NCEAS

National Center for Ecological Analysis and Synthesis

2007
Report to the National Science Foundation

1. Participants

O.J. Reichman, Director   PI

Stephanie Hampton, Deputy Director   Co-PI

Mark Schildhauer, Director of Computing

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

The Gordon and Betty Moore Foundation has supported a diversity of NCEAS projects. A new project is designed to identify, map and compare the importance of human impacts on the California Current marine ecosystem. This project partners the University of California with non-governmental organizations and federal laboratories. NCEAS also hosted a working group assembled by the Moore Foundation to examine the effects of climate change on wild Pacific salmon. Most recently, the Moore Foundation has offered to support a distributed graduate seminar that will complement a newly funded NCEAS working group that aims to reconcile the viewpoints of Fisheries science and Ecology in issues of fisheries management.

The Andrew W. Mellon Foundation has provided funding to support postdoctoral researchers and the implementation of ecoinformatics tools. During the past year, the Mellon Foundation provided support for a scientific programmer and an analytically adept postdoctoral researcher. With additional support provided by the 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.

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

The Nature Conservancy has provided funding for a postdoctoral researcher 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 recently funded a project designed to synthesize information related to the decline of endangered fishes in the San Francisco Bay Estuary.

Other Collaborators
To facilitate informatics research and to support the informatics needs of the ecological community, NCEAS continued a research partnership with three other organizations: San Diego Super Computer Center, University of Kansas and University of New Mexico (LTER Network Office).

Other collaborators are highlighted on the NCEAS web site:
http://www.nceas.ucsb.edu/fmt/doc?/nceas-web/collaborators.

2. Activities and Findings

Science Advisory Board
For our July 2006deadline, we received 40 proposals: 6 postdoctoral fellowships, 5 sabbatical fellowships ,25 working groups, and 4 distributed graduate seminars. The Science Advisory Board met September 6-7, 2006 to review these proposals; based on their recommendations, decisions were made to support no postdoctoral fellowships, 2 sabbatical fellowship, 4 working groups, and 1 graduate seminar.

For our January 2007 deadline, we received 55 proposals: 22 postdoctoral fellowships, 11 sabbatical fellowships, 23 working groups, and 1 distributed graduate seminar. The Science Advisory Board met March 7-8, 2006 to review these proposals; based on their recommendations, decisions were made to support 2 postdoctoral fellowships, 4 sabbatical fellowships, 5 working groups, and 1 distributed graduate seminar.

A list of Science Advisory Board members is available on the NCEAS web site:
http://www.nceas.ucsb.edu.

Major Research Activities
During the reporting period, May 1, 2006 through June 30, 2007, NCEAS supported 10 sabbatical visitors and 21 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 positions at Utah State University, Washington University, and Macquarie University in Sydney, Australia.. Other NCEAS postdoctoral scientists accepted research positions at University of New Mexico and University of Georgia; one of these former postdoctoral researchers has just accepted a tenure-track position at the University of Colorado in Boulder.

During the reporting period, 897 different scientists participated in activities at NCEAS (1297 total visits). NCEAS held 70 working group meetings, representing the activities of 32 different working groups, and 10 meetings.

Sabbatical Fellows

Richard Condit   Sabbatical Fellow
12/09/2005-12/08/2007
Geographic distribution of neotropical tree species: Pattern and process
propose a sabbatical at NCEAS to study geographic distributions of tree species in Central and South America. My goal is to gain understanding of the factors that limit tree ranges in neotropical forests, both at local scales (hundreds of meters across topographic or moisture gradients) and regional scales (hundreds of kilometers across climatic gradients). I have assembled extensive and precise datasets from tree plots at both scales in Panama and Ecuador, and I will develop novel population models that describe key biological processes: dispersal, reproduction, and survival of individual trees across habitats. The simulations offer predictions on spatial patterns of individuals relative to topography and habitat, and these will be compared with observed spatial patterns to determine which population processes best account for the data. Neotropical forests hold a substantial share of the worldÆs plant diversity, but our knowledge about speciesÆ ranges there is crude. Understanding the processes limiting ranges at local and regional scales is necessary to accurately predict future impact of deforestation and climate change.

James Lovvorn   Sabbatical Fellow
01/05/2006-01/04/2007
Physiological limits on realized patch structure and trophic coupling from krill to diving seabirds
As marine food webs are increasingly altered by climate change and human exploitation, it is often desirable to estimate the amount of prey at one trophic level that is needed to sustain higher trophic levels. Critical to such estimates is the tightness of trophic coupling, or the fraction of prey that are effectively available and eaten by predators. For example, small diving seabirds are limited in dive depth, so that even abundant prey like krill are unavailable unless they come near the surface. Thus, physiological constraints on these predators can make the realized patch structure of available prey quite different from that of the entire prey population. Availability of pelagic prey is also determined by prey behavior, with diel vertical movements that can vary temporally and spatially with bathymetry, light levels, and tides. Overall prey availability may vary predictably with these factors at large scales (fronts) -- however, smaller-scale features (eddies) that concentrate prey into profitable densities are far less predictable, and may not be detected without costly exploratory dives. As a result, much of the prey is never exploited. In this research, I will link models of the foraging energetics of auklets to variations in 3-dimensional dispersion of krill prey over a time series of months and years. In particular, I will explore mechanisms and develop predictive models of how physiological limits on prey availability can control and weaken trophic coupling. Resulting concepts and models will have broad utility in foodweb approaches to marine ecosystem management, for both quantifying prey stocks needed to support top predators, and determining the location and extent of viable foraging habitat.

David Stockwell   Sabbatical Fellow
10/01/2005-06/01/2006
Preparation of a book and accompanying CD of programs and data entitled "Ecological Niche Modeling: Ecoinformatics in application to biodiversity"

The proposal is to develop a seminal book on ecological niche modeling (ENM) for ecologists that could also be used as an undergraduate or masters course, and general readership. The book would feature a sequence of theory and practical exercises in developing and evaluating ecological niche models using a range of software covering geographic information systems, multivariate modeling, artificial intelligence methods, data handling and information infrastructure, supplied on accompanying CD-ROM. The book will show applications of predictive modeling methods with reference to valid inference from assumptions. Through theoretical understanding, summary of published applications and examples of inferences that can either lead to plausible or implausible conclusions, the book aims to give the reader the ability to conduct and evaluate ENM projects in any area of application.

Francis Juanes   Sabbatical Fellow
8/25/06 - 5/31/07
Comparing globally-distributed population of Pomatomus saltatrix: Life histories and fisheries
Pomatomus saltatrix is a migratory fish species with targeted fisheries throughout its global distribution. I will review the life history and ecology of the adult stages of P. saltatrix from global populations using data obtained from fisheries biologists and managers. I will produce a species phylogeny based on analysis of mitochondrial and nuclear DNA from samples being collected presently. I will then use the life history data and genetic results to separate life history traits across populations to account for phylogenetic effects and thus isolate environmental and fishing effects. Finally, I will collect information on the current status of bluefish populations around the world. My results will for the first time quantify the degree to which populations of a global fish species are adapted to their local environment and will help focus future research efforts.

Susanne Menzel   Sabbatical Fellow
5/23/06 - 9/20/06
A synthetic approach to the science of ecosystem-based management of coastal marine ecosystems (EBM)
We will develop a modeling and data integration framework for EBM and apply that framework to a case study from coastal California. By bringing experts in the modeling of natural and human systems together with policy specialists, the working group will develop a policy relevant modeling approach that includes the dynamics of social, biophysical and economic components of the ecosystem and critical feedbacks among them, and an explicit risk assessment component. Then, in collaboration with scientists and managers knowledgeable about the coastal California system, we will develop a detailed case study using this modeling approach as a basis. Key questions about how to cope with uncertainty, how to define ecosystem boundaries, and what constitute appropriate and effective indicators of ecosystem health and performance, will be addressed through the case study. The result will be a tool that scientists and policy makers use to develop an ecosystem-based approach to management of this system, and by extension others.

Michael Hochberg   Sabbatical Fellow
7/1/06 - 8/31/07
A life-history theory of animal groups

I will employ ecological, evolutionary and economic approaches towards a life-history theory of social groups. This theory will account for group formation, member recruitment, and eventual decline. Key to this approach will be explaining the establishment and maintenance of cooperative contracts among subsets of individuals, and the differential accumulation of resources (or wealth) within groups. The results will be of interest to researchers working on animal societies and in its most complex rendition the theory will apply to certain human social groups.

Peter Leavitt   Sabbatical Fellow
2/1/07 - 1/31/08
Ecological variability of lakes in time: Integrated insights from paleolimnology and long-term ecological research
The intrinsic temporal variability of an ecological system is often assumed to be constant during the period of study, yet increasingly long-term ecological research (LTER) and paleoecological analyses reveal that this variability is itself variable (e.g, paradox of enrichment). While in principle the sources, transmission and consequences of temporal variability can be quantified using fossil, LTER or simulation approaches, to date few studies have explicitly integrated insights from these complementary strategies. Consequently, this project seeks funding to address three goals: a) calibrate high-resolution paleoecological records with monitoring time series to quantify the degree to which fossil records accurately record observed ecological variability; b) test the hypothesis that the disturbance of ecosystems by increasing mass or energy transfer causes increased temporal variability of lake ecosystems, and; c) develop a novel model that links modern ecological processes in lakes with the formation of sedimentary records. Taken together, these three projects are intended to facilitate the formal integration of paleoecology and long-term ecological research.

Pablo Marquet   Sabbatical Fellow
9/1/06 - 4/30/07
Power laws in ecology
This proposal is aimed at exploring the existence of power law distributions in ecological systems from empirical and theoretical perspectives. I propose to explore in a comprehensive way the existence of power laws in body size,geographic range and abundance distributions in different taxa and at different scales. My approach focuses in analyzing the scaling of these fat-tail distributions and in developing simple models and explanations based on known scaling relationships and spatially explicit models in order to account for their emergence.

David Marsh   Sabbatical Fellow
11/10/06 - 8/9/07
Optimal design of population monitoring programs
Population monitoring data are critical for identifying threatened, recovering, or invasive species and for modeling population dynamics. The ultimate value of monitoring data, however, is highly dependent on the quality of the monitoring program. While numerous studies have evaluated the power of monitoring programs for specific populations, few general rules exist for how to optimally allocate monitoring effort. The optimal allocation of monitoring effort should depend on general characteristics of a species¿¿¿ life-history (e.g. fecundity and longevity) and on statistical aspects of population dynamics (e.g. spatial and temporal variation and

autocorrelation). Therefore, it should be possible to develop general guidelines for the optimal design of monitoring programs based on measurable population parameters. I propose to use simulation models to derive general, quantitative guidelines for the design of population monitoring programs. Specifically, my research will address the following questions: 1) What aspects of life-history or population dynamics determine the optimal monitoring strategy for a given population? 2) What amount of baseline data is necessary to choose an appropriate population monitoring strategy? 3) If an existing monitoring program is poorly designed, when is it optimal to start over with a better program? The answers to these questions will provide rigorous and practical guidelines for the design of monitoring strategies and should lead to improved assessments of population trends and processes.

