National Center for Ecological Analysis and Synthesis

2010
Report to the National Science Foundation

NCEAS Annual report 2009-2010

1. Participants

Ed McCauley, 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 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 most recent Packard EBM award has a strong emphasis on making scientific results more available and useful for policymakers.

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 continues to host Working Groups that the students themselves have convened.

A recent award from Conservation International convenes experts to develop rigorous and transparent indices of "ocean health" to guide and influence science and policy at national an international levels. Two research associates, two postdoctoral researchers, and an analyst/statistician will be supported at NCEAS.

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, formerly 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 began his new position on 1 January 2010.

Dr. William Murdoch, founding Director of NCEAS, was Interim Director from January 2008 to December 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. NCEAS currently has 46 working group and 8 distributed graduate seminar Plone collaboration websites (open source, free content management software), along with additional Plone sites serving various meetings and special projects. 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 external support, e.g. a training session the Brazilian LTER (formally PELD at INPA) supported a week-long training session in data management using approaches developed and maintained in the Knowledge Network for Biocomplexity, culminating in a new KNB node at the site. 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. We recently instituted a policy to allow new parents to work from home for 2 months after parental leave benefits have been exhausted, designed to allow a parental transition period back into the work place.

Science Advisory Board

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

For our July 2009 deadline, we received 37 total proposals. We received proposals for 18 postdoctoral fellowships, 2 sabbatical fellowships, 16 working groups, and 1 distributed graduate seminar. The Science Advisory Board met September 2-3, 2009 to review these proposals; based on their recommendations, decisions were made to support 4 postdoctoral fellowships, 1 sabbatical fellowships, 4 working groups, and 1 distributed graduate seminar.

For our January 2010 deadline, we received 57 proposals: 30 postdoctoral fellowships, 10 sabbatical fellowships, 17 working groups, and 1 distributed graduate seminar. The Science Advisory Board met on March 3-4, 2010 to review and recommend proposals. Based on their recommendations, decisions were made to support 2 postdoctoral fellowships, 4 sabbatical fellowships, 4 working groups, and 1 graduate seminar.

Science Advisory Board members during 2009-2010 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 2009, NCEAS has supported 5 sabbatical visitors and 23 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 University of Chicago, University of Toronto, McGill University, University of British Columbia, The Ohio State University, and EAWAG in Switzerland.

Since the beginning of the reporting period, 615 different scientists participated in activities at NCEAS. Of these participants, 83 were either residents of NCEAS or scientists at UCSB, and 27% were visiting from foreign institutions. A total of 41 Working Groups and 5 Distributed Graduate Seminars have been active or scheduled in the reporting period.

NCEAS also has hosted Meetings for 4 different collaborative groups. Seven Center Associates and at least 25 Scientific Visitors have been hosted at NCEAS in this reporting period. An additional 3 hosted meetings and 2 Scientific Visitors were here during the last report period, but were not included in the 2008-2009 report due to the July 2008 submission date. Activities are listed below.

Sabbatical Fellows

Occurred or were scheduled between October 1, 2009 and September 30, 2010
based on data available as of May 31, 2010

Gates, Ruth
1-Apr-10 – 31-Dec-10
Synthesizing molecular and ecological datasets to evaluate how diversity in coral endosymbiont communities (symbiodinium) maps onto environmental sensitivity in corals

Climate change related increases in seawater temperature pose a serious threat to the world's coral reefs. A key conservation issue, and research priority is understanding how corals and coral reef ecosystems will respond to these environmental shifts. Changes in the composition of coral endosymbiont (Symbiodinium spp.) communities have been proposed as a mechanism by which corals might adapt to elevated seawater conditions, in a time frame concordant with the rates of environmental change. As a sabbatical fellow at NCEAS, I propose to develop the capacity to examine the biological support for this proposed adaptive trait by synthesizing ecological data on coral responses
to thermal stress with molecular diversity data for coral endosymbiont communities. A major product of this effort will be a spatially contextualized Global Symbiodinium Database and Mapping Website that will provide an interface for any Internet user to perform text based or spatial queries of the database. I will use this powerful tool to examine how thermal history has influenced the present day global composition of coral endosymbiont associations and to evaluate whether corals that are ranked by ecological environmentally sensitivity exhibit differences in the nature and composition of their endosymbiont communities that are predictable within rank. The results of these analyses will be the subject of a review article styled for Biological Reviews or Coral Reefs and this work will
contribute to the science necessary to complete the activities in a companion NCEAS working group proposal that will be submitted in January 2010 in collaboration with Peter Edmunds and titled "Coral reefs of tomorrow: when the winners take over, what will it be like?"

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 naive 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 worlds 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.

Postdoctoral Fellows

Occurred or were scheduled between October 1, 2009 and September 30, 2010
Based on data available as of May 31, 2010

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.

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.

Baum, Julia
1-Jan-10 – 31-Dec-10
Predicting baseline, current, and future distributions and abundances of apex predators on coral reefs (Supported by Schmidt Research Vessel Foundation)

Predators can exert important controls on ecosystem structure and function, but are being rapidly depleted from the world's oceans. Remote Pacific islands harbor many of the world's remaining coral reef apex predator populations, yet little is know about these species and they are increasingly threatened by fishing pressure. My research aims to advance understanding of the ecological, physical, and anthropogenic factors that determine the abundance of these species on reefs across the Pacific, by integrating existing regional-scale spatially-explicit data into predictive species distribution models (SDMs). Robust, cross-validated models will then be used to predict geographically comprehensive predator distributions and abundances across the Pacific, to hindcast quantitative baselines for these species, and to forecast potential changes in their populations over the coming decades based on alternative management scenarios. Employing SDMs at the regional-scale in the ocean represents a novel application of these models. This research is timely, given the recent designation of many of remote Pacific reefs as

U.S. national monuments. Research findings will be communicated to NOAA scientists and conservation practitioners with the aim of informing policy decisions for shark conservation.

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.

Cao, Huiping
30-Nov-09 – 29-Nov-10
INTEROP: A Community-driven scientific observations network to achieve interoperability of environmental and ecological data (Supported by NSF Ecoinformatics grants)

Observing the advances that data management and analysis techniques have brought to our society, I desire to be a contributor in this exciting arena of progress. My main fields of research expertise are data mining and databases. Within the data mining field, I worked on discovering different kinds of movement regularities from the trajectories of moving objects. Within the database field, my research involves investigating research problems in data integration on different types of data, query evaluation and user feedback process.

Comita, Liza
16-Feb-10 – 30-Sep-11
Determinants of relative species abundance: A cross-continental comparison of tropical tree communities

Determining the causes of commonness and rarity in ecological communities is essential for understanding how communities are structured and has important implications for biodiversity conservation. Identifying the determinants of species abundance has been particularly challenging in tropical forests, which are characterized by both high species richness and high rarity. The objectives of the proposed study are to examine the determinants of, and limits to, species abundances in tropical tree communities, and to investigate whether the processes shaping species relative abundance patterns differ among forests. Specifically, I will address the following questions: (1) Do resource requirements and habitat preferences shape species' relative abundances in tropical tree communities? (2) Is there a phylogenetic signal in species relative abundance patterns? and (3) Does local-scale negative density dependence limit the abundance of tropical tree species? For the proposed project, I will take advantage of existing, standardized datasets from a global network of large forest dynamics plots coordinated by the Center for Tropical Forest Science (CTFS). CTFS possesses the world's largest database on tropical tree dynamics, with information on over 3.5 million individuals of ~7500 species, estimated to represent 10% of all tropical tree species on earth. Using these data, I will test hypotheses concerning patterns of commonness and rarity both within and among tropical tree communities. Specifically, spatially-explicit analyses of survival and growth will be used to identify drivers of species abundance patterns within diverse plant communities. Comparisons among sites will allow for an assessment of the consistency of these drivers among tropical forests that vary in biogeographic history, species composition, climate, and disturbance regime. The proposed study will be among the most comprehensive cross-site analyses of species abundance and will provide fundamental information about how diverse ecological communities are structured. An understanding of the similarities and differences among tropical forests sites will aid efforts to conserve and restore the incredible diversity of the tropics. In addition, the project will yield multiple high-profile publications, and will result in publically available derived data products and a statistical package in R, which will facilitate future research efforts by scientists around the globe.

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.

Johnson, Darren
1-Oct-09 – 30-Sep-11
Converting evolutionary costs into ecological currency: linking trait variation, natural selection, and population dynamics

Numerous studies in the ecological and evolutionary literature have estimated the magnitude of natural selection. Although natural selection is widespread and often strong, much less is known about the immediate effects of selection on population dynamics. I propose a method that can be used to quantify the direct effects of trait variation and natural selection on population dynamics. This method will be applied to meta-analyses examining the overall influence of selection on demographic components of fitness in a broad variety of organisms. Information from meta-analyses will be combined with models of population dynamics to evaluate how trait variation and selection can affect key population attributes such as size, growth rate, and probability of extinction. This work will be further applied to develop conceptual models of how different modes of selection (i.e., directional, stabilizing and disruptive) influence concurrent population dynamics. This project has clear ramifications for incorporating evolutionary considerations in the management and conservation of living natural resources.

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.

Melian, Carlos
22-Apr-08- 29-Jun-10
Unifying niche-neutral theories of molecular, community and network evolution (Supported by 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.

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.

O'Leary, Jennifer
15-Jun-10 – 14-Jun-11
Ocean Health Index (Supported by Conservation International)

The focus of the Ocean Health Index project is on narrowing the current suite of potential indicators to a tractable, meaningful, representative subset that can serve as critical tools for monitoring, planning, and policy with applicability across a range of systems and geographic scales. Specifically, this effort will bring together leading scholars and practitioners from ecology, fisheries, oceanography, economics, and the applied social sciences to develop ecosystem health metrics for the Arctic, coral reefs, estuaries, continental shelves and coastal upwelling regions. The resulting set of vital signs will serve as concrete concepts to help catalyze political will, pave the way for policy-making at all levels of government, provide critical tools to communicate the state of marine systems to the public, and facilitate much- needed integration across the social and natural sciences.

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.

Pau, Stephanie
11-Jan-10 – 30-Sep-11
Improving our understanding of the ecological controls on the distribution and phenology of C3 and C4 grasses in response to climate variations

This proposed project seeks to analyze and synthesize herbarium, climate, and satellite data over several decades to address the spatial and temporal response of C3 and C4 grasses to climate variability in the Hawaiian Islands. Complicating our understanding of C3 and C4 response to climate change and increased CO2 are large uncertainties regarding their differential response to climate variability. Numerous studies have demonstrated ecological sorting of C3 and C4 grasses along static spatial climate gradients, though few studies have focused on phenological differences between C3 and C4 grasses. In Hawaii, C4 grasses initiate a grass-fire feedback cycle that directly affects ecosystem structure and function. El Niño-driven droughts, the greatest source of interannual climate variability in Hawaii, may contribute to this feedback by providing a "tipping point" for C4 grass invasion into new regions. Results from this project will provide new information on the functional significance of C4 photosynthesis and the invasion dynamics of C4 grasses. This work will also provide insight on the response of these grasses to climate variability, and lay the groundwork for merging herbarium datasets with satellite data to create an ecological informatics database for grasses.

Petersen, Christine
15-Apr-08- 14-Apr-10
Assessing sensitivity of salmon species to river modifications and climate change (Supported by 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.

Queensborough, Simon
20-Jan-10 – 19-Jan-11
Addressing a long-standing paradox: How do dioecious plant species persist?

Breeding system impacts on the ecology and evolution of coexisting plant species. Perhaps the best example of such impacts is exemplified by dioecious plant species (those with separate male and female individuals), populations of which suffer a fitness cost because of the lower number of seed-bearing stems relative to ecologically similar hermaphroditic species. To maintain per capita growth rates that are equal to their hermaphroditic counterparts, female individuals in dioecious populations must exhibit one or more fitness advantages, which might include: higher fecundity, higher rates of offspring recruitment, earlier ages of reproduction, more frequent reproduction, or higher quality offspring. The fitness advantages predicted to have evolved in dioecious species have remained elusive because of inadequate data and a failure to fully integrate phylogeny and dynamic demographic and distribution data with other species functional traits. This study will use a newly developed functional-trait database of plant reproductive traits and recently-available rigorously collected spatially-explicit plant demographic data on >6,000 species and >3,000,000 individuals to examine the associations among breeding systems, demography and functional traits in a phylogenetically informed way in order to seek evidence for fitness advantages in dioecious taxa.

Ranganathan, Jai
4-Sep-07- 7-Jan-10
Developing a return on investment approach for conservation planning in Argentina (Supported by 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.

