alaska, salmon species in the NE Pacific encompass a fairly diverse set of strategies for meeting the variety of challenges to survival posed during the stream and ocean phases of life history. Both climate and anthropogenic changes to riverine and ocean habitat are likely to influence this risk landscape. Optimal growth rates, timing of emergence, smoltification, return from the ocean and spawning, and other behaviors could be altered by warming stream temperatures, changes in ocean upwelling patterns, installation of river obstructions, or transformation of rivers into lake environments by dams. In addition, simple changes in environmental variables may drive complex population effects due to interspecies competition, predation, and disease dynamics. We intend to use wide array of available hydrological drainage maps, abundance time-series and other datasets to consider several alternative future scenarios. A state-of-the-art climate model developed at the University of Washington will be used to inform both fine and coarse-scale hydrological landscape models constructed at several drainages between Alaska and California by a postdoctoral collaborator, also at NCEAS. The objective of my work will be to explore population dynamics of 2-4 different salmon species in response to the projected habitat change scenarios. With the larger working group, we hope to develop an innovative approach to incorporating understanding of likely selective or plastic responses to climate change. We hope to estimate the likelihood of populations reaching a quasi- extinction threshold resulting in range shifts of the different species, as well as to identify management strategies helping to enhance the resilience of populations to likely habitat changes.

**Ranganathan, Jai**

4-Sep-07- 3-Sep-09

***Developing a return on investment approach for conservation planning in Argentina (TNC)***

Temperate grassland is among the most globally endangered of ecosystem types, as it is highly threatened by the expansion of agriculture, the intensification of grazing pressure, and other human activities. I will be focusing on grassland conservation strategies for Argentina, where much of the best remaining temperate grassland can be found. Using a return on investment approach, I will explore how the inclusion of economic information can improve the quality of environmental planning for Argentinean grassland and for conservation in general.

**Ryan, Sadie**

1-Mar-09- 28-Feb-11

***Quantifying long-term landscape vegetation dynamics in and around Kibale National Park, Uganda, to establish appropriate landscapes for zoonotic disease models***

Models of zoonotic diseases, particularly those at the spillover interface, require a certain degree of spatial information that theoretical, spatially implicit models cannot always encompass. This is often the situation for parasitic or locally contaminant infectious diseases, or location-specific reservoirs that re-infect populations. For these types of diseases, particularly those that may be the subject of vaccination programs, agent-based models incorporating explicit landscapes may provide a more appropriate framework for analyzing disease spread. However, introducing the complexity of geographically explicit landscape interactions, particularly with temporal dynamics, is irrelevant if the mechanisms and agency of disease spread within that landscape is not reducible to patterns at a scale meaningful to the model's mechanistic drivers. In this project I propose to examine a specific landscape, Kibale National Park, Uganda, in which primate parasitic disease, anthropogenic fragmentation and climate change are posited to be interacting. I am currently working on agent-based models of zoonotic diseases, particularly addressing the human-primate interface, and would like to complement this work with quantified, data-driven dynamic landscapes. This will lay the groundwork for similar approaches in other sites and scenarios, such as Ebola vaccination in gorillas (with P. Walsh, NCEAS working group) and control of SIV or respiratory disease transmission in Gombe chimpanzees (with M. Wilson and A. Pusey, Jane Goodall Institute, MN).

**Williams, Jennifer**

2-Dec-08- 1-Dec-10

***Evaluating Life History Theory and the Consequences of Reproductive Strategy For Population Fluctuations***

Organisms have evolved a variety of mechanisms to maximize individual fitness in the face of environmental stochasticity that may also serve to buffer population fluctuations. Life history strategies for reproduction, including whether to produce all offspring at once (semelparity) or to spread out the reproductive effort across several bouts (iteroparity), can lead to important consequences for population persistence. While much theory predicts which strategy should be optimal for individuals, few empirical tests exist. The proposed research will use stochastic population models compiled from published and unpublished data of species that exhibit facultative semelparity to address two unresolved issues in evolutionary biology and population ecology: when can iteroparity buffer population fluctuations and do life history predictions match the observed strategy with realized levels of stochasticity? This project will help to refine current life history theory on semelparity and iteroparity, and will clarify the connection between selection pressures on individuals and the consequences for population persistence.

Understanding a mechanism that can buffer population fluctuations will also contribute to predictions of which species may be more vulnerable to increased climate variability. Support from NCEAS will be crucial for gathering the volume of data necessary to conduct this research, and collaborations with resident and visiting ecologists will enhance not only this project but initiate new research.

**Wolkovich, Elizabeth**

20-Mar-09- 23-Aug-11

***Long term plankton community dynamics in the face of climate change***

Changing climate has brought earlier springs and later winters to most regions of the globe, with associated changes documented in many ecological communities. Research primarily has examined these community shifts in light of individual species' environmental tolerances, and interspecific interactions. However, changes to dynamic links between spatially or temporally linked food webs may also be critical to understanding community-scale responses to climate change. Across systems winter food webs - under ice or snow - can provide key trophic links to the food webs of warmer months, usually supplying critical basal resources early in the warm season. For example, in alpine communities complex under-snow soil food webs develop, then degrade with snow melt, providing a critical pulse of nutrients to the summer plant communities. In marine Antarctic systems under-ice phytoplankton provide an important base to the pelagic web. Such critical links may be disrupted with climate change, as winter food webs have less time to develop and spring assemblages establish increasingly earlier. Using several long-term year-round plankton community datasets I will study how climate may alter dynamic, cross-seasonal links in freshwater food webs. Datasets include that maintained by Lyubov Izmet'seva (Irkutsk State University, Russia) for Lake Baikal, the world's largest lake, located in subarctic Siberia. In Lake Baikal, under-ice development of diatoms provides a critical resource base to the benthic food web and potentially the pelagic ice-free food web in subsequent months. I will examine how these dynamic spatial and temporal links have changed with the onset of shorter winters and earlier springs in the 60 years of data for Lake Baikal, and in other freshwater systems with longer ice-free seasons. In addition to providing basic ecological knowledge on how spatially and temporally coupled food webs may influence trophic structure and stability, this research may allow us to predict ecological responses to changing climate at the level of the food web, in addition to that of the species.

## **Distributed Graduate Seminars**

*Occurred or were scheduled between October 1, 2008 and September 30, 2009  
based on data available as of June 30, 2009*

### ***The role of MPAs in ecosystem-based management: Examining the science and politics of an ocean conservation strategy***

*Leaders: Pavia, Robert; Lindholm, James*

Recent reports by the U.S. Commission on Ocean Policy and the Pew Oceans Commission recommend specific actions necessary to drive advances in ocean governance, including the use of marine protected areas (MPAs) as tools for ecosystem-based management. With coastal development, pollution, and resource extraction pressures on MPAs increasing, national and international efforts are focusing on developing MPAs in the context of the ecosystems, both terrestrial and marine, in which they occur. We will conduct an NCEAS Distributed Graduate Seminar dedicated to clarifying the role of MPAs as tools for ecosystem-based management. The National Marine Sanctuary Program, one of the primary MPA management programs in U.S. Federal waters, will serve as a vehicle for this exploration. Graduate students from Hawaii to New Hampshire will examine how our growing scientific understanding of ecosystem processes within MPAs, and evolving ocean-observing capabilities, can allow us to manage MPAs as integral components of the ecosystems in which they reside.

***Finding common ground in marine conservation and management (Moore Foundation)***

*Leaders:* Hilborn, Ray; Worm, Boris

There is increasing concern among scientists and the general public about the current state of marine fisheries and their supporting ecosystems (Ludwig et al. 1993, Hilborn et al. 2003, Myers & Worm 2003, Pauly et al. 2003, Worm et al. 2006). 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 (Jackson 2001, Myers & Worm 2005, Polachek 2005, Hilborn 2006). 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. In the proposed Working Group we are trying 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. In a final step (to be funded by a third party) we would present our conclusions to managers, NGO and government agencies, helping them to understand the progress that has been made. 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.

***Engaging undergraduate students in ecological investigations using large, public datasets***

*Leaders:* Mourad, Teresa; Gram, Wendy; Grant, Bruce

The Ecological Society of America (ESA), in close partnership with NEON Inc., will facilitate a distributed seminar to focus on examining effective student activities and assessment strategies for using large public datasets in the classroom. The rapidly increasing availability and quantity of publicly accessible large scale datasets present an outstanding opportunity for minority-serving and small undergraduate institutions to introduce their students to a new digital age of ecology and environmental science. The teaching activities to be developed, implemented and assessed through this seminar aim to enable undergraduate students to both better understand ecological concepts and equip them with fundamentally critical quantitative ecoinformatics skills as the demand for a data-savvy workforce grows steadily in the 21st century. The seminar itself will be evaluated for its potential as a model for future faculty development. The teaching activities will be made available in a variety of sources and the pedagogical implications of these educational activities will be synthesized for publication in *Frontiers*, ESA's well-respected multi-disciplinary journal.

## Working Groups

*Occurred or were scheduled between October 1, 2008 and September 30, 2009  
based on data available as of June 30, 2009*

**Title: Genetic monitoring: Development of tools for conservation and management**

*Leader(s):* Allendorf, Fred; Schwartz, Michael

*Participants:* Fred Allendorf, C. Scott Baker, Dave Gregovitch, Michael Hansen, Jennifer Jackson, Katherine Kendall, Linda Laikre, Kevin McKelvey, Maile Neel, Isabelle Olivieri, Nils Ryman, Michael Schwartz, Ruth Shortbull, Jeffrey Stetz, David Tallmon, Barbara Taylor, Christina Vojta, Donald Waller, Robin Waples

*Abstract:*

Genetic monitoring has the potential to become a valuable tool for the management and conservation of populations. Recent rapid advances in molecular genetic techniques make it relatively easy and inexpensive to quantify temporal changes in the genetics of populations over tens or even hundreds of years. However, it is currently unknown under what circumstances genetic monitoring would provide valuable information or what genetic data are required for effective genetic monitoring. We propose a working group that will address these issues in order to provide guidance for resource managers and policy makers. We will also evaluate the potential for using genetic monitoring of candidate genes likely to be affected by climate change and other forms of stress in order to understand evolutionary responses to environmental changes. The results of this working group will be rigorous and practical guidelines for the design of genetic monitoring strategies and should lead to improved assessments of population trends and evolutionary processes.

**Title: Economic impacts of non-native forest pests and pathogens in North America**

*(supported by The Nature Conservancy)*

*Leader(s):* Aukema, Juliann

*Participants:* Juliann Aukema, Kerry Britton, Corey Chivers, Jeff Englin, Susan Frankel, Robert Haight, Thomas Holmes, Peter Kareiva, Kent Kovacs, Brian Leung, Andrew Liebhold, Frank Lowenstein, Deborah McCullough, Meghan Nuding, Erin Sills, Thomas Stohlgren, Betsy Von Holle

*Abstract:*

My research interests lie in spatial patterns, processes, and mechanisms underlying species interactions and distributions, and in applied conservation. I draw on the fields of spatial ecology, plant community ecology, plant-animal interactions, conservation biology, and epidemiology; and I strive to bridge the gap between science and conservation practice. At NCEAS, I am working on a project to quantify the economic and ecosystem impacts of non-native forest pests and pathogens in North America. Both the economic and ecosystem effects of these introductions should be considered in developing public policy.

**Title: Biogeography of Microorganisms: From Taxonomy to Traits**

*Leader(s):* Bohannan, Brendan; Green, Jessica; Wright, Ian

*Abstract:*

Microorganisms represent the vast majority of Earth's biodiversity and they play a crucial role in nearly every process of environmental importance, yet only recently have we begun to understand the distribution of microbial life. The field of microbial biogeography has grown enormously in the past 5 years, in large part due to the influence of a previous NCEAS working group. The study of microbial biogeography initially adopted a taxonomic approach, focusing on sequence signatures to identify groups of microorganisms, and using these signatures to reveal patterning in microbial biodiversity. These studies revealed classic biogeographical patterns such as the species-area relationship and isolation by distance. However the field of biogeography is changing. There is a resurging interest in understanding patterns in the distribution of not only taxa, but also the traits those taxa possess. Patterns in trait variation can be used to understand complex phenomena, including why organisms live where they do, how many taxa can coexist in a place, and how they will respond to environmental change. Technological advances such as environmental genomics place microbial ecology in a unique position to move trait-based biogeography forward. The proposed working group will bring together microbiologists who are gathering microbial biodiversity and trait data with general ecologists who are developing theory to explain and predict patterns of trait variation. The group will identify important traits in microbial biodiversity data, develop predictions regarding the distribution of such traits, and document patterns in trait-based microbial biogeography. The products of the proposed working group will not only benefit the general studies of ecology, microbiology and biogeography. They will also contribute to our understanding of the response of ecological systems to environmental change and will provide important foundational knowledge that can guide microbial bioprospecting, the search for biomolecules of pharmaceutical, agricultural and industrial importance.

***Title: Pyrogeography - fire's place in earth system science***

*Leader(s):* Bowman, David; Balch, Jennifer

*Abstract:*

It is time to rethink the place of fire on Earth. Megafires are currently overwhelming human control, despite huge budgets and mature fire-fighting technologies. There is mounting evidence that, beyond immediate destruction of life and property, landscape fires have long-term effects on global carbon stocks, biodiversity, climate, world economies, and human health. Despite fire's pervasive influence in many disciplines, there is no unifying theory or paradigm concerning the role of biomass burning in Earth science. Moreover, fire has not been satisfactorily considered by global change policy and ecosystem management. We, therefore, propose a thought experiment addressing (i) whether fire would evolve where carbon-based life is present, (ii) how it would evolve, and (iii) how humans, their cultures, and fire may have coevolved. We will combine knowledge about biomass burning across fields to develop an integrative paradigm of 'pyrogeography' that addresses these fundamental questions. This synthetic exercise will inform and coordinate participant's research to derive global products that highlight how and where shifting fire regimes will have consequences for human health, property, and ecosystem services-including global terrestrial carbon stocks. Our outputs will be a succinct review paper, an edited

volume, and a concise book that collectively will: (i) provide a conceptual framework to account for the variation of fire types (intensity, frequency, and extent) in space, time, and amongst cultures, (ii) set out working hypotheses that will guide future work, and (iii) identify major omissions of fire's important role in Earth science and management. These outputs are a prerequisite for adaptation to the apparent recent intensification of fireclimate-vegetation feedbacks, which have been exacerbated by climate change, rapid land cover transformation, and exotic species introductions that challenge the evolutionary integrity of entire biomes.

***Title:* Mechanistic distribution models: Energetics, fitness, and population dynamics**

*Leader(s):* Buckley, Lauren; Angilletta, Michael; Holt, Robert; Tewksbury, Joshua

*Participants:* Amy Angert, Michael Angilletta, Lauren Buckley, Brandon Cooper, Lisa Crozier, George Gilchrist, Sarah Gilman, Robert Holt, Timothy Keitt, Joel Kingsolver, Warren Porter, Leslie Rissler, Michael Sears, Joshua Tewksbury, Mark Urban

*Abstract:*

Biologists must understand the dynamics of species distributions to address questions about community structure and to predict distributional shifts over space and time (1). Despite recent theoretical progress (2), predictions of species' ranges still rely largely on correlational methods (3, 4). Our working group will achieve a more dynamic and mechanistic understanding of species' distributions by incorporating individual energetics, fitness curves, population dynamics, and evolutionary change. Several distinct, but complementary, mechanistic models of species' distributions were recently published and share strong mechanistic and physiological bases (5-7). The working group will evaluate these mechanistic models, synthesize salient features of each, and generalize the synthetic model to include physiological adaptation (both plastic and evolutionary), species interactions, and dispersal limitations. Model development and empirical validation will focus on predicting climate-induced shifts in native ranges and the spread of invasive species using both modern and paleontological data.