Neo Martinez   Sabbatical Fellow
12/4/06 - 12/3/07
Synthesizing and analyzing complex ecological networks with ecoinformatics
As research on food webs and other complex ecological networks advance, the difficulty of accessing increasingly abundant information about these networks forms a greater impediment to understanding their structure and dynamics. Beyond access, there is also a greater need to increase the ease and sophistication of analyzing these networks once the information is obtained. Fortunately, the advances in general network science, especially those in biological networks, and associated informatics provide many rich opportunities to increase our ability to synthesize and analyze information describing ecological networks. During an NCEAS sabbatical, I will focus on using these opportunities, especially ecoinformatic activities based at NCEAS, to increase data availability and analytical tools available for the study of ecological networks. While increasing scientists' ability to conduct such research, I will also use these enhanced abilities to study ecological networks with an emphasis on their structural evolution over deep time and the ecosystem consequences of species loss and invasions. These activities are designed to answer my central research questions, "How do ecological networks govern the function of complex ecosystems?"

Postdoctoral Fellows

Peter Adler   Postdoctoral Fellow
09/01/2005-06/30/2006
Coexistence in a changing environment: Evaluating the role of climatic variability in semiarid plant communities
Understanding how climatic variability influences the coexistence of species is critical to forecasting how climate change will affect local species diversity, especially given predicted increases in variability in many regions. The importance of variability is demonstrated by a well-developed body of ecological theory that shows how temporal fluctuations can benefit, harm, or have no effect on coexistence. My proposed research evaluates the influence of climatic variability on species diversity in widespread vegetation types of the central and western U.S. by linking unique long-term, spatially explicit datasets to theory using statistical and simulation

models. The results will represent a first step towards predicting the effects of climate change on these plant communities.

Drew Allen   Postdoctoral Fellow
03/01/2005-02/28/2007
The role of temperature in the origin and maintenance of biodiversity
The mechanisms responsible for latitudinal gradients in biodiversity are still poorly understood. Mechanistic understanding will require new theory that links short-term species coexistence to long-term speciation-extinction dynamics. My research at NCEAS will involve developing and testing a theoretical framework based on temperature dependence of biological rates and times and the dynamics of speciation and extinction. This framework will involve a synthesis of theory and data that encompasses population genetics, community ecology, and macroevolution. The primary motivations for this work are to better understand and predict changes in biodiversity along temperature gradients, and more generally, to better understand the forces that control the origin and maintenance of species.

Juliann Aukema   Postdoctoral Fellow
9/1/06 - 8/31/07
Economic and ecological implications of non-native forest pests and pathogens (TNC – Hosted by NCEAS)
My research interests lie in spatial patterns, processes, and mechanisms underlying species interactions and distributions, and in applied conservation. I draw on the fields of spatial ecology, plant community ecology, plant-animal interactions, conservation biology, and epidemiology; and I strive to bridge the gap between science and conservation practice. At NCEAS, I am working on a project to quantify the economic and ecosystem impacts of non-native forest pests and pathogens in North America. Both the economic and ecosystem effects of these introductions should be considered in developing public policy.
Juliann Aukema is supported by The Nature Conservancy.

Marissa Baskett   Postdoctoral Fellow
9/13/06 - 9/12/07
Can coral reefs survive climate change?
Climate change threatens the persistence of coral reef ecosystems in the near future through the increase in mass coral bleaching events associated with the increased frequency and magnitude of temperature extremes. However, corals and their symbiotic algae may have the potential to respond to climate change through community shifts,
physiological acclimation, and genetic adaptation. I will use analytical models and computer simulations to explore (1) the potential for coral communities to respond to a rapidly changing climate, (2) the potential indicators of coral communities most likely to survive future climate change, and (3) the interaction between additional anthropogenic impacts and coral responses to climate change. These models will further the understanding of the
interaction between evolutionary and ecological processes, inform conservation management decisions, and create a theoretical framework for synthesizing coral bleaching data.

Amber Budden   Postdoctoral Fellow
05/01/07 – 04/30/08
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.

Bernardo Broitman   Postdoctoral Fellow
01/15/2006-01/14/2007
Bottom-up ecosystem-based management of coastal systems: Social drivers of ecological and economic factors in EBM (EBM – Hosted by NCEAS)
Ecosystem-based management call for the adoption of management practices that explicitly account for the cross-linkages between ecological, economic and social components. I propose an approach to determine the goals of EBM in coastal temperate oceans through a literature review of initiatives where a social process has advanced research priorities for scientists and economists. By examining and compiling these research priorities I will to compile large datasets of the envionmental, ecological and economic variables singled out by the social process. Going one step further, I will generate uncertainty estimates through simulations that I will incorporate into simple bioeconomic models. This formal approach will allow for a clearer definition and examination of EBM in coastal systems.
Bernardo Broitman is supported by the David and Lucille Packard Foundation.

Marjorie Brooks   Postdoctoral Fellow
01/05/2006-01/04/2007
Anthropogenic stressors on aquatic ecosystems: Modeling links between UV radiation, geochemistry, bioaccumulation, and invertebrate communities at a landscape scale
Multiple environmental stressors such as trace metal contaminants, increased ultraviolet (UV) radiation, and climate warming are having synergistic effects on aquatic ecosystems. Abiotic

effects propagate through all levels of ecosystem organization, providing opportunities to develop the integrative models needed to assess and predict important interactive effects of multiple stressors. For example, when invertebrates bioaccumulate metals above thresholds beyond which some species cannot regulate metal intake, it leads to impaired growth, reproduction, and survival that alter the structure of invertebrate communities in ways that should be predictable. I propose to develop models that couple the geochemistry of natural waters as altered by UV exposure with the biological uptake of metals and the resulting structure of invertebrate communities. Current regulatory policy for metals generally ignores most natural variation and the synergistic impacts of multiple stressors (e.g., seasonal and temporal fluctuations in metal concentrations coupled with UV exposure). Based on an extensive, regional data set, my models will link atmospheric, climatic, and geochemical effects on the spatial dispersion of invertebrate diversity throughout several watersheds, and will have important implications for both regulatory policy and ecological theory.

Elsa Cleland   Postdoctoral Fellow
08/01/2005-07/31/2006
The response of ecological communities to nutrient enrichment: Utilizing meta-analysis and structural equation modeling to disentangle the influences of functional traits and environmental context
Ecologists have been fascinated by the relationship between plant species diversity and ecosystem productivity for many years. It is becoming increasingly important to understand this relationship as anthropogenic environmental changes such as nitrogen deposition fundamentally alter natural systems. At local scales, experimental research shows that species diversity tends to decline as resource availability increases. To date, diversity responses to nutrient enrichment have been quantified almost entirely by changes in taxonomic richness. Thus, we know little about the characteristics – or functional traits – of those species which decline. This research will seek to determine whether plant functional traits can predict shifts in species composition, species richness, and productivity in response to nutrient enrichment. This focus on functional traits will facilitate comparison across ecosystem types, and generalization regarding species losses and their consequences in response to environmental change.

Jonathan Davies   Postdoctoral Fellow
2/1/07 - 1/31/08
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.

John Drake   Postdoctoral Fellow
06/01/2004-06/30/2006
Risk analysis for alien species and emerging infectious diseases
Undesirable alien species and emerging infectious diseases (of both wildlife and humans) are urgent environmental concerns. Considerable effort has therefore been invested in understanding the ecology and evolution of invasive species and of infectious diseases. Despite exhibiting similar dynamics that are modeled with the same techniques, these phenomena are commonly studied by separate research communities for the purposes of risk analysis, management, and control. This project will develop techniques for risk analysis of intentional and unintentional introductions of non-indigenous species and will investigate areas of cross-fertilization with epidemiological theory. The products of this study will be tools for decision-making in the presence of uncertainty and specific recommendations for six case studies.

Allen Hurlbert   Postdoctoral Fellow
09/01/2005-08/31/2006
Exploring the Swiss Cheese Effect: The causes and consequences of patchily occupied species ranges
Although the geographic range is a fundamental unit of analysis for many macroecological and biogeographical studies, as a representation of the spatial distribution of individuals it is clearly a scale-dependent abstraction. As any amateur naturalist realizes, a species is not guaranteed to be present at every point within the range delimited by a field guide. The degree to which a species is predictably encountered within its range varies tremendously across species. Using paired datasets on species ranges and survey data for birds, butterflies, and small mammals, I plan to quantify the variation in range occupancy across species, and identify the primary species level traits (e.g. body size, population density, habitat specialization) that explain this variation. The porous nature of species' ranges also has consequences for community level analyses. The overlaying of range maps leads to an overestimate of species richness for local communities, as well as to the perceived coexistence of species that may not actually coexist at a biologically meaningful spatial scale. I also propose to examine the degree to which local community composition as identified by surveys represents a non-random subset of the regional pool (as defined by range maps) using simulation analyses.

Carrie Kappel   Postdoctoral Fellow
01/25/2006-01/24/2007
A synthetic approach to the science of ecosystem-based management of coastal marine ecosystems (EBM – Hosted by NCEAS)
As a postdoctoral fellow with the Ecosystem Based Management (EBM) project, I am working on methods for integrating multiple biophysical, social and economic datasets across spatial and temporal scales, estimating the joint uncertainties associated with the integrated data, and incorporating that uncertainty into management decision-making. These activities will be tied to

development of system models and a decision-support framework to support marine EBM in coastal California through my involvement in and coordination of the Science Frameworks for EBM working group.
Carrie Kappel is supported by the David and Lucille Packard Foundation.

Kate Lyons   Postdoctoral Fellow
08/01/2003-07/31/2006
Temporal and spatial dimensions of mammalian community structure: Pattern and process
Although progress has been forthcoming concerning macroecological patterns across large spatial scales, relatively little attention has been focused on their temporal dynamics. Moreover, understanding the responses of species to climate change is becoming increasingly important because of the effect humans have on the environment. Predicting how macroecological patterns will change in response to patterns of global warming may allow us to better prepare for the consequences of our actions through informed conservation practices and land use strategies. Comprehensive and spatially explicit data on Pleistocene mammals provide a unique opportunity to perform such spatiotemporal analyses. Community structure was dynamic: many species with historically sympatric ranges are now allopatric. I propose to examine macroecological patterns across the fluid landscape of community structure during the last forty thousand years. As is true in so many instances, the key to predicting the future lies in understanding the past.