Rodriguez, Josephine
11-Jan-10 – 10-Jan-11
Understanding a diverse insect-parasitoid community: insights from synthesizing biodiversity inventory data from the tropics

This proposal aims to synthesize the caterpillar (and their host plants and parasitoids) database inventory of the Area de Conservación Guanacaste (ACG) in Costa Rica (conducted by D. Janzen and W. Hallwachs) with an extensive genetic dataset from BOLD (Barcode of Life Data Systems) with focus on the Microgastrinae (Braconidae) an important group of caterpillar parasitoid wasps. Understanding the extent and cause of tropical insect diversity is one of the major challenges in modern ecology (Godfray et al., 1999) and generally requires two approaches: 1) rigorous biodiversity inventories of the insects at particular sites; and 2) reconstructing food webs demonstrating the trophic interactions between species (Godfray et al.,1999). Those two approaches are the major goals of this project and include testing specific hypotheses on microgastrine ecology and evolution. Specifically, I will integrate the genetic data (CO1 DNA barcodes) with inventory records to assess the number of species of microgastrine wasps and levels of host specificity. This will be followed by construction and analyses of microgastrine parasitoid food webs which will provide insights into community structure, crucial in interpreting patterns of parasitoid diversity and provide the basis for hypotheses about structuring processes (Memmott and Godfray, 1993; van Veen et al., 2006).

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).

Scheef, Lindsay
4-Jan-10 – 3-Jan-11
CAMEO: Building the foundation: New statistical tools for analyzing community dynamics with applications to marine zooplankton (Supported by NOAA/NSF CAMEO)

We will develop an extended multivariate autoregressive (MAR) modeling framework to analyze community dynamics from time-series data, and then demonstrate the framework through investigations of long-term marine plankton data sets. MAR modeling has been used extensively for freshwater plankton communities to infer the inter-species interactions, the dominant environmental drivers, and the system stability and resilience. MAR modeling is well-grounded on theory concerning population and community dynamics and comparative properties of communities, such as resistance to disturbance, resilience, and return time after disturbance. The proposed research will address four technical barriers that hinder widespread application of the MAR framework to marine data sets – observation error, lower temporal autocorrelaton due to open systems and infrequent sampling, multiple spatially-distributed sampling locations, and uncertainty introduced by unmeasured species or environmental drivers. The extended MAR framework will be used to do a comparative study of marine plankton community dynamics from different geographic regions using existing long-term data sets. The primary goals are 1) to identify the major drivers of plankton productivity and any directional changes in dynamics due to long-term changes in ocean conditions and 2) to compare the community dynamics – specifically interaction strengths and community stability – to four well-studied freshwater systems.

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 (NSF Bioinformatics)

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 Izmest'eva (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, 2009 and September 30, 2010
based on data available as of May 31, 2010

Developing curricula and model systems for sustainability science
Leaders: Cavender-Bares, Jeannine; Polasky, Stephen

Sustaining the systems that support life while meeting human needs represents one of the greatest challenges that we face in the 21st century. Sustainability science is a use-inspired science aimed at addressing this challenge. We propose a two-year distributed graduate seminar across six institutions to address core concepts in sustainability science and to develop model systems for advancement of theory and tools for sustainable management. The collaboration will benefit from interaction and synthesis across institutions and disciplines, the hallmark of

NCEAS, and from the technical, data management and cyber-support that NCEAS can provide. Four key outcomes include 1) a curriculum and publically accessible wiki for sustainability science to provide a pedagogic foundation for the emerging field, 2) the development of model systems for sustainability science to promote rapid advances, 3) a synthesis of key insights from applying a sustainability science framework to these model systems, and 4) a series of team case studies including inclusive valuation of shifts in land-use and restoration to aid decision making.

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.

A graduate seminar network to facilitate synthetic research on context-dependency in the mycorrhizal symbiosis
Leaders: Hoeksema, Jason; Bever, James

Although mycorrhizal symbioses, in which plants exchange carbohydrates for nutrients with root associated fungal symbionts, are classically considered a mutualism, they can display a high degree of variability in ecological outcomes ranging from mutualism to parasitism. Given the ubiquity and importance of this interaction, understanding the controls on its variability is paramount for basic and applied ecology. One centerpiece activity of a previous NCEAS working group ("Bridging the gap between theory and practice in mycorrhizal management," 2005-2007) was to initiate an effort to understand this ecological variability through an empirical

synthesis of mycorrhizal inoculation experiments. As part of that effort, we created a database of nearly 2000 such experiments, and developed innovative new methods for multi-factor meta-analysis to assess the relative importance of numerous biotic and abiotic factors hypothesized to explain variation among experiments in plant responses to mycorrhizal inoculation. Although important insights were gained from that analysis, it revealed limitations of the approach (detailed below) which prevented the full exploitation of that effort. Through the NCEAS distributed graduate network project proposed here, we plan to address these limitations to answer fundamental questions about context-dependency in the mycorrhizal symbiosis (detailed below). In this process, graduate students will be trained in mycorrhizal ecology, data management/ecoinformatics, and statistical meta-analysis, and will have the opportunity to take the lead in meaningful synthetic ecological science. NCEAS will provide necessary logistical support, staff support, and funding for planning and face-to-face collaboration, without which this project would not be possible.

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.

Developing best practices for testing landscape effects on gene flow
Leaders: Wagner, Helene; Waits, Lisette

A key objective of landscape genetics is to study how landscape modification and habitat fragmentation affect organism dispersal and gene flow across the landscape. Landscape genetics requires highly interdisciplinary, yet specialized professionals, and makes intensive use of spatial analysis tools such as remote sensing, GIS software and spatial statistics that have not historically been a component of training programs for population geneticists. Even when students receive disciplinary training in several of the involved fields of landscape genetics, educational programs lack the necessary linkage and synthesis among disciplines. This linkage can only be accomplished after experts from each discipline work together to develop guiding

principles for this new research area. This proposed distributed graduate seminar unites some of the most active landscape genetics groups in North America and Europe, drawing on the experience of experts both in population genetics and landscape ecology with the goal of providing an integrated overview of approaches for testing the effect of landscape pattern on dispersal and gene flow, a key topic of landscape genetics.
Each seminar will start with a video-taped lecture that introduces foundations and methods and highlights points for discussion in local seminar groups. Practical experience applying various methods to selected cases studies will be provided through a combination of computer labs, interpretation of sample output, and paper discussions. Student groups across universities will focus on a specific step in the data collection and analysis process, evaluating the consequences of different choices of methods and deriving recommendations when to use which method, with each group project leading to a scientific publication. The main goal of the synthesis meeting is to discuss how consequences of methodological choices propagate to later steps in the analysis, leading to a joint publication of best practices for testing landscape effects on gene flow.

Working Groups

Occurred or were scheduled between October 1, 2009 and September 30, 2010
based on data available as of May 31, 2010

Title: **Monarch butterflies as a model for understanding the spatiotemporal dynamics of migratory species and their response to environmental change**
Leader(s): Altizer, Sonia; Oberhauser, Karen; Ries, Leslie
Participants: Sonia Altizer, Becky Bartel, Rebecca Batalden, James Battin, Lincoln Brower, Andrew Davis, Erica Fleishman, Dennis Frey, Elizabeth Howard, Nathan Nibbelink, Karen Oberhauser, A. Townsend Peterson, Eduardo Rendon, Leslie Ries, Monte Sanford, Orley Taylor, Elise Zipkin

Abstract:
Each year, North American monarch butterflies undergo a spectacular two-way migration from breeding locations in Canada and the US to overwintering sites in Mexico. Throughout their annual cycle, monarchs utilize habitats in three different countries and require strikingly different resources and habitats at each life stage. Like other migratory animals, this shifting spatial distribution poses challenges for identifying key determinants of monarch population dynamics and assessing their conservation status. Monarchs are an incredibly popular insect that has been exceptionally well studied; multiple long-term monitoring programs exist within North America that span timescales of 3 to over 30 years. This virtually unprecedented wealth of data on a single animal species represents a rare scientific resource for understanding how natural and anthropogenic factors affect the population dynamics and movement patterns of migratory species. At the same time, a great need exists to integrate existing data sets for analysis and interpretation of both within-season and longer term population trends. Our proposed working group includes a team of experts in monarch ecology, migration biology, statistical model building, climate modeling and geography to answer the most fundamental questions of monarch biology throughout their range in North America. We will explore data from throughout the

monarchs′ annual life cycle to identify major ecological mechanisms that shape large-scale patterns of abundance and movement, and to predict the consequences of human activities, including shifting agricultural practices, deforestation and climate change, for long-term dynamics. We will also work directly with NCEAS informatics staff to develop a web-based portal that allows public access to and use of monarch butterfly observational data, much of which has been collected by volunteer observers. Although our efforts focus primarily on a single species, our questions, approaches and findings will have great relevance to understanding the dynamics of other pollinator species and neotropical migrants across North America.

Title: **Resilience of Pacific salmon to climate change** *(supported by the Moore Foundation)*
Leader(s): Beechie, Timothy; Ruckelshaus, Mary
Participants: Timothy Beechie, Correigh Greene, Joshua Lawler, Steven Lindley, Christine Petersen, Mary Ruckelshaus, David Stoms, Alisa Wade

Abstract:
This working group aims to classify populations or metapopulations of Pacific salmon along a gradient of sensitivity or resilience to climate change. The group also will examine potential management and conservation strategies that may benefit salmon populations along that gradient under alternative future climates. Attributes of salmon related to resilience include diversity of species, life history types, and genetics; abundance; and spatial distribution within catchments. This group will compile data on potential response to climate change of continental and local patterns of air temperature and precipitation, sea level, and currents and ocean conditions in the north Pacific. Responses of these environmental variables or phenomena may affect stream temperature and flows, structure and dynamics of floodplains, condition of estuaries and nearshore systems, and the abundance of food resources or predators.

Title: **Ecology of Environmental Justice in Metropolitan Areas**
Leader(s): Boone, Christopher; Cadenasso, Mary; Grove, Morgan; Pickett, Steward
Participants: Christopher Boone, Geoff Buckley, Mary Cadenasso, Daniel Childers, Kirstin Dow, Michail Fragkias, Nancy Grimm, Morgan Grove, Joseph McFadden, Melissa McHale, Jarlath O'Neil-Dunne, Laura Ogden, Diane Pataki, Steward Pickett, Stephanie Pincetl, Kirstin Schwarz, Julie Sze, Ali Whitmer, Weiqi Zhou

Abstract:
This working group brings together experts in ecology and environmental justice to examine the socio-ecological dynamics of environmental justice in five metropolitan areas – Baltimore, Los Angeles, Miami, Sacramento, and Phoenix – that occupy humid temperate, Mediterranean, arid desert, and subtropical biomes.

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

Participants: Paulo Artaxo, Jennifer Balch, Michael Bird, William Bond, David Bowman, Jean Carlson, Mark Cochrane, Carla D'Antonio, Ruth DeFries, John Doyle, Sandy Harrison, Fay Johnston, Jon Keeley, Meg Krawchuk, Christian Kull, John Marston, Max Moritz, I. Colin Prentice, Stephen Pyne, Christopher Roos, Andrew Scott, Navjot Sodhi, Thomas Swetnam, Guido van der Werf

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 uniting 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 resent, (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: **Plants for planting** *(Supported by The Nature Conservancy)*
Leader(s): Britton, Kerry
Participants: Clive Brasier, Kerry Britton, Eckehard Brockerhoff, Lynn Garrett, Andrew Liebhold, Frank Lowenstein, Carissa Marassas, Meghan Nuding, Jennifer Parke, Scott Pfister, Mike Springborn, Karen Suslow, John Peter Thompson

This working group will evaluate data availability and quality for an assessment of the costs and benefits of implementing changes to USDA Plants for Planting regulations to prevent the unintentional importation of invasive pests carried on plants into the United States.. Three scenarios will be considered: 1) status quo, in which the U.S. mainly relies on a black list system and port of entry inspections; 2) status quo plus a new category of “grey listed” plants called NAPPRA (Not Authorized for Importation Pending Pest Risk Analysis); and 3) which adds a systems approach for clean stock production to the other two mitigations. To do this, the working group will apply lessons learned as well as an econometric model developed by an associated working group (http://www.nceas.ucsb.edu/projects/12289), to better understand how changes in phytosanitary regulation lead to changes in trade flows and pest introductions. In

addition the group will undertake an analysis to determine what portion of introduced forest pests likely entered via the nursery stock pathway.

