National Center for Ecological Analysis and Synthesis

2004
Report to the National Science Foundation

1. Participants

O.J. Reichman, Director PI

Sandy J. Andelman, Deputy Director Co-PI

Mark Schildhauer, Director of Computing

Partner Organizations

Matching funds have been provided by the University of California ($ 500,000) and by the University of California, Santa Barbara.

The Andrew W. Mellon Foundation has provided funding to support three postdoctoral researchers: Sarah Gergel, Helene Muller-Landau and Diego Vazquez. Their research activities are described in the following section. In addition, the Mellon Foundation has made awards to NCEAS totaling approximately $1,150,000 to support informatics research at NCEAS.

The David and Lucille Packard Foundation has provided funding 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.

Vulcan, Inc. has provided $350,000 to support working groups and to initiate planning for a UCSB Center focused on scientific solutions to important environmental problems.

Other Collaborators

Ben Halpern and Christopher Pyke are postdoctoral fellows at NCEAS, supported by David Hamilton Smith Fellowships from The Nature Conservancy.

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

2. Activities and Findings

Science Advisory Board

For our August, 2003 deadline, we received 43 proposals for 45 activities: 15 postdoctoral fellowships; 5 sabbatical fellowships; and 25 working groups. We have made decisions to support 3 postdoctoral fellowships; 3 Center Fellows (sabbaticals); and

9 working groups. The Science Advisory Board met September 10-11, 2003, to review these proposals and based on their recommendations, decisions to support 3 postdoctoral fellowships; 3 Center Fellows (sabbaticals); and 9 working groups.

For our January, 2004 deadline, we received 46 proposals for 48 activities: 21 postdoctoral fellowships; 4 sabbatical fellowships; and 25 working groups. The Science Advisory Board met March 3-4, 2004, to review these proposals and based on their recommendations, decisions were made to support 3 postdoctoral fellowships; 2 Center Fellows (sabbaticals); and 5 working groups. A list of Science Advisory Board members is available on the NCEAS web site: www.nceas.ucsb.edu.

Major Research Activities

During the reporting period, May 1, 2003 through April 30, 2004, NCEAS supported 12 sabbatical visitors and 23 postdoctoral researchers. Of these, 3 postdoctoral researchers were supported with funding from the Andrew W. Mellon Foundation, three postdocs were supported with funds from NSF's Knowledge and Distributed Intelligence Program for the Knowledge Network for Biocomplexity, two postdocs were funded by fellowships from the David Hamilton Smith Fellowship Program of The Nature Conservancy and one was funded by the Norwegian National Research Council. 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 East Carolina University, Oregon State University (2), University of British Columbia (2), University of Minnesota, University of Wisconsin, Yale University, and Washington University. One postdoc was offered a AAAS Science and Environment Fellowship, one accepted a research position at the Smithsonian Tropical Research Institute in Panama, one was offered a position as a scientist with World Wildlife Fund, and one was offered a research position with CONICET, the Argentine National Science Council.

During the reporting period, 661 different scientists participated in activities at NCEAS (858 total visits). NCEAS supported 59 working group meetings, representing the activities of 43 different working groups, and 7 meetings. Thirteen of these working groups focus on issues of immediate relevance to resource managers and policy makers, and these are highlighted in a separate section below.

Sabbatical Fellows

Mark Burgman Sabbatical Fellow
07/01/2002-06/30/2003
Setting priorities and making decisions for conservation risk management
Risk-based decisions are made routinely in medicine, toxicology, engineering, psychology, insurance and finance. The development of methods in these fields has been rapid but the paths followed and the tools developed have been different. To some extent the differences reflect the kinds of data and the range of problems people need to solve. In part, the differences are because methods have grown in relative isolation. A common problem facing practitioners in conservation biology is to identify priorities that

discriminate among a suite of alternative actions. Biologists make decisions on a routine basis, but with little understanding of the techniques for decisions involving risk. The kinds of questions conservation biologists are obliged to answer will benefit substantially from advances in decision analysis and risk assessment made in other disciplines. This project will develop and expand the toolkit for problem solving available to conservation biologists by reviewing risk-based, priority setting methods in different fields, and bringing together people from different disciplines to examine the problems confronting conservation biologists, resulting in new approaches to finding solutions to priority setting and decision making problems.

Cliff Cunningham Sabbatical Fellow
09/01/2002-06/30/2003
The North Atlantic Project: Comparative ecology of the temperate Northwestern and Northeastern Atlantic benthic communities
Although it is one of the best-studied oceans in the world, many aspects of temperate North Atlantic marine community ecology await synthesis and research coordination. During a fellowship year at NCEAS I will work to: (1) Synthesize available information on the distribution and abundance of closely related populations that exist on both sides of the temperate North Atlantic (trans-Atlantic species). This will include compiling a list of temperate trans-Atlantic species, along with all available information on their life history. (2) Synthesize available information comparing the ecology and relative species abundance of the temperate NW and NE Atlantic nearshore communities. (3) Encourage American and European field ecologists to design and carry out coordinated experiments on both coasts of the temperate North Atlantic.

Larry Crowder Sabbatical Fellow
01/01/2004-06/30/2004
Marine conservation: Integrating science and policy Marine conservation requires not only an understanding of the biological, physical, and ecological science, but it also requires a mature understanding of the socio-political process. Poor science can doom the implementation of wise marine conservation practices, but naiveté among scientists regarding the policymaking process also can slow the application of good science. I propose two major goals for my time as a Center Fellow on sabbatical at NCEAS during 2003-2004. First, I will write a book tentatively titled, Marine Conservation: Integrating Science and Policy. This book will follow on the heels of another book on Marine Conservation Biology: The Science of Sustaining the Seas, Island Press, 2003, which I am co-editing with Elliott Norse of MCBI. The new book will be co-authored by Mike Orbach and derives from the Conservation Biology and Policy Course we have taught at the Duke University Marine Laboratory since 1997. Second, I plan to learn more about the science/policy integration process by working with an interdisciplinary group of people who deal with marine conservation from disciplines other than my own including anthropologists, economists, lawyers, journalists, marketing people, governance experts, fishermen, and environmentalists. The current working group on Marine Management (Francis and Kitchell), of which I am a member, is holding its first meeting with people from this broader interdisciplinary group in December 2002. One lesson from previous NCEAS syntheses, like the one on Marine Reserves (Lubchenco

et al.), is that even after the science is synthesized, there is much new interdisciplinary work required to implement a marine reserve. The current working group on Pratical Design of Marine Reserves (Hastings and Botsford) is addressing these issues relative to marine reserves. The purpose of my sabbatical will be to provide a roadmap for ecologists orienteering through the policy landscape.

Kay Gross Sabbatical Fellow
11/01/2002-06/30/2003
Developing a predictive framework for the maintenance and restoration of native plant diversity in grasslands
As a sabbatical fellow at NCEAS I plan to work on the synthesis and integration of data from several field projects in which I have been examining the factors that influence the composition and diversity of plant species in grassland-savanna communities in SW Michigan. My goal is to determine how spatial patterns of heterogeneity in resources and species pools influence these patterns and how to translate these results into an understanding of determinants of species diversity across communities and environmental gradients.

Michael Hochberg Sabbatical Fellow
07/01/2003-08/31/2003
Patterns in social behavior and cultural diversity
The 'tragedy of the commons' describes how individualism can result in hardship to a population as a whole. In an alternative scenario --'collective action'-- potential competitors are better-off cooperating for a common good, even if it is not obviously in their short-term individual interests. What can shift a tragedy of the commons scenario to one of collective action in human societies? Given complex social environments influenced by governments and media, migrations of peoples over different scales, and interactions among individuals who may be family, friends or perfect strangers, how can we ever hope to understand cooperation and attempt to nurture the factors promoting it? Despite a blossoming interest in theories of human cooperation, surprisingly, there has been no serious assessment of whether human societies should show characteristic patterns in social behavior and cultural diversity. I plan to spend a sabbatical year (June 2003-4) addressing this question, capitalizing on the fact that community ecology provides us with the necessary tools. Concretely, my project shall provide: 1) new models of human social change and 2) predictive equations and graphs of social behavior and cultural diversity. I will be doing one or more stays at NCEAS to carry out parts of this project.

Margaret Kinnaird Sabbatical Fellow
Timothy O'Brien
09/01/2003-08/31/2004
Functional relationships of Asian Hornbills in changing forest landscapes
Birds and mammals are important seed dispersers and pollinators in tropical rainforests and are increasingly threatened by deforestation and hunting. The use of minimum viable populations as targets for conservation may be insufficient to assure the delivery of ecological services such as seed dispersal. Hornbills (Family Bucerotidae) are a

distinctive African and Asian bird family, inhabiting savannahs, dry forests and rainforests of Sub-Saharan Africa, and India eastward to the Solomon Islands. In Asia, hornbills are largely frugivorous forest birds and important dispersers of seeds of rainforest trees. Despite more than two decades of research, there has not been an attempt to synthesize and extend knowledge about this family. We propose to collate, analyze and synthesize data that will explore the ecology and behavior of these important birds, demonstrate their functional role in forest ecosystems, highlight keystone interactions with fruit resources, and examine the conservation impact of forest loss and fragmentation for hornbills and their function in the ecosystem.