***Title:* Linking phylogenetic history, plant traits, and ecological processes at multiple scales**

*Leader(s):* Cavender-Bares, Jeannine; Ackerly, David; Burleigh, J. Gordon; Mack, Michelle; Ree, Richard; Reich, Peter

*Participants:* Jeremy Beaulieu, Marc Cadotte, Jeannine Cavender-Bares, Cathy Collins, T. Jonathan Davies, Kendi Davies, Nicholas Deacon, Matthew Helmus, Robert Holt, Dawn Kaufman, Steven Kembel, Richard Ree, Peter Wragg

*Abstract:*

We propose a series of multi-disciplinary working group meetings, sponsored jointly by NCEAS, and NESCent to investigate the links between evolutionary history, plant traits, community structure and ecosystem processes. We will use data from the Long-Term Ecological Research (LTER) network and beyond to examine the influence of phylogenetic relationships on community structure and traits relevant to ecosystem processes, at nested spatial and taxonomic scales across North America. In doing so, we will break new theoretical ground and develop new experimental and statistical protocols. Despite growing interest in understanding the influences

of phylogeny on ecological processes, a synthesis across local and continental scales has yet to be attempted. Progress toward a unified understanding of the problem has been hampered by a lack of synthesis of existing phylogenetic and ecological data. A signature outcome will be a database of phylogenetic information for North American land plants and corresponding databases of plant traits and species abundances across local and large-scale environmental gradients. A second outcome will be a set of user-friendly software tools for statistical analysis of these data. These products will be used to clarify the significance of phylogenetic history and trait evolution for community organization and ecosystem processes across critical local and continental environmental gradients in North America. A North American synthesis will provide a framework for subsequent global analyses. We propose two NCEAS and two NESCent meetings between 2007 – 09, bringing together physiological, community and ecosystem ecologists with plant systematists and computational biologists to develop new theory and statistical methods widely applicable to the study of the evolution and assembly of communities.

***Title:* Revisiting nutrient limitation in tropical forests**

*Leader(s):* Cleveland, Cory; Townsend, Alan

*Participants:* Silvia Alvarez-Clare, Mercedes Bustamante, George Chuyong, Cory Cleveland, Pauline Grierson, Kyle Harms, Benjamin Houlton, Alison Marklein, William Parton, Stephen Porder, Sasha Reed, Carlos Sierra, Whendee Silver, Edmund Tanner, Philip Taylor, Alan Townsend, Will Wieder

*Abstract:*

Tropical forests have enormous ecological and societal significance. They are home to exceptional biological diversity (including humans), they profoundly affect a suite of global scale processes, and unfortunately, they are experiencing myriad effects of global environmental change. Yet, our understanding of basic ecosystem processes such as nutrient limitation in the tropics lags far behind many temperate and high latitude ecosystems, and those data that do exist have not been thoroughly synthesized. In many respects, this deficit results from a scarcity of data, but more from the fact that the tropical rain forest biome is extraordinarily complex. Tropical forests present many unique challenges to resolving questions about nutrient limitation, including the potential for limitation by multiple elements across both small and large spatial scales. Despite these challenges, all confirmed participants of our proposed NCEAS workshop believe that we are now at the point where a productive synthesis of data describing tropical nutrient cycling and limitation can and should be undertaken, and that this endeavor has the potential to generate a suite of valuable products that will be of broad utility to ecologists, biogeochemists and to society as a whole. We therefore propose an NCEAS workshop that assembles ecologists, geologists and ecosystem modelers that collectively represent five continents and all major tropical regions to pursue three goals: 1) assemble a database and synthesize data collected using a variety of techniques to assess nutrient limitation in tropical rain forest ecosystems; 2) perform a metaanalysis of both above- and below-ground tropical nutrient limitation; and 3) further the development of conceptual and analytical ecosystem models that can better predict the fate of tropical forests in a rapidly changing environment. Our ultimate goal is to take full advantage of the NCEAS model – ranging from the opportunity to pursue the basic processes of data and conceptual synthesis, to the use of ecoinformatics resources that are unique to NCEAS – to advance our understanding of the nature of nutrient



limitation in tropical forests. The time is right for a thorough synthesis, and given the importance of tropical forests to global biogeochemistry and to society as a whole, the potential value of such an effort is high.

***Title: The role of niche conservatism in producing biodiversity gradients***

*Leader(s):* Cornell, Howard; Harrison, Susan; McCain, Christy

*Participants:* David Ackerly, Andrew Allen, Brian Anacker, Howard Cornell, Ellen Damschen, T. Jonathan Davies, John Grytnes, Susan Harrison, Bradford Hawkins, Nathan Kraft, Christy McCain, Charles Mitter, Robert Ricklefs, Kaustuv Roy, Patrick Stephens, John Wiens

*Abstract:*

Species diversity at broad spatial scales increases most strongly with productivity (terrestrial realm) and temperature (marine realm). The reason for such global-scale trends is still unknown. Ecological mechanisms operate locally and therefore appear inadequate to explain why these patterns are strongest at the largest geographic scales. Our goal is to test a novel evolutionary/historical hypothesis – the climatic “niche-conservatism” hypothesis – which postulates that more species inhabit more productive or warmer environments because most higher taxa originated in such environments, and evolutionary constraints limit occupancy of colder or more arid regions. This hypothesis yields the testable prediction that ancestral climate state accounts for the strength of productivity- or temperature-richness relationships among taxa. We will test this using newly developed phylogenetic methods on both terrestrial and marine data. We will also quantify the timescales over which niche conservatism operates, analyze historical climate-richness data, and investigate possible mechanisms for niche conservatism.

***Title: Integrated history and future of people on Earth (IHOPE): Building a community data base and testing the resilience - sustainability hypothesis across scales***

*Leader(s):* Costanza, Robert; Graumlich, Lisa; van der Leeuw, Sander

*Participants:* Steve Aulenbach, Simon Brewer, Michael Burek, Sarah Cornell, Robert Costanza, Carole Crumley, John Dearing, Catherine Downy, Carl Folke, Lisa Graumlich, Michelle Hegmon, Kathy Hibbard, Stephen Jackson, Ida Kubiszewski, Rik Leemans, Charles Redman, Paul Sinclair, Sverker Sorlin, Will Steffen, Sander van der Leeuw

*Abstract:*

Understanding the reasons for the emergence, sustainability, decline, or collapse of human societies is a key prerequisite for creating a sustainable and desirable future. A central hypothesis is that the probability of societal collapse, or failure increases with loss of resilience in social-ecological systems. The proposed working group will assemble integrated environmental and human historical data at the global scale for comparative analysis and for a few key case study areas for dynamic analysis in order to help build this understanding. We will develop criteria for integrating and analyzing disparate data across scales and disciplines. Key lessons from an ongoing project titled “Integrated Research Information System (IRIS)” using the ARCHAEOEMEDS dataset from southern Europe (van der Leeuw, 1998, 2005) will be incorporated. A key component of this activity will be developing better ways to integrate and visualize data from the broad range of relevant sources (i.e. from historical narratives to ice

cores) and with a broad range of spatial and temporal resolution and quality. In assembling the integrated data base the working group will also develop meta-variables and indices that can serve as proxies for environmental predictability and system resilience. We can then test the ability of various proxies of system resilience to explain sustainability or breakdown of social structures, relative to alternative hypotheses. A range of modeling approaches will be applied to the problem.

***Title: Limited-information fisheries management (Supported by the Paul G. Allen Family Foundation)***

*Leader(s):* Costello, Christopher

*Participants:* Richard Allen, Ragnar Arnason, Kristin Carden, Christopher Costello, Robert Deacon, Patty Debenham, Rod Fujita, Steven Gaines, Corbett Grainger, Theodore Groves, Ray Hilborn, Kristen Honey, Larry Karp, Brian Kinlan, Hunter Lenihan, Sarah Lester, John Lynham, Alec MacCall, John Melack, Frank Merry, Lars Olson, Ana Parma, Jeremy Prince, Diane Regas, Wolfram Schlenker, Andrew Solow, George Sugihara, Gil Sylvania, Quinn Weninger, Kate Wing

*Abstract:*

Effective and efficient fisheries management is often limited by available information and the high cost of collecting detailed fisheries data. Information gaps and management challenges often exist, for example, with regard to assessing stock size and dynamics, the spatial distribution of harvest given particular policies, and monitoring and enforcement of bycatch standards. This workshop, organized by the Sustainable Fisheries Group at UCSB, seeks to develop analytical innovations to deal with these challenges, with the goals of improving fishery value, compliance, accountability, and sustainability and minimizing management costs. Workshop participants will aim to identify theoretical and analytical advances in fishery management, including limited-information fisheries, with particular emphasis on: 1) spatial management approaches, 2) incentive-based management, 3) stock assessment and management under uncertainty, and 4) multi-species management. Participants will discuss the conditions under which these theoretical innovations could be practically useful in fisheries management, the benefits from applying them, and opportunities for further advances. The workshop organizers will work with Environmental Defense Fund (EDF), a leading conservation organization, to ensure that the results from this workshop are shared widely and utilized to improve on-the-ground fisheries reform.

***Title: When are matrix models useful for management? An empirical test across plant populations***

*Leader(s):* Crone, Elizabeth; Menges, Eric; Ellis, Martha

*Participants:* Timothy Bell, Paulette Bierzychudek, Elizabeth Crone, Johan Ehrlén, Martha Ellis, Tom Kaye, Tiffany Knight, Peter Lesica, Bruce Maxwell, Eric Menges, William Morris, Gerard Oostermeijer, Pedro Quintana-Ascencio, Amanda Stanley, Tamara Ticktin, Teresa Valverde, Jennifer Williams

*Abstract:*

In the past three decades, the role of matrix-based demographic models in plant conservation has steadily increased. However, the reliability of these methods remains hotly debated. Most tests of model performance have relied on strict conditions for either the datasets being tested or the criteria used to judge accuracy of the results. This leads to a potential disconnect between the variety of ways in which models are used in practice and the limited set of conditions where their performance has been evaluated. Our working group brings together a group of ecologists who have worked with these models in applied settings. We will review how models have actually been used in the recent past and discuss what predictions we expect these models to usefully provide. We will then use our demographic data from long-term studies to evaluate how well demographic models actually predict the dynamics of perennial plant populations. We will also address whether increasing methodological complexity (e.g. density dependence, integral projection modeling) improves reliability. The convergence of our group occurs at a moment when sufficient time and data have accumulated to test the predictions of demographic models at relevant time scales for management, and takes advantage of NCEAS capacities to bring together diverse groups and archive key data. Thus, this working group provides a timely opportunity to reevaluate what has become an exceptionally important tool in conservation and management.

***Title:* Envisioning a Sustainable Global Seafood Market and Restored Marine Ecosystems**

*Leader(s):* Crowder, Larry; Smith, Martin

*Participants:* James Anderson, Molly Anderson, Frank Asche, Theodore Bestor, Carrie Brownstein, Kristin Carden, Larry Crowder, Benjamin Halpern, Dane Klinger, Aaron McNevin, Roz Naylor, Cathy Roheim, Rafe Sagarin, Kimberly Selkoe, Geoffrey Shester, Martin Smith, Dale Squires, Rashid Sumaila, Mary Turnipseed, Peter Tyedmers

*Abstract:*

Ecologists, conservationists, and economists agree that many of the world's wild-capture fisheries are overfished, overcapitalized, and continue to decline. At the same time, global demand for fish protein is growing rapidly. Aquaculture provides an increasing share of the world's edible fish protein, but there are potentially adverse environmental effects of large-scale aquaculture production. Wild-capture fisheries and aquaculture together comprise the global seafood market. Though the deleterious impacts of fisheries and aquaculture on marine ecosystems have been widely studied, few studies have focused on the mechanisms by which the global seafood trade contributes to declines in marine ecosystems and how this trade might be altered to support restoration of marine ecosystems. Also, scientists from different disciplines mainly study the constituent parts of seafood production in isolation without an overarching vision of what an ecologically and economically sustainable seafood system would look like. This is the void in scholarship we seek to fill with a team of marine ecologists, conservation practitioners, natural resource economists, and an anthropologist. We seek to explore three overarching questions: 1) Can we envision a global seafood system that is sustainable and does not degrade marine ecosystems? 2) Are there features of the global seafood trade that, if enhanced, could facilitate bottom-up sustainability of individual fisheries and aquaculture operations? 3) Are there top-down policy instruments or international agreements that would nudge the global seafood trade towards more sustainable practices? This study is timely and of vital importance, and we believe we have assembled an ideal team to carry it out. By linking knowledge about how the global seafood trade works with knowledge about the ecological

impacts of fisheries and aquaculture operations, we will identify the pressure points to shift the global seafood trade away from harming marine ecosystems and towards a sustainable seafood system.

***Title: Conservation planning for ecosystem functioning: Testing predictions of ecological effectiveness for marine predators (EBM; Packard Foundation)***

*Leader(s):* Doak, Daniel; Estes, James; Wootton, J. Timothy; Williams, Terrie

*Participants:* Ian Carroll, Daniel Doak, Mark Emmerson, James Estes, Benjamin Halpern, Ute Jacob, David Lindberg, James Lovvorn, Daniel Monson, Mark Novak, Craig Osenberg, M. Timothy Tinker, Terrie Williams, J. Timothy Wootton

*Abstract:*

At a major symposium on marine ecosystem-based management at the 2005 AAAS meetings, one of the three principal themes deemed critical for future progress was interaction web dynamics; the way in which species interact with one another and their physical environment. In particular, the scientific basis for marine ecosystem-based management must better incorporate understanding of the influences of multiple predator species on interaction web dynamics. These interactions are increasingly recognized as critical to the maintenance and restoration of marine communities and hence to the planning of marine reserves and other conservation strategies. Our working group will directly tackle this important issue, asking what approaches are most successful in estimating the interaction strength, also termed ecological effectiveness, of predator species on nearshore communities and how to use limited information on these effects to best conduct conservation planning in these ecosystems. We will focus our initial efforts on three extremely well-studied predator guilds of West Coast, near shore communities: sea otters in kelp forests; predatory whelks in mid-intertidal benthic communities, and wading shore birds in high to mid intertidal communities. For each of these very different systems, extensive data exist on the effects of predator abundance, physiology, and individual behavior. We will assemble these diverse data sets and use them to develop detailed interaction models as well as more broad-brush models that may be applicable to less-well-studied communities. Our overall goal is to use these models to ask what aspects of predator physiology and behavior, and what aspects of prey community structure, most determine the ecological effectiveness of predators and thus must be understood in order to plan viable marine conservation strategies.

***Title: Machine learning for the environment***

*Leader(s):* Drake, John; Langford, Bill

*Participants:* Peter Buston, Rich Caruana, Thomas Dietterich, John Drake, Jane Elith, Reuben Keller, Andreas Krause, Bill Langford, Dragos Margineantu

*Abstract:*

We believe that environmental science, ecology, and conservation biology would be greatly enriched by expanding the ecologist's analytical toolbox to include machine learning (ML) approaches to data analysis. We use the term ML loosely to distinguish between parametric statistics and a variety of new, computational methods for recognizing and analyzing patterns in data. Generally, parametric methods assume highly restrictive theoretical properties of data, such

as additivity, linearity, independence, and distribution (e.g., normality). Ecological data, by contrast, represent highly complex systems and commonly violate these assumptions [1-3]. Unfortunately, failure to appreciate these subtleties of ecological data often results in misguided analysis and incomplete or incorrect conclusions. In recent years, ML researchers have developed techniques for analyzing data not suited to parametric statistics. Older machine learning algorithms include neural networks and decision trees. Now, newer techniques like boosting and kernel methods (e.g., support vector machines), provide new opportunities for extracting subtle patterns from complex data, while hybrid methods integrate parametric models and ML to exploit computation and hard-won biological understanding simultaneously. Despite successes elsewhere (e.g., bioinformatics, astrophysics) ML has not been widely adopted by ecologists. Complex situations that might be addressed with ML include identifying optimal policies for managing ecological systems under uncertainty, forecasting, nonlinear modeling, and scientific inference with non-independent data. Accommodating these scientific and statistical difficulties within parametric statistics ranges from cumbersome to impossible. Therefore, we propose a working group to identify obstacles, scope out promising research, produce case studies, and develop a book length tutorial for ecologists on the practical application of ML.