Title: **Tidal wetland carbon sequestration and greenhouse gas emissions model**
Leader(s): Callaway, John; Crooks, Steve; Megonigal, Pat; Doherty, Abe
Participants: Richard Ambrose, Omar Aziz, John Callaway, Christopher Craft, Steve Crooks, Abe Doherty, Stephen Faulkner, Jason Keller, Shuguang Liu, Pat Megonigal, Sian Mooney, James Morris, Enrique Reyes, Lisa Schile, Lisamarie Windham-Myers

Abstract:
Wetlands are important in global carbon cycling because they accumulate carbon in wood and soil organic matter, but they also emit methane, CH444, a potent greenhouse gas (GHG) (Bridgham et al. 2006). Tidal wetlands are a potentially effective sink for carbon through accretionary processes both in response to sea-level rise or via restoration (Chmura et al. 2003, Duarte et al. 2005, Crooks et al. 2009). Tidal wetlands also have low methane emissions, making restoration of these wetlands a promising technique for reducing greenhouse gas emissions. Research to date on tidal wetland carbon dynamics has been uncoordinated geographically and narrowly focused. Carbon sequestration and greenhouse gas emissions are complicated as belowground biomass accumulation and methane production increase from saline to freshwater tidal settings (Bridgham et al. 2006). There is a real need not only to synthesize work in different parts of the country and on different aspects of wetland carbon budgets, but also to incorporate understanding from multiple fields into an integrated model of wetland carbon dynamics, including production, decomposition, sequestration and greenhouse gas GHG emissions. An integrated model would provide the scientific framework to guide wetland climate change mitigation and adaptation policies on many scales. State, regional, national and international initiatives are rapidly being implemented to reduce GHG emissions through cap-and-trade systems. Carbon offset protocols are essential for any carbon trading program, which requires development of reliable, quantified performance standards. Sale of the carbon offsets from tidal wetland restoration projects could be a significant new funding mechanism for restoration, with billions of dollars of offsets expected to be sold in the next five years. The proposed working group will evaluate and test the potential to develop empirically-based and process-based models of carbon dynamics that identify variations in sequestration and emissions across gradients of salinity, inundation, tidal range, and suspended sediment supply. The working group will include experts in a wide range of fields, including the development of carbon offset protocols, to ensure that the products of the working group will directly integrate with GHG emissions reduction programs.

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

Participants: Carol Adair, Robert Bagchi, Patricia Balvanera, Bradley Cardinale, Emmett Duffy, Lars Gamfeldt, Andrew Gonzalez, Sarah Hobbie, David Hooper, Jonathan Lefcheck, Mary O'Connor, Daniel Piotto

Abstract:
We propose a working group that will advance recent efforts to synthesize one of the fastest growing fields of ecology - Biodiversity and Ecosystem Functioning. Over the past two decades, more than 200 experiments have examined how the diversity of bacteria, fungi, plants and animals influence important ecosystem processes in habitats throughout the world. Though diversity effects have by no means been universal, recent summaries have revealed considerable generality in how the number of genes, species, and functional groups of organisms impacts the efficiency by which communities process the energy and matter that define how ecosystems 'function'. These results suggest that modern biodiversity loss may have substantial impacts on the services that ecosystems provide to humanity. But the research remains controversial, in part, because results of often highly simplistic experiments have yet to be translated into meaningful predictions about how biodiversity loss will impact ecological processes in realistic systems at appropriate scales. We will overcome such limitations by accomplishing three goals at this frontier between academic and applied ecology:
(1) We will develop quantitative scaling relationships that allow conversion of the results of small - scale, short - term experiments into predictions about the fraction of species required to optimize biological processes in more natural ecosystems.
(2) We will characterize how biodiversity simultaneously impacts the suite of ecosystem processes that have been measured in past experiments to identify trade - offs and potential synergisms, and to provide guidance on optimizing the multi - functionality' of diverse systems.
(3) We will evaluate how the impacts of biodiversity on key ecological processes (e.g., biomass production) can be translated into ecosystem 'services' (e.g., CO2 uptake and storage) that can be used to aid decisions in conservation and management.

Title: **A synthesis of patterns, analyses, and mechanisms of beta-diversity along ecological gradients**
Leader(s): Chase, Jonathan; Sanders, Nathan; Freestone, Amy
Participants: Marti Anderson, Jonathan Chase, Howard Cornell, Thomas Crist, Kendi Davies, Amy Freestone, Susan Harrison, Brian Inouye, Nathan Kraft, Nathan Sanders, James Stegen, Nathan Swenson, Mark Vellend

Abstract:
The factors that regulate biodiversity in any given locality are well studied, and include environmental, biotic, and regional factors. An important but poorly understood aspect of biodiversity is the variation in the composition of species that occur in different localities. This compositional variation, known as Beta-diversity, is driven by a variety of factors. Understanding the patterns of Beta-diversity and underlying processes that shape it is fundamental to studies of biodiversity, but is hampered by a lack of appropriate metrics, statistical analyses, and datasets. This working group will bring together ecologists with varied expertise in biodiversity and its statistical analysis across a variety of ecosystems. We will

develop Beta-diversity metrics and analyses. We will then use these to synthesize the patterns of Beta-diversity among a variety of taxa along key ecological gradients to understand how and why Beta-diversity varies spatially, and how it influences the scaling of biodiversity from small to large scales. This research will not only provide a much clearer understanding of biodiversity gradients across ecological scales, but will inform biodiversity conservation and restoration actions, which typically only focus on local spatial scales.

Title: **Global expansion of jellyfish blooms: Magnitude, causes and consequences**
Leader(s): Condon, Robert; Graham, William; Duarte, Carlos
Participants: Lucas Brotz, Craig Carlson, Robert Condon, Michael Dawson, Mary Beth Decker, Carlos Duarte, William Graham, Steven Haddock, Cathy Lucas, Alenka Malej, Hermes Mianzan, Kylie Pitt, Jennifer Purcell, Kelly Robinson, Kentaro Suzuki, Shin-ichi Uye

Abstract:
Jellyfish are an important and often conspicuous component of oceanic food webs. During the past several decades, dramatic spatial increases and temporal shifts in jellyfish distributions have been reported around the world. Undoubtedly there are associated ecological ramifications such as food web and biogeochemical pathway alterations. Moreover, socio-economic impacts include damage to fisheries, industry and tourism. However, reports have remained local in scope, and scientists agree that a composite understanding of the extent of the problem is still lacking. The bottle-neck is the lack of synthetic analyses across marine ecosystems, due to the present fragmentation of data sources. This proposal will provide a global synthesis of reports of jellyfish abundance to achieve four main objectives: (1) to examine the hypothesis of a global expansion of jellyfish blooms, and to explore the possible drivers for this expansion; (2) to examine the effects of jellyfish blooms on the ecosystem, addressing in particular, carbon cycling, and food webs; (3) to identify current and future consequences of jellyfish blooms for tourism, industry and fisheries, including ecosystem-based management on regional and global scales; and (4) to notify the public at large of the project results. The centerpiece of this project will be a scientifically coordinated global jellyfish and environmental database based on already identified datasets from coastal, estuarine and open-ocean regions. This is a two year project and meetings will be a combination of plenary and specific group level sessions involving data acquisition and statistical analyses, global synthesis of trajectory maps of regional jellyfish blooms, generation of conceptual diagrams of the role of jellyfish in biogeochemical cycles and food webs, and discussions relating to the socio-economic ramifications of jellyfish blooms. Discussions surrounding the framework of the database and identifying deficiencies and additional data requirements will take place in the first meeting. The deliverable products addressed in the proposal include: (1) at least six group publications submitted to major scientific journals in addition to several articles in the popular literature, (2) several new process-oriented proposals to be submitted to US and international funding bodies based on hypotheses generated from the database, (3) multi-lingual website and blog housed on the NCEAS network including the interactive jellyfish database, and educational information on jellyfish blooms, (4) two public seminars and discussion forums, hosted in Spain and another one facilitated by NCEAS coinciding with one of the meetings, (5) white papers designed for funding agencies and environmental managers identifying research priorities and protocols for monitoring jellyfish

blooms, and (6) a book detailing the biogeochemical, ecological and societal aspects of jellyfish blooms.

Title: **Forecasting phenology: Integrating ecology, climatology, and phylogeny to understand plant responses to climate change**
Leader(s): Cook, Benjamin; Wolkovich, Elizabeth
Participants: Jenica Allen, Toby Ault, Julio Betancourt, Kjell Bolmgren, Elsa Cleland, Benjamin Cook, Theresa Crimmins, T. Jonathan Davies, Nathan Kraft, Susan Mazer, Gregory McCabe, Brian McGill, Abe Miller-Rushing, Camille Parmesan, Jim Regetz, Nicolas Salamin, Mark Schwartz, Steve Travers, Elizabeth Wolkovich

Abstract:
The magnitude and direction of plant species responses to climate change has widespread consequences for trophic interactions, ecosystem services, and our ability to predict the shape of future communities. To date, however, research has focused primarily on documenting species responses without developing a detailed understanding of why some species and communities vary with climate and others do not. Combining expertise from ecologists, phylogeneticists, and climatologists, we will use extensive plant phenology data from experimental and observational studies across North America and Europe to conduct a metaanalysis and develop robust predictors of plant phenology responses and sensitivities to climate change. Our resulting database of phenological studies, their related climate variables, and phylogenetic trees will be, we believe, the most comprehensive data available to study the relationship between climate change and plant species phenological responses. Our comparison of experiments to observational studies will test whether short-term, small-scale manipulations of climate can predict the long-term trends seen on global scales, and should improve the design of future climate manipulation experiments. Additionally, our work will develop new approaches for the use of climate metrics in ecology and inform the designs of government data inventories and citizen science projects.

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, Lauren Buckley, Howard Cornell, Ellen Damschen, T. Jonathan Davies, John Grytnes, Susan Harrison, Bradford Hawkins, Robert Holt, Ginger Jui, Nathan Kraft, Jerome Mathieu, Christy McCain, 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: **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 Ehrlen, 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, Luis Bourillon, Carrie Brownstein, Kristin Carden, Ratana Chuenpagdee, Larry Crowder, Kristen Dubay, Gary Gereffi, Atle Guttormsen, Benjamin Halpern, Ahmed Khan, Dane Klinger,
Lisa Liguori, Aaron McNevin, Roz Naylor, Mary O'Connor, Cathy Roheim, Raphael 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: **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, Barbara Dobrin, Steven Dolins, John Donoghue, Brian Enquist, Karla Gendler, Naia Holme, Peter Jorgensen, Gabriela Lopez-Gonzalez, Zhenyuan Lu, Yadvinder Malhi, Brian McGill, Sheldon McKay, Jeff Ott, Robert Peet, Oliver Phillips, William Piel, Mark Schildhauer, Lindsey Sloat, Jens Svenning, Nathan Swenson, Barbara Thiers, Cyrille Violle, Corine Vriesendorp, Susan Wiser, 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: **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, Kathy Hieb, Theresa Jacobson, John Largier, Wendy Meiring, Zack Powell, Bruno Sanso, Mark Stacey, 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: **Prediction of responses of wild Pacific salmon to climate change** *(supported by the Moore Foundation)*
Leader(s): Fleishman, Erica
Participants: Nancy Baron, Timothy Beechie, Samantha Chilcote, Forrest Cole, Cornelia Dean, Erin Euloth, Erica Fleishman, Richard Harris, Ray Hilborn, Chris Jordan, John Kimball, Emily Knight, Richard Lincoln, Nathan Mantua, Robert McClure,

Elizabeth Neeley, Randall Peterman, Christine Petersen, Tom Reed, Brian Riddell, Mary Ruckelshaus, Daniel Schindler, Dave Secord, Jack Stanford, Erik Stokstad, David Stoms, Eric Volk, Alisa Wade, Robin Waples, Michael Webster

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, Erica Fleishman, Wim Kimmerer, Ralph Mac Nally, Ken Newman, Jim Thomson, Howard Townsend

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 and mechanisms behind the organism declines in the San Francisco Estuary, but to place these declines in the broader context of estuarine degradation, organism declines, and approaches to solving these problems in other geographic regions. Among other goals, we seek to examine simultaneously the effects of multiple potential drivers on one or more fishes. Further, we aim to investigate whether fishes differ in their response to given drivers. We also wish to explore the ability of Bayesian analysis, path analysis, or other modeling approaches to draw inference regarding ecological relationships among pelagic fishes, human actions, and inherent variability in the estuarine system.

Title: **Measuring ecological, economic and social values of coastal habitats to inform ecosystem-based management of land-sea (EBM)** *(Supported by the Packard Foundation)*
Leader(s): Granek, Elise; Koch, Evamaria; Barbier, Edward; Stoms, David; Aswani-Canela, Shankar
Participants: Sarah Freed, Elise Granek, Sally Hacker, Benjamin Halpern, Carrie Kappel, Christopher Kennedy, Evamaria Koch, Stephen Polasky

Abstract:
The recent Australia cyclone and the 2005 Caribbean hurricane season, coupled with the 2004 tsunami in the Indian Ocean, have stimulated interest in protective services provided by near-shore estuarine, wetland and mangrove habitats. The popular press now links the loss of human life and property to the degradation of interface ecosystems. These events provide a unique opportunity to quantify the value of protective services provided by near-shore vegetated habitats and compare them with economic gains from habitat conversion (e.g. forestry, shrimp farms, or development). We propose using these habitats in a case study for developing and testing assessment and planning tools for ecosystem-based management (EBM) that incorporates terrestrial and marine environments. We will bring together economists, ecologists, geographers, social scientists, and coastal managers to (1) collect and distill existing but scattered data on coastal zone services and value, (2) assess local community attitudes and institutions, and disseminate information about short-term vs. long-term values to help managers determine conservation zones, and (3) use data and modeling to plan EBM strategies that incorporate the interface nature of these systems.