James F. Kitchell Sabbatical Fellow
10/01/2003-04/30/2004
Food web models for aquatic ecosystems
I have three goals for my time as a Center Fellow on sabbatical at NCEAS during 2003-2004. First, I will develop a synthesis and summary of the accomplishments derived from a working group "Models for Alternative Management Policies for Marine Ecosystems" which has been supported through NCEAS during 2001-2003. Second, I will prepare a monograph based on analyses of the bioenergetics models developed for a total of 47 fish species over the past several years. Third, I will develop a subset of those models and use them to provide guidance to management of predator-prey interactions in the Colorado River reaches of the Grand Canyon where fish populations are currently being manipulated as part of an active adaptive management program sponsored through the USGS's Grand Canyon Monitoring and Research Center.

Per Lundberg Sabbatical Fellow
09/01/2002-06/30/03
Dynamics of large mammalian herbivores in changing environments: Alternative modeling approaches
The world's populations of large herbivores have shown dramatically different dynamics during the last two decades. The abundance and distribution of some ungulate species has declined abruptly, while other species have become excessively abundant, and still others have shown complex, oscillatory dynamics. These patterns seem to result from a composite of influences, including those operating at global and local scales. Conventional population models are rooted in assumptions about steady state and do not adequately incorporate environmental variability. We propose a working group that will exploit data sets and expertise from different regions to develop new models of ungulate population dynamics, capable of accommodating the complexity of environmental interactions at different spatial and temporal scales.

Gary Mittelbach Sabbatical Fellow
11/01/2002-06/30/2003
Determinants of species diversity at varying spatial scales
Understanding the factors that determine species diversity at varying spatial scales is fundamental to the management and preservation of biodiversity. I would like to spend 9 months of my upcoming sabbatical (Sept. 2002-June 2003) at NCEAS working on three projects that examine the processes regulating species diversity at geographical

scales ranging from local communities to cross-continental patterns. The first of these projects examines one of the fundamental mechanisms thought to regulate species diversity within a local community - the extent of spatial heterogeneity in resource availability and the richness of the regional species pool. To examine these mechanisms, I will analyze three years of field data from an experimental manipulation of soil nutrient heterogeneity and regional species pools on the diversity of plant species in a prairie savanna community. Results from this study will be synthesized relative to other studies that have manipulated soil nutrients, plant productivities, and species pools. In the second project, I will be examining the importance of climate and available energy in determining patterns of species richness across very broad spatial scales (e.g., continents). This work will be conducted as part of an ongoing NCEAS working group in "Energy and geographic variation in species richness". The above projects focus on ecological mechanisms thought to regulate biodiversity at varying spatial scales. Differences in species richness between geographical regions or biomes (e.g., tropics versus temperate zone), however, are ultimately determined by differential rates of evolutionary diversification (speciation minus extinction). Therefore, the third project I want to undertake while on sabbatical is to examine how differences in species diversity between the tropics and temperate regions (i.e., the latitudinal gradient) may be generated by differential rates of evolutionary diversification. In addition to these three research projects, I plan to participate in the NCEAS-based Knowledge Network for Biocomplexity (KNB) graduate seminar series on scale-dependent patterns in biodiversity.

W. John O'Brien Sabbatical Fellow
01/01/2004-07/31/2004

Global change and eutrophication: Modeling of arctic lake ecosystems

Two projects involving the examination of complex data sets and the development of integrative models of ecological processes are proposed. Both of the projects address ecological questions of general interest and importance. One has as its primary goal the integration of biological and hydrological information to examine change in Arctic lake chemistry and productivity as it relates to indicators of global climate change. The second project involves synthesizing data from studies worldwide, including those from the Arctic LTER, in which lake nutrients have been manipulated (either experimentally increased or municipally decreased) to examine the impact of nutrients on zooplankton density and production as phytoplankton densities are altered.

Julia Parrish Sabbatical Fellow
01/01/2004-09/30/2004

Marine Conservation

Marine conservation is a fast emerging multi-discipline responding to the depletion of resources in the marine environment. However, unlike terrestrial conservation, or the more broadly-based conservation biology, marine conservation lacks the written material – especially single volumes which integrate across issues and approaches – to codify itself. This gap is also present in the academic realm, where the vast majority of courses on conservation lack a serious marine component. My proposed work at NCEAS is to write a textbook on marine conservation, incorporating ecology and

marine biology; oceanography and physical science; fisheries and natural resource management; and law, economics, and social science.

Will Wilson Sabbatical Fellow
07/01/2002-06/30/2003
A broad look at organismal interactions: Linking intraspecific social interactions to an interspecific resource-consumer framework
Three areas of ecological research have traditionally been considered distinct: resource--consumer processes, behavioral ecology, and the study of social interactions that lead to animal grouping. Recent work has demonstrated that animal grouping can emerge within a spatial resource-consumer model. Such a connection between these two areas provides an ideal situation for linking social interactions between individuals to an individual's resource gathering. This connection enables the general study of the overall selection on an individual possessing both foraging and social behaviors. The sabbatical work proposed here will build upon these results and combine these three areas into one synthetic framework for theoretical analysis. The overall goal is to understand the evolutionary stability of social interactions, and discover under what situations different types of social interactions should be expected. The tangible results of this work will be a book summarizing the empirical and theoretical literature of these three areas, and synthesizing these areas into a single theoretical framework that may provide a roadmap for future research. Simulation code developed for this work will also be made freely available over the Web.

Postdoctoral Fellows

Elizabeth Borer Postdoctoral Fellow
09/01/2003-08/31/2004
Synthesizing intraguild predation theory and data
Although intraguild predation (IGP), a form of omnivory, is widespread in natural communities and has received significant attention in the recent theoretical and empirical literature, a gulf exists between theoretical predictions about the role of IGP in food webs and our understanding of its role in real communities. With few exceptions, the IGP literature falls into two categories operating at different time-scales: (1) theory presenting long-term effects of IGP on species persistence and population densities, and (2) short-term studies demonstrating IGP and, from theory, extrapolating the outcome for populations and communities. In addition, IGP models have been formulated for predator-prey (e.g. Holt and Polis 1997), host-parasitoid (Briggs 1993), and host-parasite (or pathogen) (e.g. Hochberg and Holt 1990) systems. Although the broad predictions of all of these model formulations are the same, this commonality is not generally recognized. I propose to synthesize this diffuse body of theory, assess the information available from short-term empirical studies, and test theoretical IGP predictions with empirical data.

Peter Buston Postdoctoral Fellow
10/01/2002-9/31/2004
The ecology of hermaphroditic breeding systems

There is an enormous diversity of hermaphroditic breeding systems distributed throughout the plant and animal kingdoms. To gain a greater understanding of this diversity, I propose to investigate the socio-ecological factors that underlie the evolution of these systems. First, I will develop new game-theoretic models, to generate explicit predictions about how ecological, social, and genetic factors combine to influence the distribution of reproduction within the breeding systems of both sequential and simultaneous hermaphrodites. Second, I will synthesize the extensive, but scattered, empirical literature on plant and animal (vertebrate and invertebrate) hermaphroditic breeding systems, gathering data on the socio-ecological factors that theoretical models indicate might give rise to these systems. Third, I will use this database, in conjunction with the comparative method, to test the alternative models, and determine which factors are indeed the key determinants of the different hermaphroditic breeding systems. The research will provide a comprehensive socio-ecological framework within which the breeding systems of all hermaphrodites can be understood. The work is important because understanding the breeding system of a species can be the key to effectively managing and conserving its populations

David Chalcraft Postdoctoral Fellow
06/10/2002-12/17/2003
A Knowledge Network for Biocomplexity: Building and evaluating a metadata-based framework for integrating heterogeneous scientific data
Complexity is an inherent property of living systems that arises from direct and indirect interactions among the earth's physical, chemical, and biological components. Biocomplexity includes the structural and functional attributes of dynamic systems that arise at all levels of biological organization, including individuals, populations, and communities. Importantly, ecological components of biocomplexity (e.g., biodiversity, ecosystem services) are in crisis, and are undergoing potentially irreversible changes in the face of rapid human population growth and economic development. Wise stewardship, based on all available scientific knowledge concerning these natural systems, is essential. Data Catalyzed by these societal concerns, and facilitated by technology advances, scientists focused on complex ecological systems have generated an explosion of ecological and environmental data. When integrated with data from other disciplines (e.g., meteorology), these data have the potential to greatly enhance understanding of biocomplexity. However, broad-scale and synthetic research is stymied because these data are largely inaccessible due to their spatial dispersion, extreme structural and semantic heterogeneity, and complexity.
This material is based upon work supported by the National Science Foundation under Grant No. DEB99-80154.

Karl Cottenie Postdoctoral Fellow
02/01/2003-01/31/2005
Local versus regional processes: Integrating space and environment
Both local and regional processes can structure local communities, however, their relative roles are poorly understood. The classical methodology used to determine their relative importance is to examine the shape of the relationship between local and regional diversity. However, this approach has been criticized on several conceptual

and methodological grounds. This proposal aims to integrate local (biotic and abiotic) and regional (spatial) information, using three novel research methodologies. These will be applied on a range of data sets, starting with zooplankton, but expanding to other aquatic taxa and terrestrial systems. Moreover, I will extend the methodology to genetic data, in order to make a direct comparison between processes working at the interspecific and intraspecific levels. The results will elucidate the processes that generate structure in populations and communities.