Christy McCain   Postdoctoral Fellow
01/13/2004-01/12/2007
Elevational trends in biodiversity: Examining theoretical predictions across taxa
Documenting patterns and understanding factors producing and maintaining global biodiversity have been fundamental goals of ecological research since the first expeditions of Darwin and Wallace. After a century and a half of research on biodiversity patterns and processes, Brown asserted that a general explanation for patterns of biodiversity would emerge in the next few years, particularly for elevational and latitudinal patterns. Elevational gradients hold enormous potential for understanding general properties of biodiversity since variable topography is global, and predictable climatic patterns with large concomitant changes in biodiversity occur over small spatial scales. Additionally, biodiversity studies along elevational gradients have been amassed for many taxa on mountain ranges across the globe. Lomolino outlined some testable diversity hypotheses in a research agenda, which would lead to a general explanation for elevational patterns, including climatic hypotheses, species-area effects, community overlap patterns, and historical factors. In the first quantitative synthesis, I tested some of the predictions for elevational diversity patterns of non-volant small mammals (n = 51) with intriguing results. Peak alpha diversity occurred at higher elevations on taller mountains, evidence supporting a combination of climatic factors influencing diversity patterns. In contrast, gamma diversity patterns supported the predictions of the mid-domain effect, displayed a positive, linear trend with latitude, and showed trends consistent with species-area effects. To further examine these preliminary trends, I propose addressing the following questions: (1) Is there a latitudinal trend in elevation of peaks in diversity on mountainsides? (2) Does the species-area relationship inherent to elevational gradients mask other mechanisms producing and maintaining biodiversity? (3) Is there general support for the community overlap hypothesis on elevational gradients? (4) Are there general mechanisms producing elevational diversity patterns across taxa?

Brad McRae   Postdoctoral Fellow
11/01/2005-10/31/2006
Linking landscape ecology and population genetics using algorithms from circuit theory
The proposed research addresses a lack of quantitative models that can link data on landscape pattern and gene flow in natural populations. Because current landscape connectivity models focus on dispersal but not emergent patterns of gene flow, they are unable to take advantage of a growing number of population genetic datasets for validation, and cannot predict genetic effects of landscape change. Similarly, population genetic models either ignore spatial heterogeneity or suffer from prohibitive data and/or computational requirements. I propose to develop models which borrow computationally efficient algorithms from circuit theory to bridge geographic and genetic data and predict effects of landscape pattern on genetic structuring in natural populations.

Carlos Melián   Postdoctoral Fellow
02/22/2005-02/21/2007
The evolution of behavior and the structure of ecological networks
Most studies on community ecology have focused on single interaction types (i.e., antagonistic, mutualistic, or competitive). On the other hand, the bulk of behavioral studies have considered interactions among individuals within the same species (i.e., group behavior or group size). To improve our understanding of community structure, I propose to investigate the interdependence between group behavior and the structure of ecological networks integrating multiple interaction types. First, I will introduce behavioral strategies among species within the framework of gametheoretic models. Second, I will complement existing database on food webs by introducing species group size and different interaction types. Third, I will use this enlarged database to test alternative behavioral models of network built up to determine mechanisms generating the structure of ecological networks. This research should provide a first step toward understanding the role of group behavior in the structure of ecological networks with multiple interaction types. The relevance of this work relies on the integration of behavioral and community ecology.

John Orrock   Postdoctoral Fellow
06/01/2004-05/31/2007
Interactions between mammalian herbivores and associated plant communities
The grasslands of California represent one of the most dramatic biological invasions in the world: 9.2 million ha (almost 25% of the entire state) are dominated by non-native plants. My work at NCEAS will evaluate whether non-native plants subsidize native consumers, leading to stronger impacts of native consumers on native plants (i.e. apparent competition). I will characterize how differences in consumer behavior among patches change the spatial extent of apparent competition (and thus invasion).

Jennifer Smith   Postdoctoral Fellow
10/01/2005-09/30/2006
Coral reef degradation: Determining the relative role of top-down and bottom-up factors in the global decline of coral reefs
Coral reef ecosystems are among the most diverse and highly productive ecosystems on the planet yet are currently threatened by a number of natural and anthropogenic factors (Connell 1978, Hughes et al. 2003, Bellwood et al. 2004). Regardless of the cause, reef degradation generally

results in an irreversible phase-shift from dominance by reef-building coral to dominance by fleshy macroalgae (Petraitis and Dudgeon 2004). These shifts are believed to be irreversible and lead to communities that are less diverse and much less complex. While a number of natural disturbances can cause localized coral mortality, reduced top-down control (caused by overfishing) and increased bottom-up control (caused by nutrient pollution) are the most frequently implicated causes of anthropogenic reef degradation (McCook 1999). Past research has focused on either one or the other of these factors independently, has involved large-scale field-based correlations and more recently involved factorial field and laboratory manipulations. However, despite much effort there is not consensus in the scientific community as to how these factors independently and interactively influence phase-shift formation (Smith 2003). Further, not all phase-shifts are alike; some result in blooms of a single species of algae while others result in a more diverse mixed species assemblage and still others involve invasive non-indigenous species. Through analysis and synthesis of data from the literature I propose to develop conceptual models to determine the relative strength of top-down versus bottom-up control on coral reefs. I also propose to conduct a meta-analysis of these data to test several hypotheses regarding the importance of top-down and bottom-up control across several gradients in the tropics including latitude, diversity and disturbance. Lastly, using a pre-existing database I will assess the role of top-down and bottom-up factors on the success of exotic macroalgae on tropical reefs and conduct a risk assessment to identify species that are likely to be more invasive than others. The information generated by this project will be highly useful in implementing sound science-based management decisions for conservation of coral reef ecosystems across the globe.

Patrick Stephens   Postdoctoral Fellow
10/01/2005-09/30/2006
The effects of lineage age on the species richness of regional assemblages
Like area, time is a factor that must constrain diversity at some level, yet very little is known about how time and species richness are related in most groups. It was widely accepted during the first half of the 20th century that time constrained diversity in many groups, though there was little direct evidence for this. Ironically, interest in the relationship waned just before the phylogenetic tools necessary to investigate it directly it were developed. I propose to investigate the relationship between the relative age and species richness of regional assemblages in a wide variety of organisms.

Mark Urban   Postdoctoral Fellow
9/15/06 - 9/14/07
Interaction traits and metacommunity gene flow
The metacommunity framework is stimulating novel predictions about community dynamics by considering both local species interactions and regional migration. In a similar manner, local evolution and gene flow can shape the diversity of ecologically relevant traits which, in turn, can alter local species interactions. Hence joint consideration of evolutionary and ecological processes may offer additional insights about communities. However, few empirical generalizations have emerged about how landscape connectivity and community heterogeneity govern trait distributions of interacting species in metacommunities. Toward this end, I am synthesizing data on variation in interaction traits—those characters that shape the outcomes of interspecific encounters—to explore relationships between trait distributions, community

structure and landscape connectivity. Using assimilated data on natural and common garden studies of interaction trait variation, I then plan to evaluate interaction trait variation attributed to gene flow and community composition as conditioned on species' dispersal abilities and generation lengths. Results will be used to inform rapidly advancing theories on evolution in metacommunities.

Piet Verburg   Postdoctoral Fellow
07/16/2004-07/15/2006
Climate forcing of lacustrine energy fluxes
Lakes are warming up globally with the recent climate warming. The effect of the warming on the ecosystems in the lakes depends on the impact on the physics of the lakes. The proposed research investigates the changes since 1980 in energy fluxes leaving and entering lakes in various climatic settings and the relation of these changes with regional meteorology. Implications for aquatic ecosystems will be determined.

Distributed Graduate Seminar
Biodiversity, conservation and ecosystem services in managed landscapes

Fabrice De Clerck   John Lambrinos
Heidi Asbjornsen   Margie Mayfield
Karen Garrett   Stacy Philpott
Thomas Gordon   Kimberly Russell

Abstract:

This Distributed Graduate Seminar (DGS) aims to synthesize current ecological information on the role that biodiversity in agricultural landscapes (agrobiodiversity) plays in providing ecosystem services. In recent years numerous studies aimed at examining the importance of agroecosystems to the conservation of biodiversity have been published. These studies focus on identifying the types of agricultural landscapes, and landscape components that support the greatest levels of biodiversity (Dale, Pearson et al. 1994; Daily, Ehrlich et al. 2001; Horner-Devine, Daily et al. 2003; Mayfield and Daily 2005). The most commonly discussed goal associated with these studies is to determine whether and how agricultural landscapes can be managed to support high levels of biodiversity, while continuing to allow for profitable agriculture (DeFries, Foley et al. 2004; Ricketts 2004). Less attention has been given to the role that agrobiodiversity plays in providing ecosystem services or how agrobiodiversity can be managed to increase both on- and off-farm services. Our DGS takes advantage of growing knowledge of biodiversity and ecosystem functioning to identify key relationships between agrobiodiversity and ecosystem services. We anticipate that our efforts will greatly advance understanding of how changes in species composition and overall diversity may enhance or diminish key ecosystem services. Specifically, we aim to identify key mechanisms that drive agrobiodiversity and ecosystem service relationships; identify whether and how differing spatial arrangement and levels of connectivity between agricultural and natural landscape components impact the provision of services; and propose management options that maximize both conservation and positive relationship between agrobiodiveristy and ecosystem services.

Working Groups

Paleobiology Database (Hosted by NCEAS)
John Alroy, Charles Marshall and Arnold Miller – leaders

Aberhan, Martin	Hughes, Nigel	Rogers, Raymond R.
Alroy, John	Ivany, Linda	Sessa, Jocelyn
Behrensmeyer, Anna K.	Kidwell, Susan	Sims, Hallie J.
Blois, Jessica	Kiessling, Wolfgang	Smith, Dena
Bottjer, David J.	Kosnik, Matthew	Stein, William
Buick, Devin	Kowalewski, Michal	Tiffney, Bruce
Carrano, Matthew	Krug, Andrew Zack	Tomasovych, Adam
Clyde, William C.	Looy, Cindy	Uhen, Mark D.
Foote, Michael	Miller, Arnold I.	Wagner, Peter J.
Fursich, Franz T.	Nardin, Elise	Wall, Patrick
Gastaldo, Robert A.	Nowak, Michael	Webster, Mark
Gensel, Patricia G.	O'Donnell, Matthew	Weiser, Michael
Gerber, Sylvain	Patzkowsky, Mark E.	Whatley, Robin
Head, Jason	Plotnick, Roy E.	Wing, Scott
Hendy, Austin	Raymond, Anne	
Holland, Steven M.	Rees, P.M. (Allister)	

Our picture of global diversification and extinction on long time scales is mostly based on generalized data for Phanerozoic marine macroinvertebrates. While every effort was made to guarantee the comprehensiveness of this data set, the community has been aware that sampling artifacts may contribute to the observed trends. Until now, we have been unable to remove these effects. Several robust methods for doing this are now available, but these methods use locality-specific data that are not a part of the existing, more generalized compilations. In order to confirm the reality of the major observed patterns, a collaborative data compilation project needs to be initiated. We wish to form a working group to do this. As a first step, we propose a workshop this August involving workers who have specialized in analyzing paleontological diversity data. This workshop will determine the scope, goals, structure, and time table of a database project. Immediately after the workshop, a post-doc who will serve as project coordinator will begin a two-year residency at NCEAS. Over the following two years, experts specializing on particular parts of the fossil record will meet at NCEAS to guide the data collection process. A final meeting will focus on preparing collaborative publications showing how these data influence our picture of marine diversification and extinction.