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, Fikret Berkes, Ann Bostrom, Greg Bratman, Kai Chan, Ratana Chuenpagdee, Gretchen Daily, Rachelle Gould, Anne Guerry, Benjamin Halpern, Neil Hannahs, Sarah Klain, Jordan Levine, Bryan Norton,
Mary Ruckelshaus, Roly Russell, Terre Satterfield, 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 compete 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: Paul Allen, Nick Brand, John Cobb, Roger Dahl, Michael Daigle, Tim DiLauro, Jim Green, Jeff Horsburgh, Matthew Jones, Carl Lagoze, Hilmar Lapp, Giri Palanisamy, Robert Sandusky, Ryan Scherle, Mark Servilla, David Vieglais, Todd Vision, Robert Waltz, Bruce Wilson

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

Title: **Unifying approaches to statistical inference in ecology**
Leader(s): King, Aaron; Rohani, Pej
Participants: Stephen Ellner, Matthew Ferrari, Giles Hooker, Edward Ionides, Bruce Kendall, Aaron King, Ken Newman, Daniel Reuman, Pej Rohani

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: Erin Bray, Joan Browder, Mary Freeman, Nina Hemphill, Christopher Konrad, David Lytle, Laura McMullen, Ted Melis, Meryl Mims, Julian Olden, Mark Pyron, 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: **Restoring an ecosystem service to degraded landscapes: Native bees and crop pollination**
Leader(s): Kremen, Claire; Williams, Neal
Participants: Daniel Cariveau, Luisa Carvalheiro, Natacha Chacoff, Saul Cunningham, Rufus Isaacs, Steve Javorek, Christina Kennedy, Claire Kremen, Eric Lonsdorf, Yael Mandelik, Lora Morandin, Simon Potts, Jim Regetz, Ingolf Steffan-Dewenter,
Julianna Tuell, Blandina Viana, Neal Williams, Rachael Winfree

Abstract:

Ecosystem services are critical to human survival; managing ecosystems for services could also provide important benefits for biodiversity. Unfortunately, we seldom understand the ecology of these services well enough to manage them. Pollination services are necessary for 15-30% of our food supply, and are comparatively well-understood relative to other ecosystem services. We propose to synthesize data on bee populations, pollinator communities and pollination services across agro-natural landscapes, in order to: (1) develop models of the persistence of populations, communities and pollination function at the landscape scale; (2) design an experiment to restore and monitor pollination function in agro-natural landscapes, replicated across sites, landscapes and regions; and (3) extend this example to create a general, conceptual framework for analyzing and managing ecosystem services. This work will improve our ability to manage agricultural lands, which occupy 38% of terrestrial area, with benefits for food security, human health and biodiversity.

Title: **Parasites and food webs - the ultimate missing links**
Leader(s): Lafferty, Kevin; Dobson, Andrew; Pascual, Mercedes
Participants: Stefano Allesina, Andrew Beckerman, Alice Boit, Cheryl Briggs, Giulio De Leo, Andrew Dobson, Jennifer Dunne, Thilo Gross, Kevin Lafferty, Pablo Marquet, Neo Martinez, Erin Mordecai, Mercedes Pascual, Owen Petchey, 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, Rebecca Epanchin-Niell, Robert Haight, Alan Hastings, Dan Herms, John Kean, Danny Lee, Andrew Liebhold, Deborah McCullough, 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: **Reefs, food, people - Coral reef fisheries and food security** *(Hosted by NCEAS)*
Leader(s): Max, Lisa
Participants: Alice Alldredge, Edward Allison, Kate Brown, Richard Church, Christopher Costello, Frank Davenport, Chris Funk, Sara Hughes, Michael Marshall, Lisa Max, Nada Petrovic, Stuart Sweeney, James Watson, Annie Yau

Abstract:
Coral reefs are a food source for millions of people worldwide. These ecosystems are under increasing stress from multiple anthropogenic threats including pollution, climate change, and overfishing. While many studies have examined the impact of these threats on coral reef ecosystems and the fisheries they support, we know relatively little about the subsequent food security implications for people who rely on coral reef systems.

The purpose of our research is to better understand (1) the conditions under which coral reef fisheries influence a country's food security, (2) the mechanisms involved in this influence, and (3) how well prepared countries are to adapt to changes in coral reef ecosystems. To do so we are targeting thirty-nine tropical and sub-tropical island nations and have collected data on a range of variables: fish catch, protein consumption, malnutrition, fish trade, disasters, demographics, and management strategies.

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: Jochen Albrecht, Ian Douglas, Balazs Fekete, Pamela Green, Nancy Grimm, Jenny Gronwall, Rebecca Hale, Valentina Mara, Peter Marcotullio, Robert McDonald, Lilly Parshall, Carmen Revenga, Andrea Sarzynski, Niels Schulz, Megan Todd

Abstract:
For the first time in history, a majority of people live in cities, and 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 change, 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: **Choosing (and making available) the right environmental layers for modeling how the environment controls the distribution and abundance of organisms**
Leader(s): McGill, Brian; Jetz, Walter; Guralnick, Robert; McPherson, Jana
Participants: Jennifer Balch, Lauren Buckley, David Conklin, Jane Elith, Simon Ferrier, Rodney Forster, Robert Guralnick, Robert Hijmans, Walter Jetz, John Leathwick, Christy McCain, Brian McGill, Jana McPherson, Ramakrishna Nemani, Stephanie Pau, Steven Phillips, Thiago Fernando Rangel, Sassan Saatchi, Florencia Sangermano, Woody Turner

Abstract:
We seek to understand how the environment controls species distributions. Despite the fact that a great deal of work in physiology has been done on this problem and that literally thousands of niche models (regressions of distribution on environment) have been run, we know surprisingly little about basic questions. Which aspects of environment are most central in controlling the distribution and abundance of organisms? How does this change with organism? with scale? what are the mechanisms linking environment to species distributions? We propose to assemble a state-of-the-art set of environmental layers that incorporate well-known but rarely used measures that have direct links to physiological processes like frost, water stress, growing season, soil properties, drainage properties, etc. We will assemble these variables into a unified, global, gridded, high resolution data set that will be made available to the public. This will be of enormous benefit to the community. We will use this data to explore the above-mentioned basic questions about the nature of the links between the environment and the distribution of organisms.

Title: **A framework to assess ecosystem health in support of ecosystem-based management of coastal-marine systems (EBM)** *(Supported by the Packard Foundation)*
Leader(s): McLeod, Karen; Crowder, Larry; Rosenberg, Andrew; Fogarty, Michael
Participants: Daniel Brumbaugh, Larry Crowder, Kendra Daly, Michael Fogarty, Steven Gaines, Benjamin Halpern, Leah Karrer, Steve Katona, Heather Leslie, Karen McLeod, Stephen Polasky, Andrew Rosenberg, Jameal Samhouri, Paul Sandifer, Janna Shackeroff, Kevin St. Martin, William Stelle, Heather Tallis

Abstract:
Maintaining healthy, productive marine ecosystems is a recurrent theme in policy recommendations, management deliberations, and public sentiment. While healthy oceans are a broadly shared goal, distinct vital signs to gauge the state of oceans have not been widely

implemented, yet are essential for effective policy-making. This working group will reduce hundreds of candidate indicators to a manageable set that will serve as critical monitoring and planning tools for effective marine ecosystem-based management. Specifically, we will bring together leading scholars and practitioners from ecology, fisheries, oceanography, economics, and applied social sciences to develop ecosystem health metrics for the Arctic, continental shelves, coral reefs, estuaries, and coastal upwelling regions. We will address three overarching questions: (1) What does ecosystem health mean and how can we measure it? (2) How can we measure the degree to which human well-being is sustained by marine systems? (3) How transferable are such metrics across different systems? The indicators developed through this initiative will serve as concrete concepts to help catalyze political will, pave the way for policy-making at all levels of government, provide critical tools to communicate the state of marine systems to the public, and facilitate much-needed integration across the social and natural sciences.

Title: **Long-term phenological changes in tundra plants in response to experimental warming and observed changes in climate**
Leader(s): Oberbauer, Steven; Troxler, Tiffany
Participants: Robert Baxter, Syndonia Bret-Harte, Mark Burgman, Elisabeth Cooper, Sarah Elmendorf, Anna Maria Fosaa, Greg Henry, Annika Hofgaard, Robert Hollister, Frith Jarrad, Ingibjorg Svala Jonsdottir, Kari Klanderud, Julia Klein, Esther Levesque, Ulf Molau, Steven Oberbauer, Christian Rixen, Adrian Rocha, Edward Schuur, Gus Shaver, Robert Slider, Orjan Totland, Tiffany Troxler, Carl Henrik Wahren, Jeffrey Welker

Abstract:
Arctic regions are predicted to undergo strong warming in coming decades, and they have already undergone measurable warming within recent decades. A coordinated international experiment on the effects of warming on the phenology and growth of individual tundra species and on plant communities, the International Tundra Experiment (ITEX), started in 1990 to directly measure the ways in which tundra plants and communities respond to consistent, lowlevel increases in temperature across the tundra biome. Tundra systems are clearly capable of responding to climate warming on fairly short time scales, without artificial increases in nutrients, and these changes will have significant impacts regionally and globally. One aspect of tundra plants that is highly sensitive to slight changes in temperature is phenology, the timing of key life-history events such as bud burst, leaf growth, flowering etc. The species phenology, growth and community data analyzed to date show responses that in many ways mirror patterns seen along climate gradients, but changes are too subtle and too variable to be detected by most individual-site studies, some after more than a decade of warming. ITEX as an observing network provides a unique opportunity to evaluate plant phenology changes at a global scale across the tundra biome. In this working group we will evaluate changes in plant phenology across the tundra biome over the past 10-15 years in two ways: 1) controls plots versus plots subject to long-term experimental warming, and 2) phenology of controls measured during the mid 1990s with controls remeasured during the recent International Polar Year field season. The primary request of this working group proposal is for access to facilities and expertise at NCEAS, as we can provide much of the support for participants.

Title: **Monitoring responses of Pacific salmon to climate change** *(supported by The Moore Foundation)*
Leader(s): Peterman, Randall
Participants: Pete Adams, Douglas Drake, Steve Fleischman, Sean Gallagher, Harold Geiger, Kim Hyatt, Chris Jordan, David Larsen, Phil Larsen, Steve Leider, Richard Lincoln, Anthony Olsen, Chuck Parken, Randall Peterman, Jeffrey Rodgers, Phil Roger, Jim Ruzycki, Shaun Walbridge

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: **Supporting decision making in the Coral Triangle Initiative: Prioritizing socially and economically viable projects and places for biodiversity conservation** *(Supported by the Packard Foundation)*
Leader(s): Possingham, Hugh; Klein, Carissa
Participants: Vera Agostini, Maria Beger, Travis Bover, Joshua Cinner, Leanne Fernandes, Helen Fox, Edward Game, Leah Gerber, Hedley Grantham, Alison Green, Abdul Halim, Benjamin Halpern, James Hardcastle, Christina Hicks, Leah Karrer, Carissa Klein, Richard Leck, Fiorenza Micheli, Stephen Oxley, Hugh Possingham, Elizabeth Selig, Kimberly Selkoe, Mark Spalding, John Tanzer, Annabelle Trinidad

Abstract:
The coral reefs of the Coral Triangle provide sanctuary for the highest concentration of marine biodiversity in the world and support the livelihoods and protein needs of millions of people. The health and productivity of these reefs are in serious decline from numerous threats, ranging from local threats such as over fishing and pollution, to the global threat of climate change. Local threats reduce the resilience of coral reefs to withstand global impacts from climate change, resulting in deterioration of reef structure and the ability of these ecosystems to sustain their ecological interactions. We will assemble data from disparate sources to develop a framework for prioritizing between places and among specific conservation actions that cost-effectively mitigate proximate land- and sea-based threats to coral reefs and apply it to regions within the Coral Triangle. With the overall goal of supporting decision making, we will work in close collaboration with local managers and policy makers to synthesize this data and develop a framework that is capable of considering complex ecological, social, and economic dynamics

relevant to the region. We will demonstrate its utility at local and regional scales and under different social and economic management constraints within the Coral Triangle. Typically, management decisions on the land and sea are made independently, without fully considering how terrestrial land-uses impact marine biodiversity. Our work is novel as it is the first example of using economic theory to balance decisions between land and sea-based management actions. This information will help guide decision makers in determining where, when, and how money would be spent efficiently to protect coral reefs, sustain protein needs, and foster livelihoods of millions, in the face of a changing climate.