***Title: Developing an integrated botanical information network to investigate the ecological impacts of global climate change on plant biodiversity***

*Leader(s):* Enquist, Brian; Condit, Richard; Peet, Robert; Boyle, Brad; Dolins, Steven

*Participants:* Sandy Andelman, Brad Boyle, Jeannine Cavender-Bares, Richard Condit, Doug Daly, Steven Dolins, Brian Enquist, Karla Gendler, Naia Holme, Peter Jorgensen, Gabriela Lopez-Gonzalez, Yadvinder Malhi, Brian McGill, Robert Peet, Oliver Phillips, Mark Schildhauer, Lindsey Sloat, Jens Svenning, Nathan Swenson, Barbara Thiers, Corine Vriesendorp, Susan Wisser, Hans ter Steege

*Abstract:*

Many of the major questions in ecology span enormous geographic and temporal scales, yet much ecological knowledge is still based on observations of individual investigators conducted at single locales, often covering scales of only a few hundred square meters. Understanding ecological patterns and predicting future changes, including those caused by human impact, necessitates a holistic approach covering large spatial scales, and this will only be achieved by identifying, retrieving, and synthesizing diverse data from distributed sources: heterogeneous data from a global confederation of collaborating scientists including a broad range of disciplines. To address this pressing need, we propose to network eight of the largest databases on plant inventories in the Americas to assemble an accessible and readily analyzable database warehouse on distributions and abundances. With it, we will answer major questions of direct relevance to conservation of new world biota. In particular, how does climate and latitude influence the relative distribution and abundance of narrow and widespread plant species? While this and associated questions have been mainstays for ecology our inability to integrate data has significantly limited our ability to answer them. The proposed working group will significantly improve our ability to finally answer these questions. We will also make distribution and abundance data widely available so that further analyses, for example covering other plant taxa or particular regions, will be possible. It is also part of our plan to continue expanding our meta-database with additional inventories, collections, and plots not yet digitized, plus future field

work. This data network will provide a baseline of critical data will allow ecologists to address fundamental issues in plant ecology and global change biology.

**Title: Prediction of responses of wild Pacific salmon to climate change** (*supported by the Moore Foundation*)

*Leader(s):* Fleishman, Erica

*Participants:* Omar Aziz, Liz Banse, Nancy Baron, Timothy Beechie, Erica Fleishman, Correigh Greene, Kendra Holt, John Kimball, Joshua Lawler, Steven Lindley, Luis Francisco Madrinan, Nathan Mantua, Niels Maumenee, Eli Meir, Elizabeth Neeley, Randall Peterman, Christine Petersen, Tom Reed, Jim Regetz, Mary Ruckelshaus, Mark Schildhauer, Daniel Schindler, Jack Stanford, David Stoms, Fengge Su, Alisa Wade, Shaun Walbridge, Robin Waples, Michael Webster, Huan Wu

*Abstract:*

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, and potential management responses, on populations of salmon and the ecosystems they inhabit. We will conduct synthetic research on the following four high-priority research topics: (1) identification of mechanisms that limit the geographic range of salmon populations and exploration of how these mechanisms may change under projected scenarios of climate change, (2) development of monitoring programs that can identify changes in populations of Pacific salmon and attribute those changes to different potential mechanisms, including climatic change, (3) examination of the relative importance of evolutionary and plastic responses of Pacific salmon to climate change, and (4) classification of salmon populations or metapopulations along a gradient of sensitivity or resilience to climate change, and potential management and conservation strategies that may benefit salmon populations along that gradient under alternative future climates.

**Title: Ecosystem analysis of pelagic organism declines in the Upper San Francisco Estuary** (*supported by the US Fish & Wildlife Service*)

*Leader(s):* Fleishman, Erica

*Participants:* Marissa Bauer, William Bennett, Larry Brown, Jon Burau, Gonzalo Castillo, Steven Culberson, Fred Feyrer, Erica Fleishman, Mike Johnson, Wim Kimmerer, Ralph Mac Nally, Mark Maunder, John Melack, Dennis Murphy, Ken Newman, Catherine Ruhl, Andrew Sih, David Stoms, Jim Thomson, Howard Townsend

*Abstract:*

Abundance indices of four important pelagic fishes in the upper San Francisco Estuary (the low-salinity regions of the San Francisco Bay-Delta and Suisun Bay)-delta smelt, juvenile striped bass, longfin smelt, and delta shad-have been declining since 2001. Delta smelt is an endemic species listed as threatened under both the California and United States Endangered Species acts. Protection of delta smelt often determines water management actions in the estuary, affecting more than 22 million people in California and a multibillion dollar agricultural industry. Longfin smelt also is native to California. Striped bass and threadfin shad both are introduced species, but

they support valuable recreational fisheries. Because of the ecological, economic, and political importance of these fishes, there is considerable pressure to find causes of the observed declines and provide information that may help reverse these trends. NCEAS will work with the Interagency Ecological Program (IEP) for the San Francisco Bay / Sacramento - San Joaquin Estuary, a team representing three state, six federal, and one non-governmental organization, and with the CALFED Bay-Delta Program to gain a better understanding of the causes and mechanisms behind the organism declines in the San Francisco Estuary. The project team also aims to place these declines in the broader context of estuarine degradation, organism declines, and approaches to dealing with these problems elsewhere in the nation and world. In particular, we are interested in identifying other systems that might serve as models for how to approach issues in California and ultimately might lead to general principles and lessons for estuarine research and management strategies.

*Title: **Valuation of marine ecosystem services** (Supported by the Ocean Protection Council)*

*Leader(s):* Fleishman, Erica

*Participants:* Christine Blackburn, Drew Bohan, Roelof Boumans, Kevin Boyle, Steve Colt, Donald Crocker, Meghan Ellis, Erica Fleishman, Gillian Kerr, Gunnar Knapp, Ricardo Lopez, Tim O'Higgins, Hans Radtke, Nejem Raheem, Murray Rudd, David Stoms, Paula Swedeen, John Talberth, Chuck Willer

*Abstract:*

NCEAS and the California Ocean Protection Council are collaborating to examine existing methods of market and non-market valuation of marine ecosystem services. Participants in this workshop will compile a lexicon related to market and non-market valuation of ecosystem services. In addition, the group will outline available strategies for deriving the value of ecosystem services and associated uncertainties in measurement or interpretation. Participants will develop a preliminary list of services in coastal marine California that are expedient and tractable to value. They also will help to scope the potential for valuation of one or more services by future working groups of economists and ecologists.

*Title: **Climate change and conservation** (supported by Wildlife Conservation Society)*

*Leader(s):* Fleishman, Erica; Tabor, Gary

*Participants:* Dominique Bachelet, Marjorie Brooks, Molly Cross, Carolyn Enquist, Erica Fleishman, Lisa Graumlich, Lee Hannah, Lara Hansen, Gregory Hayward, Marni Koopman, Joshua Lawler, John Nordgren, Brian Petersen, Daniel Scott, Sarah Shafer  
Gary Tabor, Erika Zavaleta

*Title: **Potential role of contaminants in declines of pelagic organisms in the Upper San Francisco Estuary, California** (supported by the US Fish & Wildlife Service)*

*Leader(s):* Fleishman, Erica

*Participants:* Marjorie Brooks, Larry Brown, Tracy Collier, James Drever, Dick Dugdale, Erica Fleishman, Mike Johnson, David Krolick, Peggy Lehman, Sam Luoma, Carys Mitchelmore, Alex Parker, Daniel Schlenk, Nathaniel Scholz, James Sickman, David Stoms,

Swee Teh, Inge Werner, Suzanne van Drunick, Peter van Veld

*Abstract:*

In late 2004, scientists noted that abundance indices of several pelagic fishes in the upper San Francisco Estuary (delta smelt, age-0 striped bass, longfin smelt, and threadfin shad) had remained unusually low since 2001. Delta smelt is an endemic species listed as threatened under both the California and U.S. Endangered Species Acts. Protection of delta smelt often determines water management actions in the estuary, which supplies drinking water to more than 22 million people and supports a multi-billion dollar agricultural industry. The abundance of longfin smelt, another native species, has a strong positive relationship to freshwater outflow. Striped bass and threadfin shad are both introduced species that contribute substantially to the total biomass of pelagic fishes in the ecosystem and support valuable recreational fisheries. NCEAS and the Interagency Ecological Program are collaborating to convene several working groups on issues related to decline of pelagic organisms. We hope not only to gain a better understanding of the specific causes of the organism declines in the San Francisco Estuary, but to place these declines in the broader context of estuarine assessment and management in other geographic regions. This working group seeks to investigate the potential influence on observed declines of contaminants such as pyrethroid use, changes in wastewater discharge as California's human population increases, and changes in use of pesticides. Contaminants may be having chronic effects or effects on the food web rather than acute effects detectable by traditional bioassays. Wastewater includes steroids and other pharmaceuticals that can affect the endocrine and immune systems. There also may be maternal effects on eggs and larvae.

***Title: Interactions between the near-coastal ocean and the San Francisco Estuary***

*(supported by the US Fish and Wildlife Service)*

*Leader(s):* Fleishman, Erica

*Participants:* Larry Brown, James Cloern, Erica Fleishman, Paul Hershberger, Kathy Hieb, John Largier, Cynthia LeDoux-Bloom Ricardo Lopez, Jay Lund, Luis Francisco Madrinan, Wendy Meiring, Nadav Nur, Christine Petersen, Bill Peterson, Thomas Powell, Bruno Sanso, Ted Sommer, Mark Stacey, Jan Thompson, Monika Winder

*Abstract:*

The aim of this working group is to identify, analyze, and synthesize existing data on interactions between the near coastal ocean and the San Francisco Estuary with a non-exclusive focus on declining pelagic fishes. Substantial changes in the biological communities of San Francisco Bay may have occurred in response to a state change in the California Current system after 1998. The state change was characterized by increased upwelling, enhanced primary production, and strong southerly flow. These changes in the near coastal ocean were associated with increased biomass of phytoplankton, new seasonal phytoplankton blooms, declines in the distribution and abundance of bivalve mollusks, and high abundance of several predators of bivalves in San Francisco Bay. Processes in the near coastal ocean may have direct or indirect influences on abundance and survival of several fishes of management concern, including longfin smelt, striped bass, and possibly delta smelt. Changes in the near coastal ocean might also influence survival of outmigrating juvenile salmonids, including Chinook salmon and steelhead rainbow trout, as they enter the ocean. These results indicate that proper understanding and management



of the San Francisco Estuary requires knowledge of ocean processes as well as riverine and internal estuarine processes. The working group will attempt to examine the relative influence of processes in the near coastal ocean on the fishes and other organisms in the San Francisco Estuary.

**Title: Synthetic macroecological models of species diversity**

*Leader(s):* Gotelli, Nicholas; Colwell, Robert; Rahbek, Carsten

*Participants:* Marti Anderson, Hector Arita, Anne Chao, Robert Colwell, Sean Connolly, Robert Dunn, Nicholas Gotelli, Gary Graves, Jessica Green, Walter Jetz, Anne Magurran, Christy McCain, Carsten Rahbek, Thiago Fernando Rangel, Jorge Soberon Mainero, Campbell Webb

*Abstract:*

A major unsolved problem in macroecology and biogeography is the origin and maintenance of species richness gradients. Biogeographers are currently divided into three major camps: those who favor historical or phylogenetic mechanisms, those who favor explanations based principally on geographic patterns of contemporary environmental variables, and those who advocate the incorporation of null model approaches. In the existing catalog of simple null models, species' geographic ranges are randomized within a bounded domain, producing a middomain effect (MDE); a peak of species richness towards the center of the geographical domain. This working group will seek to develop a novel synthesis of historical, contemporary environmental, and MDE hypotheses, by modeling species' geographic ranges in an environmentally heterogeneous geographical domain, with spatially explicit colonization, range expansion, speciation, and extinction.

**Title: Cultural ecosystem services from marine and coastal systems: Counting the intangibles** (*supported by the Packard Foundation*)

*Leader(s):* Guerry, Anne; Chan, Kai

*Participants:* Vic Adamowicz, Patricia Balvanera, Xavier Basurto, Ann Bostrom, Kai Chan, Ratana Chuenpagdee, Gretchen Daily, Rachelle Gould, Anne Guerry, Benjamin Halpern, Neil Hannahs, Sarah Klain, Jordan Levine, Bryan Norton, Mary Ruckelshaus, Roly Russell, Debra Satz, Heather Tallis, Ulalia Woodside

*Abstract:*

The field of ecosystem service science has begun to align economic incentives with conservation outcomes by identifying and valuing a more complete set of the services provided to humans by ecosystems than is traditionally considered in decision-making processes. Ecosystem services are the provision of things and experiences by ecosystems for people. The ecologists and economists working in this field have primarily focused on measuring, mapping, and valuing provisioning and regulating services; cultural services are always mentioned, but the integrated incorporation of such services into decision-making remains decades behind the more tangible services. We propose to change this by jump-starting the integration of cultural services into ecosystem-service decision-making tools. This working group will bring together an interdisciplinary group of ecologists, anthropologists, political scientists, philosophers, sociologists, and practitioners to tackle the thorny question "How do changes in ecosystems affect changes in cultural values in different scenarios for use of coastal and marine regions?" We will review the available data

linking such ecosystem change to changes in cultural values, paying particular attention to interactions between services, and to non-linearities. Our project will provide a framework for employing quantitative and—where necessary—qualitative methods to explicitly consider such values in marine and coastal planning.

**Title: INTEROP: Creation of an international virtual data center for the biodiversity, ecological and environmental sciences** (*Supported by NSF Ecoinformatics grants*)

*Leader(s):* Jones, Matthew; Michener, William; Smith, Kathleen

*Participants:* Suzanne Lorraine Allard, John Cobb, Bob Cook, Duane Costa, Patricia Cruse, Mike Frame, Stephanie Hampton, Vivian Hutchison, Matthew Jones, Steve Kelling, Hilmar Lapp, William Michener, Mark Servilla, Kathleen Smith, Carol Tenopir, David Vieglais, Todd Vision, Bruce Wilson

**Title: Unifying approaches to statistical inference in ecology**

*Leader(s):* King, Aaron; Rohani, Pej

*Participants:* Carles Breto, Stephen Ellner, Matthew Ferrari, Giles Hooker, Edward Ionides, Valerie Isham, Aaron King, Katia Koelle, Michael Lavine, Ken Newman, Daniel Reuman, Pej Rohani, Helen Wearing

*Abstract:*

In the face of ecological complexity, it has very often proved useful to formulate mathematical models, which allow us to examine the consequences of specific sets of assumptions. While this approach has generated interesting and important ideas, progress has been frustrated by a fundamental hurdle: direct confrontation of models and data in a statistically robust way. We propose a working group aimed at overcoming this hurdle by synthesizing numerous state-of-the-art techniques. The approaches we will consider explicitly take into account common causes of mismatch between models and data such as process noise (demographic and environmental stochasticity), measurement error, unobserved variables, and nonstationarity. The end result of this working group will be a thorough review of the strengths and weaknesses of the various approaches under different circumstances and a set of easy-to-use statistical tools for use by non-specialists.

**Title: Evaluating responses of freshwater ecosystems to experimental water management** (*supported by NOAA*)

*Leader(s):* Konrad, Christopher; Olden, Julian

*Participants:* Joan Browder, Mary Freeman, Keith Gido, Nina Hemphill, Paul Higgins, Francine Hughes, Christopher Konrad, David Lytle, Laura McMullen, Ted Melis, Meryl Mims, Julian Olden, Christopher Robinson John Schmidt, John Williams

*Abstract:*

The availability of fresh water to meet the demands of a growing human population and simultaneously ensure ecosystem integrity has emerged as one of the world's primary resource issues (Postel and Richter, 2003; Alcamo et al. 2008). Water management for people and

ecosystems remains an open scientific question (Acreman and Dunbar 2004, Arthington et al.2006) that is being answered with experimental approaches to releasing water from dams and other control structures for ecological benefits in rivers, floodplains, and estuaries. Flow experiments present an unrivaled opportunity to evaluate large-scale experimental approaches in ecosystem management because of shared scientific approaches. We propose bringing scientists together in a working group to integrate the site-specific results of large-scale flow experiments and synthesize general lessons to guide future large-scale experiments and ecosystem management in other places. We will:

- 1) test the limits of extrapolation across scales and integration across sites in drawing general conclusions about ecological responses to flow experiments;
- 2) identify criteria for attributing immediate, direct responses and long-term changes in the status of populations, communities, and ecosystems to experimental manipulation; and 3) develop innovative approaches that facilitate the transfer of knowledge from large-scale experiments to broader applications.