Biodiversity and conservation value of agricultural landscapes of Mesoamerica
Robin Chazdon and Daniel Griffith - leaders

Robin Chazdon	Bryan Finegan	Celia Harvey
Alejandro Estrada	Jose Gobbi	Oliver Komar
Bruce Ferguson	Daniel Griffith	Miguel Martinez-Ramos

Helda Morales   Lorena Soto-Pinto   Michiel van Breugel
Ronald Nigh   Mark Wishnie

Abstract:
This working group will synthesize information from research conducted across eight Mesoamerican countries to elucidate and promote principles for conservation action in human-impacted landscapes of Mesoamerica and to enhance the contribution to biodiversity conservation of forest fragments, extant agriculture, post-agricultural secondary forests, and forest restoration projects. Substantial ecological data sources are available now to develop such a synthesis and to promote the use of current knowledge in conservation planning, biodiversity assessment, corridor development, and transnational cooperation, all with local community participation. We anticipate that this internationally-based effort will provide scientific information critical to the Mesoamerican Biological Corridor and to harmonizing biodiversity conservation and agricultural production throughout Mesoamerica.

Habitat modification in conservation problems: Modeling invasive ecosystem engineers

Kim Cuddington and Jeb Byers – leaders

Byers, Jeb	Hastings, Alan	Lenihan, Hunter S.
Crooks, Jeff	Jones, Clive G.	Talley, Theresa
Cuddington, Kim	Lambrinos, John	Wilson, Will G.

We propose a working group to develop models and analyze data for species that substantially modify their environment. We will incorporate such habitat modification in models describing population and community dynamics of invasive species. Therefore, we will simultaneously develop methods of modeling "ecosystem engineers", and produce generalizations regarding the effects of invasive habitat modifiers. Finally, we will develop quantitative criteria to determine when it is necessary to consider ecosystem engineering in ecological problems.

Ecological stoichiometry and the spatial distributions and temporal dynamics of arthropods

Diane Davidson and William Fagan - leaders

Steven Cook	Peter Hamback	Todd Palmer
Diane Davidson	Holly Martinson	Katie Schneider
William Fagan	Terrence McGlynn	

Abstract:
Stoichiometry, the study of the balance of multiple elements in living systems, is increasingly recognized as an integrative axis within ecology and across biological disciplines. We seek to characterize a series of little-explored links between stoichiometry and the spatial distributions and temporal dynamics of arthropods. These issues lie at the interface of macroecology and macrophysiology. We focus on four arthropod groups where different stoichiometric mechanisms likely help determine species-level spatial distributions and/or temporal dynamics. These include three taxonomically defined groups (the Orthoptera [grasshoppers and crickets], the Lepidoptera [butterflies and moths], and the Hymenoptera [ants and bees]) plus one ecologically defined group (troglobites [obligate cave dwellers]). Mechanisms link an arthropod's stoichiometry with its capacities for growth, reproduction, and dispersal. We use these linkages as springboards for testing three hypotheses. First, focusing on orthopterans and lepidopterans, we will characterize how a species' stoichiometry is linked to its tendency to exhibit "outbreak" dynamics and what elements are most important. Second, focusing on hymenopterans and troglobites, we will test

how an arthropod's stoichiometric content relates to the breadth of habitats it exploits. Lastly, focusing on orthopterans, hymenopterans, lepidopterans and other arthropods, we will test whether these same stoichiometric mechanisms imply that the elemental content of some species will predispose them to respond to global change via shifts in their geographic ranges. We will address these three issues by characterizing the "intersections" of several ecological databases. Our work will be primarily from an empirical, ecoinformatic perspective; however, we will complement these efforts with theoretical modeling of insect outbreak dynamics in stoichiometrically explicit population models.

Machine learning for the environment

John Drake and Bill Langford - leaders

Jonathan Chase	Jane Elith	Dragos Margineantu
Thomas Dietterich	Cesare Furlanello	Julian Olden
Andrew Dobson	Trevor Hastie	Gill Ward
John Drake	Reuben Keller	Matt White
Saso Dzeroski	Bill Langford	Bianca Zadrozny

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

Conservation planning for ecosystem functioning: Testing predictions of ecological effectiveness for marine predators (EBM – Hosted by NCEAS)

Daniel Doak, Jim Estes, Tim Wootton and Terrie Williams – leaders

Carruthers, Tim J.	Heck, Kenneth L.	Olyarnik, Suzanne
Dennison, William C.	Hughes, Randall	Orth, Robert J.
Duarte, Carlos M.	Kendrick, Gary A.	Short, Frederick T.
Fourqurean, James W.	Kenworthy, W. Judson	Waycott, Michelle

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

Vulnerability of carbon in permafrost: Pool size and potential effects on the climate system
Christopher Field and Josep Canadell – leaders

Bockheim, James	Hagemann, Stefan	Rinke, Annette
Canadell, Josep	Kuhry, Peter	Schuur, Ted
Euskirchen, Eugenie	Lafleur, Peter	Tarnocai, Charles
Field, Christopher B.	Mazhitova, Galina	Venevsky, Sergey
Goryachkin, Sergey V.	Nelson, Frederick	Zimov, Sergei

Ecosystem responses that cause carbon loss to the atmosphere in a warming climate could greatly accelerate climate change during this century. Potentially vulnerable carbon pools that currently contain hundreds of billion tons of carbon could be destabilized through global warming and land use change. Some of the most vulnerable pools on land and oceans are: soil carbon in permafrost, soil carbon in high and low-latitude wetlands, biomass-carbon in forests, methane hydrates in the coastal zone, and ocean carbon concentrated by the biological pump. The risk of large losses from these pools is not well known, and is not included in most climate simulations. Preliminary analyses indicate a risk over the coming century that may be larger than 200 ppm of atmospheric CO_2, rivaling the expected release from fossil fuel combustion. This proposal will quantify the carbon content of the vulnerable pools in permafrost soils and analyze the risk of large releases of carbon from these pools over this century.

SpecNet
John Gamon and Faiz Rahman - leaders

Nicholas Coops	Santonu Goswami	Carlos Portillo
Jennifer Dungan	John Grace	Hong-lie Qiu
Iolanda Filella	A. Alexander Held	Faiz Rahman
John Gamon	Thomas Hilker	Dan Sims
Steve Garrity	Michael Hill	Loris Vescovo
Damiano Gianelle	Karl Huemmrich	Lee Vierling
Anatoly Gitelson	Andrew Oliphant	

Abstract:

SpecNet (Spectral Network) is a network of terrestrial flux tower sites where 'near surface' remote sensing is being conducted to improve our understanding of controls on the biosphere-atmosphere carbon exchange. SpecNet sampling closely matches the spatial and temporal scale of flux measurements, allowing a direct comparison of remotely sensed signals to factors affecting fluxes. We propose a SpecNet Working Group that will examine the optical, thermal, and flux data emerging from these sites. A primary goal will be to standardize the remote sensing instrument, algorithms, data processing protocols, and data products for comparative analyses. The next step will be to compare results across ecosystems to reveal contrasting controls on carbon flux. This effort will help link remote sensing to fluxes, assist in validating satellite products (e.g. NPP derived from the MODIS sensor), and will provide an improved scientific foundation for emerging carbon policy.

Synthetic macroecological models of species diversity

Nicholas Gotelli, Robert Colwell, and Carsten Rahbek - leaders

Hector Arita	Gary Graves	Carsten Rahbek
Robert Colwell	Walter Jetz	Thiago Fernando Rangel
Sean Connolly	Kate Lyons	Campbell Webb
David Currie	Anne Magurran	Michael Willig
Nicholas Gotelli	Christy McCain	

Abstract:

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

Analysis of long-term litter decomposition experiments: Synthesis at the site, regional, and global levels

Mark Harmon – leader

Austin, Amy   Currie, William S.   Parton, William J.
Berg, Bjorn   Harmon, Mark   Silver, Whendee L.
Burke, Ingrid C.   Lin, Kuo-chuan   Trofymow, Tony

Although numerous short-term experiments have been used to develop conceptual and simulation models of decomposition, very little is known about the later stages of this process. Exclusion of this later stage has led, at best, to incomplete understanding of ecosystem carbon and nitrogen dynamics. We propose a working group to examine the wealth of litter and decomposition data that has been produced by several recent long-term field experiments. Our analysis will initially be based on data from LIDET (Long-term Intersite Decomposition Experiment Team), a 27-site experiment conducted over a 10-year period. We will then incorporate results of other networks in Canada and Europe as well as other long-term results into this synthesis. Data will be used to reexamine fundamental paradigms that have guided ecosystem analysis for over a decade. We will also test the ability of simulation models developed from short-term experiments to predict long-term trends. Results from our working group will then be used to produce global maps of litter decomposition-related variables including litter production, substrate quality, carbon and nitrogen stores, and decomposition rates.

Narrowing the gap between theory and practice in mycorrhizal management

Jason Hoeksema, Nancy Johnson, and James Umbanhowar - leaders

Lyn Abbott	Roger Koide	William Swenson
James Bever	R. Michael Miller	James Umbanhowar
Bala Chaudhary	John Moore	Lawrence Walters
Catherine Gehring	Peter Moutoglis	Gail Wilson
Jason Hoeksema	Anne Pringle	Catherine Zabinski
Nancy Johnson	Mark Schwartz	
John Klironomos	Suzanne Simard	

Abstract:
Research on interactions between plants and their symbiotic mycorrhizal fungi has increased dramatically during the last decade, generating a confusing body of theoretical and empirical results. Simultaneously, there has been an explosion in commercial applications of mycorrhizal fungi in agriculture, horticulture, forestry and ecosystem restoration. Considering the unexpected consequences of many human introductions of non-native plants and animals, and our current lack of understanding of the factors controlling mutualistic performance of mycorrhizas, it is alarming that so little caution is being used in commercial applications of mycorrhizal fungi. Our proposed working group will: 1) perform meta-analyses to synthesize the currently disparate body of empirical and theoretical work on mycorrhizal function within communities and ecosystems, 2) develop models of mycorrhizal performance with environmental conditions and plant and fungal phenotypes as variables, 3) generate recommendations and precautions regarding the commercial use of mycorrhizal inoculum, 4) establish an online database that documents inoculation trials and tracks their outcome over time, and 5) organize a symposium at an international conference. In addition to contributing to the development of principles to guide mycorrhizal management, our efforts will help generate better theories for understanding the roles of mutualisms in population and community dynamics.