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, Long Cao, Robert Dickinson, Noah Diffenbaugh, Christopher Field, Kevin Gurney, Forrest Hoffman, Bruce Hungate, Robert Jackson, Lara Kueppers, Beverly Law, Yaqiong Lu, Sebastiaan Luyssaert, Thomas O'Halloran, Martin Otte, Julia Pongratz, James Randerson, Abigail Swann, Kaiguang Zhao

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: **Towards understanding marine biological impacts of climate change**
Leader(s): Richardson, Anthony; Poloczanska, Elvira
Participants: Andrea Anton, Keith Brander, Chris Brown, John Bruno, Lauren Buckley, Mike Burrows, Carlos Duarte, Mark Gibbons, Benjamin Halpern, Carrie Kappel, Pippa Moore, Mary O'Connor, John Pandolfi, Camille Parmesan, 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 specializing 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, Michael Antolin, Mark Dale, Bryan Epperson, Marie-Josee Fortin, Rolf Holderegger, Patrick James, Pierre Legendre, Stephanie Manel, Jerome Mathieu, Brad McRae, Melanie Murphy, Hugh Possingham, Noah Rosenberg, Michael Rosenberg, Kim Scribner,
Stephen Spear, Andrew Storfer, Helene Wagner, 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., Fst 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: **Human impacts of water infrastructure on watershed ecosystems and the sustainability of irrigated agriculture in the coterminous US**
Leader(s): Sabo, John; Bowling, Laura; Schoups, Gerrit
Participants: Laura Bowling, Thomas Dunne, William Graf, John Sabo, Gerrit Schoups, Tushar Sinha, Ellen Wohl

Abstract:
The goal of the proposed working group is twofold: 1) to measure the ecological footprint of freshwater infrastructure in the US (e.g., dams, irrigated agriculture, growing urban centers), and 2) to identify sustainable solutions to potential water shortages given climate change and rapid growth of major US urban areas. The underlying approach includes synthesis of numerous publicly available datasets describing surface and groundwater hydrology, human population growth, agriculture, economics and ecology. The approach also includes a novel analysis in which we will apply macroscale hydrologic models and IPCC climate forecasts to provide sustainable solutions to water shortages that consider water for cities, farms and biodiversity. The group hopes to publish 2‐3 high impact papers prior to the 25th anniversary of
Cadillac Desert: The American West and its disappearing water (Reisner 1986, Penguin Press) in 2011. The activities will culminate in a final workshop in which noted popular press authors and policy makers are invited to write an op‐ed piece to be submitted to the NY Times. This popular press article will comment on the state of US freshwater infrastructure then (based on Cadillac Desert) and now (based on our scientific work), and propose a policy platform for freshwater sustainability in the US.

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: Farshid Ahrestani , Luis Bermudez, Nicolas Bertrand, Benno Blumenthal, Shawn Bowers, Huiping Cao, Simon Cox, Judith Cushing, Philip Dibner, Peter Fox, Damian Gessler, Corinna Gries, Jeff Horsburgh, Matthew Jones, Steve Kelling, Jessie Kennedy, Marie-Angelique Laporte, Ben Leinfelder, Bertram Ludaescher, Joshua Madin, Deborah McGuinness, Chris Mungall, Margaret O'Brien, Robert Raskin, Alan Rector, Mark Schildhauer, Wade Sheldon, David Valentine, Stu Weibel, Andrew Woolf

Advances in environmental science increasingly depend on information from multiple disciplines to tackle broader and more complex questions about the natural world. Such advances, however, are hindered by data heterogeneity, which impedes the ability of researchers to discover, interpret, and integrate relevant data that have been collected by others. A number of earth

science disciplines, however, are recognizing the interoperability benefits of describing data at the level of observation and measurement, rather than at the level of the data set. The investigators propose the Scientific Observations Network (SONet) to initiate a multi-disciplinary, community-driven effort to define and develop the necessary specifications and technologies to facilitate semantic interpretation and integration of observational data across earth science domains.

The technological approaches will derive from recent advances in knowledge representation that have demonstrated great utility in enhancing scientific communication and data interoperability within the genomics community. This effort will constitute a community of experts consisting of environmental science researchers, computer scientists, and information managers, to develop open-source, standards-based approaches to the semantic modeling of observational data. Working groups of experts will also engage in extending this core data model to include a broad range of specific measurements collected by the representative set of disciplines, and a series of demonstration projects will illustrate the capabilities of the approaches to confederate data for reuse in broader and unanticipated contexts.

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, John Melack, John Oram, Daniel Schlenk, Nathaniel Scholz, James Sickman, Frank Spurlock, Inge Werner, Don Weston, Qingfu Xiao, Thomas Young, Minghua Zhang

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, Alan Flint, Lorrie Flint, Janet Franklin, Alex Hall, Lee Hannah, Maki Ikegami, Jim Lutz, Joel Michaelsen, Max Moritz, Kelly Redmond, Helen Regan, Patrick Roehrdanz, M. Rebecca Shaw, Nate Stephenson, Alexandra Syphard, Anthony Westerling, Tom Wigley

Title: **Evolutionary ecology of primate life histories** *(Funded jointly with NESCent)*
Leader(s): Strier, Karen; Alberts, Susan
Participants: Susan Alberts, Jeanne Altmann, Diane Brockman, Anne Bronikowski, Marina Cords, Linda Fedigan, William Morris, Anne Pusey, Tara Stoinski, Karen Strier

Abstract:
Primates are highly charismatic and often serve as flagship species in conservation efforts. They are also the closest living relatives of humans, and therefore hold the keys to resolving many questions about human evolution and ecology. However, the slow life histories of primates, combined with their complex social systems, their behavioral plasticity, and the challenging field conditions in which primate researchers must work, have severely limited analyses of mortality and fertility in wild, unprovisioned primate populations. This in turn limits both conservation efforts and comparative analyses that can shed light on the population dynamics and the social and ecological adaptations that have shaped both human and nonhuman primate evolution. We propose a Primate Life Histories Working Group to compare mortality and fertility schedules across taxa and evaluate a set of hypotheses about the evolution of mortality, and the relative importance to fitness of variation in fertility and survival rates. Using unique, individual-based life history data that have been collected from wild populations by eight working group participants over a minimum of 15 years, we will develop age-specific mortality and fertility schedules and create population projection matrices for each species. Our immediate goals are to test current hypotheses about the evolution of mortality, lifespan and reproduction, in order to advance our understanding of primate evolution. Our longer-term goal is to move toward a collaborative, shared databank housing irreplaceable life history data on primates. Many primate species are endangered or are under increasing anthropogenic pressure, and compiling these data is important both for conservation efforts and for scientific archives.

Title: **Efficient wildlife disease control: From social network self-organization to optimal vaccination**
Leader(s): Walsh, Peter
Participants: Denis Boyer, Damien Caillaud, Margaret Crofoot, Lauren Meyers, Sadie Ryan, 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 habit 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.

Meetings Hosted by NCEAS

Occurred or were scheduled between October 1, 2009 and September 30, 2010
based on data available as of May 31, 2010

20-Oct-09 - 23-Oct-09
Leader: Mack, Michelle
Climate warming and fire in a naive biome: Using insights from boreal forest to understand causes and consequences of fire intensification in arctic tundra *(Hosted by NCEAS)*

28-Oct-09 - 29-Oct-09
Leader: Hampton, Stephanie
USGS Powell Center Ecoinformatics Planning

9-Nov-09 - 16-Nov-09
Leader: Melian, Carlos
Unifying niche-neutral theories of molecular, community and network evolution

29-Mar-10 - 31-Mar-10
Leader: Schildhauer, Mark
Public domain ADMB project *(Supported by Moore Foundation)*

Following are hosted meetings that met prior to October 1, 2009, but were not reported in the NSF 2008-2009 report due to submission of the report prior to the end of the reporting period:

10-Sep-09 - 12-Sep-09
Leader: Hove, Alisa; Clark, Robyn; Drus, Gail; Forest, Skip; Flores, Carola

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

10-Sep-09 - 10-Sep-09
Leader: Jones, Matthew
Semantic enhancements

21-Sep-09 - 24-Sep-09
Leader: Archer, Reginald; Hoaglund, Elizabeth; Lynch, Margaret; Needles, Lisa; Sadro, Steve
Identifying successful management strategies for rebuilding collapsed fisheries *(Luce Fellows) (Hosted by NCEAS)*

Scientific Visitors

Occurred or were scheduled between October 1, 2009 and September 30, 2010
based on data available as of May 31, 2010

Dr. Zhang Wei *(Head of delegation)* , **Dr. Liao Hong, Dr. Yang Liexun, Dr. Zhang Linxiu, Dr. Gu Ruisheng, Mr. Wei Qin, Dr. Zhang Xiliang, Dr. Han Xingguo, Dr. Luo Yong, Dr. Bai Yongfei**
28-Oct-09 through 30-Oct-09
Chinese delegation visiting from Chinese academies of science and science foundation, accompanied by National Science Foundation
Host: Hampton, Stephanie

Marissa Bauer
9-Nov-09 through 10-Nov-09
Ecosystem analysis of pelagic organism declines in the Upper San Francisco Estuary
Host: Fleishman, Erica

James Bever
2-Mar-10 through 18-Mar-10
CSIRO Career Award with Pete Thrall
Host: Hampton, Stephanie

Trevor Davies
1-Apr-10 through 31-Dec-11
Quantitative Fisheries Modeling
Host: Hampton, Stephanie

Michael Hochberg

2-Mar-10 through 18-Mar-10, 26-Jul-10 through 2-Aug-10 *and* 12-Aug-10 through 21-Aug-10
CSIRO Career Award with Pete Thrall
Host: Hampton, Stephanie

Kate Kirby
18-Nov-09 through 31-Oct-10
Kids Do Ecology
Hosts: Connors, Margaret

Jalene LaMontagne
27-Mar-10 through 3-Apr-10
Asian University for Women
Host: McCauley, Edward

Marie-Angelique Laporte
20-Mar-10 through 30-Jun-10
INTEROP: A Community-driven scientific observations network to achieve interoperability of environmental and ecological data
Host: Schildhauer, Mark

Chris Lortie
1-May-07 through 21-Apr-10
1-May-07 through 30-Jun-10
Occurrence of publication bias in ecology
Host: Budden, Amber

Jerome Mathieu
1-Oct-09 through 13-Jan-10
Describing and testing spatial variation in ecological communities
Host: Hampton, Stephanie

Craig McClain
24-Mar-10 through 25-Mar-10
National Evolutionary Synthesis Center
Host: Hampton, Stephanie

Scott Merrill
6-Apr-09 through 5-Apr-12

Understanding the link between precision agriculture and landscape ecology
Host: Stephanie Hampton

Marla Ranelletti
6-Apr-10 through 5-Apr-11
Ocean Health Index
Host: Halpern, Benjamin

Curtis Runyan
1-Jan-09 though 18-Jan-11
Nature Conservancy Magazine
Host: Stephanie Hampton

Courtney Scarborough
12-Apr-10 through 11-Apr-11
Ocean Health Index
Host: Halpern, Benjamin

Alison Specht
6-Jan-10 though 14-Jan-10
Australian Centre for Ecological Analysis & Synthesis
Host: Hampton, Stephanie

Peter Thrall
2-Mar-10 through 18-Mar-10
CSIRO Career Award
Host: Hampton, Stephanie

Following are scientific visitors prior to October 1, 2009, but not reported in the NSF 2008-2009 report due to submission of the report prior to the end of the reporting period:

Lauren Buckley
1-Jul-09 through 1-Aug-09
Mechanistic distribution models: Energetics, fitness, and population dynamics
Hosts: Buckley, Lauren; Angilletta, Michael; Holt, Robert; Tewksbury, Joshua
and
1-Jul-09 through 1-Aug-09
The role of niche conservatism in producing biodiversity gradients
Hosts: Cornell, Howard; Harrison, Susan; McCain, Christy

Erin Wilson
29-Sep-09 through 30-Sep-09
Long term plankton community dynamics in the face of climate change
Host: Wolkovich, Elizabeth

Center Associates Hosted by NCEAS

Occurred or were scheduled between October 1, 2009 and September 30, 2010 based on data available as of May 31, 2010

Baron, Nancy
COMPASS/SeaWeb (Hosted by NCEAS)
3-May-04 through 2-May-11

Courtney, Steven
Roles of scientists and science managers
14-Sep-09 through 30-Sep-11