***Title: Parasites and food webs- the ultimate missing links***

*Leader(s):* Lafferty, Kevin; Dobson, Andrew; Pascual, Mercedes

*Participants:* Stefano Allesina, Cherie Briggs, Giulio De Leo, Andrew Dobson, Jennifer Dunne, Ryan Hechinger, Armand Kuris, Kevin Lafferty, Neo Martinez, John McLaughlin, Jane Memmott, Erin Mordecai, Mercedes Pascual, Robert Poulin, David Thielgtes, Richard Williams

*Abstract:*

Food webs are a conceptual underpinning for community ecology. Unfortunately, nearly all webs do not include parasites. Considering that parasitism is the most popular lifestyle on Earth, there is concern that food webs may not be complete without parasites. This working group brings together a range of experts on parasitism, food web theory, and empirical food webs to consider how parasites can be included into food-webs and to explore the consequences of their inclusion. The working group will focus on developing theoretical food webs capable of considering parasites, investigate, in detail, the few food webs that include parasites, and collate information that will allow us to assemble food-webs for a number well-studied ecosystems for which parasite data are available. Ultimately we hope to convince ecologists to incorporate parasites into all future food web studies.

***Title: Applying population ecology to strategies for eradicating invasive forest insects***

*(supported by US Forest Service)*

*Leader(s):* Liebhold, Andrew; McCullough, Deborah

*Participants:* Ludek Berec, Julie Blackwood, Robert Haight, Alan Hastings, Dan Herms, John Kean, Danny Lee, Andrew Liebhold, Deborah McCullough, Becky Niell, Max Suckling, Patrick Tobin, Takehiko Yamanaka

*Abstract:*

Eradication refers to management activities that result in the extirpation of a species from a given area. Despite the vast amounts of money and effort expended on eradication programs and their importance to mitigation of undesirable effects of non-indigenous species, a scientific basis for

eradication founded on basic principles of population ecology is lacking. We plan to assemble a team comprised of applied ecologists familiar with invasive forest insects and eradication efforts, theoretical ecologists with expertise in the dynamics of low-density populations, and economists with backgrounds in optimization and decision theory. This diverse group will assemble historical data and develop population models that capitalize on our knowledge of Allee effects, stochastic dynamics, and spatial ecology to formulate and optimize new strategies for eradicating alien species and for identifying conditions under which eradication is practical.

**Title: Ecosystem services on an urbanizing planet: What 2 billion new urbanites means for air and water** (*Co-sponsored with The Nature Conservancy*)

*Leader(s):* McDonald, Robert; Marcotullio, Peter

*Participants:* Deborah Balk, Marilyn Brown, Ian Douglas, Thomas Elmqvist, Balazs Fekete, Nancy Grimm, Rebecca Hale, Shu-Li Huang, Jeffrey Kenworthy, Peter Marcotullio, Robert McDonald, Carmen Revenga, Niels Schulz

*Abstract:*

Urbanization is expected to add almost 2 billion new urban residents by 2030. While there is growing awareness that cities affect almost every ecosystem on Earth and are increasingly vulnerable to environmental changes, there are few global estimates of urbanization's impact on key ecosystem services. This is particularly true for freshwater availability and clean air, which may be massively impacted by urbanization and may be key future vulnerabilities for urban residents. We propose to assemble an intellectually diverse Working Group to produce the first calculation of the global impact of urban activities on two ecosystem services: freshwater use and availability for drinking and sanitation; and the atmosphere's capacity to absorb pollutants such as particulate matter, ozone, and carbon dioxide from fossil-fuel consumption while remaining healthy to breathe and avoiding extreme climate change. During our meetings scientists and policymakers will synthesize datasets of urban demographic, socio-economic, and biophysical change affecting the supply and demand of these two key ecosystem services. Our calculation of freshwater and atmospheric impacts will be incorporated into a high-profile scientific publication quantifying the ecological impact of future urbanization.

**Title: Tools and fresh approaches for species abundance distributions**

*Leader(s):* McGill, Brian; Etienne, Rampal; Green, Jessica

*Participants:* David Alonso, Marti Anderson, Volker Bahn, Maria Dornelas, Brian Enquist, Rampal Etienne, Jessica Green, Fangliang He, Allen Hurlbert, Anne Magurran, Pablo Marquet, Brian Maurer, Brian McGill, Helene Morlon, Han Olf, Annette Ostling, Candan Soykan, David Storch, Karl Ugland, Ethan White

*Abstract:*

The species abundance distribution (SAD) is a central pattern in ecology and of great importance for basic and applied management questions. Yet, surprisingly little progress has been made in identifying the mechanisms responsible for this fundamental pattern. We identify seven obstacles that have slowed progress in this field of research. We propose a working group that will develop a standardized database of SADs and computer code for analyzing SADs. The working group

will publish these for the scientific community at large and also use them to pursue a promising new direction in exploring SADs based on perturbations (how the SAD changes as various environmental factors covary).

***Title: Benchmarking ecosystem response models with experimental data from long-term CO2 enrichment experiments***

*Leader(s):* Norby, Richard; Luo, Yiqi; Oren, Ram; Prentice, I. Colin; Hanson, Paul

*Participants:* Steve Del Grosso, Michael Dietze, Paul Hanson, Thomas Hickler, Atul Jain, Julian Jenkins, David Kicklighter, Anthony King, Yiqi Luo, Belinda Medlyn, Richard Norby, Ram Oren, William Parton, I. Colin Prentice, M. Lynn Tharp, Peter Thornton, Shusen Wang, Victoria Wittig, Sonke Zaehle

*Abstract:*

Ecosystem models have been increasingly incorporated into earth system models to predict climatic and atmospheric dynamics. However, ecosystem models themselves are far from perfect and need continued improvement. We will advance this necessary model improvement using some of the longest and most comprehensive data sets on CO<sub>2</sub> impacts on ecosystems from field experiments. Twelve ecosystem process and land surface models, which are being used for predicting terrestrial response to atmospheric and climatic change, will be parameterized with site and weather data from the Duke University and Oak Ridge National Laboratory free-air CO<sub>2</sub> enrichment (FACE) experiments. We will evaluate the ability of the models to reproduce the measured processes of the carbon, water, and nitrogen cycles of the experimental forest stands and their responses to elevated atmospheric CO<sub>2</sub> concentration. Similarities and differences among the models and their components will provide guidance for improving all of the models. With the experimental data as a benchmark for model performance, the utility of the models for extrapolation to environmental change questions can be demonstrated with increased confidence. This working group will include participants who are most familiar with the experimental data, a data manager to assemble and format the data for model input, representatives from diverse modeling groups, and a neutral observer to synthesize model results. This data-model intercomparison project has the potential to provide better scientific outputs for policy making.

***Title: Monitoring responses of Pacific salmon to climate change (supported by The Moore Foundation)***

*Leader(s):* Peterman, Randall

*Participants:* Pete Adams, Doug Drake, Erica Fleishman, Harold Geiger, Kendra Holt, Chris Jordan, David Larsen, Steve Leider, Rich Lincoln, Luis Francisco Madrinan, Anthony Olsen, Chuck Parken, Randall Peterman, Christine Petersen, Jeffrey Rodgers

*Abstract:*

This working group will develop monitoring programs that can identify changes in populations of Pacific salmon and attribute those changes to different potential mechanisms, including climatic change. Analyses of data from such programs will (1) document changes in salmon populations,

(2) provide empirical data to compare with previous predictions, (3) inform evaluation of alternative hypotheses about mechanisms by which climate change affects salmon, and (4) inform suggested actions to maintain wild Pacific salmon populations over the long term. The group will develop guidelines for identifying an appropriate monitoring design given both budget constraints and location-specific concerns about the response of Pacific salmon to climate change. These guidelines will be applied to several illustrative situations. Further, the group will explore the consequences of deviating from the “best” design for a given situation, which will facilitate quantification of tradeoffs among monitoring programs.

***Title: Linking carbon storage in terrestrial ecosystems with other climate forcing agents: A synthesis allowing for effective carbon dioxide stabilization policies***

*Leader(s):* Randerson, James; Canadell, Josep; Jackson, Robert

*Participants:* Ray Anderson, Roni Avissar, Dennis Baldocchi, George Ban-Weiss, Gordon Bonan, Ken Caldeira, Josep Canadell, Robert Dickinson, Noah Diffenbaugh, Christopher Field, Kevin Gurney, Forrest Hoffman, Bruce Hungate, Robert Jackson, Lara Kueppers, Beverly Law, Sebastiaan Luyssaert, Thomas O'Halloran, Martin Otte, James Randerson

*Abstract:*

Reforestation, afforestation, and avoided deforestation mitigation options influence climate at local to global scales by mechanisms in addition to their effect on stabilizing atmospheric carbon dioxide levels. In some cases, for example, climate forcing from concurrent changes in albedo, evapotranspiration, and aerosols may have a larger impact regionally and globally than the net effects of greenhouse gases, yet these mechanisms are not accounted for in current policy frameworks such as the Kyoto Protocol. We propose a series of three meetings, bringing together ecosystem ecologists, climate scientists, and policy experts to synthesize recent work on tradeoffs between biogeochemical and biophysical forcing agents associated with land cover change. In a second step, we plan to draft a policy perspective that reevaluates the role of terrestrial ecosystems in climate policy.

***Title: Making decisions on complex environmental problems***

*Leader(s):* Regan, Helen; Sarkar, Sahotra

*Participants:* Mark Burgman, Mark Colyvan, Martin Drechsler, James Dyer, James Justus, Lynn Maguire, Christopher Margules, Tara Martin, Helen Regan, Kristina Rothley, Sahotra Sarkar

*Abstract:*

Environmental scientists must often facilitate complex decision-making based on scientific data but subject to societal and other constraints on management options. Complexity arises from: (i) multiple, often incommensurable, criteria that must be incorporated into decisions; (ii) decisions that must reflect the often conflicting long- and short-term goals of multiple stakeholders; and (iii) decisions that must be made in the presence of risk and uncertainty. The purpose of this project is to characterize scenarios for environmental decision-making and develop a conceptual taxonomy of them; review existing methods for dealing with multiple criteria and objectives, multiple stakeholders, and risk and uncertainty; develop integrated protocols for the use of these

methods for complex decision making scenarios in conservation, wildlife management and/or environmental science; develop software tools for some of the methods for which existing tools are inadequate; test protocols and tools against available data sets; and identify areas in which more research is needed.

***Title: Towards Understanding Marine Biological Impacts of Climate Change***

*Leader(s):* Richardson, Anthony; Poloczanska, Elvira

*Participants:* Andrew Bakun, Keith Brander, Chris Brown, John Bruno, Lauren Buckley, Mike Burrows, Carlos Duarte, Pippa Moore, Mary O'Connor, John Pandolfi, Elvira Poloczanska, Anthony Richardson, Maria Sanchez-Camacho, David Schoeman, William Sydeman

*Abstract:*

This Working Group will provide the globally coherent view of marine biological changes in response to climate change that is currently lacking but so desperately needed. We will bring together marine experts specialising in diverse ecosystems and robust statistical analysis to address

key questions concerning the vulnerability of marine systems to climate change:

1. What are the similarities and differences between marine and terrestrial systems in terms of types and rates of responses?
2. Which marine species, taxonomic groups and systems (e.g., pelagic, benthic, rocky shore, sandy beach, coral reef) are most sensitive?
3. What are the similarities and differences in the types and rates of responses in tropical, temperate and polar seas?
4. Do multiple human stresses increase vulnerability of species and habitats to climate change?
5. Can we attribute change in marine ecosystems to climate change?

To answer these key questions, we will undertake three tasks:

Task 1: Database assembly – Build a marine climate impacts database employing an innovative tiered approach to classify impacts. The database will be publicly-accessible through the NCEAS data repository, enabling researchers to validate entries and upload new results.

Task 2: Impacts analysis – Address the first 4 key questions above by applying robust meta-analytic

techniques (e.g., Parmesan & Yohe 2003) to the marine climate impacts database.

Task 3: Attribution – Employ the analytical techniques of the IPCC (2007) and Rosenzweig et al. (2008) to attribute changes in marine biological ecosystems to global warming with a high degree of certainty (key question 5).

***Title: An Interdisciplinary Approach To Advancing Landscape Genetics***

*Leader(s):* Rosenberg, Michael; Epperson, Bryan; Storfer, Andrew

*Participants:* Corey Anderson, Mark Dale, Bryan Epperson, Marie-Josée Fortin, Rolf Holderegger, Patrick James, Pierre Legendre, Stephanie Manel, Brad McRae, Melanie Murphy, Noah Rosenberg, Michael Rosenberg, Kim Scribner, Stephen Spear, Andrew Storfer, Lisette Waits

*Abstract:*

Landscape genetics is the intersection of landscape ecology with population genetics. While spatial analytical methods have been applied to genetic data for three decades, advances in high-throughput collection of genetic data combined with increased availability of GIS-based landscape data have outpaced advances in statistical methods. Classical population genetic measures (e.g.,  $F_{st}$  and Nei's  $D$ ) are aspatial in nature and most often applied to allele frequencies from limited numbers of molecular markers. Today we are capable of generating hundreds of markers from distinct individuals (e.g., genome-wide SNP assays or AFLP loci). A distinct benefit of landscape genetics is that significantly more genetic variation can be explained by spatially-explicit analyses than traditional aspatial analyses. As such, landscape genetics holds great promise for ecological genetics research, such as explaining processes that affect the distribution of neutral or adaptive genetic variation, revealing cryptic barriers to dispersal, and developing conservation programs focused on landscape features that facilitate connectivity among populations. This working group will bring together landscape ecologists and spatial analysts with population geneticists to (1) examine the applicability of historic and currently used spatial tools for estimating spatial genetic structure with the various types of data generated in modern population genetics studies; (2) examine the statistical rigor of each combination of statistic and data type to test hypotheses about underlying spatial-temporal processes; (3) adapt existing and invent new methods for analyzing modern genomic data in a spatial context; and (4) develop forums for communicating with practicing ecological and evolutionary geneticists, landscape ecologists, spatial statisticians and conservation biologists.

***Title: INTEROP: A Community-driven scientific observations network to achieve interoperability of environmental and ecological data (Supported by NSF Ecoinformatics grants)***

***Leader(s):*** Schildhauer, Mark

***Participants:*** Luis Bermudez, Shawn Bowers, Philip Dibner, Corinna Gries, Matthew Jones, Mark Schildhauer

***Title: Potential interactions between urban runoff and decline of pelagic fishes (Supported by the US Fish and Wildlife Service)***

***Leader(s):*** Schlenk, Daniel

***Participants:*** Larry Brown, Erica Fleishman, John Melack, John Oram, Daniel Schlenk, Nathaniel Scholz, Geoff Scott, James Sickman, Frank Spurlock, Don Weston, Thomas Young, Minghua Zhang, Qingfu Zhao

***Abstract:***

Urban runoff has been identified as one of many potential drivers of the decline of pelagic fishes in the upper San Francisco Estuary. Participants in this working group will use an ecological risk-assessment approach to address potential chemical influences on delta smelt, longfin smelt, threadfin shad, and striped bass in urban environments. Housing and transportation infrastructure drains into spawning and nursery areas for these species. Three of the species spawn during months in which rain typically falls, leading to substantial urban storm runoff. Shifts in the pesticides applied in urban environments, from organophosphates to synthetic pyrethroids and, more recently, phenyl pyrazoles, have coincided with steep declines in pelagic fishes. These



newer pesticides have relatively long persistence times, and may be transported in sediments into the fishes' habitat. There is potential for relatively high toxicity to prey items for larval fishes as well as to early life stages of the fishes.