Spatial and temporal community dynamics: Sharing data to answer questions

Jeff Houlahan, C. Scott Findlay and David Currie – leaders

Cottenie, Karl	Houlahan, Jeff	Stevens, Richard
Ernest, S. K. Morgan	Legendre, Pierre	Woiwod, Ian
Findlay, C. Scott	McArdle, Brian	Wondzell, Steve
Fuhlendorf, Samuel D.	Muldavin, Esteban	
Gaedke, Ursula	Russell, Roly	

General ecological principles can, by definition, only be derived from studies that span multiple taxa, geographic areas, and time periods. Such a broad research agenda implies data-sharing among many researchers from diverse geographic regions. Many of the technological barriers to data-sharing have been and are being addressed but there still exist many sociological obstacles to data-sharing because researchers are often, understandably, reluctant to share hard-won datasets. We propose to identify the key barriers to data-sharing and provide incentives to overcome these barriers. Once an effective data-sharing model is developed we will build a 'pilot' database using multi-species, site and time period datasets contributed by the working group participants. This database will be used to answer fundamental ecological questions such as; Are more diverse communities more stable? Is the diversity-stability relationship scale, taxon or habitat specific? Are natural communities regulated primarily by biotic or abiotic factors? Does the answer to that question depend on the scale, taxa and/or habitats being studies? Do spatial and temporal variability change in some predictable way with scale? This working group is intended to be a pilot project for a large-scale 'consortium' of ecologists sharing multi-species, site, and time period datasets to derive general ecological principles.

Conservation priorities: Can we have our biodiversity and ecosystem services too?

Peter Kareiva, Taylor Ricketts, Gretchen Daily, and Stephen Polasky - leaders

Adamowicz, Vic	Kareiva, Peter	Sanchirico, James
Armsworth, Paul	Mendoza, Guillermo	Shaw, M.
Aukema, Juliann	Morris, Belinda	Tallis, Heather
Burgess, Neil	Munishi, Pantaleo	Tam, Christine
Cameron, Dick	Naidoo, Robin	Thompson, Barton
Chan, Kai	Nelson, Erik	West, Paul
Daily, Gretchen	Polasky, Stephen l	White, Sue y
Davis, Holly	Regetz, Jim	Wickel, Bart
Drumm, Andy	Ricketts, Taylor	
Goldstein, Joshua	Rouget, Matthieu	

Abstract:
The delineation of biodiversity hotspots that protect as many species as possible with as little land as possible has been the dominant paradigm in conservation science. Recently, however, this paradigm has been challenged on two accounts. The first challenge is that the burgeoning human population will make it impossible to adequately secure biodiversity in "protected areas", and that instead we must turn to working landscapes with substantial human use as places of biodiversity value. Second, with so much of the world impoverished, there is a need for land management that first and foremost ensures that basic natural services (or "ecosystem services") are provided to people. We intend to explore the spatial congruence between ecosystem services and biodiversity at multiple spatial scales, and in so doing ask to what extent the provision of

ecosystem services and biodiversity protection can be aligned, and what are the tradeoffs where they are not aligned?

This will be much more than a simple mapping exercise because it will be important to extend methods of ecosystem valuation to services and levels of detail that have been lacking thus far in the literature. Most existing maps of ecosystem services simply categorize each land area as a habitat type, and then assign to that habitat type some "generalized dollar value". In contrast we seek to create a spatially explicit accounting of biodiversity targets and ecosystems services, along with a consideration of who benefits from the services, and who might be expected to pay for them and how.

Our purpose is not to replace the goal of biodiversity protection with the goal of ecosystem service protection. Rather we seek to understand if and how the two goals might both be met, as well as how to minimize tradeoffs between the two goals where biodiversity and services are not strongly correlated. In addition to doing the spatial analyses of services and biodiversity, we will explore financial mechanisms that might help pay for the services.

Our working group will start with a mapping and valuation exercise entailing the Upper Yangtze River in China because of the many critical resource decisions this biodiversity rich region is currently facing. We will then extend our analyses to other systems, as well as different spatial scales. Our working group will be fluid with membership varying depending on the systems and analyses under discussion; however the two hallmarks of this effort are its mix of on-the-ground conservation experience from international conservation NGO's and academic scholars, including economists, ecologists and conservation planners.

Unifying approaches to statistical inference in ecology
Aaron King and Pej Rohani - leaders

Carles Breto	Valerie Isham	Ken Newman
Stephen Ellner	Bruce Kendall	Daniel Reuman
Matthew Ferrari	Aaron King	Pej Rohani
Gavin Gibson	Katia Koelle	Helen Wearing
Edward Ionides	Michael Lavine	

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.

Meta-analysis in ecology: Lessons, challenges and future

Julia Koricheva and Jessica Gurevitch - leaders

Isabelle Cote	Christopher Lortie	William Swenson
Peter Curtis	Kerrie Mengersen	James Umbanhowar
Jessica Gurevitch	Ransom Myers	Lawrence Walters
Michael Jennions	Michael Rosenberg	Gail Wilson
Julia Koricheva	Hannah Rothstein	Catherine Zabinski
Marc Lajeunesse	Christopher Schmid	
Joseph Lau	Gavin Stewart	

Abstract:
Meta-analysis represents a set of statistical methods for quantitative research synthesis developed in medicine and social sciences in late 1970s and introduced to ecology in early 1990s. It provides a more objective and informative alternative to narrative reviews and ¿vote-counting¿ approaches traditionally used for research synthesis in ecology. Despite its great potential in addressing both basic and applied research questions, the progress in meta-analytic applications in ecology is still hindered by the limited availability of meta-analytic training for ecology students, limited palette of meta-analytic techniques and tools available in ecology compared to that available in medicine and social sciences, and the need to adjust these techniques to account for the structure of ecological data and the nature of ecological questions. The aims of our working group are to facilitate and to promote the thoughtful and critical use of meta-analysis for research synthesis in ecology, and to improve the power and rigour of ecological meta-analysis. These aims will be achieved by writing a handbook of meta-analysis for ecologists, by updating existing statistical software for ecological meta-analysis, by creating an online forum on ecological meta-analysis containing bibliography and teaching aids, by taking advantage of recent methodological developments in quantitative research synthesis in medicine and social sciences, and by adjusting standard meta-analytical procedures to address specific ecological issues and problems.

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

Christopher Lortie, Lonnie Aarssen, Julia Koricheva and Tom Tregenza – leaders

Aarssen, Lonnie	Koricheva, Julia	Lortie, Christopher J.
Budden, Amber E.	Leimu, Roosa	Tregenza, Tom

Progress in a scientific discipline is normally achieved through publication and dissemination of knowledge. Number of publications and their citation frequency are also widely used for academic evaluation of individual researchers, departments, and universities. Therefore, any bias in publication and dissemination of scientific content may potentially affect the development of a field in terms of what kind of information is available for synthesis, who is successfully employed, and where funding is allocated. We will specifically focus on publication bias in ecology in this working group using meta-analysis techniques (and other standard statistics) on several sizeable collections of published papers and related online resources such as citation frequencies and impact factors. We have loosely identified three levels of attributes of the publication and dissemination process in ecology: characteristics of the study (number of hypotheses, effect size, support for main hypothesis), attributes of the publication itself (merit, length, number and gender of authors), and attributes of the journal (reputation, impact factor,

circulation). General publication biases identified in medicine and ecology include the file drawer problem, overinterpretation bias, dissemination bias, status bias, visibility bias, and gender bias. Few synthetic studies however have quantitatively tested the importance of these proposed biases nor related these biases to specific attributes of the publication process. Furthermore, there has been no quantitative evaluation of the relative importance and potential interactions between these factors.

Tools and fresh approaches for species abundance distributions

Brian McGill, Rampal Etienne, John Gray and Jessica Green - leaders

David Alonso	Jessica Green	Han Olff
Marti Jane Anderson	Fangliang He	Annette Ostling
Habtamu Kassa Benecha	Allen Hurlbert	Mutsunori Tokeshi
Maria Dornelas	Anne Magurran	Karl Ugland
Brian Enquist	Pablo Marquet	Ethan White
Rampal Etienne	Brian Maurer	
John Gray	Brian McGill	

Abstract:

The species abundance distribution (SAD) is a central pattern in ecology and of great importance for basic and applied management questions. Yet, surprisingly little progress has been made in identifying the mechanisms responsible for this fundamental pattern. We identify seven obstacles that have slowed progress in this field of research. We propose a working group that will develop a standardized database of SADs and computer code for analyzing SADs. The working group will publish these for the scientific community at large and also use them to pursue a promising new direction in exploring SADs based on perturbations (how the SAD changes as various environmental factors covary).

The roles of natural enemies and mutualists in plant invasions

Charles Mitchell and Alison Power – leaders

Agrawal, Anurag	Maron, John	Power, Alison G.
Bever, James	Mitchell, Charles	Seabloom, Eric
Gilbert, Gregory S.	Morris, William F.	Torchin, Mark E.
Hufbauer, Ruth A.	Parker, Ingrid M.	Vazquez, Diego

Invasive plant species both threaten native biodiversity and are economically costly (OTA 1993, Williamson 1996, Wilcove et al. 1998, Mack et al. 2000, Pimentel 2002). Recent results (Mitchell and Power 2003) suggest that invasive plants become widespread problems, in part, because they are released from attack by pathogens relative to their native range. However, the roles of herbivores and mutualists in plant invasions remain controversial (Maron and Vila 2001, Keane and Crawley 2002, Agrawal and Kotanen 2003), and the potential for interactive effects of natural enemies and mutualists has been little considered. This working group will examine the joint roles of herbivores, pollinators, mycorrhizal fungi, and pathogens in plant invasions. The first goal of this working group will be to more fully quantify the effects of plant introductions on their associations with these enemies and mutualists. We will achieve this by synthesizing existing data on the geographic occurrence and impact of insect herbivores, mycorrhizal fungi, pollinators, and pathogens. We will then examine to what degree changes in naturalized plants' associations with

these other organisms can explain major patterns in biological invasions, particularly variation among naturalized species in their ecological impacts.