Sergio Floeter Postdoctoral Fellow
09/01/2003-08/31/2004
Diversity, biogeography and macroecological patterns of Atlantic reef fishes
This proposal aim to develop the great potential of reef-fishes as model taxa for biogeographical and macroecological analysis of reef areas in the Atlantic. Detailed large-scale studies of Atlantic reef fishes were always hampered by the lack of reliable geographical distribution of species. Now a multi-institutional international team of researchers is building the most accurate species distribution database possible for the entire tropical and subtropical Atlantic. This extensive new database covering 2404 species from 74 families will be used to 1) synthesize current knowledge of reef fish diversity and endemism in the Atlantic, 2) search for large-scale patterns and affinities among zoogeographical provinces, and 3) advance our understanding of biogeographical and macroecological marine patterns through the test of a series of hypothesis including the operation of biogeographical barriers, dispersal potential, biotic invasions, and the stepping stones concept.

Sarah Gergel Postdoctoral Fellow
09/01/2000-05/31/2003
Protecting water by conserving land:
The importance of spatial arrangement in influence ecosystem processes
Strategic placement of restored wetlands can reduce sediment and nutrient inputs to aquatic systems, attenuating the effects of agricultural conversion. While the role of riparian buffer strips for controlling sediments and nutrient runoff is established, the benefits of strategic placement of conserved land in the rest of a watershed is poorly understood. I will create watershed models of select ecoregions to determine the optimal spatial arrangement of land in an entire a watershed for minimizing sediment and/or nutrient runoff. This work will address a fundamental question of ecology, "When does the spatial arrangement of habitats matter for the functioning of ecosystem processes?" and will provide critical information for managers regarding strategic land acquisition.

Ben Halpern Postdoctoral Fellow
09/01/2003-08/31/2004
Predicting community-level responses to disturbance: Implications for reserve design (Hosted by NCEAS)
Determining the causes of community stability and productivity remains an elusive goal for ecologists and conservationists alike. A major impediment to filling this gap in our understanding is the lack of ecological data at a scale large enough and over long

enough a timeframe to allow differentiation of ephemeral and local changes in biological communities from persistent and general patterns. Using data from the Channel Islands kelp forest monitoring program, which spans hundreds of kilometers and 22 years, I will apply a variety of time-series and multi-factor statistical models to test which factors affect community variables such as stability, trophic and community structure, and productivity (measured as biomass). Results from this work will provide ecologists, conservationists, and resource managers an essential tool for developing more appropriate expectations for long-term responses of biological communities to anthropogenic influences, both negative (e.g., species invasions, species loss, habitat alteration, effects of climate change) and positive (e.g., protection within parks and reserves).

Tiffany Knight Postdoctoral Fellow
01/05/2004-01/04/2005
Beyond hand-pollinations: Linking pollen limitation to plant population biology
Pollen sufficiency is an important determinant of plant reproductive success, and thus a major driver in plant ecology and evolution. Despite hundreds of empirical studies addressing the causes and consequences of pollen limitation, we lack a quantitative synthesis. Our working group will bring together evolutionary biologists, pollination ecologists, plant demographers, and theoreticians to produce new insight into the ecological and evolutionary significance of pollen limitation. We will 1) use contemporary theory as a framework for synthesis (via meta-analysis) of published and unpublished empirical data to determine the ecological attributes that are generally associated with pollen limitation, and 2) develop new theory that integrates pollen limitation with plant modularity, resource allocation and perenniality, as well as with plant demography, population growth rates and time to extinction.

Bill Langford Postdoctoral Fellow
02/01/2002-01/31/2005
Evaluation functions for ecological image segmentation
This project examines and enhances various forms of evaluation functions used in the comparison and optimization of image segmentation algorithms. It defines quantitative criteria for definition of the evaluation functions and uses them in the design and selection of these functions. It also investigates the relationship between errors in landscape pattern metrics and segmentation and classification algorithms. Finally, it coordinates the creation of a repository of correct segmentations of aerial and remotely sensed ecological imagery to improve algorithm development by making rigorous comparison of algorithms possible.

Kate Lyons Postdoctoral Fellow
08/01/2003-07/31/2004
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
01/13/2004-01/12/2005
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?

Jannicke Moe Postdoctoral Fellow
10/01/2003-04/01/2004
Stoichiometry and population dynamics of consumer-resource systems: A combined experimental and modelling approach (Hosted by NCEAS)
A recent approach in ecology, ecological stoichiometry, recognises resource quality (nutrient ratios) as a limiting factor in addition to resource quantity. In the proposed

project, we will apply this approach to study classical population-ecological problems in a new perspective. Theoretical models of consumer-resource systems have predicted dramatic and counter-intuitive changes in population dynamics, when nutrient recycling and nutrient-limited growth are considered. However, most of these models are not yet evaluated experimentally. An important prediction is that increased phosphorous enrichment leads to more unstable population dynamics of the consumer, and eventually to extinction, although the resource persists. We will test this prediction by exposing laboratory systems of zooplankton (Daphnia) and algae to a range of phosphorous concentrations, and study the long-term dynamics of the system. Using non-parametric modelling, we aim at developing a new statistically-derived model for this system. Such models make few a priori assumptions about the form of the functions, and are therefore well-suited for exploring unknown relationships among variables. By combining such a flexible modelling approach with the stoichiometric perspective, we expect to provide new insight into general ecological problems.

Angela Moles Postdoctoral Fellow
08/25/2003-08/24/2004
The radiation of seed mass strategies worldwide
Recent accumulation of large, multi-species databases of plant traits, combined with major advances in our knowledge of phylogenetic relationships among the angiosperms mean that it is now possible to investigate the role of shifts in seed mass, growth form and dispersal syndrome in the radiation of the angiosperms out of the tropics. Approximately 6500 seed masses are now known for species from all around the world (database accumulated during my PhD). The aim of this proposal is to array these seed masses on to the phylogenetic tree of angiosperms to quantify where and when in the history of the angiosperms the major divergences in seed mass occurred. Then it will become possible to assess how closely divergences in seed mass have been associated with divergences in growth form, dispersal mode or latitude, and to investigate the sequence in which shifts in plant traits and distribution have occurred.

Helene Muller-Landau Postdoctoral Fellow
01/01/2002-12/31/2003
Landscape-scale variation in forest communities and the distribution of tree life history strategies
Tree species vary greatly in their life history strategies, exhibiting variation in their seed size, growth rate, life span, fecundity, and many other characters. The distribution of strategies within a forest affects community structure and dynamics, including successional patterns of species turnover and biomass accumulation, spatial patterns of species occupancy, and resilience to disturbance of various kinds. Landscape-scale variation in factors such as the length of the growing season, nutrient availability, and disturbance regime influences the distribution of tree life history strategies found within local communities. I propose to use new analytical techniques to estimate the distribution of life history strategies within communities from existing data on tree species composition and species characteristics for as many tropical and temperate forests as possible. Then, I will analyze differences in the distribution of life history strategies between communities, and their associations with climatic and other factors.

In parallel, I will continue theoretical work on the evolution of life history strategies within communities. The overall objective is to contribute to a better understanding of the distribution of tree life history strategies within and among communities, and of the implications for forest structure and dynamics.

Jill Murray (formerly Schmidt) Postdoctoral Fellow
03/05/2001-12/31/2003
Bridging microbial and theoretical ecology to investigate cooperative strategies in bacteria
Microbiologists have recently become equipped to identify the taxonomy of bacteria in situ, understand phylogenetic relationships among groups, and assay gene expression in individuals, a development that parallels the explosion of natural-history studies by general ecologists a century ago. One of the most exciting recent discoveries is that bacteria engage in extensive chemical signaling and density-dependent behavior, some of which appears to involve cooperative adaptive strategies. Paralleling early ecologists who studied cooperation, microbiologists have not yet developed rigorous theory to test these ideas. Because theoretical and microbial ecology have developed with little interdisciplinary crossover, microbiologists have not capitalized on the existing framework that is now available to investigate cooperation in higher organisms. The gap between empirical microbiology and quantitative theoretical ecology is a common theme that must be addressed as microbial natural history unfolds. I aim to work at the interface of the two fields; my goal is to learn if and how cooperative strategies play a role in the spatial distributions of bacteria in nature. This work will involve predictive numerical and simulation modeling of microbial foraging strategies and their resulting spatial patterns, developed to enable discrimination amongst modes of selective pressure in future experimental tests. A mechanistic understanding of adaptive strategies in bacteria is essential to the understanding microbial food webs, bacterial infections, biogeochemical cycles, and the bioremediation of contaminated habitats. The scaling of ecological theory to microscopic proportions will also benefit general ecology, as long-standing questions can be tested in microbial systems that can be modeled almost perfectly and tested over relatively vast spatial and temporal scales given the sizes and generation times of bacteria.

Christopher Pyke Postdoctoral Fellow
12/05/2000-12/31/2004
Climate, ecosystems, and land-use: Understanding environmental variability in human-dominated landscapes (Hosted by NCEAS)
Environmental variation creates both risk and opportunities for conservation. The implications of environmental variation in any particular situation vary depending on climatic processes, ecosystem responses, and land-use patterns. Consequently, it is necessary to understand potential interactions between these factors in order to design conservation strategies that use variation to reduce risk and take advantage of opportunities to increase species persistence. Informed action can offset the natural tendency for risk from environmental variation to increase as the total amount of habitat in a landscape decreases. The proposed research addresses this issue by: (1) simulating how climate, ecosystems, and land-use interact over time to change patterns of

environmental variation, and (2) applying this framework to evaluate risks faced by vernal pool ecosystems in the Central Valley of California. The results of this work will help conservationists develop better tools for reserve design, understand processes underlying patterns of environmental variability, and manage local vernal pool landscapes to reduce risks associated with landscape and climate change.