Halpern, Benjamin
Mapping Human Impacts to Massachusetts Marine Ecosystems
1-Jun-09 through 31-Dec-10

Raheem, Nejem
Valuation of marine ecosystem services
1-Dec-08 through 30-Nov-09

Ranganathan, Jai
Science communication through podcasting
8-Jan-10 through 30-Jun-10

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
21-Sep-05 through 20-Sep-09

Wade, Alisa
Assessment of the sensitivity of wild Pacific salmon to climate change
1-Jun-09 through 31-May-10

Research Training Activities

Six graduate 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, 2009 and September 30, 2010
based on data available as of May 31, 2010

Han, Xueying (Shirley)
1-Jan-09 - 30-Jun-10
Ecoinformatics graduate internships: Metadata for ecological data sets
Project Lead: Schildhauer, Mark

Soong, Oliver
1-Jan-09 - 31-Mar-10
Ecoinformatics graduate internships: Implementation of Kepler scientific workflows
Project Lead: Schildhauer, Mark

Elmore, Aaron
1-Apr-10 - 30-Jun-10
Ecoinformatics graduate internships: Constructing a global jellyfish bloom database
Project Lead: Schildhauer, Mark

Wheeler, Matt
1-Apr-10 - 30-Jun-10
Ecoinformatics graduate internships: Constructing a botanical information network (BIEN) database
Project Lead: Schildhauer, Mark

Nuding, Amelia
1-Jan-10 - 30-Jun-10
Engaging undergraduate students in ecological investigations using large, public datasets: Distributed Graduate Seminar
Project Lead: Mourad, Teresa; Gram, Wendy; Grant, Bruce

Vercruse, Robin
24-Nov-09 - 31-Mar-10
Metrics of successful collaborations
Project Lead: Hampton, Stephanie

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 (series)
Non-academic Careers (series)
Mentoring
Social Networking in Science
Outreach with K-12 Students
Tips from Editors on Being a Good Reviewer
Working with the Media
Introducing Synthesis in Teaching
Dual Career Couples

Technical Training

Occurred or were scheduled between October 1, 2009 and September 30, 2010
based on data available as of May 31, 2010

16-Nov-09 – 17-Nov-09
AIC Workshop
Instructor: David Anderson

19-Feb-10
Writing Seminar
Instructor: Josh Schimel

8-Apr-10
Statistics training workshop
Instructor: Jim Regetz

18-Jun-10 – 21-Jun-10
R-phylogenetics workshop [Hosted by NCEAS]
Instructors: Mike Alfaro and Luke Harmon

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", "Open Access in Science.", and "Gender and Academia: The Leaky Pipelines".

Networking of Visiting and Resident Scientists

Residence at the Center provides many additional opportunities for meeting visiting scientists. "Tea Time with the Postdocs" 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 senior editor for The Nature Conservancy's magazine
- The Director of Ocean Science Outreach for COMPASS
- NCEAS Outreach Coordinator

Further, the Packard Foundation supported a media training for scientists involved not only in EBM projects but also relevant NSF-supported projects, such as members of a Working Group focused on jellyfish blooms, and several NCEAS postdocs. This training workshop had an emphasis on communicating with policymakers, with presentations from COMPASS and journalists from *Science*, National Public Radio, Miller-McCune magazine, and *E & E News*. Several news pieces resulted either directly, or indirectly through connections made in this workshop.

A former NCEAS postdoc who was supported by The Nature Conservancy, Jai Ranganathan, is now pursuing science communication as a direct result of the media introduction and support for communication he received as a postdoc at NCEAS. He began learning about podcasting during his postdoc, and sharing the podcasts on a blog (http://www.nceas.ucsb.edu/jai/). Ranganathan developed a helpful relationship with Miller-McCune Magazine through the media training workshop NCEAS supported with funds from the Packard Foundation.

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.

Postdocs Jennifer Balch and Mary O'Connor used their media training to communicate effectively with policymakers and other members of the public interested in climate change at the Governors' Global Climate Summit 2 in Los Angeles (October 2009). Governor Schwarzenegger's staff invited the Deputy Director to bring NCEAS scientists to the Summit. Balch approached 4 of the 9 Amazonian Governors during coffee breaks and told them about her work on fire in Brazil, speaking in Portuguese; after the conference she sent the Governors and their Ministers of Environment a data set that she had collected from forests in their regions, about the effects of fire on carbon storage and release, data that they had asked her about during the meeting. O'Connor actively networked, participated in Q&A sessions, and ultimately made verbal contributions to the documents prepared for the marine climate impacts briefings that discussion leaders prepared following the conference.

While it is notoriously difficult to effectively track the individual public communication activities resulting from the work of dispersed participants, we do know that it has been an active year for some groups. For example, the 2005-2007 Working Group on "Ecosystem-based management for the oceans: The role of zoning" used their NCEAS work this year in briefings and expert roundtables in Washington DC, public commentary on proposed ocean policy, and in creating several petitions to federal leaders.

Examples of Projects that Received Prominent Press Coverage

> ***Googling Food Webs: Can an Eigenvector Measure Species' Importance for Coextinctions?***
> Stefano Allesina and Mercedes Pascual
> **PLoS Computational Biology. Vol: 5(9). Pages 1-6**24 April 2009
> e.g., *New York Times*:
> http://www.nytimes.com/projects/magazine/ideas/2009/#natural_science-4
>
> ***Rebuilding Global Fisheries.***
> Worm, Boris; Hilborn, Ray; et al.
> Science. Vol: 325. Pages 578-585.
> e.g., National Public Radio Science Friday
> http://www.sciencefriday.com/program/archives/200907311

Sustainability and global seafood
Martin Smith et al.
Science Vol: 327, Pages 784-786.
e.g., *United Press International* (UPI)
http://www.upi.com/Science_News/2010/02/12/More-aid-needed-for-sustainable-seafood/UPI-51151266006015/

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. Our Distributed Seminar for undergrads is continuing, 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). NCEAS postdocs Josephine Rodriguez and Sadie Ryan represented NCEAS at the 2009 SACNAS meeting, with the NCEAS Outreach Coordinator.

Rodriguez was also selected for the SACNAS Leadership Institute, a training program for underrepresented minority scientists interested in amplifying their leadership skills, sponsored by AAAS.

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 2009-2010.

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. Ten NCEAS scientists and one graduate student provided instruction and mentoring to 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 in March at NCEAS for students, their families and teachers, and NCEAS staff.

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

Collaborations in outreach and assessment

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 occurred in October 2009 at NESCent. Participants included NCEAS, NIMBios, NESCent, NEON, and iPlant.

NCEAS also participated in a "Research Center Evaluation" meeting at NIMBios in April 2010. Other participants included: NESCent, NEON, and iPlant, NSF, MBI, and EOL/BioSync. We have actively discussed assessment strategies with NESCent and NIMBios in particular, and are presently evaluating the potential of adopting NESCent's administrative database structure that may streamline assessment and reporting.

Diversity of Community Engagement

Since 1995, over 4,700 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 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 275 distinct journals. Since 1995, participants have come from over 1,550 different institutions. Finally, 29% 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 1,800 since the establishment of NCEAS (Figure 8). (This does not include 193 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 214 newly reported publications for the period of 1 July 2009 (last report submission date) – 13 June 2010. 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 are reported to NSF separately.

In addition to publications reported, we have listed 12 data sets that were registered or uploaded to the NCEAS Data Repository since 1 July 2009. NCEAS scientists have reported that they made 49 presentations of their NCEAS work, and submitted 12 new proposals to other organizations as a result of activities at NCEAS. NCEAS is aware that at least 6 of these were granted funding.

Publications Reported from July 1, 2009 to June 13, 2010

Includes journal articles, books, and book chapters
* *Indicates publication is being updated from those previously reported as "in press"*

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NCEAS Related Data Sets Registered or Uploaded to NCEAS Data Repository July 1, 2009 to June 13, 2010

Based on data available as of 6/30/2009

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2010. POD! Fish - 20mm Stations 1995-2006 Core Stations.

3. Tables and Figures

Table 1. Science Advisory Board Members 2009-2010

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

SAB Members 2008-2009	Institutions	Term
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 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, Kathryn	Dartmouth College	2008-2011
Miriti, Maria	Ohio State University	2008-2011
Osenberg, Craig	University of Floria	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

September 1, 2009 – May 31, 2010

Fall 2009

September 3	**Sadie Ryan, NCEAS** *Zoonotic buffet: a tour of diseases we share with animals*
September 10	**John Williams, NOAA** *Columbia River salmon: who (or what) will save them?*
September 17	**Keith Brander, Technical University of Denmark** *Effects of climate change on global fisheries*
September 24	**Bob Costanza, University of Vermont** *Understanding the past to create a sustainable and desirable future*
October 1	**Meg Crofoot, Harvard University** *The home field advantage: the relative importance of location and group-size in capuchin intergroup competition*
October 8	**Mark Capelli, NOAA** *Southern California Steelhead recovery planning under the Endangered Species Act*
October 15	**Jarrett Byrnes, UCSB** *Causes and consequences of biodiversity in southern California kelp forests*
October 22	**Florian Altermatt, UC Davis** *Ecological and evolutionary dynamics in Daphnia metapopulations*
October 29	**Jérôme Mathieu, Université Pierre et Marie Curie** *Describing and testing spatial variation in ecological communities: some recent developments and applications*

November 5	**Uromi Goodale, UC San Diego** *Do pioneer species really like high light? Sri Lankan rain forest pioneer species' response to and recovery from extreme events*
November 12	**Carol Adair, NCEAS** *Building a better model: How to best model long-term litter decomposition across diverse climates*
November 19	**Michelle Mack, University of Florida** *Novel disturbance in arctic tundra: Ecosystem consequences of a large fire on Alaska's North Slope*
November 26	**Thanksgiving **No EcoLunch****
December 3	**Steven Courtney, Sustainable Ecosystems Institute** *The ESA and science in public: Risky but fun*
December 10	**Brian McGill, University of Arizona** *Variation in abundance across space and between species - towards a general theory*
December 17	**Will Graf, University of South Carolina** *Science, policy, and politics for everglades restoration*

Winter / Spring 2010

January 14	**Darren Johnson, NCEAS** *Trait variation in marine fish larvae and effects of selection on population dynamics*
January 21	**Lindsay Scheef**, **NCEAS** *Occurrence and significance of zooplankton resting egg accumulation in seagrass sediments*
January 28	**John Sabo, ASU and NCEAS sabbatical fellow** *Measuring the sustainability of water infrastructure, agriculture and ecosystems in the face of water scarcity in the Cadillac Desert*
February 4	**Mark Novak, UCSC** *The nonlinear strength and stability of species interactions in omnivorous food webs*
February 11	**No Ecolunch**
February 18	**Josephine Rodriguez, NCEAS** *Integrating large-scale inventories, DNA barcodes and phylogenies to explore the biodiversity of parasitoid wasps in the tropics*
February 25	**Kate Kirby, UBC** *Biodiversity, cultural diversity, and globalization: understanding diversity loss in tropical agroecosystems*

March 4	**Felisa Smith, UNM** *Of mammoths, methane, and man: the unforeseen effects of the extinction of megafauna in the terminal Pleistocene.*
March 11	**Leah Gerber, ASU and NCEAS sabbatical fellow** *Integrating behavior and demography in vertebrate conservation*
March 18	**Liza Comita, NCEAS**
March 25	**Craig McClain, NESCENT** *Grannies, bullies, Cajun cooking, and beta diversity in the deep*
April 1	**Sidhartha Goyal**, **Kavli Institute for Theoretical Physics** *Understanding quorum sensing in Bacteria*
April 8	**Scott Merrill, NCEAS** *Understanding the link between precision agriculture and landscape ecology*
April 15	**Kim Cahill, UC Davis** *Global change in local places: Climate change and the future of high-quality winegrowing in California*
April 22	**Rick Halsey, The California Chaparral Institute** *Grizzlies, fire, and science in the chaparral*
May 6	**Carlos Duarte, Mediterranean Institute for Advanced Studies (IMEDEA)** *Return to Neverland: Shifting baselines and the management of ecosystems*
May 13	**Christina Tague, UCSB's Donald Bren School** *Integrating geology, vegetation and snow in modellng climate change impacts in the Western US mountains*
May 20	**Stephanie Pau, NCEAS** *The diversity of Hawaiian dry forests and their role as a signal for climate change*
May 27	**Kevin Lafferty, USGS and UCSB** *Parasites and ecosystems*

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.

Journal Title	2008 Impact Factor	Number NCEAS pubs as of June 17, 2010*
Science	28.103	72
Nature	31.343	37
Ecology Letters	9.392	92
Proceedings of the National Academy of Sciences	9.38	53
Global Change Biology	5.876	28
Ecology	4.874	131
Conservation Biology	4.705	40
American Naturalist	4.67	74

* 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.