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

Fiorenza Micheli and Andrew Rosenberg - leaders

Kenneth Broad	Ben Halpern	Fiorenza Micheli
Dan Brumbaugh	Carrie Kappel	Giacomo Osio
Christopher Costello	Salvador Lluch Cota	Andrew Rosenberg
Ronald Eastman	Marc Mangel	James Sanchirico
Michael Fogarty	Rebecca Martone	Geoffrey Shester
Steven Gaines	Susanne Menzel	David Siegel

Abstract:
We will develop a modeling and data integration framework for EBM and apply that framework to a case study from coastal California. By bringing experts in the modeling of natural and human systems together with policy specialists, the working group will develop a policy relevant modeling approach that includes the dynamics of social, biophysical and economic components of the ecosystem and critical feedbacks among them, and an explicit risk assessment component. Then, in collaboration with scientists and managers knowledgeable about the coastal California system, we will develop a detailed case study using this modeling approach as a basis. Key questions about how to cope with uncertainty, how to define ecosystem boundaries, and what constitute appropriate and effective indicators of ecosystem health and performance, will be addressed through the case study. The result will be a tool that scientists and policy makers use to develop an ecosystem-based approach to management of this system, and by extension others.

Gradients in biodiversity and speciation

Gary Mittlebach, Howard Cornell and Douglas Schemske – leaders

Allen, Andrew (Drew) P.	McCain, Christy M.	Roy, Kaustuv
Brown, Jonathan	McCune, Amy R.	Sax, Dov F.
Bush, Mark	McDade, Lucinda A.	Schemske, Douglas W.
Cornell, Howard V.	McPeek, Mark A.	Schluter, Dolph
Harrison, Susan	Mittelbach, Gary	Sobel, Jay
Hurlbert, Allen	Near, Thomas J.	Turelli, Michael
Knowlton, Nancy	Price, Trevor	
Lessios, Harilaos A.	Ricklefs, Robert E.	

The diversity of life varies predictably with climate and is greatest where it is warm and wet (the humid tropics). But, the question "why" has puzzled biologists for over a century. Recent attention has focused on evolutionary mechanisms, in particular whether speciation rates may vary predictably with climate/latitude, whether such variation in speciation rates can account for higher species richness in tropical environments, and what mechanisms might cause geographical variation in speciation rates. We propose to bring together an interdisciplinary team of ecologists, evolutionary biologists, and paleontologists to address the conceptual issues of how climate interacts with ecological and physiological processes to affect speciation rates. Our goal is to test whether speciation/diversification rates vary with climate/latitude using

phylogenetic and paleontological data. However, formidable challenges stand in the way of these tests. Therefore, our group will work to identify ways to meet these challenges and to address methodological issues of how to use phylogenetic analysis, as well as paleontological data, to estimate rates of speciation and evolutionary diversification across geographical gradients.

Global trajectories of seagrasses: Establishing a quantitative basis for seagrass conservation and restoration

Robert Orth and William Dennison – leaders

Tim Carruthers	Anne Hughes	Frederick Short
William Dennison	Gary Kendrick	Michelle Waycott
Carlos Duarte	W. Kenworthy	Susan Williams
James Fourqurean	Suzanne Olyarnik	
Kenneth Heck	Robert Orth	

Seagrasses are a group of flowering plants that have evolved a unique set of characteristics to live, grow, and reproduce in marine underwater habitats (Les et al., 1997), with key ecosystem services that they provide to coastal areas of the world (Costanza et al., 1997). During the past two decades there has been a significant increase in the number of studies on the distribution, abundance, biology and ecology of seagrasses, including the recent publication of a seagrass atlas (Green and Short, 2003); methods book (Short and Coles, 2001) and research synthesis (Larkum et al., in press). However, the need for a better understanding of seagrasses today has taken on a new meaning and increased urgency. The rate of ecosystem alteration in coastal regions where seagrasses reside is accelerating (Cohen et al., 1997), and these alterations are occurring globally (Short and Wyllie-Echeverria, 1996). The very survival of seagrasses, which have been present for the past 100 million years, depends on their ability to cope with these natural and anthropogenic alterations. The goal of the 'Global Seagrass Trajectories' working group, and the designated sub-groups, will be to use quantitative approaches to critically evaluate the types of changes that seagrasses are experiencing and evaluate likely causes. A previous qualitative examination of the literature indicates that seagrasses are experiencing loss rates (Green and Short, 2003) which match or exceed those of other threatened coastal habitats, such as salt marshes, mangrove forests, and coral reefs (e.g., Pandolfi et al., 2003), for which there is ample scientific and social awareness. Yet, a global assessment with quantitative data for seagrasses is lacking and is the focus of this effort. Synthesizing available information and conveying them to the broader scientific community and society in an effective way will be a key outcome of this project.

Ecosystem-based management for the oceans: The role of zoning

Gail Osherenko, Elliott Norse, Larry Crowder, Oran Young and Satie Airame - leaders

Satie Airame	Ben Halpern	Robbin Peach
Larry Crowder	Stephen Langdon	Andrew Rosenberg
Jon Day	Karen McLeod	James Sanchirico
Fanny Douvere	Lance Morgan	James Wilson
Charles Ehler	Elliott Norse	Oran Young
Julie Ekstrom	John Ogden	
Po Chi Fung	Gail Osherenko	

Abstract:

The proposed working group on Ocean Ecosystem Management will explore the role of place-based systems in achieving ecosystem-based ocean management. The U.S. Commission on Ocean Policy (2004) and the Pew Oceans Commission (2003) both recommend ecosystem-based management of the 4.4 million square miles of ocean within the jurisdiction of the United States. The Pew Oceans Commission Report, as well as numerous scientists, managers, and advocacy organizations, has called for development of ocean zoning as a key component of ecosystem-based management. Ocean zoning is the authoritative regulation and allocation of access and use to specific marine geographic areas. Zoning systems aim to separate competing uses, reduce conflict, increase certainty among users, and protect sensitive marine resources. Fisheries management has increasingly used spatial regulation to determine access, protect nursing and spawning areas, reduce gear impacts, etc. More recently, place-based marine management is growing through the establishment of marine protected areas (MPAs), including fully protected no-take reserves and areas offering protection from a limited set of uses. This working group will bring together ecologists and social scientists to explore the concept, practice, and opportunities for ocean zoning in a unique political and social climate primed for change. We will focus particularly on the question of whether or not and how zoning systems can be used to implement ecosystem-based management of oceans within the jurisdiction of the United States. The working group goals are to: (1) compile and synthesize information on existing systems of ocean zoning and their ecological and social impacts, (2) compile and synthesize available ecological and social data necessary to design and develop effective zoning systems, (3) develop the concept of ocean zoning within the context of ecosystem based management, and (4) design a set of principles and policies for creation of sustainable and resilient ecosystem-based ocean zoning systems. We have identified a group of leading thinkers engaged in developing an understanding of the complex ecological and social dynamics of ocean systems. The resources of NCEAS will enable us to bring these experts together to advance our understanding of marine ecosystems and our ability to implement scientifically based and effective ecosystem management.

When, and how much, does fear matter? Quantitatively assessing the impact of predator intimidation of prey on community dynamics
Evan Preisser and Daniel Bolnick – leaders

Abrams, Peter A.	Orrock, John L.	Schmitz, Oswald J.
Bolnick, Daniel I.	Pantel, Jelena	Sih, Andrew
Dill, Lawrence M.	Peacor, Scott	Trussell, Geoffrey
Grabowski, Jonathan	Peckarsky, Barbara	Vonesh, James R.
Luttbeg, Barney	Preisser, Evan L.	Werner, Earl E.

Interactions between predators and their prey are the cornerstone of food-web ecology. Ecologists have traditionally thought of such interactions in terms of the number of prey consumed by predators. A mounting array of evidence suggests that prey are far from helpless victims, however, and that they employ a wide array of defensive strategies. The costs of these strategies can include reduced energy income, lower mating success, or increased vulnerability to other predators. Predators can thus reduce prey density both through direct consumption (density-mediated interactions, 'DMIs') and through the costs arising from anti-predator strategies (trait-mediated interactions, 'TMIs'). The presence of TMIs can introduce nonlinearities into species interactions that profoundly affect both short-term interactions and longterm population dynamics. We will use meta-analysis to evaluate patterns of TMIs across a range of ecosystems,

taxa, and as a function of predator, prey, and resource density, and to determine the relative importance of different forms of TMIs (reductions in feeding, mating opportunities, reproductive allocation, etc) in shaping predator-prey interactions. Our empirical results will be used to help develop models of predator-prey interactions incorporating both density-mediated and a range of trait-mediated effects, in turn allowing us to generate new hypotheses testable by meta-analysis. We will produce: 1) a series of articles, including one which proposes TMIappropriate experimental methodologies; 2) an article for the general public; and 3) a comprehensive database of TMI research.

Making decisions on complex environmental problems

Helen Regan and Sahotra Sarkar - leaders

Mark Burgman	Christopher Margules	Mary Ruckelshaus
Mark Colyvan	Tara Martin	Sahotra Sarkar
James Dyer	Alexander Moffett	Brian Skyrms
Mark Lubell	Helen Regan	
Lynn Maguire	Kristina Rothley	

Abstract:
Environmental scientists must often facilitate complex decision-making based on scientific data but subject to societal and other constraints on management options. Complexity arises from: (i) multiple, often incommensurable, criteria that must be incorporated into decisions; (ii) decisions that must reflect the often conflicting long- and short-term goals of multiple stakeholders; and (iii) decisions that must be made in the presence of risk and uncertainty. The purpose of this project is to characterize scenarios for environmental decision-making and develop a conceptual taxonomy of them; review existing methods for dealing with multiple criteria and objectives, multiple stakeholders, and risk and uncertainty; develop integrated protocols for the use of these methods for complex decision making scenarios in conservation, wildlife management and/or environmental science; develop software tools for some of the methods for which existing tools are inadequate; test protocols and tools against available data sets; and identify areas in which more research is needed.