*Title: **Global climate change and adaptation of conservation priorities** (Supported by The Nature Conservancy)*

Leader(s): Shaw, M. Rebecca

Participants: Daniel Cayan, Frank Davis, Curtis Deutsch, Alan Flint, Alex Hall, Lee Hannah, Jim Lutz, Jason MacKenzie, Joel Michaelsen, Max Moritz, Chris Potter, Christophe Randin, Kelly Redmond, Helen Regan, Terry Root, Steve Schneider, M. Rebecca Shaw, Nate Stephenson, Alexandra Syphard, Karyn Tabor, Christina Tague, Anthony Westerling, Tom Wigley

*Title: **Effects of trade policy on management of non-native forest pests and pathogens** (Supported by The Nature Conservancy)*

Leader(s): Turner, James

Participants: Juliann Aukema, Greg Bratman, Kerry Britton, Eckehard Brockerhoff, Joseph Cavey, Bill Dickerson, Lynn Garrett, Robert Haack, Stephanie Hampton, Frank Lowenstein, Carissa Marassas, Meghan Nuding, Lars Olson, Matthew Royer, Margaret Shannon, Erin Sills, Christa Speckmann, Mike Springborn, James Turner, Christina Vieglais

*Abstract:*

This working group will explore whether federal records on interceptions of non-native forest pests and pathogens can be used to identify species that may colonize the United States during the next several decades. The group will attempt to estimate the economic and ecological costs of such colonizations given different volumes and origins of trade. In addition, the group will explore how different policies related to interdiction, detection, or eradication may affect costs.

*Title: **Efficient wildlife disease control: From social network self-organization to optimal vaccination***

Leader(s): Walsh, Peter

Participants: Damien Caillaud, Margaret Crofoot, Liliana Salvador, Samuel Scarpino, Peter Walsh

*Abstract:*

As large vertebrates are restricted to ever smaller populations, the threat posed by infectious disease grows. This multidisciplinary working group will investigate how information on social network connectivity can be used to make wildlife disease control programs more efficient. Using primates as a model system, we will build from studies on the way in which memory-based cognitive skills drive social network self-organization to the modeling of optimal disease control. Our modeling will be strongly data-based, using large datasets on ranging and disease prevalence/mortality from gorillas, chimpanzees and four monkey species to parameterize and validate agent-based simulation models. The datasets are from primate species that both suffer

disease spillover from humans (e.g. measles, yaws, gut parasites) and act as reservoir or intermediate hosts for viruses that are of high public health (HIV, yellow fever) or bioterror (anthrax, Ebola) importance. The group's research will be focused on three overlapping topics. First, we will investigate how cognitive skills influence social network self-organization and interact with landscape processes such as habitat degradation and hunting to determine patterns of disease emergence. Second, we will evaluate both generic strategies for controlling disease in protected areas and detailed case studies of optimal disease control in specific systems, including a special focus on controlling the impact of Ebola, which has killed about one third of the world's protected area gorilla population over the last 15 years. Third, the group will perform cost-benefit analyses to evaluate the cost-effectiveness and feasibility of vaccination relative to other conservation strategies, as well as make recommendations on which steps need to be taken to streamline the movement of vaccines and treatments from laboratory development to field implementation. Working group products will include both basic research on the mechanisms of disease network self-organization and more applied work on optimal disease control in real systems. A large body of primary and derived data products will be deposited in publicly accessible databases. The group has excellent diversity and balance in terms of the scientific discipline, career stage, gender, and geographic origin of its participants.

***Title: Exploring compensatory mitigation and markets as mechanisms for resolving fisheries bycatch: Biodiversity conservation conflicts***

*Leader(s):* Wilcox, Chris; Donlan, C. Josh

*Participants:* Vanessa Adams, Peter Baxter, Zachary Brown, Larry Crowder, Richard Cudney-Bueno, C. Josh Donlan, Kristen Fletcher, Jennifer Lavers, James Mandel, Sean Pascoe, Hoyt Peckham, Oliver Pergams, Drew Tulchin, Mary Turnipseed, Chris Wilcox, Dana Wingfield

*Abstract:*

The social and economic importance of fisheries and the biological realities of its impacts results in cardinal tensions over ocean resources. Fisheries provide approximately 16% of all protein consumed by humans and are valued at US\$82 billion annually. However, eight percent of the global fishery catch is bycatch which is discarded; resulting in major impacts on marine systems. Increasingly, institutions are pressuring for sustainable management of species impacted by fisheries. Where bycatch cannot be avoided, fishery closures are being implemented, often driven by lawsuits, with costly outcomes for society. An offset approach to this conflict could facilitate high value uses of biological resources while making conservation gains for threatened species. Taking seabirds as an example, fishers could be levied for bycatch and capital transferred to fund conservation actions on breeding colonies (e.g., the removal of invasive mammals; the primary threat to seabirds worldwide). A preliminary analysis has shown eradication of invasive predators can be 12 times more effective from an economic cost-conservation benefit perspective in comparison with fisheries closures. In addition, transferable bycatch fees, which could increase with endangerment, also provide individual incentives for avoiding bycatch, the most effective mechanism for sustainable management of fisheries. We are developing a general framework for this approach, using seabirds and sea turtles as case studies. Given limited conservation dollars, compensatory mitigation provides an opportunity to address a global concern, maximize the return on investment of conservation interventions, and forge an

alliance between conservation and fisheries organizations, circumventing costly and socio-politically damaging battles over bycatch conflicts.

***Title: Finding common ground in marine conservation and management***

*Leader(s):* Worm, Boris; Hilborn, Ray

*Participants:* Julia Baum, Trevor Branch, Felicia Coleman, Jeremy Collie, Christopher Costello, Michael Fogarty, Beth Fulton, Ray Hilborn, Jeffrey Hutchings, Simon Jennings, Olaf Jensen, Heike Lotze, Pamela Mace, Tim McClanahan, Colin Minto, Stephen Palumbi, Ana Parma, Daniel Ricard, Andrew Rosenberg, Reg Watson, Boris Worm, Matthew Wright, Dirk Zeller

*Abstract:*

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. Clearly, one of the solutions to integrating the interests and efforts of fisheries biologists and ecologists is to expose young scientists to the goals and approaches of the various interested parties dealing with these issues. Accordingly, NCEAS will coordinate a Distributed Graduate Seminar (DGS) to involve graduate students and mentors from six universities.

***Title: Toward an adequate quantification of CH<sub>4</sub> emissions from land ecosystems: Integrating field and in-situ observations, satellite data, and modeling***

*Leader(s):* Zhuang, Qianlai; Melillo, Jerry; Prinn, Ronald; McGuire, A. David

*Participants:* Christopher Butenhoff, Patrick Crill, Ed Dlugokencky, Vincent Gauci, Sander Houweling, M. Aslam Khalil, A. David McGuire, John Melack, Jerry Melillo, Ronald Prinn, William Reeburgh, Jinyun Tang, Katey Walter, Kimberly Wickland, Xiaozhen Xiong, Qianlai Zhuang, Sergei Zimov

*Abstract:*

Emissions of CH<sub>4</sub> from natural and managed land ecosystems account for a significant source of greenhouse gases to the atmosphere. In recent decades, extensive field observations of CH<sub>4</sub> emissions and atmospheric CH<sub>4</sub> concentrations have been made during a time in which process-based and inversion modeling approaches have matured as powerful tools in estimating regional and global CH<sub>4</sub> emissions. However, there are still substantial uncertainties in estimating CH<sub>4</sub> exchange with the atmosphere. Much of this uncertainty arises from uncertainties in the extent of wetland distributions and incomplete understanding of the controls and mechanisms of methanogenesis, methanotrophy, and CH<sub>4</sub> transport pathways to the atmosphere. Furthermore, there is variability in which factors control CH<sub>4</sub> production and consumption in different natural and managed ecosystems. For example, in northern high latitudes, permafrost dynamics significantly influences emissions, while the seasonality of wetland extent is critical in determining emissions from tropical regions. For managed ecosystems (e.g., rice paddies), irrigation and fertilization significantly impact both methanogenesis and methanotrophy. Here we propose a Working Group to make progress in synthesis of CH<sub>4</sub> dynamics through three activities: 1) to identify key issues in quantifying CH<sub>4</sub> emissions from land ecosystems through conducting comparisons of model and field observations for different geographical locations and ecosystems; 2) to parameterize and extrapolate process-based models at regional and global scales and explore the uncertainty of CH<sub>4</sub> emissions; and 3) to couple process-based estimates with inversion modeling approaches to constrain the uncertainty with air-borne, satellite, and in-situ observed datasets and to identify the factors, mechanisms, and controls to the uncertainty of emissions at large-scales.

*Following are working groups that met prior to October 1, 2008, but were not reported in the NSF 2007-2008 report due to submission of the report prior to the end of the reporting period:*

**Title: Governance feasibility of marine ecosystem-based management: A comparative analysis (EBM) (supported by The Packard Foundation)**

*Leader(s):* Christie, Patrick; Pollnac Richard

*Participants:* Nygiel B. Armada, Patrick Christie; Liza Eisma-Osorio, Cirse Gonzalez, Jill Harris, Mark Hixon, David Jap, Gordon K.Lowry, Robin Mahon, Diana Pietri, Richard Pollnac, Brian Tissot, Anna Varney, Alan White

*Abstract:*

The EBM Feasibility NCEAS working group has three main goals: 1) assessing how to modify governance structures to facilitate effective ecosystem-based management (EBM) in developing and developed world contexts; 2) generating practical ecological and social indicators for EBM, and 3) producing analyses and planning materials useful for scientists, EBM practitioners, and policy makers around the world. It will draw together disparate, socio-ecological datasets from the Philippines, Southwestern Africa, the Caribbean, and Hawaii Island to assess EBM success as measured by common social and ecological goals of various programs. These results will result in synthetic peer reviewed journal articles and form the basis for an empirically-based how-to guidebook and training program to support coastal EBM.

**Title: Risk assessment for climate change and forest pathogens in western North America**  
(supported by US Forest Service)

**Leader(s):** Fleishman, Erica; Frankel, Susan

**Participants:** Erica Fleishman, Susan Frankel, Lee Hannah, Paul Hennon, Jennifer Juzwik, Charles G. Shaw, Rona Sturrock, Rob Venette, Alex Woods, James Worrall

**Abstract:**

NCEAS, the Western Wildland Environmental Threat Assessment Center (WWETAC), and the USDA Forest Service, Pacific Southwest Research Station are collaborating to develop a risk assessment for climate change and forest pathogens in western North America. This project will bring together individuals with expertise in forest pathology, quantitative modeling, and climate science. Ultimately, we anticipate that the project will yield two products: (1) a manuscript, suitable for submission to a peer-reviewed journal, on design and output of models describing relationships between climate change and forest pathogens in western North America, and (2) a risk assessment for forest pathogens in Western North America under a changing climate.

## **Meetings Hosted by NCEAS**

*Occurred or were scheduled between October 1, 2008 and September 30, 2009  
based on data available as of June 30, 2009*

05 Dec 08

***How to Work Effectively in the Classroom with 5th Graders***

Leader: Margaret Connors

04 Jan 09 - 07 Jan 09

***Assisted Migration (Hosted by NCEAS)***

Leader: Dov Sax

07 Jan 09

***David H. Smith conservation research fellows & NCEAS fellows discussion of career options (Hosted by NCEAS)***

Leader: Erica Fleishman

18 Jan 09 - 21 Jan 09

***The 60-year data set of plankton dynamics in Lake Baikal: Examining facets of the jewel of Siberia (Hosted by NCEAS)***

Leader: Moore, Marianne

27 Jan 09 - 28 Jan 09

***Open Access Publishing (Hosted by NCEAS)***

Leader: O.J. Reichman

06 Feb 09

***Towards a unified model for describing ecological and environmental observation data***

Leaders: Schildhauer, Mark; Jones, Matthew; Madin, Joshua; Bowers, Shawn; Kelling, Steve; Sugarbaker, Larry

09 Feb 09 - 13 Feb 09

***Adaptive capacity of human populations to coral reef fisheries dynamics (Luce Fellows hosted by NCEAS)***

Leaders: Watson, James; Carden, Kristin; Marshall, Michael; Petrovic, Nada; Davenport, Frank; Max, Lisa; Hughes, Sara; Murtinho, Felipe; Yau, Annie

02 Mar 09 - 05 Mar 09

***Identifying successful management strategies for rebuilding collapsed fisheries (Luce Fellows hosted by NCEAS)***

Leaders: Archer, Reginald; Hoaglund, Elizabeth; Lynch, Margaret; Needles, Lisa; Sadro, Steve

11 Mar 09

***Public domain ADMB project (Moore Foundation)***

Leader: Mark Schildhauer

16 Apr 09 - 18 Apr 09

***Investigating the impact of integrating social variables into water quality research: A review and meta-analysis (Luce Fellows hosted by NCEAS)***

Leader(s): Hove, Alisa; Clark, Robyn; Drus, Gail; Forest, Skip; Flores, Carola

*Scheduled for 28 Sep 09 - 30 Sep 09*

***Marine natural capital project (Hosted by NCEAS)***

Leader: Mary Ruckelshaus

## **Scientific Visitors**

*Occurred or were scheduled between October 1, 2008 and September 30, 2009  
based on data available as of June 30, 2009*

**Bodini, Antonio**

17-MAR-09 - 06-APR-09

*Reverse engineering of ecological networks: From the disassembly to the construction of robust networks*

Host: Stefano Allesina

**Buckley, Lauren**

15-MAY-09 - 01-AUG-09

*The role of niche conservatism in producing biodiversity gradients*

Lead PI: Howard Cornell

**Connolly, John**

22-MAR-09 - 24-MAR-09

*Using phylogenetic information to predict the relative importance of equalizing versus stabilizing mechanisms on species coexistence*

Host: Marc Cadotte

**Crona, Beatrice**

14-NOV-08 - 30-NOV-08

*Disciplinary synthesis and collaboration in ecology: Organizations, research groups, and work lives*

Host: John Parker

**Fridley, Jason**

09-MAR-09 - 14-MAR-09

*Using phylogenetic information to predict the relative importance of equalizing versus stabilizing mechanisms on species coexistence*

Host: Marc Cadotte

**Grace, Peter**

30-MAR-09

*Australian Terrestrial Ecosystem Research Network & the Australian Center for Ecological Analysis & Synthesis*

Host: Stephanie Hampton

**Krivan, Vlastimil**

04-DEC-08 - 12-DEC-08

*Unifying niche-neutral theories of molecular, community and network evolution (Gift)*

Host: Carlos Melian

**Lortie, Christopher**

01-MAY-07 - 31-AUG-09

*Occurrence of publication bias in ecology*

Host: Amber Budden

**Mack, Jeremy**

05-JUN-09 – 10-JUN-09

*Graduate Student research: UV effects on freshwater plankton*

Host: Stephanie Hampton

**Persson, Lennart**

22-APR-09 - 28-APR-09

*Population and community ecology of ontogenetic development and growth*

Host: Andre de Roos

**Sork, Victoria**

26-MAR-09

*Data archiving solutions*

Host: Rick Reeves

**Wade, Alisa**

15-JUN-09

*Climatic sensitivity of salmon*

Host: Christine Peterson

*Following are scientific visitors prior to October 1, 2008, but not reported in the NSF 2007-2008 report due to submission of the report prior to the end of the reporting period:*

**Anahonak, Joshua**

25 Aug 08

*Brooks Institute student video documentary project: "Women in Science"*

Host: Stephanie Hampton

**Fox, David**

18 Aug 08 – 19 Aug 08

*Effective plant density metrics &*

Host: Stephanie Hampton

**Hochberg, Michael**

3 Sep 08 – 8 Sep 08

*Evolving Metacommunities*

Lead PI: Mark Urban

**Lynch, Heather**

8 Sep 08 – 12 Sep 08



*Dendritic landscapes: Exploring connectivity and biodiversity in an alternative geometry*

Host: William Fagan

## **Center Associates Hosted by NCEAS**

*Occurred or were scheduled between October 1, 2008 and September 30, 2009*

*based on data available as of June 30, 2009*

### **Alroy, John**

Paleobiology Database (Hosted by NCEAS)

### **Baron, Nancy**

SeaWeb (Hosted by NCEAS)

### **Dobkin, David**

Analysis and Conservation Prioritization of Landscape Connectivity in Nevada (Wilburforce)

### **Halpern, Benjamin**

Ecosystem-based Management Program (Packard Foundation)

### **Melian, Carlos**

Unifying niche-neutral theories of molecular, community and network evolution (Microsoft)

### **Raheem, Nejem**

Valuation of marine ecosystem services (Ocean Protection Council)

### **Selkoe, Kimberly**

Elucidating marine dispersal with population genetics: A simulation approach with case studies on the Northwest Hawaiian Islands and the Pacific coasts of Baja and Southern California (Hosted by NCEAS)

## ***Research Training Activities***

Thirteen graduate students and three undergraduate students were involved with research activities at NCEAS during the reporting period. They are listed below, along with the titles of the projects on which they worked.