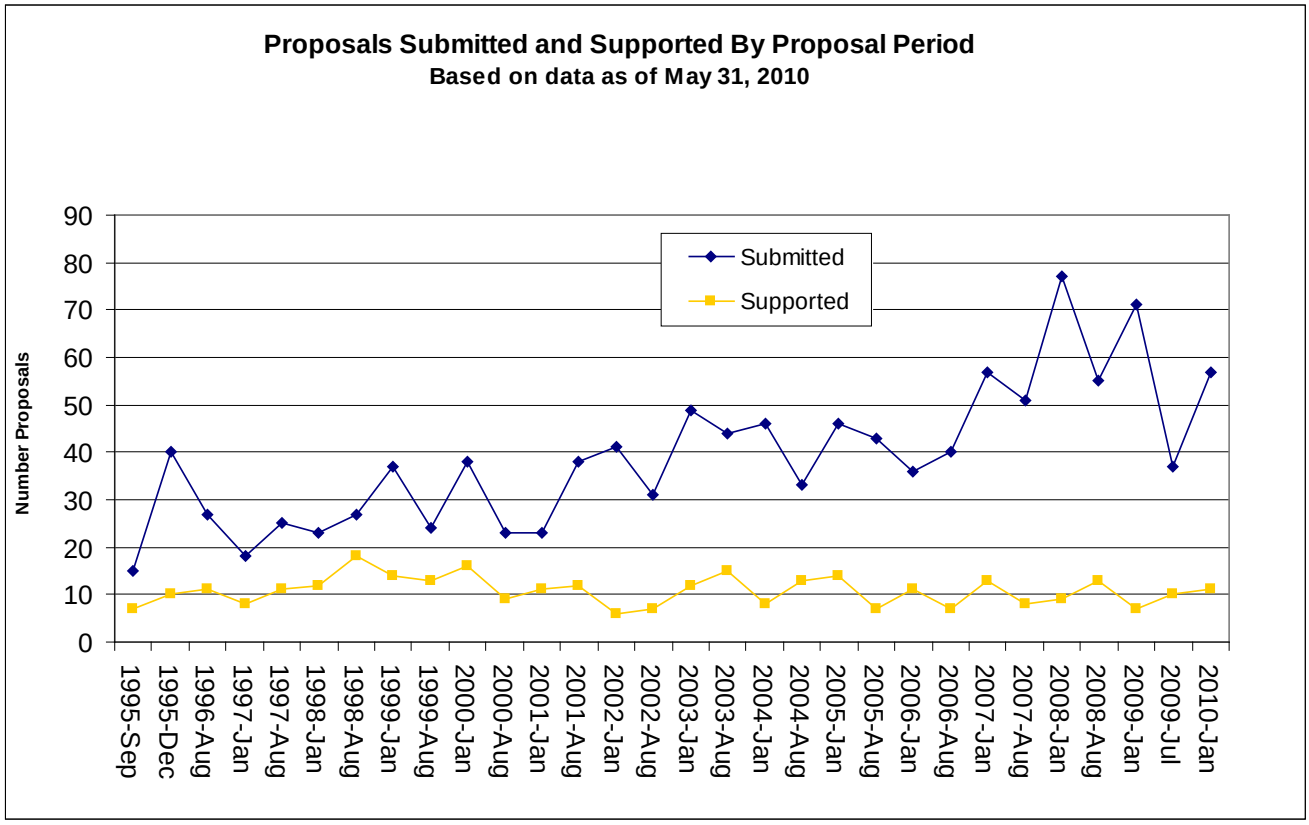
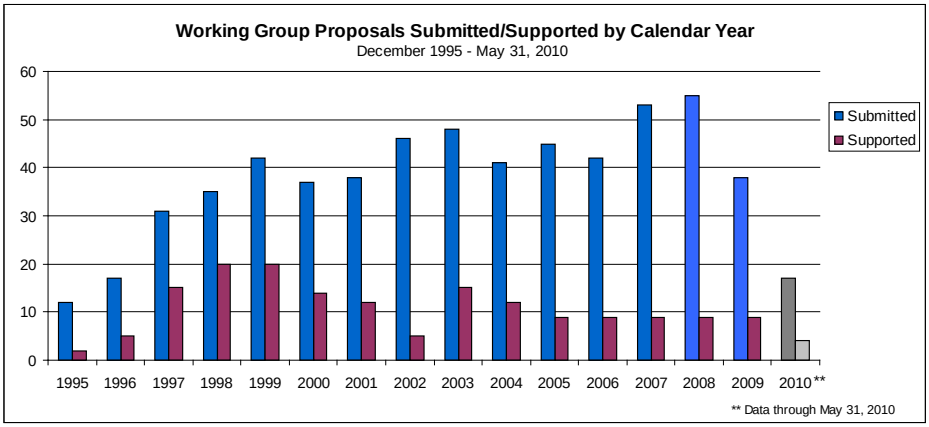
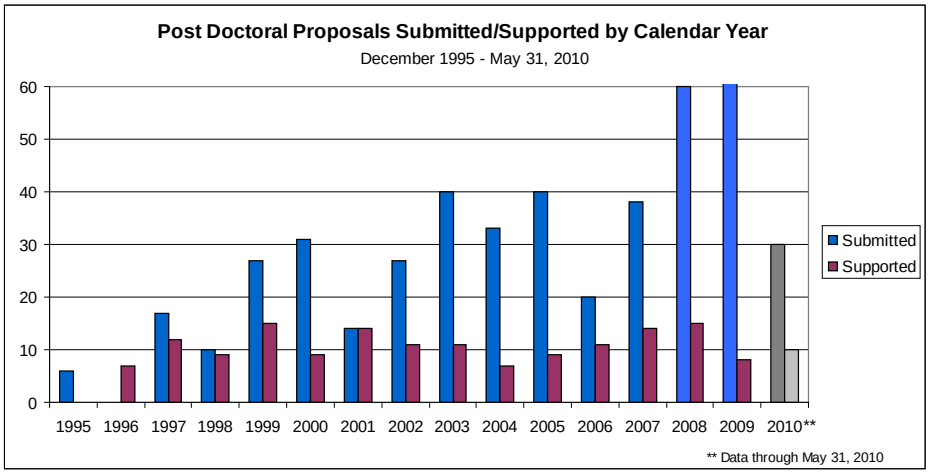


Figure 2. Proposals submitted and supported by activity type since NCEAS establishment.





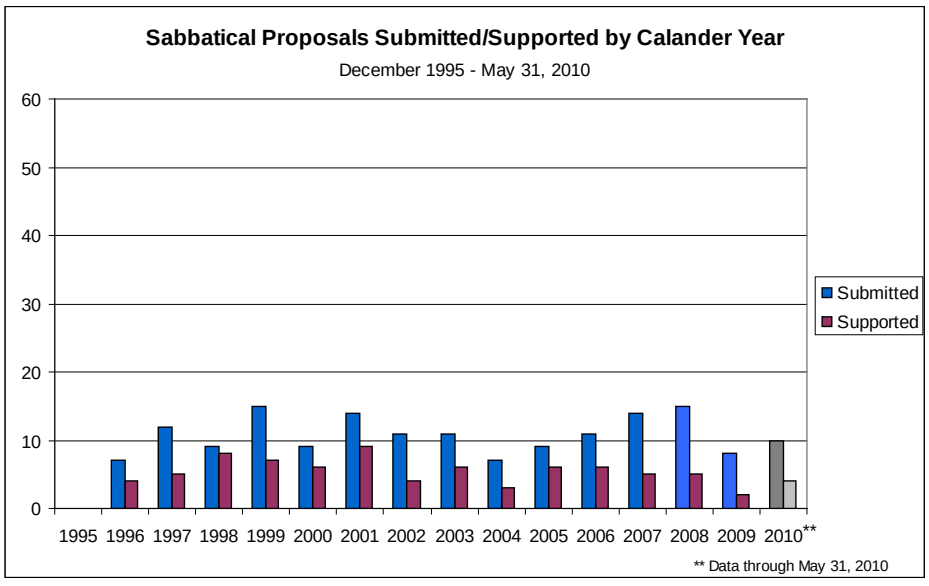
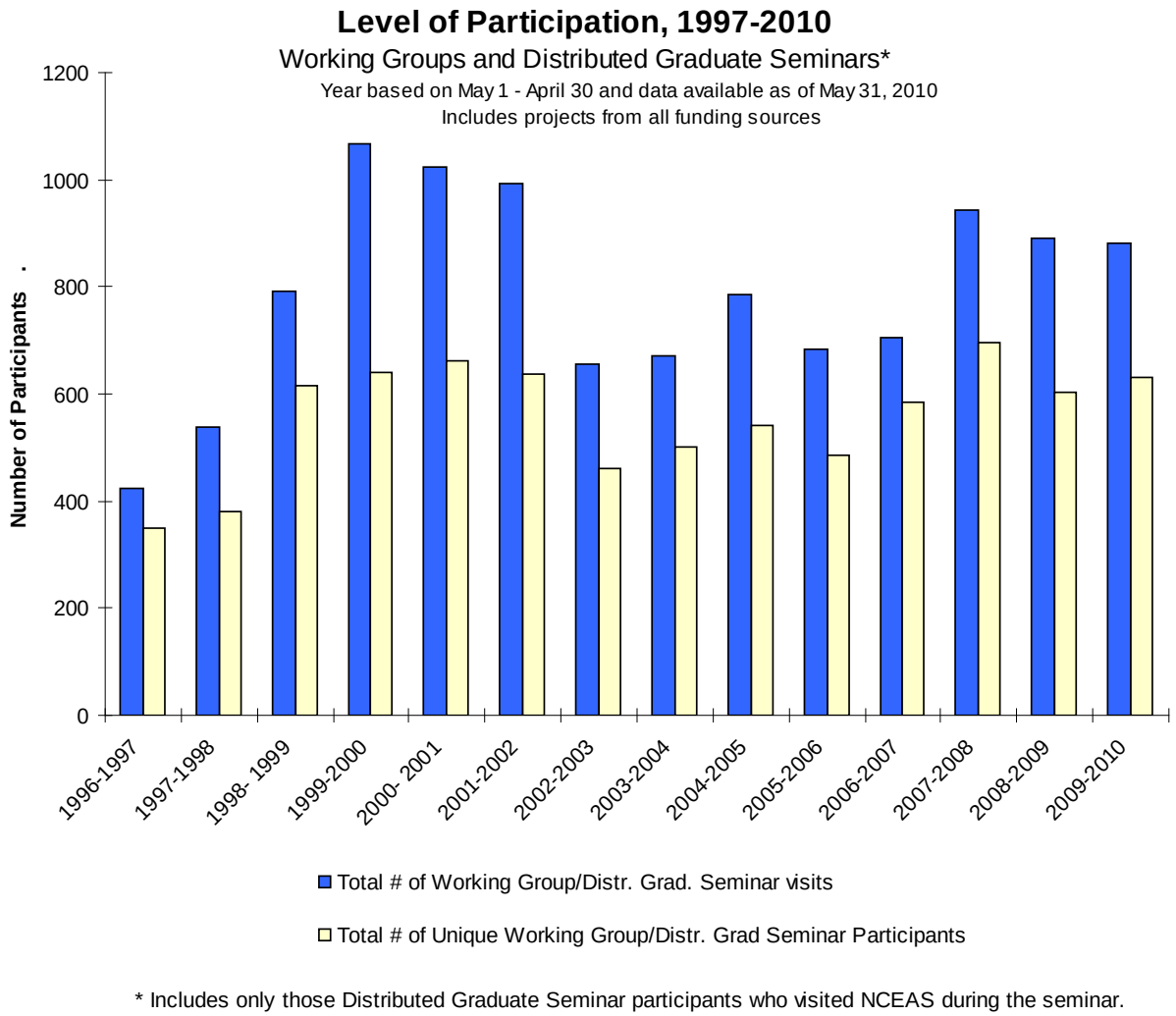


Figure 3. Number of participants since 1997, reported by the total number participants unique per year (i.e., excludes multiple visits within a year).



* 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.