Exotic species: A source of insight into ecology, evolution, and biogeography

Dov Sax, Steven Gaines and Jay Stachowicz – leaders

Blackburn, Tim M.	Holt, Robert D.	O'Connor, Mary I.
Brown, James H.	Hughes, Randall	Pelc, Robin
Bruno, John	Lafferty, Kevin	Rice, William
Cassey, Phillip	Lockwood, Julie	Sax, Dov F.
D'Antonio, Carla	Mack, Richard N.	Stachowicz, Jay
Gaines, Steven D.	Mayfield, Margie	Tilman, David
Hastings, Alan	Needles, Lisa	Vellend, Mark

Exotic species pose a serious threat to the structure and function of native ecosystems and cause significant economic damage. In spite of these costs, exotic species present unique opportunities to advance our conceptual understanding of ecological patterns and processes. By using exotic species as a vast array of natural experiments we can address questions at scales that would otherwise be non-experimental, and we can observe processes that have occurred repeatedly in the past, but that have previously gone unrecorded. Indeed exotic species may present one of the best

inroads available to understanding ecology, evolution and biogeography. The goals of this working group are three-fold. First, to explore the insights that exotic species provide to fundamental conceptual issues in ecology, evolution and biogeography. Second, to provide a model for the budding field of invasion biology, which currently is focused strongly on applied issues, but which could be redirected to simultaneously study both applied and conceptual issues. Third, to use the insights we gain to ecology, evolution and biogeography to in turn improve our ability to manage and mitigate the damage caused by exotic species. To accomplish these goals, we propose a novel model that includes the delegation of work prior to the first meeting of the working group; we have identified a motivated body of scientists who are ready to initiate this work. This approach should allow us to produce a great number of conceptual insights, as well as a great number of important publications, that will advance the study of ecological systems and our ability to effectively manage them.

Lianas and tropical forest dynamics: Synthesis of Pan-tropical patterns from regional data sets
Stefan Schnitzer and Robyn Burnham - leaders

Frans Bongers	Jeffrey Gerwing	Francis Putz
Robyn Burnham	David Kenfack	Hugo Romero Saltos
Jerome Chave	Lucia Lohmann	Stefan Schnitzer
David Clark	Helene Muller-Landau	Duncan Thomas
Saara DeWalt	Parthasarathy	Campbell Webb
Corneille Ewango	Narayanaswamy	
Paul Fine	Diego Perez Salicrup	

Abstract:
Lianas (woody vines) are an important component in tropical forest dynamics, altering forest regeneration, species diversity and ecosystem-level processes such as carbon sequestration. Recently, the study of liana ecology has increased substantially throughout the tropics; however, methods for collecting liana data are only rarely consistent and there is little comparability in liana abundance, biomass, diversity, composition, or community dynamics across large areas of the tropics. Until these data sets are combined and synthesized, many large-scale questions on the ecology of lianas will remain unanswered. We propose an NCEAS Working Group to standardize, combine, and synthesize the many liana data sets from research groups around the world. In doing so, we will compile a pan-tropical data set with which we can answer specific questions about the contribution of lianas to forest diversity and biomass worldwide, as well as the pan-tropical distribution of many important liana taxa. Four main goals will be addressed during two Working Group Meetings and the intervening year. (1) Establish logical and useable guidelines for censuses of lianas, given different research goals. (2) Assemble and synthesize preexisting data sets on liana stem diameter, abundance, and diversity using empirically derived correction factors to generate a uniform, pan-tropical data set on lianas. (3) Estimate liana biomass at the whole-forest and regional levels using new and substantially more robust stem diameter-to-biomass equations. (4) Create standard systematic databases and maps of the geographic distribution of liana taxa and maps of liana hotspots to identify conservation priorities.

Comparing trophic structure across ecosystems
Jonathan Shurin, Helmut Hillebrand and Daniel Gruner – leaders

Borer, Elizabeth T.	Elser, James J.	Shurin, Jonathan B.
Bracken, Matthew	Gruner, Daniel S.	Smith, Jennifer E.
Cardinale, Brad	Harpole, W. Stanley	Smith, Melinda D.
Cebrian, Just	Hillebrand, Helmut	Strong, Donald R.
Cleland, Elsa	Ngai, Jackie	Wolkovich, Elizabeth
Cottingham, Kathryn L.	Sandin, Stuart	
de Mazancourt, Claire	Seabloom, Eric	

Trophic structure, the partitioning of biomass among organisms at different positions in a food web, varies both within and among ecosystems. However, the causes of this variation are poorly understood. Elton's "pyramid of numbers", where primary producers dominate and consumer densities decrease as trophic levels become more remote from the base of production, applies well to most terrestrial systems. However, many aquatic ecosystems apparently violate Elton's rule with inverted biomass pyramids, or ratios of heterotroph-to-autotroph biomass (H:A) greater than one. In this proposal, we describe synthetic work aimed at understanding differences in trophic structure and the relative strength of bottom-up and top-down inputs between diverse freshwater, marine and terrestrial ecosystems. We will test candidate hypotheses for this variation based on factors known to distinguish food webs in the two habitats, such as nutrient limitation and turnover rates, productivity (quantity) and nutrient stoichiometry (quality). Meta-analysis of local-scale herbivore manipulation experiments will be integrated with theoretical development of food web models, and with larger-scale temporal and spatial patterns from resource gradients. This work will move us closer to a comprehensive trophic-dynamic theory, unified across taxa and ecosystem types. It will also increase our mechanistic understanding of how human impacts, such as eutrophication or predator extirpation, propagate or attenuate in ecosystems through trophic interactions.

Evolutionary and ecological sorting in space

Mark Urban and Mathew Leibold – leaders

Amarasekare, Priyanga	Loeuille, Nicolas	Urban, Mark
de Mazancourt, Claire	Norberg, Jon	Vellend, Mark
DeMeester, Luc	Pantel, Jelena	Wade, Michael
Leibold, Mathew	Strauss, Sharon	

The last fifteen years have witnessed an increasing realization that ecological dynamics operating at coarse spatial scales have important ecological consequences. One of the more exciting ideas that has ensued is the 'metacommunity' (Figure 1), a concept that has contributed significant insights about population, community and ecosystems ecology (see Leibold et al. 2004 for a recent review, Holyoak et al. 2005 for the scope of this idea). To date, however, the metacommunity concept has been evaluated in a purely ecological context. Nevertheless, close parallels and obvious interrelations exist between ecological and evolutionary dynamics at multiple spatial scales (McPeek and Gomulkiewicz 2005). Mounting evidence suggests that evolutionary dynamics can occur on time scales similar to those involving ecological dynamics (Cousyn et al. 2001, Kinnison and Hendry 2001, Grant and Grant 2002, Yoshida et al. 2003). If so, metacommunity and evolutionary dynamics may interact strongly. Yet, we are only now beginning to understand this interaction. While metacommunity ecology will continue to contribute interesting insights about a diverse array of ecological phenomena, we foresee that these insights will soon be constrained by our limited knowledge about how ecological and

evolutionary processes interact in metacommunities. We seek to bring together scientists from diverse backgrounds to synthesize current knowledge and generate new understanding about evolutionary and metacommunity dynamics. We intend to 1) develop and refine an evolving metacommunity framework, 2) explore the potential for emergent dynamics by incorporating evolution into existing metacommunity models; 3) evaluate how multi-species interactions impact community evolution and dynamics; and 4) develop tools to test and apply the theory. The proposed synthesis of evolutionary and metacommunity theory promises to improve our understanding of species coexistence and provide strategies for preserving biodiversity and controlling rapidly evolving pests and pathogens

Exploring compensatory mitigation and markets as mechanisms for resolving fisheries bycatch: Biodiversity conservation conflicts
Chris Wilcox and Josh Donlan – leaders

Buckelew, Stacey	Graham, Alistair	Pergams, Oliver R.W.
Crowder, Larry B.	Hemphill, Arlo	Sagarin, Rafe
Cudney-Bueno, Richard	Lavers, Jennifer	Squires, Dale
Donlan, C. Josh	Melvin, Edward	Wilcox, Chris
Fletcher, Kristen	Pascoe, Sean	Wingfield, Dana
Gjertsen, Heidi	Peckham, Hoyt	

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

Toward an adequate quantification of CH4 emissions from land ecosystems: Integrating field and in-situ observations, satellite data, and modeling
Qianlai Zhuang, Jerry Melillo, Ronald Prinn, A. David McGuire – leaders

Patrick Crill
 Ed Dlugokencky
 Steve Frolking
 Vincent Gauci
 Michael Keller
 Aslam Khalil
 Elaine Matthews
 Kyle McDonald

A. David McGuire
Jan Fokke Meirink
John Melack
Jerry Melillo
Chris Potter
William Reeburgh
Qian Tan
Jinyun Tang

Merritt Turetsky
Katey Walter
Jeffrey White
Kimberly Wickland
Jingfeng Xiao
Xiaozhen Xiong
Qianlai Zhuang
Sergei Zimov

Abstract

Emissions of CH4 from natural and managed land ecosystems account for a significant source of greenhouse gases to the atmosphere. In recent decades, extensive field observations of CH4 emissions and atmospheric CH4 concentrations have been made during a time in which process-based and inversion modeling approaches have matured as powerful tools in estimating regional and global CH4 emissions. However, there are still substantial uncertainties in estimating CH4 exchange with the atmosphere. Much of this uncertainty arises from uncertainties in the extent of wetland distributions and incomplete understanding of the controls and mechanisms of methanogenesis, methanotrophy, and CH4 transport pathways to the atmosphere. Furthermore, there is variability in which factors control CH4 production and consumption in different natural and managed ecosystems. For example, in northern high latitudes, permafrost dynamics significantly influences emissions, while the seasonality of wetland extent is critical in determining emissions from tropical regions. For managed ecosystems (e.g., rice paddies), irrigation and fertilization significantly impact both methanogenesis and methanotrophy. Here we propose a Working Group to make progress in synthesis of CH4 dynamics through three activities: 1) to identify key issues in quantifying CH4 emissions from land ecosystems through conducting comparisons of model and field observations for different geographical locations and ecosystems; 2) to parameterize and extrapolate process-based models at regional and global scales and explore the uncertainty of CH4 emissions; and 3) to couple process-based estimates with inversion modeling approaches to constrain the uncertainty with air-borne, satellite, and in-situ observed datasets and to identify the factors, mechanisms, and controls to the uncertainty of emissions at large-scales.