### **Graduate Student Interns**

*Occurred or were scheduled between October 1, 2008 and September 30, 2009*

*based on data available as of June 30, 2009*

### **Baskerville, Ed**

09 Feb 09 – 13 Feb 09

*Reverse engineering of ecological networks: From the disassembly to the construction of robust networks*

Project Lead: Stefano Allesina

**Botkin, Ben**

*Understanding the landscape of seafood consumption in the US* (Hosted by NCEAS)

Project Lead: Kimberly Selkoe

**Clark, Robyn**

01 Jan 09 – 30 Sep 09

*Ecoinformatics Graduate Internships*

Project Lead: Mark Schildhauer

**Davenport, Frank**

01 Jan 09 – 31 Mar 09

*Ecoinformatics Graduate Internships*

Project Lead: Mark Schildhauer

**Deacon, Nicholas**

01 Sep 08 – 31 May 09

*Linking phylogenetic history, plant traits, and ecological processes at multiple scales*

Project Lead: Jeannine Cavender-Bares

**Freed, Sarah**

01 Jul 08 – 30 Sep 08

*Measuring ecological, economic and social values of coastal habitats to inform ecosystem-based management of land-sea (EBM, Packard Foundation)*

Project Lead: Elise Granek

**Grod, Olyana**

20 Nov 08 – 30 Nov 08

*A quantitative exploration of the role of publication-related biases in ecology*

Project Lead: Christopher Lortie

~ and ~

02 Mar 09 – 20 Mar 09

*Occurrence of publication bias in ecology*

Project Lead: Amber Budden

**Groulx, David**

01 Jan 09 – 31 Mar 09

*Ecoinformatics Graduate Internships*

Project Lead: Mark Schildhauer

**Han, Xueying (Shirley)**

01 Jan 09 – 30 Jun 09

*Ecoinformatics Graduate Internships*

Project Lead: Mark Schildhauer

**Lamarque, Lauren**

28 Nov 08 – 10 Dec 08

*A quantitative exploration of the role of publication-related biases in ecology*

Project Lead: Christopher Lortie

**Nuding, Amelia**

21 Jul 08 – 30 Jun 10

*Economic impacts of non-native forest pests and pathogens in North America (The Nature Conservancy)*

Project Lead: Juliann Aukema

**Soong, Oliver**

01 Jan 09 – 30 Sep 09

*Ecoinformatics Graduate Internships*

Project Lead: Mark Schildhauer

**Teck, Sarah**

01 Oct 08 – 31 Mar 09

*Distributed graduate seminar - The role of MPAs in ecosystem-based management: Examining the science and politics of an ocean conservation strategy*

Project Lead: Robert Pavia

**Undergraduate Intern***Occurred or were scheduled between October 1, 2008 and September 30, 2009 based on data available as of June 30, 2009***Lang, Sarah**

12 Jan 09 – 10 Jun 09

*Metrics of successful collaborations*

Leader: Stephanie Hampton

**Mehrkens, Lea**

21-Oct-08 - 01-Feb-09

*Meta-analysis of ecological meta-analyses*

Leaders: Menge, Duncan; Cadotte, Marc

**Simon, Ari**

12 Jan 09 – 31 Jul 09

*Metrics of successful collaborations*

Leader: Stephanie Hampton

## **Postdoctoral Training Sessions**

For training sessions, NCEAS Postdoctoral Associates are the primary audience, with attendance by other NCEAS scientists (e.g., sabbaticals, graduate students) and UCSB scientists of all stages welcomed.

## **Career Development Series**

*(Sabbaticals and UCSB faculty are invited to provide faculty perspective in a discussion with Postdocs on career development topics that vary from year to year.)*

- Academic Job Application Process
- Mentoring
- Developing Web Pages and Blogs
- Non-academic Careers
- Social Networking in Science
- Outreach with K-12 Students
- "Where Should You Send Your Next Paper?"
- Networking
- Introducing Synthesis in Teaching
- Women in Scientific Careers

## **Technical Training**

*Occurred or were scheduled between October 1, 2008 and September 30, 2009  
based on data available as of June 30, 2009*

17 Feb 09

***R Training workshop*** (primarily for graduate students)

Instructor: Marc Cadotte

18 Feb 09 – 20 Feb 09

***R training workshop*** (primarily for postdocs)

Instructors: Jim Regetz and Rick Reeves

09 Mar 09 – 10 Mar 09

***AD Model Builder Training Workshop*** (Moore Foundation)

Instructors: Johnnoel Ancheta, Mark Maunder and Anders Nielsen

30 Jun 09 – 04 Aug 09

***Paleobiology Database*** (Hosted by NCEAS)

Instructor: John Alroy

15 Jul 09 – 20 Jul 09

*Ecoinformatics in South Africa (Mellon Foundation)*  
Instructors: Matt Jones, Jim Regetz, Mark Schildhauer

## **Additional seminars**

The wide range of visiting and resident scientists at NCEAS provides excellent opportunities for interactions through the NCEAS Ecolunch seminar series. A list of speakers is provided in Table 2. In addition, the Postdoctoral Associates organize an informal Friday afternoon discussion on diverse topics. In this reporting period, Friday afternoon discussions included topics such as “Ethics and logistics of multiple authors,” “Navigating peer review of manuscripts” and “Building better scientific presentations.”

## **Networking of visiting and resident scientists**

Residence at the Center provides many additional opportunities for meeting visiting scientists. During the past reporting period Postdoc residents created the event "Tea Time with the Postdocs", which has been formally implemented as a regular activity. "Tea Time" augments opportunities for interactions by setting aside specific times for Working Groups to mingle with NCEAS residents.

## **Education and Outreach Activities**

NCEAS publicizes new research to increase the public understanding of science through press releases and information on our website, provides outreach training and experiences to resident scientists, fosters the inclusion of synthesis in ecology education and contributes, educationally and culturally, to the local community through a K-12 program and participation in community events.

## **Communicating Science**

### ***Press/Publicity***

NCEAS continues to emphasize the importance of media coverage and media training, expanding its coverage to maximize exposure for its research, education and outreach efforts. Working with NCEAS scientists, collaborators, and funding sources we have increased visibility of NCEAS activity and results via public media. We continue to prepare and coordinate press releases with an expanding number of scientists' home institutions, University of California, and NSF media professionals; and work with resident and visiting scientists to craft public-oriented summaries of their research.

### ***Media Training***

Media Training is a key component of the postdoctoral experience at NCEAS. This year we offered several interactive presentations on how scientists can communicate their work

effectively to journalists. Included were sessions on science blogging, how the media reports on science, and how to conduct both radio interviews and interviews with writers.

The presenters included:

- A freelance science writer who writes for national publications/websites including the Wall Street Journal and Popular Science
- A senior editor for The Nature Conservancy's magazine
- An award winning news director from an NPR affiliate station – this visit resulted in a radio piece about NCEAS that aired the following morning
- The Director of Ocean Science Outreach for COMPASS
- NCEAS Outreach Coordinator

### ***Public Understanding of Science***

NCEAS maintains a section of the website with material written for the general public - "Featured Research Underway". We interact with journalists and other communications professionals, and collaborate with local and national organizations such as COPUS, the Coalition on the Public Understanding of Science, Year of Science 2009, and COMPASS, to promote public interest in and understanding of science.

A highlight this year was a collaboration between NCEAS scientists, the Santa Barbara Poet Laureate and the local community college's writing program. Nine NCEAS scientists were interviewed by local poets who then composed works inspired by the research. The results included a public poetry reading and showcase for NCEAS researchers, a cable television broadcast of the event, and a chapbook currently in press.

### ***Examples of Projects that Received Prominent Press Coverage***

#### ***Fire in the Earth System***

David M.J.S. Bowman, Jennifer K. Balch et al.

**Science** 324(5926):481-484

24 April 2009

e.g., *Science News*: <http://www.sciencenews.org/view/feature/id/44800/title/Fire>

#### ***Mapping Cumulative Human Impacts to California Current Marine Ecosystems***

Benjamin Halpern et al.

**Conservation Letters** Online April 17, 2009

e.g., *The Picayune Item* 23 July 2009:

[http://www.picayuneitem.com/statenews/local\\_story\\_204133224.html](http://www.picayuneitem.com/statenews/local_story_204133224.html)

#### ***The Status of the World's Land and Marine Mammals: Diversity, Threat and Knowledge***

Jan Schipper et al.

**Science** 322 (5899): 225-230

10 October 2008

e.g., *The Washington Post* 7 October 2008: <http://www.washingtonpost.com/wp-dyn/content/article/2008/10/06/AR2008100600641.html>

***Accelerating Loss of Seagrasses Across the Globe Threatens Coastal Ecosystems***

Michelle Waycott et al.

PNAS Online July 2009

e.g., *New Scientist* 3 July 2009: <http://www.newscientist.com/article/dn17412-meadows-of-the-sea-in-shocking-decline.html>

***Climate change and the world's 'Sacred Sea' Lake Baikal, Siberia***

Marianne V. Moore et al.

BioScience. Vol: 59(5): 405-417

May 2009

e.g., *CNN*, 1 May 2009:

<http://www.cnn.com/2009/TECH/science/05/01/eco.lakebaikal/index.html>

## Diversity Initiatives

NCEAS continues to expand efforts to reach students and scientists from groups currently under-represented in ecology.

We have completed several recruitments for Distributed Graduate Seminars (DGS) and worked with PI's to include Minority Serving Institutions in their proposals, with the intention of reaching our goal: to have 25% of participating institutions be MSI's. We recently hosted a Distributed Seminar, organized in partnership with ESA's Diversity and Education program and NEON, in which half of participating colleges/universities are Minority Serving Institutions.

NCEAS works with NESCent and other partners to co-produce a suite of activities to promote careers in ecology and evolution. These include a scientific symposium, career panel, and film discussion at the annual conference of the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS). The program was offered at the 2007 and 2008 conferences and planning is underway for the 2009 conference.

Our K-12 program, Kids Do Ecology, reaches a local community in which participating elementary classrooms have high Hispanic enrollment, from 45-94% Hispanic students in 2009.

NCEAS embarked on a partnership with the Ecological Society of America's SEEDS program to support diversity in the field of ecology. Activities for 2008-9 included:

- A presentation at the annual SEEDS Leadership meeting introducing students to synthesis in education and research [Synthesis in Education, Carlos Melián and Margaret Connors, ESA SEEDS Leadership Meeting, Sevilleta LTER, New Mexico, February 27, 2009]
- Providing scientific and computing consultation to SEEDS in developing a SEEDS chapters group outreach project

- Providing support for our postdoctoral fellows to present their research at Minority Serving Institutions. We are now partnering with ESA's SEEDS program to focus these presentations at schools with SEEDS Chapters.

## **K-12 and Community Outreach**

NCEAS offers postdoctoral and sabbatical fellows training and hands-on opportunities for outreach through the K-12 Kids Do Ecology program and associated activities.

Kids Do Ecology (KDE), a successful program that has been our primary means of outreach to K-12 students since 1995, continues to flourish. Fourteen NCEAS scientists and two graduate students provided instruction and mentoring to 240 students at high Hispanic enrollment schools. Prior to postdoc visits to local KDE classrooms, we conducted a "teach-in" for Postdoctoral Associates with three local schoolteachers leading a discussion on how to work with elementary school children. An annual Poster Presentation Day was held at NCEAS for students, their families and teachers, and NCEAS staff. The popular Kids do Ecology website has a newly updated Spanish language version.

NCEAS scientists participated in the broader community by giving talks on campus, coordinating an Ecolunch seminar series, participating in the Science & Poetry event described above, and judging ecology projects for the Santa Barbara Country Science Fair.

## **Collaborations in outreach**

NCEAS is working with other NSF-funded Centers to explore common needs in communication, education and outreach. A meeting of outreach and education staff from the Centers will take place in October 2009 at NESCent. Participants include NIMBios, NESCent, NEON, and iPlant.

## **Diversity of Community Engagement**

Since 1995, over 4,500 scientists have participated in activities at NCEAS and (Figure 3) shows the level of participation per year. The vast majority of NCEAS visitors come only once (Figure 4), allowing NCEAS to continue to engage new scientists. Of these NCEAS participants, 148 come from Minority Serving Institutions as presently defined by the Department of Education (i.e., Minority Institutions, Historically Black Colleges and Universities, Alaska Native-Serving Institutions, High Hispanic Enrollment, Hispanic-Serving Institutions, Indian Tribally Controlled Colleges and Universities, and Native Hawaiian-Serving Institutions). Representation of women in Working Groups at NCEAS continues to grow (Figure 5), and has increased on the Science Advisory Board since NCEAS establishment (Figure 6). Disciplinary breadth continues to increase; participants over the lifespan of NCEAS have belonged to over 550 different professional societies and have published their NCEAS work in 250 distinct journals. Since 1995, participants have come from over 1,500 different institutions. Finally, 24% of the participants during this reporting period to date were from non-academic institutions.



We continue to strive to reach new participants. The NCEAS leadership and our Science Advisory Board actively encourage Working Group leaders to recruit participants who have not had previous NCEAS experience. Figure 7 shows a trend consistent with the Board's increasing scrutiny of participant lists, encouraging recruitment of new faces; seemingly more participants report that their first knowledge of NCEAS has come via invitation from a Working Group leader. We advertise our Call for Proposals through professional listservs, such as Ecolog, and the relatively high number of "hits" on our online Call for Proposals that are directed to us from email servers following these listserv advertisements indicates success in gaining attention through this approach.

## ***Publications and Products***

The total number of publications from NCEAS activities now exceeds 1,600 since the establishment of NCEAS (Figure 8). (This does not include 189 publications from the NSF-supported SEEK project, which are reported to NSF independently.) Recently we matched our publications to the most recent Impact Factor scores available, and we present in Table 3 selected high-impact journals and the number of publications NCEAS has had in these journals over its lifespan.

Below we list 358 newly reported publications for the period of 1 July 2008 (last report submission date) – 30 June 2009. Note that this list includes publications that have been reported to us by participants in NCEAS activities during this period, and actual publication dates may precede this period. It also includes some publications for which we now have complete citations, and were reported as "in press" in the past. It does not include publications reported for the SEEK project, which is reported to NSF separately.

In December 2008, we made a major effort to solicit product reporting from participants, such that some publication dates precede this reporting period, but these publications have not been previously reported to NSF. Additional NCEAS-related publications were also discovered in a special project in which we searched the ISI Web of Knowledge database. In addition to publications reported, we have listed 24 data sets that were registered or uploaded to the NCEAS Data Repository since 1 July 2008. NCEAS scientists have reported that they made 109 presentations of their NCEAS work, and submitted 22 new proposals to other organizations as a result of activities at NCEAS. NCEAS is aware that at least 10 of these were granted funding.