Eric Seabloom Postdoctoral Fellow
06/01/1997-06/30/2004

Effects of plant-community composition on animal movement

The evolution of behavior and plant-community dynamics are two seemingly disparate elements in ecology. However, the movement of animals through a landscape can have strong impacts on the competitive coexistence of various plant life-history strategies, and the distribution of resources can alter animal-movement patterns. Accordingly, animal behavior and plant-community dynamics can be inextricably linked by the influence of animal movement on the composition of plant communities and, in the case of herbivores, the effects of plant-community composition on animal movement. For disturbance-generating herbivores, the link between the animal-movement patterns and plant-community composition is particularly strong, because the animal's foraging success is dependent on the composition of the plant community and the animal's movement generates disturbances that can profoundly alter the competitive balance among plant species.

Disturbance-generating herbivores are of additional interest because of their strong effects on the physical environment. For example, the tunneling behavior of pocket gophers can increase the heterogeneity of soil nitrogen, phosphorous, and carbon at the soil surface, but soil mixing will decrease vertical variability. In addition, the burrowing activity of gophers will lower soil bulk density and increase water infiltration, temperature, and litter decomposition rates. Pocket gopher activity is also a major force determining the rates of soil movement on hillslopes.

In my research, I am using a variety of modeling techniques to examine the interactions between the behavior of disturbance-generating animals, the structure of the associated plant community, and the ecosystem processes that result from this interaction. These models range from spatially-explicit movement models to analytical models of animal energetics and soil erosion.

This modeling work is closely coordinated with a series of field experiments designed to test the predictions in the California grassland system. This system is of particular interest, because of the high density of pocket gophers and their large apparent impacts on plant community composition and soil, nutrient, and water flux. In addition, the outcome of these studies is of profound conservation interest, because of widespread invasion of California native grasslands by exotic annual species.

Jonathan Shurin Postdoctoral Fellow
09/01/2000-05/31/2003

Detecting species interactions in survey data: New approaches and applications

Geographic variation in community structure can be driven by the physical environment, biotic interactions, stochastic factors such as colonization and disturbance history, or by interactions among all three. The question of what factors are most

important in structuring communities remains highly contentious. This proposal describes work aimed at integrating techniques for detecting interspecific associations with ordination approaches for analyzing patterns of species distributions with respect to the physical environment. My goal is to generate synthetic models of community dynamics that include biotic and abiotic processes. I will apply the new method to the analysis of a large data set of zooplankton species distributions and limnological features among lakes, and to time series data of species abundances within lakes.

Melinda Smith Postdoctoral Fellow
06/17/2002-12/31/2003
A Knowledge Network for Biocomplexity: Building and evaluating a metadata-based framework for integrating heterogeneous scientific data
Complexity is an inherent property of living systems that arises from direct and indirect interactions among the earth's physical, chemical, and biological components. Biocomplexity includes the structural and functional attributes of dynamic systems that arise at all levels of biological organization, including individuals, populations, and communities. Importantly, ecological components of biocomplexity (e.g., biodiversity, ecosystem services) are in crisis, and are undergoing potentially irreversible changes in the face of rapid human population growth and economic development. Wise stewardship, based on all available scientific knowledge concerning these natural systems, is essential. Data Catalyzed by these societal concerns, and facilitated by technology advances, scientists focused on complex ecological systems have generated an explosion of ecological and environmental data. When integrated with data from other disciplines (e.g., meteorology), these data have the potential to greatly enhance understanding of biocomplexity. However, broad-scale and synthetic research is stymied because these data are largely inaccessible due to their spatial dispersion, extreme structural and semantic heterogeneity, and complexity.
This material is based upon work supported by the National Science Foundation under Grant No. DEB99-80154.

Richard Stevens Postdoctoral Fellow
12/15/2002-12/14/2004
Environmental determinants of biodiversity
Understanding the mechanistic bases of patterns in biodiversity has challenged ecologists and evolutionary biologists alike for more than a quarter of a century (Rosenzweig 1995). Although the ubiquity of gradients in species richness is well documented at coarse scales of resolution, it is unclear to what extent patterns are recapitulated at the level of local communities or for any other aspect of biodiversity (Stevens and Willig 2001). Biodiversity represents the totality of variation in living things (Tilman 2000). Thus, it is likely that no one measure such as species richness, or any one perspective, such as that of taxonomic diversity, can provide a comprehensive characterization. Investigations that simultaneously explore fundamental components of biodiversity (i.e., taxonomic, functional, or phylogenetic diversity) will allow for analyses that provide deeper, more comprehensive understanding regarding the distribution of biota across space and time. Although secondary gradients (e.g., latitudinal diversity gradients) have been described ubiquitously, much less is known

about the primary environmental gradients or suite of gradients that cause such patterns. Numerous biotic and abiotic characteristics vary spatially in different but correlated ways. Distinguishing the relative contributions of a number of environmental characteristics to gradients in biodiversity will contribute substantially to our understanding of ecology, biogeography, and evolution. Moreover, resolution of the effects of primary gradients on the spatial distribution of biodiversity may also greatly enhance our understanding of the mechanistic basis of secondary gradients such as those described for latitude.

Mark Torchin Postdoctoral Fellow
10/01/2003-09/30/2004

Using biological invasions to test predictions of population control by parasites

Introduced species are a major threat to global biodiversity, ranked second only to habitat loss (Vitousek 1990, Wilcove et al. 1998). The damage caused by exotic species results from the high population densities and large body sizes that they attain in their new location (Vitousek 1990, Wilcove et al. 1998, Ruiz et al. 1999, Torchin et al. 2001, 2002). Escape from the effects of natural enemies is a frequent explanation given for the success of introduced species (Keane and Crawley 2002, Shea and Chesson 2002). Recently, Torchin et al. (in press) demonstrated that introduced species are parasitized by half the number of parasite species compared to where they are native and that introduced populations are also less heavily parasitized (% infected) than native populations. However, while parasites are ubiquitous and pervasive, the extent to which parasites mediate invasions and result in increased ecological performance of introduced species has not been evaluated. Further, the extent to which introduced parasites and pathogens are responsible for damage to native species has not been quantified. Using existing data, I propose to extend a database which I developed for a NCEAS working group (Diseases and Conservation Biology) and employ a meta-analysis to test several hypotheses which explore the role of parasites in biological invasions. Further, by using biological invasions as "natural experiments", I will design this project to investigate a more fundamental question in ecology: How do parasites affect the distribution and abundance of their hosts?

Diego Vázquez Postdoctoral Fellow
10/01/2002-09/30/2004

Null models for specialization and asymmetry in plant-pollinator systems

Pollination biologists have recently suggested that pollination systems may have a greater degree of generalization in plant pollinator interactions than previously thought. However, there have been no attempts to provide null models against which to compare the observed patterns. I propose to conduct research to develop such models, and to use them to test patterns of specialization observed in available datasets of plant-pollinator interactions. My proposed research has the potential to provide important insights about how plants and pollinators interact, and to synthesize ideas on plant-pollinator interactions, species-abundance patterns, and abundance-range size relationships.

Jack Williams Postdoctoral Fellow
06/17/2002-08/20/2003
A Knowledge Network for Biocomplexity: Building and evaluating a metadata-based framework for integrating heterogeneous scientific data
Complexity is an inherent property of living systems that arises from direct and indirect interactions among the earth's physical, chemical, and biological components. Biocomplexity includes the structural and functional attributes of dynamic systems that arise at all levels of biological organization, including individuals, populations, and communities. Importantly, ecological components of biocomplexity (e.g., biodiversity, ecosystem services) are in crisis, and are undergoing potentially irreversible changes in the face of rapid human population growth and economic development. Wise stewardship, based on all available scientific knowledge concerning these natural systems, is essential. Data Catalyzed by these societal concerns, and facilitated by technology advances, scientists focused on complex ecological systems have generated an explosion of ecological and environmental data. When integrated with data from other disciplines (e.g., meteorology), these data have the potential to greatly enhance understanding of biocomplexity. However, broad-scale and synthetic research is stymied because these data are largely inaccessible due to their spatial dispersion, extreme structural and semantic heterogeneity, and complexity.
This material is based upon work supported by the National Science Foundation under Grant No. DEB99-80154.

Working Groups

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

Aberhan, Martin	Head, Jason	Olszewski, Tom
Alroy, John	Holland, Steven	Patzkowsky, Mark
Bambach, Richard	Huber, Brian	Pfefferkorn, Hermann
Behrensmeyer, Anna	Hughes, Nigel	Plotnick, Roy
Bottjer, David J.	Hunter, John	Raymond, Anne
Boyce, C. Kevin	Ivany, Linda	Rees, P.M. (Allister)
Budd, Ann F.	Jablonski, David	Rogers, Raymond
Carrano, Matthew	Johnson, Kirk	Sims, Hallie
Clyde, William	Kidwell, Susan	Stein, William
Doyle, James	Kiessling, Wolfgang	Tiffney, Bruce
Eble, Gunther	Korn, Dieter	Uhen, Mark
Erwin, Douglas	Kosnik, Matthew	Wagner, Peter
Fara, Emmanuel	Kowalewski, Michal	Wang, Hongshan
Foote, Michael	Lidgard, Scott	Wang, Xiaoming
Fursich, Franz	Looy, Cindy	Wilf, Peter
Gastaldo, Robert	Lupia, Richard	Wing, Scott
Gensel, Patricia	Marshall, Charles	
Harper, David	Miller, Arnold	

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.