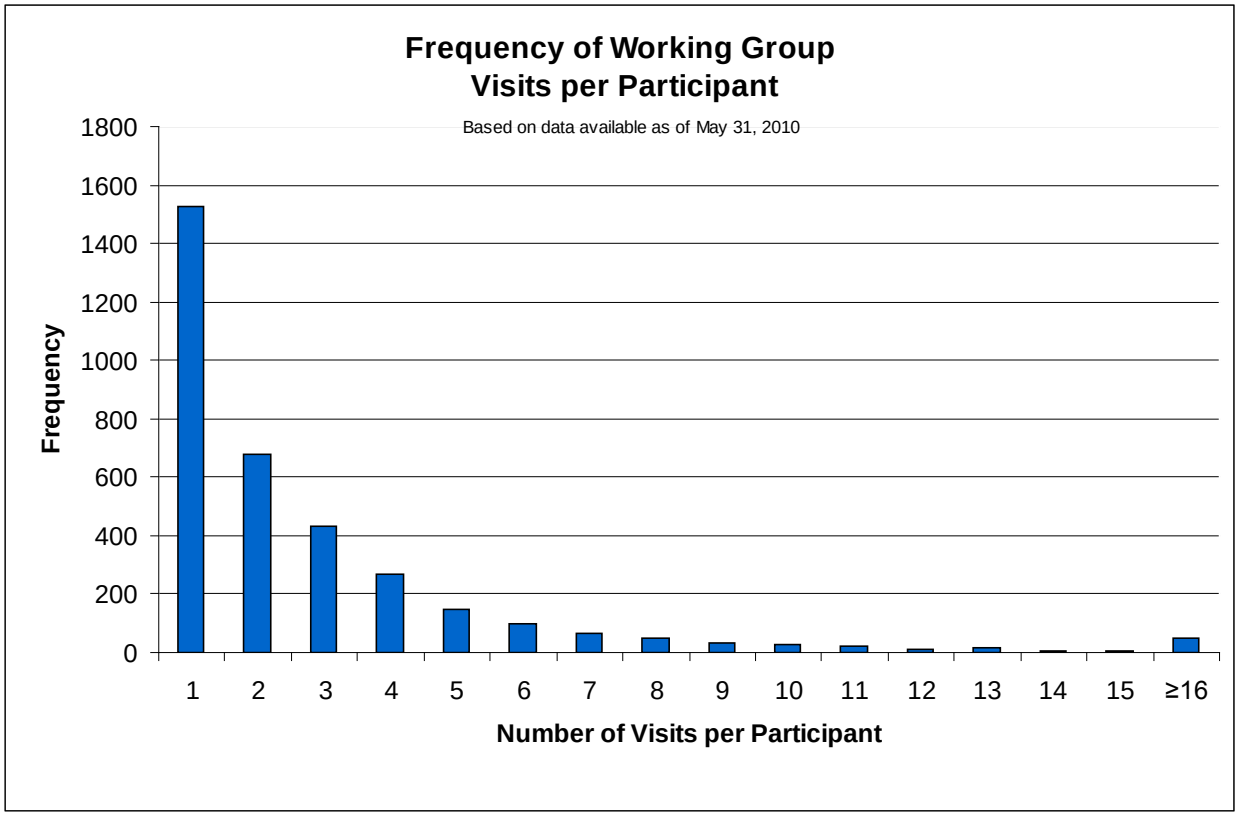


Figure 5. Percent women participating in Working Groups since establishment of NCEAS in 1995. For comparison, among ESA members who answered diversity survey questions for a 2006 report, the average female representation on faculty was 36% (30% women among senior professors, 44% women among junior professors).

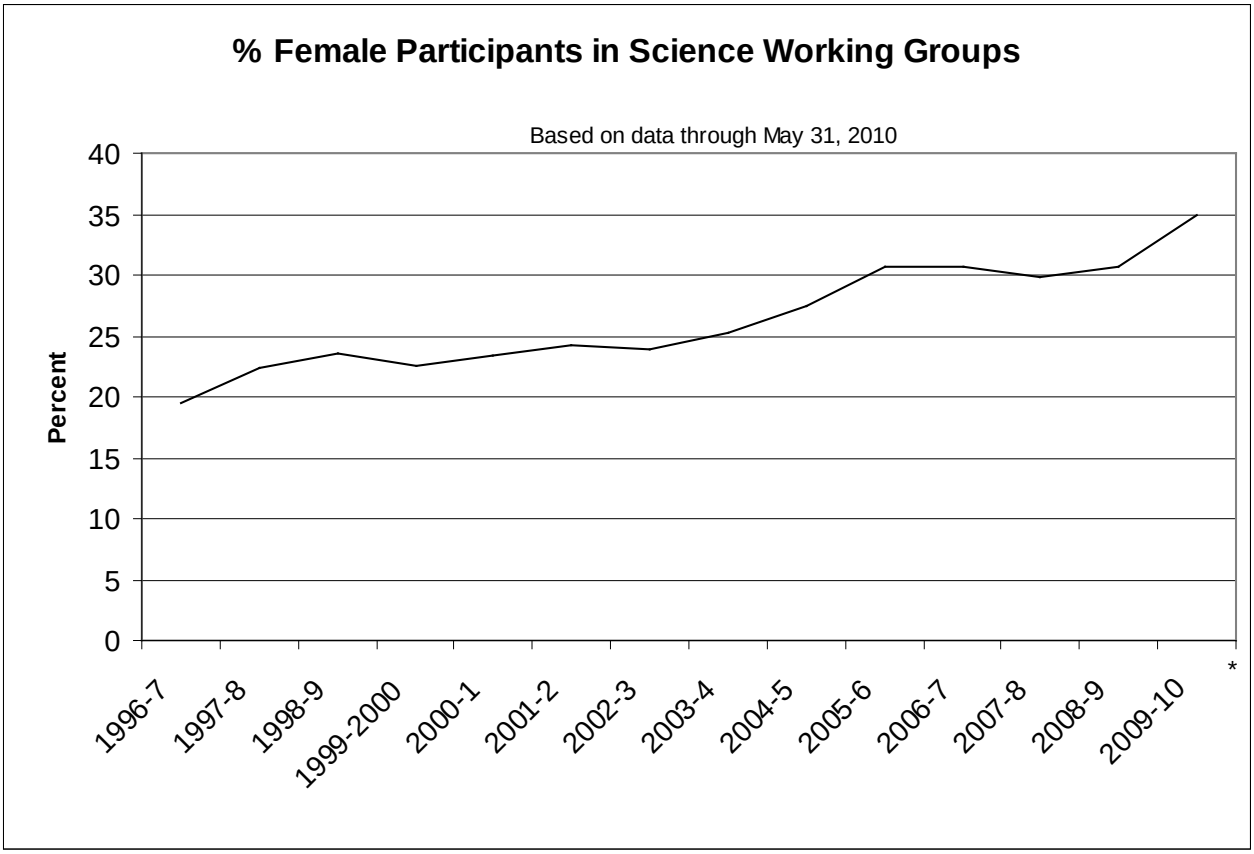


Figure 6. Percent women on the NCEAS Science Advisory Board for each year since NCEAS establishment. For comparison, among ESA members who answered diversity survey questions for a 2006 report, the average female representation on faculty was 36% (30% women among senior professors, 44% women among junior professors).

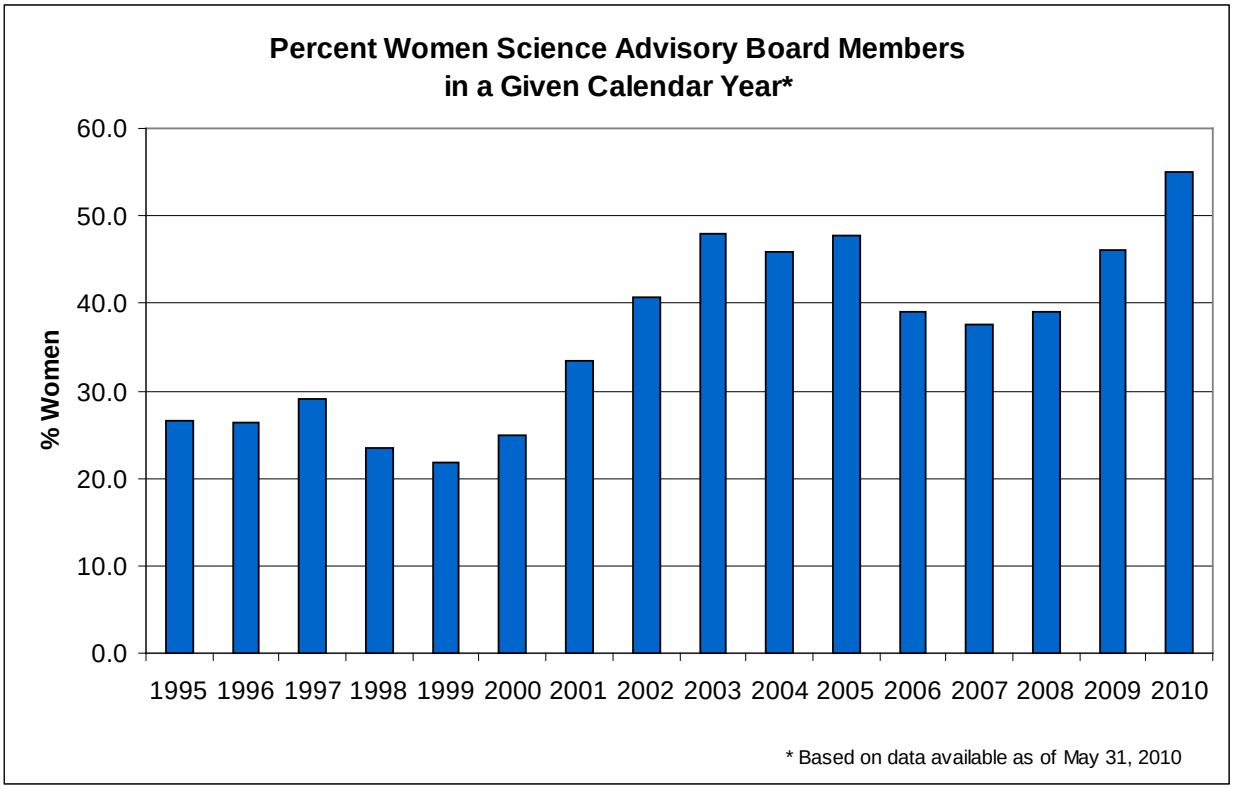


Figure 7. How did you hear about NCEAS?

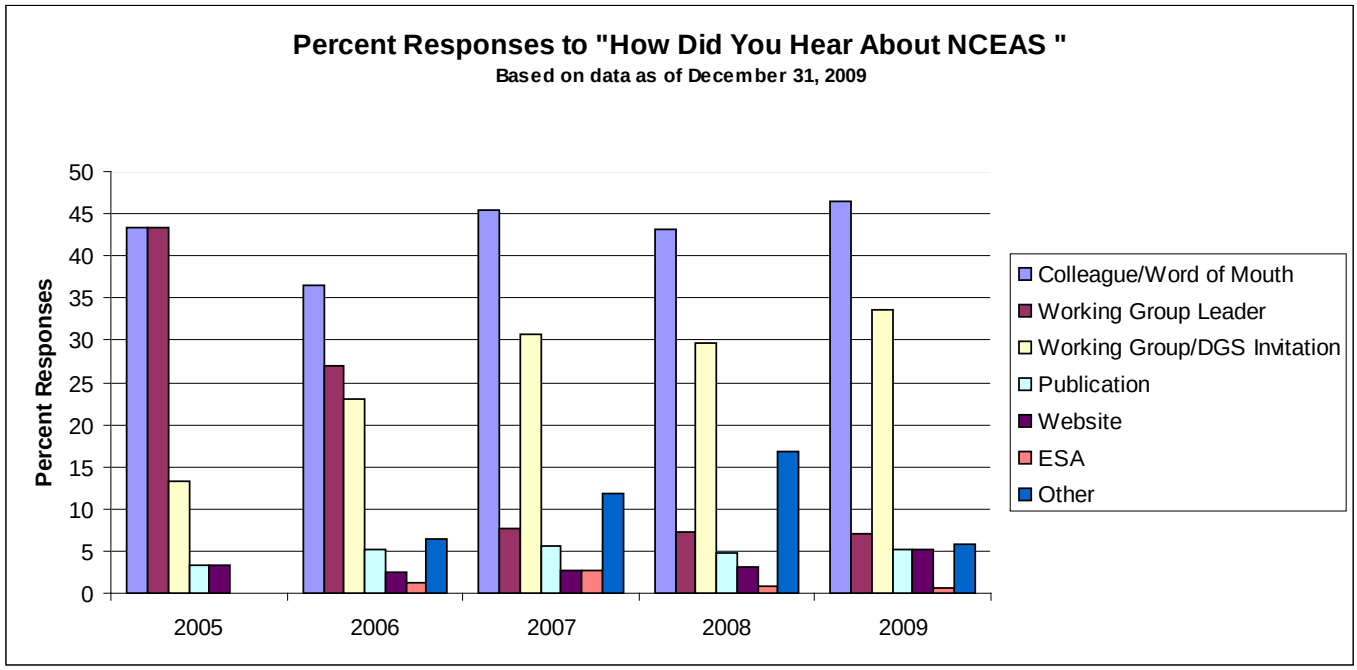


Figure 8. Number of publications reported from NCEAS activities since establishment in 1995, by publication date.