### **Publications Reported from July 1, 2008 to June 30, 2009**

Includes journal articles, books, and book chapters

\* *Indicates publication is being updated from those previously reported as "in press"*

## Publications

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Based on data available as of 6/30/2009

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2008. USFS F. 2008. Forest Inventory and Analysis National Program.  
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### 3. Tables and Figures

#### **Table 1. Science Advisory Board Members 2008-2009**

A complete history of Science Advisory Board members can be found at <http://www.nceas.ucsb.edu/sab/cumulative>.

| <b>SAB Members<br/>2008-2009</b> | <b>Institutions</b>                                   | <b>Term</b> |
|----------------------------------|---|-------------|
| Baron, Jill                      | US Geological Survey                                  | 2005-2008   |
| Grenfell, Bryan                  | Pennsylvania State University                         | 2005-2008   |
| Micheli, Fiorenza                | Stanford University                                   | 2005-2008   |
| Morris, Bill                     | Duke University                                       | 2005-2008   |
| Arita, Hector                    | Universidad Nacional Autonoma de Mexico               | 2006-2009   |
| Hacker, Sally                    | Oregon State University                               | 2006-2009   |
| Hungate, Bruce                   | Northern Arizona University                           | 2006-2009   |
| Jackson, Steve                   | University of Wyoming                                 | 2006-2009   |
| Kendall, Bruce                   | University of California, Santa Barbara               | 2006-2009   |
| Levin, Phil                      | National Oceanographic and Atmospheric Administration | 2006-2009   |
| Bever, Jim                       | Indiana University                                    | 2007-2010   |
| Denno, Robert                    | University of Maryland                                | 2007-2010   |
| Harms, Kyle E.                   | Louisiana State University                            | 2007-2010   |
| Martiny, Jennifer<br>Hughes      | University of California, Irvine                      | 2007-2010   |
| Pfister, Cathy                   | University of Chicago                                 | 2007-2010   |
| Tank, Jennifer                   | University of Notre Dame                              | 2007-2010   |
| Thrall, Peter H.                 | CSIRO Agricultural Sustainability Initiative          | 2007-2010   |
| Ashley, Mary                     | University of Illinois at Chicago                     | 2008-2011   |
| Belnap, Jayne                    | US Geological Society                                 | 2008-2011   |
| Bjornstad, Ottar                 | Pennsylvania State University                         | 2008-2011   |
| Cottingham,<br>Kathryn           | Dartmouth College                                     | 2008-2011   |
| Miriti, Maria                    | Ohio State University                                 | 2008-2011   |

|                            |   |           |
|----------------------------|---|-----------|
| Osenberg, Craig            | University of Florida                         | 2008-2011 |
| Rickets, Taylor            | World Wildlife Fund                           | 2008-2011 |
| Briggs, Cherie             | University of California, Santa Barbara       | 2009-2011 |
| Ceballos-Gonzales, Gerardo | Instituto de Ecología, UNAMK                  | 2009-2011 |
| Essington, Tim             | University of Washington                      | 2009-2011 |
| Holmes, Elizabeth          | National Marine Fisheries Service, Seattle WA | 2009-2011 |
| Pendall, Elise             | University of Wyoming                         | 2009-2011 |
| Smith, Felisa              | University of New Mexico                      | 2009-2011 |

## **Table 2. Ecolunch seminars at NCEAS**

August 28, 2008- June 11, 2009

### **Fall 2008**

|                     |   |
|---------------------|---|
| <b>August 28</b>    | <b>Jacob Weiner, NCEAS &amp; University of Copenhagen</b><br><i>Allocation, plasticity and allometry in plants</i>  |
| <b>September 4</b>  | <b>Daniel Schlenk, University of California, Riverside</b><br><i>Impacts of estrogenic activity in fish from the Southern California Bight</i>                        |
| <b>September 11</b> | <b>Elizabeth Borer, Oregon State University</b><br><i>Fertilization, consumers, and competition: community context determines grassland viral prevalence</i>          |
| <b>September 18</b> | <b>Francisco Madrinan, NCEAS</b><br><i>Investigating responses of riverine habitats and Pacific salmon to climate change</i>  |
| <b>September 25</b> | <b>Patrick Christie, University of Washington</b><br><i>Feasibility of marine protected area networks and marine ecosystem-based management in the Philippines</i>    |
| <b>October 2</b>    | <b>Lauren Buckley, NCEAS</b><br><i>The broad-scale ecology of ectothermy</i>  |
| <b>October 9</b>    | <b>Anne Magurran, University of St. Andrews</b><br><i>Diversity and time</i>  |
| <b>October 16</b>   | <b>Howard Cornell, University of California, Davis</b><br><i>Can unsaturation be reconciled with strong interspecific competition in local species assemblages?</i>   |
| <b>October 23</b>   | <b>Sophie Parker, University of California, Santa Barbara</b><br><i>The impacts of invasive species in California grasslands: potential mechanisms of persistence</i> |
| <b>October 28</b>   | <b>Ben Gilbert, University of California, Santa Barbara</b><br><i>Dominance and diversity: Linking species abundances to their effects on community membership</i>    |
| <b>October 30</b>   | <b>Rich Norby, Oak Ridge National Laboratory</b><br><i>Forest responses to rising atmospheric CO<sub>2</sub></i>  |
| <b>November 6</b>   | <b>Christine Peterson, NCEAS</b><br><i>Seasonal constraints on rockfish larval dispersal along the central California coast</i>                                       |
| <b>November 13</b>  | <b>Stephanie Hampton, NCEAS</b><br><i>Long-term warming in the world's largest lake - Lake Baikal, Siberia</i>  |

- November 20**                    **Larry Crowder, Duke University**  
*Steps toward implementation of marine ecosystem-based management*
- November 27**                    **No EcoLunch- Thanksgiving holiday**
- December 4**                    **Jennifer Balch, NCEAS**  
*Amazon transitional forests: sensitive or resistant to frontier fire?*
- December 9**                    **Vlastimil Krivan, Academy of Sciences of the Czech Republic**  
*The evolutionary stability of the ideal free distribution*
- December 11**                    **Kerry Woods, NCEAS & Bennington College**  
*Why we don't know much about late-successional forests: working with long-term studies in slow systems controlled by rare events*

## Winter/Spring 2009

- January 8**                    **Marc Cadotte, NCEAS**  
*Community consequences of changes in phylogenetic diversity*
- January 15**                    **Jonathan Davies, NCEAS**  
*An entangled bank: the generation and maintenance of biodiversity across scales*
- January 22**                    **Whendee Silver, University of California, Berkeley**  
*The promise and peril of science in a social context: examples from soil carbon sequestration research in California*
- January 29**                    **Lara Kueppers, University of California, Merced**  
*Feedbacks between climate change and plant distribution*
- February 5**                    **Christopher Costello, University of California, Santa Barbara**  
*TURFs and MPAs for spatially connected resources*
- February 12**                    **William Michener, University of New Mexico**  
*Building informatics solutions for multi-decadal ecological research: re-envisioning science, technology, and the academic culture*
- February 19**                    **Carlos Melian, NCEAS**  
*Diversification and coexistence in multilevel biological networks assemblages*
- February 26**                    **Kevin McKelvey, US Forest Service: Rocky Mountain Research Station**  
*Can unsaturation be reconciled with strong interspecific competition in local species*
- March 5**                    **Hector Arita, National Autonomous University of Mexico**  
*The 'diversity field' of New World bats: linking distribution and diversity patterns*
- March 12**                    **Jason Fridley, Syracuse University**  
*Diversity and function of a species-rich grassland: more than the sum of its parts?*

- March 19**                    **Jennifer Williams, NCEAS**  
*Exotic plant success: experiments, models, life history, and more*
- March 26**                    **Duncan Menge, NCEAS**  
*Dual paradoxes in ecosystem ecology: examining the nitrogen cycle in tropical and temperate forests*
- April 2**                        **Amber Budden, NCEAS**  
*Pride and Prejudice: an exploration of bias in ecological publishing*
- April 9**                        **Stefano Allesina, NCEAS**  
*A prelude and three fugues on groups in ecological networks*
- April 16**                    **Mary O'Connor, NCEAS**  
*Linking physiological rates and community ecology: effects of temperature on dispersal and species interactions*
- April 23**                    **Elizabeth Wolkovich, NCEAS**  
*Linking community and ecosystem ecology through detritus*
- April 30**                    **André M. de Roos, NCEAS & University of Amsterdam**  
*TBA*
- May 7**                         **Victoria Wittig, University of Illinois at Urbana-Champaign**  
*Impacts of rising carbon dioxide and tropospheric ozone on the growth and productivity of trees*
- May 14**                    **Lesley Lancaster, NCEAS**  
*Maternal effects as adaptations to correlational selection in a lizard*  
*AND*  
*The history of evolutionary diversification in and beyond the California flora*
- May 28**                    **Jonathan Levine, University of California, Santa Barbara**  
*The importance of niches for the maintenance of species diversity*
- June 4**                        **Sadie Ryan Simonovich, NCEAS**  
*The effects of contact structure, demography and movement on disease transmission within a primate metapopulation*
- June 11**                    **Ted Bergstrom, University of California, Santa Barbara**  
*Economics of BioOne and other journal bundles*

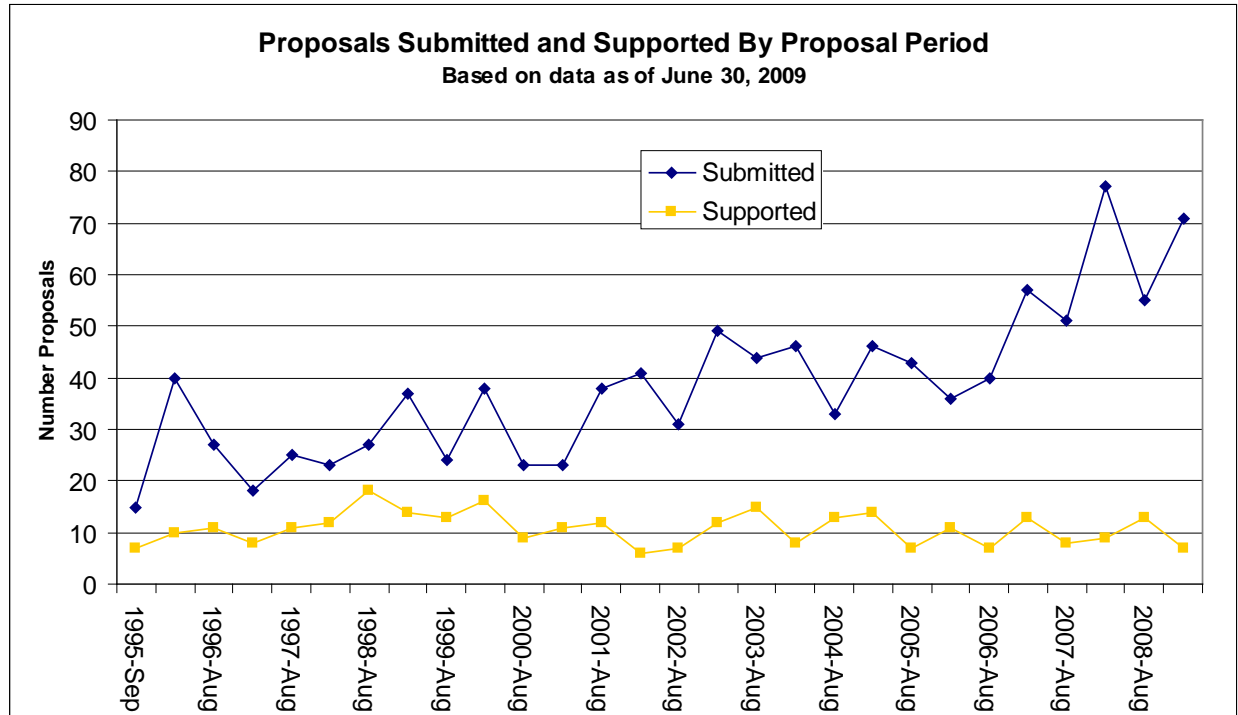
**Table 3. Number of NCEAS articles published in a selection of high-impact journals** since the establishment of NCEAS in 1995, sorted by Impact Factor of the journal.

| <b>Journal Name</b>                                  | <b>Impact Factor</b> | <b>Number NCEAS<br/>pubs as of June<br/>30, 2009*</b> |
|--|----------------------|---|
| Nature   | 28.751               | 33  |
| Science  | 26.372               | 67  |
| Trends in Ecology and Evolution                      | 14.797               | 40  |
| PLoS Biology   | 14.1                 | 7   |
| Annual Review of Ecology, Evolution, and Systematics | 10.34                | 14  |
| Proceedings of the National Academy of Sciences      | 9.64                 | 41  |
| Ecology Letters                                      | 8.204                | 77  |
| Ecological Monographs                                | 8.117                | 5   |
| Ecology  | 4.822                | 117   |
| Global Change Biology                                | 4.786                | 24  |
| American Naturalist                                  | 4.543                | 61  |
| Evolution  | 4.502                | 8   |
| Frontiers in Ecology and the Environment             | 4.269                | 20  |
| Proc. Royal Society of London Series B               | 4.11                 | 18  |

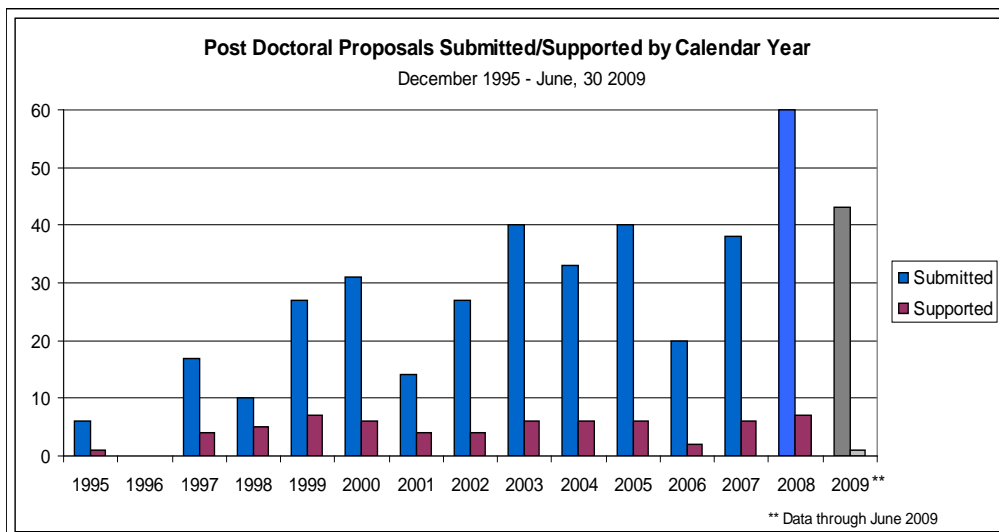
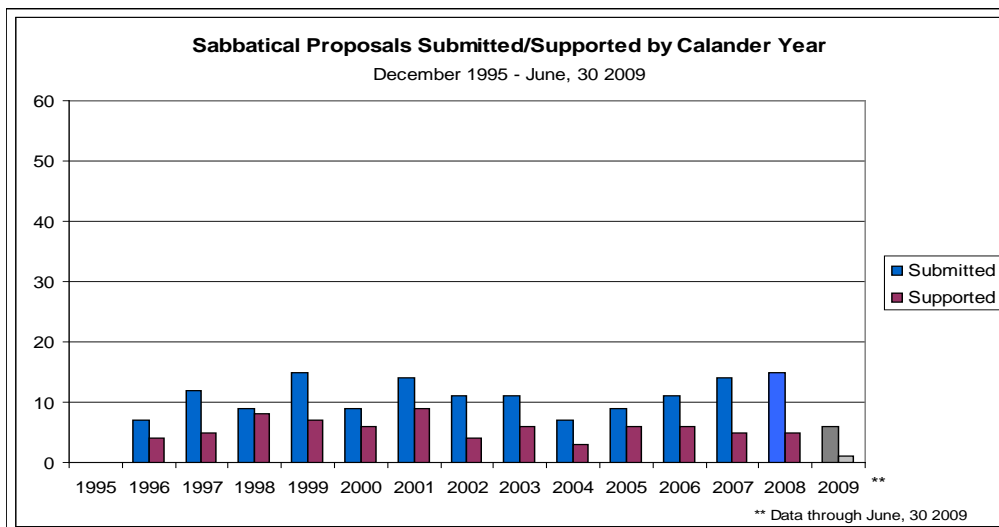
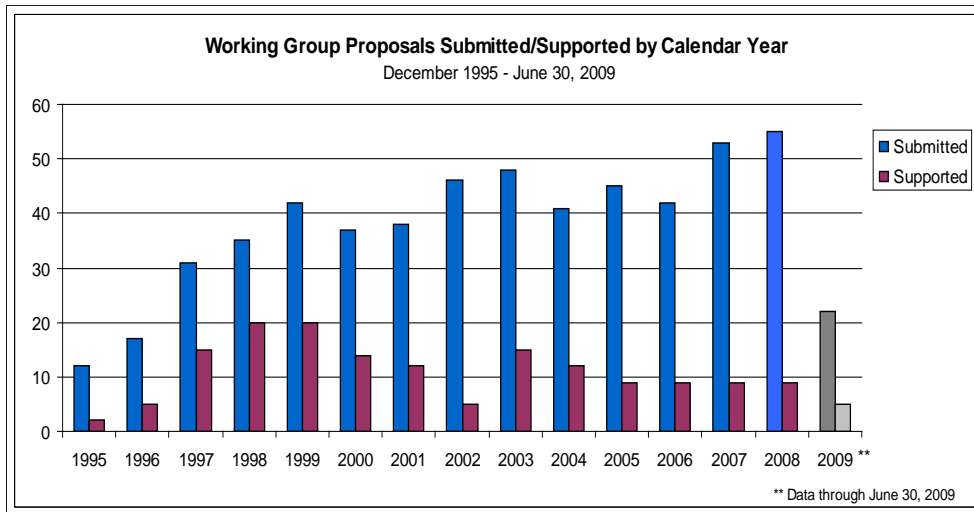
\* Over NCEAS lifetime; Does not include SEEK publications