Understanding the role of infectious disease in mammalian mating and social systems (Extended)

Sonia Altizer and Charles Nunn – leaders

Altizer, Sonia	Fenton, Andrew	Patel, Nikki
Antonovics, Janis	Fulford, Jenny	Pedersen, Amy
Cunningham, Andrew	Gittleman, John	Poss, Mary
Daszak, Peter	Jones, Kate	Pulliam, Juliet
Dobson, Andrew	Lindenfors, Patrik	Thrall, Peter
Ezenwa, Vanessa	Nunn, Charles	Vitone, Nick

This meeting will focus on (1) integrating the various datasets that are being compiled by individual members of the group, which is necessary for distributing these data over the WWW, (2) finalizing statistical results that are being conducted currently by individuals or subgroups of the working group, and (3) finishing manuscripts that are co-authored by three or more members of the working group. We have made great progress on compiling records of parasites and infectious diseases in over 100 species of wild primates, with the first round of results from our analyses nearly finalized. In addition to examining the effects of host social and mating behavior, two interesting patterns that have emerged in repeated comparative tests are the importance of host density and host diversification rates in explaining parasite community diversity within species. Members of our working group have begun compiling similar data on carnivores and ungulates, while others are building databases of parasite species traits (including host specificity and transmission mode). We have already produced four published (or in press) papers that acknowledge NCEAS support, initiated a second effort to collaborate with Conservation International in applying these data to conservation issues, and received NSF funds to support components of this project that lie outside the realm of NCEAS funding. At this stage, the bulk of our remaining research can be accomplished individually and within subgroups over email. However, a final meeting is necessary to integrate these currently independent datasets and spearhead our efforts to disseminate the data and results over the WWW and through journal publications. Merging multiple datasets on hosts and parasites requires the

expertise of both veterinary parasitologists and comparative biologists examining the data simultaneously. At the meeting in June, 2003, we would also like to work with Mark Schildhauer to develop a format for data presentation over the WWW. Moreover, during the past two meetings theoreticians in our group have developed an innovative individual-based model for varying social and mating systems to examine the consequences for the spread and evolution of infectious disease. The conceptual framework for this model required three full meetings to develop, and was surprisingly advanced by input from nearly everyone in the working group. Because this model will be coded and tested during the next 10 months, it will be essential to obtain feedback and criticism from behavioral ecologists and parasite specialists following their initial series of simulations.

Beyond hand-pollinations: Linking pollen limitation to plant population biology

Tia-Lyn Ashman, Tiffany Knight, Susan Mazer, and Martin Morgan – leaders

Amarasekare,Priyanga	Johnston, Mark	Parker, Ingrid
Ashman, Tia-Lynn	Knight, Tiffany	Steets, Janette
Burd, Martin	Mazer, Susan	Vamosi, Jana
Campbell, Diane	Mitchell, Randall	Wilson, Will
Dudash, Michele	Morgan, Martin	

Pollen sufficiency is an important determinant of plant reproductive success, and thus a major driver in plant ecology and evolution. Despite hundreds of empirical studies addressing the causes and consequences of pollen limitation, we lack a quantitative synthesis. Our working group will bring together evolutionary biologists, pollination ecologists, plant demographers, and theoreticians to produce new insight into the ecological and evolutionary significance of pollen limitation. We will 1) use contemporary theory as a framework for synthesis (via meta-analysis) of published and unpublished empirical data to determine the ecological attributes that are generally associated with pollen limitation, and 2) develop new theory that integrates pollen limitation with plant modularity, resource allocation and perenniality, as well as with plant demography, population growth rates and time to extinction.

Patterns in microbial biodiversity

Brendan Bohannan, Peter Morin, Anna-Louise Reysenbach, and Jennifer Hughes – leaders

Bohannan, Brendan	Jürgens, Klaus	Ovreas, Lise
Brown, James	Kane, Matthew	Petchey, Owen
Colwell, Robert	Kuske, Cheryl	Reysenbach, Anna-Louise
Fuhrman, Jed	Leibold, Mathew	Smith, Val
Green, Jessica	Morin, Peter	Staley, James
Horner-Devine, Claire	Murray, Jill	Tiedje, James
Hughes, Jennifer	Muyzer, Gerard	Ward, David
Huisman, Jef	Naeem, Shahid	

Microorganisms represent the vast majority of Earth's biodiversity and they play a crucial role in nearly every process of environmental importance. However we know very little about how microbial diversity is generated and maintained. Our ignorance is due in part to the isolation of microbial diversity studies from the general study of

biodiversity. The proposed working group will bring together microbial biologists who are gathering microbial diversity data and ecologists who study biodiversity, to share tools and approaches, to look for patterns in microbial diversity data, and to propose future directions for microbial biodiversity research.

Facilitation and competition on alpine elevation gradients: A global experiment on the organization of plant communities

Ragan Callaway, Richard Michalet, Robin Brooker, and Christopher Lortie – leaders

Berlow, Eric	Choler, Philippe	Pugnaire, Francisco
Bowman, William	Hacker, Sally	Smith, Molly
Brooker, Robin	Kikvidze, Zaal	Valiente-Banuet, Alfonso
Callaway, Ragan	Lortie, Christopher	
Cavieres, Lohengrin	Michalet, Richard	

We propose to organize three meetings, each 7-10 days, in order to analyze data and develop conceptual, empirical, and mathematical models with a working group that has been loosely organized and conducting experiments on interactions in alpine plant communities around the world. Results from one of the nine sites for which data have been collected, the French Alps, and other preliminary analyses indicate that interactions shift from highly competitive in low elevation alpine meadows to highly facilitative in communities »1000m higher and near the physical limits of plant growth. These competitive and facilitative interactions also appear to be coupled with community properties such as biomass, diversity, evenness, and the relative abundance of target species. Furthermore, shifts in species interactions and the intensity of species interactions along elevation gradients appear to correlate with community characteristics and regional climate. We are requesting funds from NCEAS to solve the problems inherent to such a large group of investigators from different parts of the world with a large data set. Funding will allow us to work cohesively as a group on statistical analyses of experimental data, to integrate experimental results with community properties in innovative ways, and to develop empirical and conceptual models for the relationship between climate, biogeography, and plant interactions on gradients.

Integrating the aquatic with the terrestrial component of the global carbon budget

Jonathan Cole, Carlos Duarte and Yves Prairie – leaders

Caraco, Nina	Kortelainen, Pirkko	Striegl, Robert
Cole, Jonathan	McDowell, William	Tranvik, Lars
Downing, John	Middelburg, Jack	
Duarte, Carlos	Prairie, Yves	

The traditional compartmentalized approaches to developing inventories of carbons pools and fluxes in the biosphere have generated gaps in the form of key components. Among these key components, freshwater and wetland ecosystems, have been largely ignored or assumed negligible. Recent literature suggests that freshwater ecosystems contribute significantly to some regional carbon balances. We hypothesize, based on a preliminary assessment of the easily available data, that these key components are critical for a reliable estimation of carbon movements at a global scale as well. While the oceans and

terrestrial forests are responsible for the net uptake of atmospheric CO2, freshwater ecosystems process a large amount of terrestrially-derived primary production and alter the balance between C sequestration and net CO2 release. This project aims at synthesizing existing information on the linkage between terrestrial and freshwater ecosystems to yield an improved representation of carbon cycling.

Ecological processes and evolutionary rates

Niles Eldredge and John Thompson – leaders

Brakefield, Paul	Jablonski, David	McPeek, Mark
Eldredge, Niles	Lenski, Richard	Miller, William
Gavrilets, Sergey	Lieberman, Bruce	Thompson, John

In recent years, the science of ecology has become increasingly directed toward questions at larger spatial and temporal scales. The same is true of evolutionary biology. Our working group will be a direct attempt to evaluate where and when evolutionary biology is important to our understanding of ecological analyses of large-scale spatial and temporal processes. This evolutionary/ecological link is at the heart of the major questions identified at the recent combined GSA/ESA symposium (Hunter 1998). This group will also build explicitly upon one of the research areas that has already become established at NCEAS through related working groups: the role of ongoing evolution in the organization of biodiversity.

SpecNet

John Gamon – leader

Cheng, Yufu	Held, A. Alexander	Oliphant, Andrew
Christensen, Torben	Houston, Stan	Qian, Yonghai
Cordova, Vicente	Huemmrich, Karl	Rahman, Faiz
Dungan, Jennifer	Huxman, Travis	Salinas-Zavala, Cesar
Fenstermaker, Lynn	Johansson, Torbjörn	Sims, Dan
Gamon, John	Katul, Gabriel	Steffey, Duane
Gutschick, Vincent	Luo, Hongyan	Tweedie, Craig
Hastings, Steven	Oechel, Walter	Vourlitis, George

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.

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

Mark Harmon – leader

Burke, Ingrid	Hart, Stephen	Randerson, James
Currie, William	Olsson, Mats	Silver, Whendee
Harmon, Mark	Parton, William	

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.

Spatial and temporal community dynamics: Sharing data to answer questions

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

Brown, James	Houlahan, Jeff	Rojo, Carmen
Cumming, Graeme	Legendre, Pierre	Russell, Roly
Currie, David	Magnuson, John	Tilman, David
Ernest, Morgan	Muldavin, Esteban	Woiwod, Ian
Findlay, C. Scott	Noble, David	Wondzell, Steve
Fuhlendorf, Samuel	Raimondi, Pete	

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.