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

Chris Wilcox and Josh Donlan - leaders

Stacey Buckelew
 Larry Crowder
 Richard Cudney-Bueno
 Paul Dalzell
 C. Josh Donlan
 Kristen Fletcher
 Heidi Gjertsen

Alistair Graham
Jennifer Lavers
Edward Melvin
 Sean Pascoe
 Hoyt Peckam
 Oliver Pergams
 Richard Rice

Rafe Sagarin
Manuel Sequeiros
Dale Squires
Chris Wilcox
Dana Wingfield

Abstract:

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

The 60-year data set of plankton dynamics in Lake Baikal: Examining facets of the jewel of Siberia
Evgeny Zilov, Marianne Moore and Stephanie Hampton – leaders
Dennis, Brian
Hampton, Stephanie E.
Izmestyeva, Lyubov R.
Mokryy, Andrey V.
Moore, Marianne V.
Paromchuk, Anna
Peshkova, Ekaterina V.
This international working group will use time-series analysis to analyze a 60-year data set describing the plankton community of Lake Baikal (Siberia) – the deepest, oldest, and most biotically diverse lake on the planet. Due to financial constraints on scientific research in Russia during the post-Soviet era, an extraordinary data set describing the dynamics of the plankton community in Lake Baikal has been greatly underutilized, and it is nearly unknown by the international scientific community. Using this high-resolution data set, we will explore spatial-temporal patterns in plankton abundance and community structure, and compare effects of perturbations on plankton dynamics. This work will increase our understanding of ecosystem functioning in one of the world's great lakes, and it will bring the Lake Baikal dataset to international recognition, encouraging future exploitation of this rich scientific resource.

Meetings Hosted by NCEAS

Name   Sponsor and Project Title

Frank Davis   Planning Meeting for a (non-NCEAS) Distributed Graduate Seminar on Wildlife Habitat Plans

Cliff Duke   ESA Workshop on Data Centers

Brett Tyler   Planning Meeting for Proposed Plant Synthesis Center

Jami Montgomery   WATERS Network Modeling Committee

Kathryn Mengerink   Ecosystem-based Management Governance Group

Erica Fleishman   Wild Salmon Ecosystems

Terri Williams   Physiological Research, Integration, Synthesis,and Modeling (PRISM)

Peter Kareiva   Ecosystem Services and Biodiversity

Matt Jones   Science Environment for Ecological Knowledge (SEEK)

Peter Leavitt   Alaska Salmon Paleoecological Investigations

Scientific Visitors

Name   Project Title

Priyanga Amarasekare   University of California, Los Angeles

Adan Caballero Vazquez Centro de Investigacion y de Estudios Avanzados

Jofre Carnicer   Estación Biológica De Doñana, Spain

Joseph Fargione   University of New Mexico

Leah Gerber   Arizona State University

Eli Holmes   National Marine Fisheries Service

Vlastimil Krivan   Academy of Sciences of the Czech Republic

Sarah Lester   SeaWeb

John Sabo	Arizona State University
Elizabeth Seminet-Reneau	University of Idaho
Brice Semmens	National Marine Fisheries Service
Steve Katz	National Marine Fisheries Service
Drew Talley	San Francisco State University
Ben Weintraub	National Marine Fisheries Service
Marcin Zalewski	Polish Academy of Sciences

Center Associates Hosted by NCEAS

Name	Project Title
John Alroy	Paleobiology Database
Nancy Baron	SeaWeb
Ellen Damschen	University of California, Santa Barbara
Kim Selkoe	University of Hawaii
Tommaso Zillio	International School of Advanced Studies (ISAS), Italy
Lynda Bunting	University of Regina, Canada
Brad Stenger	Wired Magazine

Research Training Activities

Sixteen graduate student interns 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

Intern	Project Title
Emily Althoen	Kids Do Ecology

Shinichi Asao   Kids Do Ecology

Elliot Chasin   The causes and consequences of patchiness in kelp forests and implications for coastal marine reserve design (Hosted by NCEAS)

Ashley Conrad-Saydah Distributed Graduate Seminar: Biodiversity, conservation and ecosystem services in managed landscapes

Julia Ekstrom   Knowledge and capacity-building to support ecosystem-based management (EBM) for sustainable coastal-marine systems (Hosted by NCEAS)

John Kefauver   Elevational trends in biodiversity: Examining theoretical predictions across taxa

Caitlin Kontgis   Predicting Community Level Responses (Hosted by NCEAS)

David Lamb   Paleobiology Database (Hosted by NCEAS)

Candace Low   The response of ecological communities to nutrient enrichment: Utilizing meta-analysis and structural equation modeling to disentangle the influences of functional traits and environmental context

Brent Miller   Interactions between mammalian herbivores and associated plant communities (Hosted by NCEAS)

Suzanne Olyarnik   Global trajectories of seagrasses: Establishing a quantitative basis for seagrass conservation and restoration

Christine Shearer   Human Impacts in the California Current (Hosted by NCEAS)

Catherin Schwemm   The evolution of behavior and the structure of ecological networks

Katie Schneider   Ecological stoichiometry and the spatial distributions and temporal dynamics of arthropods

Ana Spalding   A synthetic approach to the science of ecosystem-based management of coastal marine ecosystems (EBM)

Sarah Teck   Human Impacts in the California Current (Hosted by NCEAS)

Education and Outreach Activities

NCEAS continues to enhance and refine its ongoing scientific activities, while at the same time exploring and implementing new education and outreach opportunities in accordance with our outreach plan.

Make broad array of potential users aware of opportunities at NCEAS

We promote increased awareness of NCEAS opportunities, targeting groups including scientists from small, non-research universities, from underrepresented groups, scientists from abroad, government, NGO's, and private organizations. We widely publicize our Call for Proposals, including use of e-marketing and exposure on a variety of websites and newsletters. Our postdoctoral program was recently covered in a journalistic piece about non-traditional postdoctoral positions in *Nature* .

Design of the new NCEAS website includes materials that will appeal to a broader audience and better explain our programs to potential participants. The website features expanded coverage of the postdoctoral and distributed graduate seminars programs for perusal by potential applicants. Training opportunities are highlighted, along with synopses of postdoctoral associates' research, and products from prior distributed graduate seminars.

We have expanded efforts to publicize our public Data Repository, and feature a recently acquired data set each month on the NCEAS home page.

Inform the general public about NCEAS and important ecological results

NCEAS is committed to increasing the public understanding of science, and our communication initiatives address the need to explain ecological issues, research, and solutions to the public, policy makers, and resource managers to foster informed decision making at all levels.
We have expanded publicity for new NCEAS research by developing our capacity to release our own press advisories, and by improving our ability to coordinate releases with the University of California and other institutions. An NCEAS News Archive with press releases and summaries of featured research underway written for the public appear on our web site.

NCEAS provides media training for our scientists. Journalists from National Public Radio, the Aldo Leopold Institute, Wired Magazine, and local media present talks on how the media works, how to conduct interviews and how to prepare clear, accessible, media-ready messages.

Engage the local student community

Graduate students participate as interns, research assistants and as part of working groups. Our weekly Ecolunch series frequently attracts graduate students and postdoctoral researchers from UCSB.

The Center and its scientists participated in the broader community this year by giving talks and seminars, providing outreach to local schools (See KDE below), awarding ecology prizes to

students in the Santa Barbara County Science Fair, and participating with local organizations such as the Santa Barbara Educators Round Table, the Ocean Communicators Alliance, and Merito at the Channel Islands Marine Sanctuary.

Provide technical training through NCEAS activities
One of the major benefits of a synthesis center is the engagement of thousands of scientists and students. NCEAS continues to emphasize technical training for all NCEAS participants. NCEAS Ecoinformatics Program scientists train hundreds of scientists at the Center to use the latest ecoinformatics tools. NCEAS collaborates to provide ecoinformatics workshops for scientists and resource managers around the country, as part of the efforts of the SEEK project.

In the past year, we have completed the first two recruitments for a Distributed Graduate Seminars (DGS) Program to introduce the principles of data sharing and interdisciplinary collaboration to a new generation of scientists. These integrated, multi-campus graduate seminars are designed to engage students in ecological analysis and synthesis.

Increase participation by underrepresented groups
NCEAS works in partnership with other scientific organizations to develop ideas and actions for increasing the awareness of careers in ecology among underserved and underrepresented students throughout the country. NCEAS scientists and outreach staff introduce students to careers in ecology and informatics through conference presentations, seminars offered by our Postdoctoral Associates at Historically Minority Institutions and Minority Serving Institutions, and local work at the K-12 level.

Our expectation for Working Groups, made explicit in our Calls for Proposals, is that each will include a diversity of participants, including women and members of underrepresented communities.

NCEAS has designated its Distributed Graduate Seminar Program as a focus program for diversity. We actively engage with potential PI's and those selected by our SAB to meet the goal of involving participants in each seminar from universities that serve underrepresented groups (at least 25% of total participants).

The first DGS selected was a bilingual team, collaborating in both English and Spanish, with all group leaders being junior faculty, and most new to NCEAS. This seminar involved faculty and students from the U.S. and Costa Rica, included Spanish-language literature in their syntheses, and intends to publish in both English and Spanish. Our newest DGS will include eight participating schools including three MSI's and one Argentinean university.
NCEAS' Kids Do Ecology (KDE) is a successful program that has been our primary means of outreach to K-12 students since 1995. NCEAS scientists work locally with 5th grade classes to provide inquiry- based instruction in the scientific method as applied to ecological questions. The participants include a high percentage of students who are English learners. We expanded the program's size and reach this year, working with ten classrooms and including a primarily Hispanic serving school in the neighboring city of Carpinteria. Eight NCEAS postdoctoral fellows and three UCSB graduate students acted as mentors.

Our companion bilingual (Spanish/English) website continues to be well used internationally. We have added new content on biomes, and careers in ecology, and have contracted with a translator to have an improved Spanish language version launched.

NCEAS actively seeks collaborations with other organizations fostering diversity in STEM fields, including University of California system-wide initiatives, such as UC's Alliance for Graduate Education and the Professoriate program, the American Institute of Biological Sciences, the Society for Advancement of Chicanos and Native Americans in Science, and the National Evolutionary Synthesis Center.

Publications

Below we list publications for the reporting period May 1, 2006-June 30, 2007. This period spans the overlap of the previous Cooperative Agreement with our current award. 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.

Citations in italics were previously reported as in press.

Adler, Peter B.; Hille Ris Lambers, Janneke; Kyriakidis, Phaedon; Guan, Qingfeng; Levine, Jonathan M.. 2006. Climate variability has a stabilizing effect on the coexistence of prairie grasses. Proceedings of the National Academy of Sciences. Vol: 103(34). Pages 12793-12798.

Adler, Peter B.; Hille Ris Lambers, Janneke; Levine, Jonathan M.. 2007. A niche for neutrality. Ecology Letters. Vol: 10. Pages 95-104.

Adler, Peter B.; Levine, Jonathan M.. 2007. Contrasting relationships between precipitation and species richness in space and time. Oikos. Vol: 116. Pages 221-232.

Aizen, Marcelo A.; Harder, Lawrence D. 2007. Expanding the limits of the pollen-limitation concept: effects of pollen quantity and quality. Ecology 88(2): 271-281.

Allen, Andrew P.; Gillooly, James F.. 2006. Assessing latitudinal gradients in speciation rates and biodiversity at the global scale. Ecology Letters. Vol: 9. Pages 947-954.

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