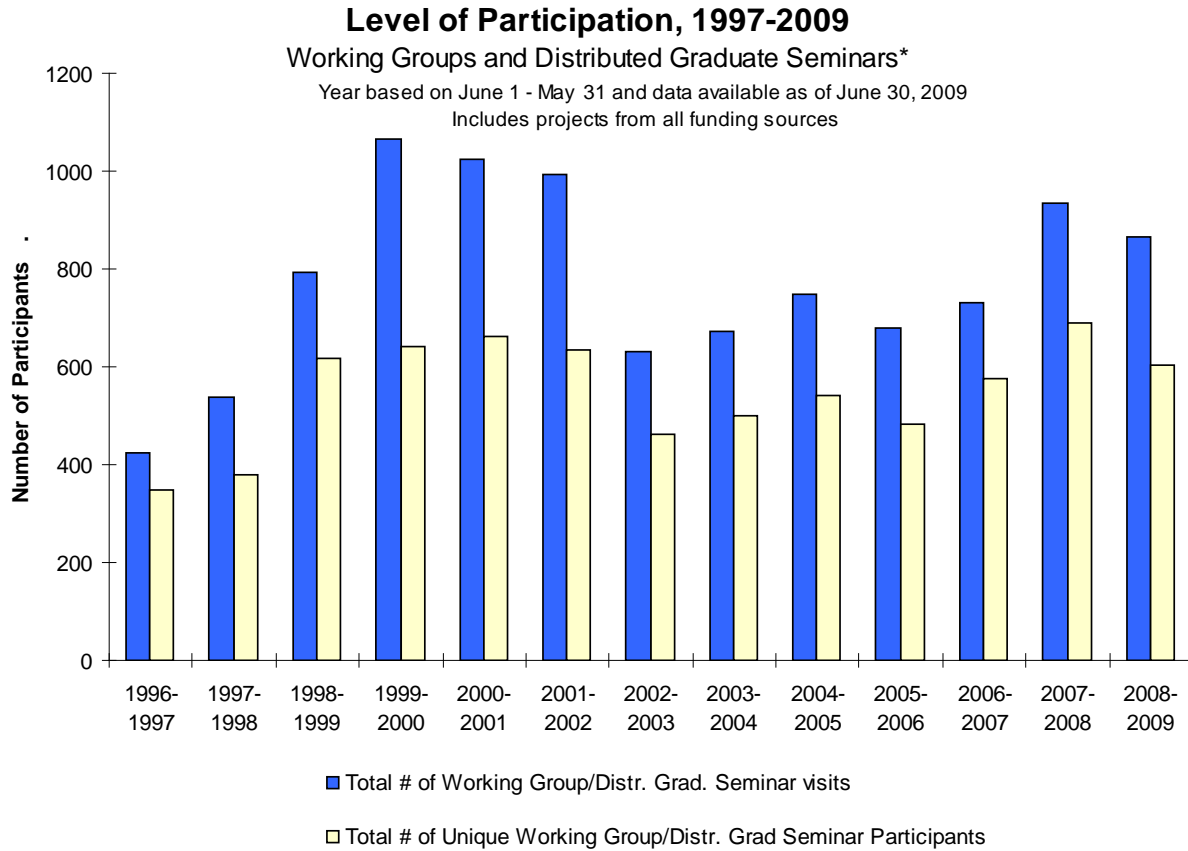
**Figure 1. Number of proposals submitted and supported** in total for each proposal period since the establishment of NCEAS in 1995.



**Figure 2. Proposals submitted and supported by activity type since NCEAS establishment.**

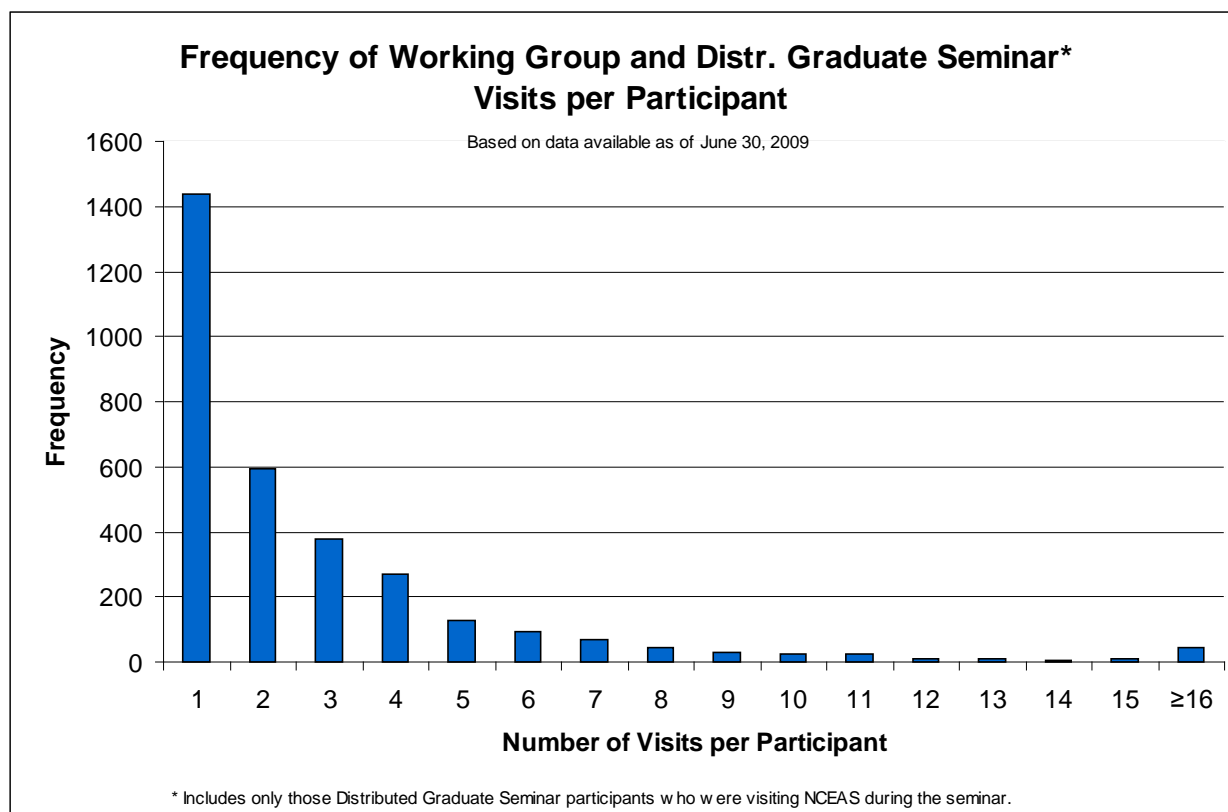


**Figure 3. Number of participants since 1997**, reported by the total number participants unique per year (i.e., excludes multiple visits within a year).

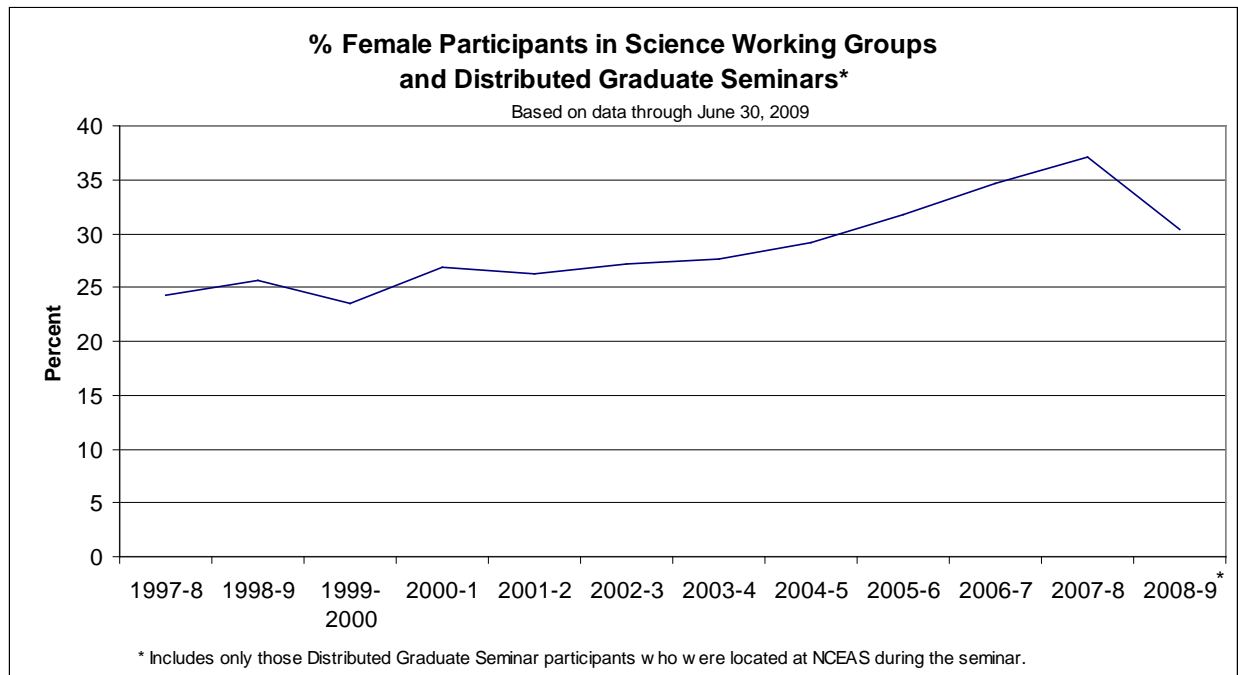


\* Includes only those Distributed Graduate Seminar participants who visited NCEAS during the seminar.

**Figure 4. Frequency of visits** by each unique Working Group participant since establishment of NCEAS in 1995.

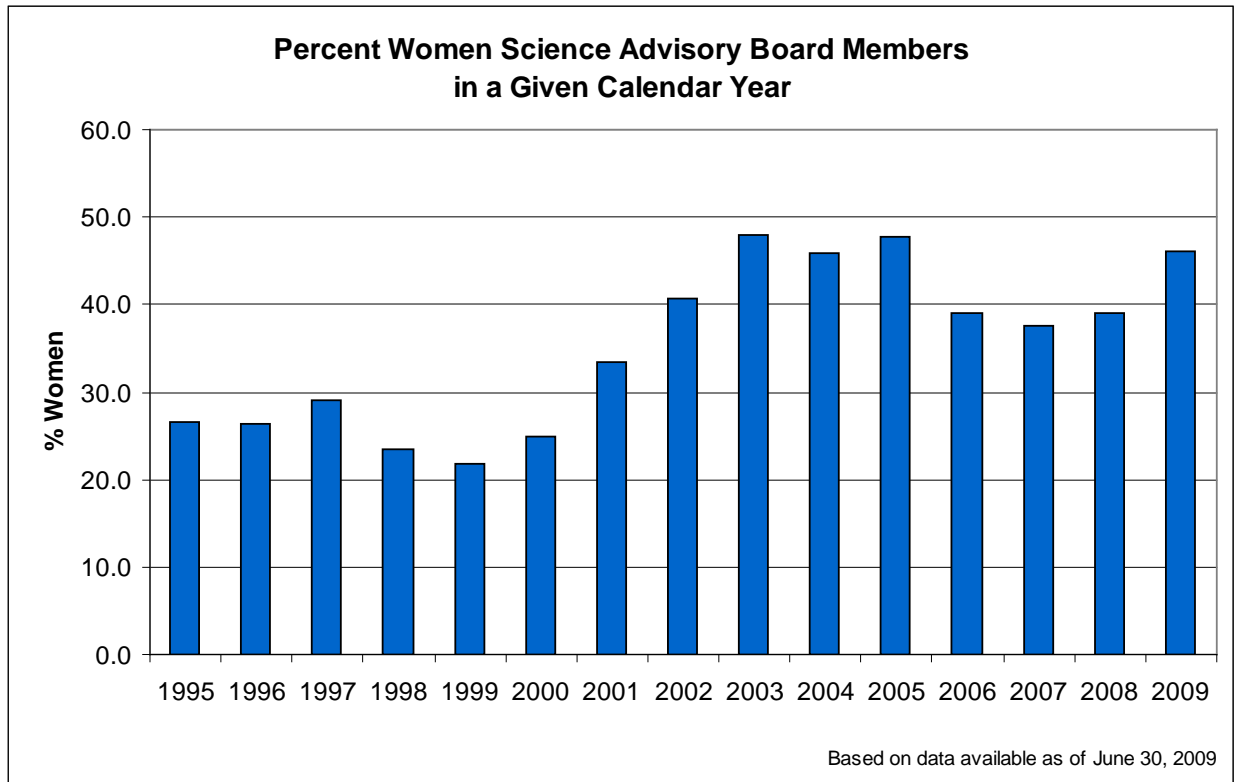


**Figure 5. Percent women participating in Working Groups** since establishment of NCEAS in 1995. For comparison, among ESA members who answered diversity survey questions for a 2006 report, the average female representation on faculty was 36% (30% women among senior professors, 44% women among junior professors).

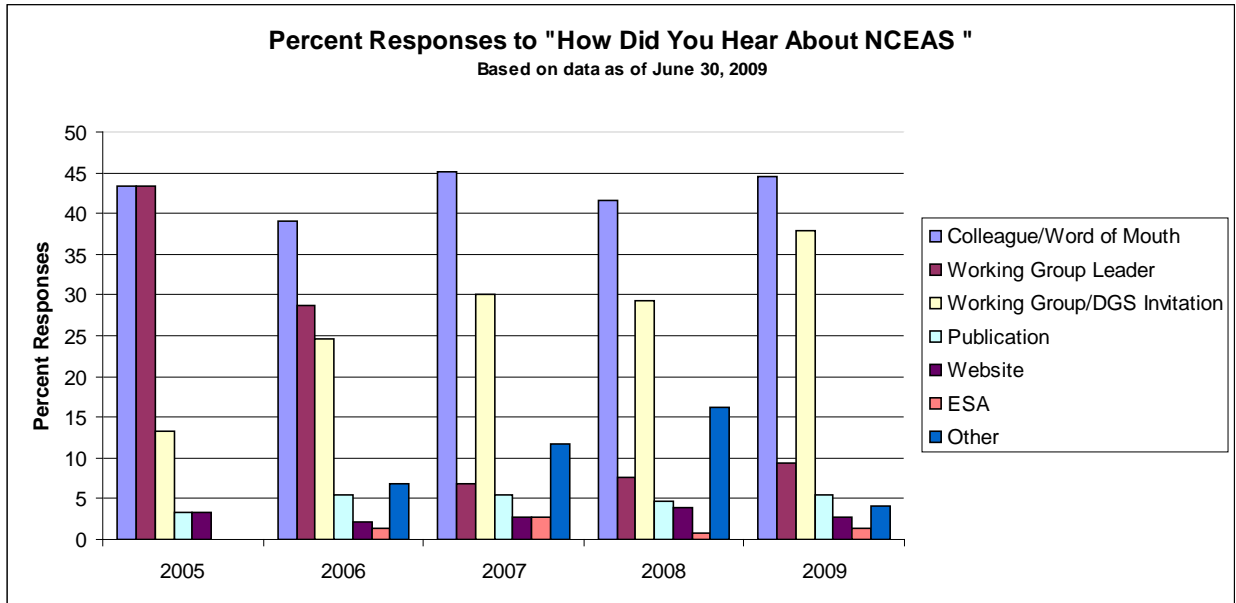


**Figure 6. Percent women on the NCEAS Science Advisory**

**Board** for each year since NCEAS establishment. For comparison, among ESA members who answered diversity survey questions for a 2006 report, the average female representation on faculty was 36% (30% women among senior professors, 44% women among junior professors).



**Figure 7. How did you hear about NCEAS?**



**Figure 8. Number of publications** reported from NCEAS activities since establishment in 1995, by publication date.