Science Environment for Ecological Knowledge (SEEK) (Hosted by NCEAS)

Matthew B. Jones, Mark P. Schildhauer, James H. Beach, Bertram Ludaescher, William K. Michener – leaders

Altintas, Ilkay	Kukla, Robert	Spears, Rod
Anderson, Mark	Lee, Michael	Stewart, Aimee
Beach, James	Liu, Xianhua	Stockwell, David
Berkley, Chad	Ludaescher, Bertram	Sundermier, Amy
Bowers, Shawn	McCartney, Peter	Tao, Jing
Brunt, James	Michener, William	Trajkova, Joana
Franz, Nico	Peet, Robert	Vieglais, David
Gauch, Susan	Pennington, Deana	Villa, Ferdinando
Higgins, Dan	Pyle, Richard	Wang, Jenny
Jones, Matthew	Rajasekar, Arcot	Williams, Rich
Kennedy, Jessie	Reichman, O.	Zhu, Bing
Krivov, Serguei	Schildhauer, Mark	

The goals of the Science Environment for Ecological Knowledge (SEEK) are to make fundamental improvements in how researchers can 1) gain global access to ecological data and information, 2) rapidly locate and utilize distributed computational services, and 3) exercise powerful new methods for capturing, reproducing, and extending the analysis process itself. The project involves a multidisciplinary team of computer scientists, ecologists and technologists from the Partnership for Biodiversity Informatics (PBI), a consortium comprising the National Center for Ecological Analysis and Synthesis (NCEAS); the San Diego Supercomputer Center (SDSC); the University of Kansas (KU); and the University of New Mexico (UNM) and partnering institutions (Arizona State University, University of North Carolina, University of Vermont, and Napier University in Scotland).

An ecological-economic analysis of pest-control services: The Brazilian Free-tailed Bat as a model

Thomas Kunz – leader

Betke, Margrit	Gomez, Irma	McCracken, Gary
Cleveland, Cutler	Grant, William	Medellin, Rodrigo
Correa Sandoval, Adriana Nelly	Hallam, Thomas	Moreno-Valdez, Arnulfo
Federico, Paula	Horn, Jason	Sansone, Chris
Frank, Jeff	Kunz, Thomas	Stevens, Richard
	Lopez, Juan	

Ecosystem services underpin human existence, yet we know little about the magnitude of these services in terms of what policy makers need to incorporate into decision-making frameworks. The objective of this project is to analyze existing databases for developing an ecological-economic model of pest-control services provided by an important insectivorous bat (Tadarida brasiliensis). Computer algorithms will be developed for estimating numbers of bats based on infrared thermal imaging, and population models of pest species will be developed based on available life-history data. Dynamic modeling and GIS will be used to integrate extant databases on bat foraging from Dopper radar (NEXRAD) data, crop and insect phenology, seasonal migration of bats and insects, and agricultural crop distribution, yield, and inputs. Ultimately, models will include sensitivity analysis to estimate the monetary value of the pest-control service, and thus

provide the first comprehensive analysis of a major vertebrate predator of importance to agroecosystem productivity in North America.

Ecological metaphors: Their cultural resonance and what we can do about it
Brendon Larson – leader

Baake, Ken	Grady, Joseph	Larson, Brendon
Bono, Jim	Haila, Yrjo	Mikkelson, Gregory
Callicott, J. Baird	Hurlbert, Stuart	Rohrer, Timothy
Cuddington, Kim	Lach, Denise	Schell, Charlotte
Fox Keller, Evelyn	Lakoff, George	Slobodkin, Lawrence

Ecologists commonly use metaphors to develop their ideas and to communicate them to the public. Unfortunately, by their very nature metaphors may be interpreted in different ways by different constituencies, and this may lead to misunderstanding of ecological concepts. For example, a recent paper in Science (Chew and Laubichler 2003, Science 301: 52-53) reported on the prevalent use of the term “natural enemies” in recent scientific literature. “Natural enemies” and related terms such as exotic and invasive resonate with foreign policy, so it is perhaps unsurprising that some individuals claim that invasive species policy is xenophobic. As another example, consider the challenges that have arisen with the attempt to convince people that “disturbance” is an important and beneficial ecological process. Our NCEAS working group, consisting of ecologists, metaphor researchers, philosophers and science communication scholars, will assess whether there is anything we can do to ameliorate the misinterpretation and misapplication of ecological metaphors. Can we better control which metaphors are used? Is there any way to reduce misinterpretation of established metaphors? Practically, we will develop suggestions for wise metaphor use among ecologists.

The Meta-Community Concept: A framework for large scale community ecology?
Mathew Leibold – leader

Amarasekare, Priyanga	Holt, Robert	Loreau, Michel
Chase, Jonathan	Holyoak, Marcel	Mouquet, Nicolas
Cottenie, Karl	Hoopes, Martha	Shurin, Jonathan
Gonzalez, Andy	Law, Richard	Tilman, David
	Leibold, Mathew	

The concept of meta-communities was developed in an effort to link community ecology theory at the local level with regional and global models at larger spatial scales. Currently there are two contrasting views of meta-communities. The "patch-dynamics" perspective is based on the idea that similar local habitat patches are colonized by species that interact to produce communities consisting of different species depending on their dispersal abilities. In contrast, the "species-sorting" view assumes that sites differ in their abiotic environment, causing interacting species to sort themselves differently along gradients depending on their competitive abilities at different sites. The first view ignores local population dynamics and therefore allows for non-equilibrial abundances but it ignores intrinsic heterogeneity among local sites. The second view is generally modeled using equilibrium models of local population dynamics but accounts for heterogeneity among sites. Empirical evidence suggests that both of these approaches are useful for understanding patterns in real communities.

Thus there is a need for a more synthetic approach. We propose to form a collaborative group to work on such a synthesis. Our goal is to explore what happens when both sets of metacommunity processes occur. We hope to use this synthetic approach to explore their roles in regulating phenomena such as the trophic structure, patterns of diversity and composition along environmental gradients and the role of regional processes such as dispersal in ecosystem processes.

PrecipNet: Analysis and synthesis of precipitation and ecosystem change

Michael Loik – leader

Barker, David	Lambrecht, Susan	Smith, Stanley
Cable, Jessie	Loik, Michael	Tissue, David
Grizzle, Heath	Nagel, Jennifer	Zak, John
Huxman, Travis	Patrick, Lisa	

The goal of the NCEAS PrecipNet Synthesis Group is to analyze and synthesize results of the effects of climate change on ecosystems. In particular, we will analyze data from studies on the effects of altered timing and magnitude of rain and snowfall across different ecosystems and geographic regions. Another important goal is to promote interdisciplinary research between natural and social scientists regarding the impacts of precipitation and ecosystem change and the interrelationships with human systems and institutions. Our meeting will result in: a review article on the current state of knowledge about precipitation change effects on ecosystems; development of databases on the world wide web and on CD-ROM that would be available for all global change studies; and maps predicting how ecosystem responses to precipitation change will affect ecological communities across regional scales. The PrecipNet Synthesis Group includes James Ehleringer (Univ. Utah), Brent Haddad (UC Santa Cruz), John Harte (UC Berkeley), Rod Heitschmidt (Ft. Keogh Range Exp. Sta.), Alan Knapp (Kansas State Univ.), Guanghui Lin (Biosphere II, Columbia Univ.), Michael Loik (UC Santa Cruz), William Pockman (Univ. New Mexico), Rebecca Shaw (Carnegie Inst. For Plant Biology), Eric Small (New Mexico Tech), Stan Smith (Univ. Nevada, Las Vegas), David Tissue (Texas Tech Univ.), Jake Weltzin (Univ. Tennessee), David Williams (Univ. Arizona), and John Zak (Texas Tech Univ.).

Life-history variation and community structure in neotropical rainforest communities: Ecological and phylogenetic influences

Susan Mazer, David Ackerly, Miguel Martinez-Ramos and Horacio Paz – leaders

Ackerly, David	Mazer, Susan	Terborgh, John
Condit, Richard	Moles, Angela	Vriesendorp, Corine
Harms, Kyle	Muller-Landau, Helene	Webb, Campbell
Ibarra-Manriquez, Guillermo	Paz, Horacio	Wright, Ian
	Pitman, Nigel	Wright, Joseph
Martinez-Ramos, Miguel	Poorter, Lourens	
	Silman, Miles	

Several key questions in evolution and ecology may be answered by the analysis of comparative data sets in which information on the demography, life history, and relative abundance of large numbers of species is jointly analyzed. For example, the detection of strong associations between habitat, soil quality, seed mass, life form, dispersal mode,

and other life history traits has shed light on the selective forces (e.g., light availability and disturbance) that influence the evolution of these attributes within and among taxa.

Virtually all investigators of plant communities have used this approach on single community-level data sets compiled by their own research group (Jackson, 1981, Garwood, 1983, Foster and Janson, 1985, Mazer, 1987, Ibarra-Manrríquez & Oyama. 1993, Grubb & Metcalfe, 1996 [flora of Queensland, various sites, analyzing pooled data], Rees 1997 [British flora pooled)], Harms and Dalling, 1997, Clark et al., 1998, Hodkinson, et al., 1998 [British flora, pooled]. Relatively few researchers have evaluated data sets including information from more than one community (Hammond & Brown, 1995 (three Neotropical communities), Lord, Westoby & Leishman, 1995 (five temperate floras), Lord et al., 1997 [tropical vs. temperate floras]). In the proposed NCEAS working group, we will bring together a group of community ecologists and evolutionary biologists to use community-level data to address two sets of questions that depend on the joint analysis of multiple data sets. Because these questions (see below) require the analysis of both pooled and separate community-level data, we have selected participants who have independently collected similar data in ecologically similar plant communities.

The roles of natural enemies and mutualists in plant invasions

Charles Mitchell and Alison Power – leaders

Agrawal, Anurag	Klironomos, John	Power, Alison
Bever, James	Maron, John	Seabloom, Eric
Callaway, Ragan	Mitchell, Charles	Torchin, Mark
Gilbert, Gregory	Morris, William	
Kareiva, Peter	Parker, Ingrid	

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.

An information infrastructure for vegetation science

Robert Peet, Dennis Grossman, Michael Jennings and Marilyn Walker – leaders

Anderson, Mark
Faber-Langendoen, Don
Gramling, Joel

Grossman, Dennis H.
Jacobs, Lee Anne
Jennings, Michael D.
Lee, Michael
Peet, Robert K.
Tart, David L.

Vegetation classification is of central importance to biological conservation for planning and inventory, to resource management for monitoring and planning, and to basic scientific research as a tool for organizing and interpreting ecological information. All of these activities require that ecological units be defined and that their distribution on the landscape be known and understood. Vegetation classification contributes significantly to analysis of ecological problems that vary in scale from persistence of tiny populations of endangered species to global projections of the impact of climate change. Technological advances have made practical large-scale analyses that cross agency jurisdictions or geographic regions and address applied ecological issues as diverse as global change, ecosystem management, and conservation planning. However, all such efforts depend on having available a common set of well defined and broadly accepted classification units.

Seasonality and the population dynamics of infectious diseases

Mercedes Pascual and Andrew Dobson – leaders

Alonso, David	Dobson, Andrew	Koelle, Katia
Altizer, Sonia	Grenfell, Bryan	Lele, Subhash
Bjornstad, Ottar	Hosseini, Parviez	Pascual, Mercedes
Cattadori, Isabella	Hudson, Peter	Rodo, Xavier
Codeco, Claudia	Kendall, Bruce	Rohani, Pej
De Leo, Giulio	King, Aaron	Satake, Akiko

Seasonal variation takes many forms in the natural world. All of us notice the annual cycles in temperature, day length, and rainfall, and these have profound effects on rates of resource production and availability that plants and animals respond to in order to modify their reproduction and maintenance schedules. These regular cycles impose constraints and create opportunities for transmission of infectious diseases. Humans also superimpose seasonal processes onto their lives in a way that creates opportunities for infectious diseases; for example school semesters and annual vacations. This working group will examine the different ways in which seasonal variation in population size, contact rates and the survival of free-living infectious stages modifies the population dynamics of infectious diseases. The working group will bring together biologists, epidemiologists and mathematicians all of who have worked on different aspects of these problems. The workshop is particularly relevant to our understanding of the potential disease problems associated with climate change.

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

Dov Sax, Steven Gaines and Jay Stachowicz – leaders

Blackburn, Tim	D'Antonio, Carla	Grosberg, Richard
Brown, James	Davis, Mark	Hastings, Alan
Bruno, John	Gaines, Steven	Holt, Robert

Lafferty, Kevin	Rice, William	Tilman, David
Lockwood, Julie	Ricklefs, Robert	Wares, John
Mack, Richard	Sax, Dov	
Marquet, Pablo	Stachowicz, Jay	

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.

Can we now determine if, when, and how microbial community composition impacts ecosystem processes? Will that understanding yield critical new information about ecosystem function and response to change?

Josh Schimel – leader

Allen, Michael	Neff, Jason	Treseder, Kathleen
Bohannan, Brendan	Schimel, Josh	
Firestone, Mary	Sinsabaugh, Robert	

Linking populations and process dynamics has been a major thrust in ecology for the last decade or more. This issue has been a concern in microbial ecology, but linking microbial community dynamics with ecosystem scale processes has been a major challenge. There remains debate as to whether any such linkages really exist, though there are theories about which processes should be sensitive to community composition and there have been a number of individual studies that support these theories. There has not, however, been any broad and effective synthesis to test theories or critically assess how best to establish microbe-ecosystem linkages. We propose a working group that will identify the most successful current approaches for establishing linkages, work with available data sets and existing ecosystem models to determine how to best incorporate appropriate microbial community dynamics into larger-scale models, and work with the models to evaluate the effects of incorporating microbial dynamics into them.

Macro-Ecology and biogeography: Hierarchical (Bayesian) model development using data from South Africa

John Silander – leader

Barber, Jarrett	Holsinger, Kent	Reeves, Gail
Cowling, Richard	Latimer, Andrew	Silander, John
Gelfand, Alan	Laurie, Henri	Tadross, Mark
Hegerl, Gabriele	Lewis, Paul	Wu, Shanshan
Hewitson, Bruce	Midgley, Guy	
Holder, Mark	Rebelo, Anthony	

We propose a Working Group that will focus on developing hierarchical (Bayesian) statistical models to explain joint spatial patterns in plant species distributions (and thus diversity), using unique datasets from South Africa.

The statistical models will: be individual species-based, be spatially explicit, utilize individual species attributes (including phylogenetic information), and include various explicit sources of environmental heterogeneity. The models will be hierarchical in attempting to explain joint patterns of species distributions, thus getting at diversity directly from a mechanistic perspective. We know of no other studies which have taken this approach. In building, validating and comparing the models, we have access to unique data sets from South Africa: 1) the Protea Atlas species inventory; 2) A set of explanatory GIS data layers for the Cape Floristic Region (CFR); 3) cladistic/phylogenetic data on taxa in the Proteaceae; 4) a database of up to 4000 releves from the CFR; and 5) potentially, access to a database of the distribution (at ¼ degree grid cells) of all 23,000 flowering plant species in Southern Africa. The CFR is one of the world's hottest hotspots of plant diversity, and the Protea Atlas dataset may be the most complete presence-absence data set for any taxonomic group across any region.

Global change and infectious disease

Mark L. Wilson and Leslie A. Real – leaders

Ahumada, Jorge	Hawley, William	Singer, Burton
Bouma, Menno	Hay, Simon	Smith, David
Dobson, Andrew	McKenzie, Ellis	Smith, Katherine
Glass, Gregory	Pascual, Mercedes	Wilson, Mark
Gupta, Sunetra	Real, Leslie	
Halloran, M. Elizabeth	Sachs, Jeffrey	

A major element underlying many emerging and reemerging infectious diseases is environmental change. This may be manifested through direct and intentional landscape changes(e.g. hydroelectric dams, agricultural development projects, irrigation, urban expansion, mining, deforestation), indirect habitat changes that favor transmission (e.g. increased vector breeding sites, evolution of virulence, or enhanced contact with infectious agents), and the possibility that other indirect abiotic effects including climate change might alter the intensity or distribution of various diseases. A better understanding of these processes is needed for risk is to be understood and reduced, and for outbreak forecasts are to be made accurate and credible. The goal of this sub-group is to explore various associations between environmental change and specific infectious

diseases that have strong environmental links by analyzing data sets with extensive and well-documented temporal and/or spatial variation.

Specifically, we propose to begin by analyzing two categories of infectious disease. The first is vectorborne disease. Within this category we focus on a mosquito-borne anthroponosis, human malaria, which will be analyzed using data from various sites and sources throughout the world. Time-series analysis and study of spatial patterns among cases and environmental variables will be undertaken using standard time-series and GIS-based statistical models. An attempt will be made to test hypotheses that are based in the biology of vectors, human ecological relations with the environment and each other, and climatic factors that influence transmission.

Diarrheal diseases comprise the second category. Evolutionary theory and empirical studies indicate that diarrheal diseases evolve increased or decreased virulence in response to environmental changes. Specifically, this work suggests that when waterborne routes of transmission are available natural selection will favor highly exploitative pathogen variants because in such environments the costs of exploitation are low. Even ill, immobilized hosts can act as sources of infection because fecal material is removed and washed in water that can contaminate supplies of drinking water. Conversely, if safe water supplies are provisioned, we predict pathogens to evolve toward benignity. There exists a great amount of data in the literature and in unpublished records (e.g., located in ministry of health archives) that we propose to analyze to test this prediction. Our focus in this second category will be on the bacterial agents of dysentery, because the inherent virulence of these agents varies at the species level, and the frequencies of these species in human populations spans the length of time over which water supplies have been improved (i.e., over the past century).

Working Groups With Near Term Relevance for Resource Managers and Policy Makers

A Knowledge Network for Biocomplexity: Building and evaluating a metadata-based framework for integrating heterogeneous scientific data

Jim Reichman, James Brunt, John Helly, Matthew Jones and Michael Willig – leaders

Andelman, Sandy J.	Fegraus, Eric	McPherson, Guy
Biggs, Harry	Garrett, Karen	Peel, Mike
Bowles, Christy	Gotelli, Nicholas J.	Smith, Melinda
Branan, Bill	Gramling, Joel	Stromberg, Mark
Carney, Karen	Gross, Katherine L.	Swemmer, Tony
Chalcraft, David R.	Horner-Devine, Claire	Trollope, Winston
Cleland, Elsa	Jennings, Michael D.	Vandermast, David
Collins, Scott L.	Keddy, Paul	Waide, Robert B.
Cox, Stephen B.	Knapp, Alan K.	Williams, Jack
Devine, Claire	Kruger, Judith	Willig, Michael R.
Drake, John	Loreau, Michel	Wilsey, Brian J.
Dukes, Jeff	Mau-Crimmins, Theresa	Wojdak, Jeremy
Emery, Sarah		Zambatis, Nick

Complexity is an inherent property of living systems that arises from direct and indirect interactions among the earth's physical, chemical, and biological components.

Biocomplexity includes the structural and functional attributes of dynamic systems that arise at all levels of biological organization, including individuals, populations, and communities. Importantly, ecological components of biocomplexity (e.g., biodiversity, ecosystem services) are in crisis, and are undergoing potentially irreversible changes in the face of rapid human population growth and economic development. Wise stewardship, based on all available scientific knowledge concerning these natural systems, is essential. Data Catalyzed by these societal concerns, and facilitated by technology advances, scientists focused on complex ecological systems have generated an explosion of ecological and environmental data. When integrated with data from other disciplines (e.g., meteorology), these data have the potential to greatly enhance understanding of biocomplexity. However, broad-scale and synthetic research is stymied because these data are largely inaccessible due to their spatial dispersion, extreme structural and semantic heterogeneity, and complexity.

Setting priorities and making decisions for conservation risk management

Mark Burgman – leader

Andelman, Sandy	Franklin, Janet	Regan, Helen
Ben-Haim, Yakov	Hayes, Keith	Ruckelshaus, Mary
Burgman, Mark	Keith, David	Runge, Michael
Carmel, Yohay	Langford, Bill	Spanos, Aris
Costello, Christopher	Mace, Georgina	Stirling, Andy
Cumming, Geoff	Manly, Brian	Thompson, Colin
Elith, Jane	Mayo, Deborah	Tyre, Andrew
Fegraus, Eric	McCarthy, Mick	Wilcox, Chris
Ferson, Scott	Meiring, Wendy	Wintle, Brendan
Fidler, Fiona	Moilanen, Atte	
Fox, David	Possingham, Hugh	

Risk-based decisions are made routinely in medicine, toxicology, engineering, psychology, insurance and finance. The development of methods in these fields has been rapid but the paths followed and the tools developed have been different. To some extent the differences reflect the kinds of data and the range of problems people need to solve. In part, the differences are because methods have grown in relative isolation. A common problem facing practitioners in conservation biology is to identify priorities that discriminate among a suite of alternative actions. Biologists make decisions on a routine basis, but with little understanding of the techniques for decisions involving risk. The kinds of questions conservation biologists are obliged to answer will benefit substantially from advances in decision analysis and risk assessment made in other disciplines. This project will develop and expand the toolkit for problem solving available to conservation biologists by reviewing risk-based, priority setting methods in different fields, and bringing together people from different disciplines to examine the problems confronting conservation biologists, resulting in new approaches to finding solutions to priority setting and decision making problems.

Global change impacts on landscape fires

Michael Flannigan and Sandra Lavorel – leaders

Cary, Geoff	Flannigan, Michael	Fotheringham, C.

Gardner, Robert	Keeley, Jon	Li, Chao
Keane, Robert	Lenihan, Jim	

A major problem in projecting ecological change and understanding its mechanisms is the lack of non-equilibrium dynamics in ecological models. The inclusion of disturbance, especially fire is essential for dynamic vegetation models to simulate transient changes in vegetation composition and structure. Understanding landscape dynamics in relation to fire, and how these dynamics may be altered by climate and land use changes is a priority. The development of fire-vegetation models at landscape scales is a crucial gap in land management. Additionally, understanding human impacts on the fire regime is critical for projecting vegetation change in human-modified landscapes, which now occupy large proportions of the globe. The objective of this working group is to use the current well-developed understanding of fire behavior/fire ecology and fire-weather to develop a set of dynamic fire-climate-vegetation models that simulate fire effects at temporal and spatial scales relevant to vegetation change. We will use a common modeling environment, LAMOS, to conduct this research. LAMOS (a Landscape Modeling Shell) is an interactive and flexible landscape modeling platform designed to include alternative methods for simulating vegetation response to landscape change. This proposal specifically addresses three questions: 1) How well do different landscape fire models reproduce fire statistics under current climate, both with respect to each other and with respect to fire history records at selected sites, 2) At what spatial and temporal scales does landscape pattern influence the fire regime, and 3) Under which weather conditions are fire patterns sensitive to fuel landscape pattern, and how often under present / future climate is the threshold of sensitivity crossed.

Models of alternative management policies for marine ecosystems

Robert Francis and James Kitchell – leaders

Aydin, Kerim	Gaichas, Sarah	Olson, Robert
Crowder, Larry	Hinke, Jefferson	Orbach, Michael
Dalton, Michael	Kaplan, Isaac	Polovina, Jeffrey
Field, John	Kitchell, James	Pooley, Samuel
Fluharty, Dave	Martell, Steve	Walters, Carl
Francis, Robert	Nelson, Russell	Watters, George

We are employing comparative approaches based on a common modeling framework developed for each of five large marine ecosystems in the North Pacific Ocean. Each of these ecosystems has served as the focus of controversy over the ecological consequences of fishery management practices, protection for threatened or endangered species, and the relative importance of large-scale environmental variability. Each of these ecosystems has been the focus of model development effort using the common framework of an Ecopath/Ecosim approach. We are using these five models as the basis for evaluating policy effects on ecosystem structure, clarifying the tradeoffs in fishery and conservation goals, and designing robust management strategies. We have also created novel ways of visualizing complex ecosystem models, as a way to make them more accessible to policy makers. Our efforts are supported by the National Center for Ecological Analysis and Synthesis.

Development of tools for the practical design of marine reserves

Alan Hastings and Louis Botsford – leaders

Baskett, Marissa	Gaylord, Brian	Micheli, Fiorenza
Botsford, Louis	Halpern, Ben	Rosenberg, Andy
Brumbaugh, Dan	Hastings, Alan	Wahle, Charles
Carr, Mark	Kinlan, Brian	Warner, Robert
Fluharty, Dave	Largier, John	Yoklavich, Mary
Gaines, Steven	Leff, Jamie	

We propose a working group to examine the general question of moving from theory to policy, specifically looking at the design of marine reserves, building on the quantitative results obtained under a previous NCEAS working group, "A Theory of Marine Reserves", by J. Lubchenco, S. Gaines and S. Palumbi. Whereas the modeling in that working group was a development of a general theory of marine reserves, the focus of the working group proposed here will be an application of that theory to specific problems. Rather than consider ideal optimal reserve configurations, we will study implementing actual marine reserves, given a specific situation and constraints (i.e., current fishing rate, current state of the ecosystem, limited area under consideration, uncertainty in larval dispersal, fisher behavior). The goal will be to develop scientifically sound design tools that can be used in ongoing and future implementation efforts for reserve systems, considering reserves designed both to improve fisheries and to conserve natural marine ecosystems. This effort can be viewed as a paradigm for the problem of translating ecological theory into practical policy applications.

The ecology of marine diseases (Extended)

Drew Harvell – leader

Dobson, Andrew	Jani, Andrea	McCallum, Hamish
Ellner, Stephen	Kim, Kiho	Pascual, Mercedes
Gerber, Leah	Kuris, Armand	Porter, James
Harvell, Drew	Lafferty, Kevin	Ward, Jessica

I am requesting funding for one more meeting of the Marine Disease Working Group. The three main objectives of our working group are: (1) detect evidence of increasing impacts of disease in the ocean, (2) assess application of terrestrial pathogen models to marine outbreaks (and in the process, compare what's known of characteristics of terrestrial and marine disease), (3) develop statistical and modeling approaches for marine diseases.

A dynamic integrated model of land use, carbon flows and carbon sequestration supply in Costa Rica

Suzi Kerr and Alexander Pfaff – leaders

Cifuentes-Jara, Miguel	Kauffman, J.	Pfaff, Alexander
Hughes, Flint	Kerr, Suzi	Tosi, Joseph
Jobse, Judith	Liu, Shuguang	Watson, Vicente

With the rise in importance of global climate change, society is actively exploring the possibility of using forest ecosystems as a carbon sink. Tropical forests may offer over two-thirds of such opportunities. The protection of tropical forests could offset global

fossil fuel C emissions and reduce the cost of emissions limitations set in Kyoto. Certified emissions credits (CERs) under the Clean Development Mechanism (CDM) established in Kyoto will likely incorporate tropical forest sinks within efforts to meet emissions targets. While this could in principle result in significant economic and sequestration benefits, actual evidence on tropical C sinks is sparse. However, society must soon make key decisions concerning tropical forest sinks in the CDM.

The first major goal of our project is to estimate how much C sequestration will be generated in Costa Rica in response to any given monetary reward for C sequestration. Our advances in the ecological and economic components will be coupled to produce our first integrated output, an estimated supply or, equivalently, cost function for C sequestration (i.e., a relationship between the C reward and the C sequestration supplied by land users).

Our advances in the economic component start with excellent existing GIS databases on land use and land cover, and on the factors expected to affect land use choices. We will extend both of these types of data sets, in particular extending land-cover information back in time, and adding improved data on land returns. Next, we will both apply and extend the frontier of economic, observationally-based modeling of land use to provide a map from key factors to land choices.

On the ecological side, our advances start with systematic and comprehensive measurement of aboveground and soil C present within the range of forest ecosystems of Costa Rica, as well as the C dynamics within land-use gradients of each of those systems (e.g., pastures, croplands, and secondary forests of varying ages). With this and existing data, we will calibrate and verify both process-based and empirically-based ecological models that generate C predictions of varying complexity. This provides a map to C stocks from land use choices within different ecosystems. Our second goal is to contribute to the effective design of the rules that allow C sequestration in tropical locations to replace emissions reductions in developed countries. Our analyses will provide the necessary information for the baselines that permit CERs to be defined, and a C market to function. We will also perform integrated sensitivity analyses to determine whether simplified versions of our disciplinary and integrated models maintain sufficient accuracy. Sufficient accuracy will ensure the sequestration outcomes envisioned, while greater simplicity, which translates to lower costs of participation in trading, will stimulate further participation, lowering costs and raising efficiency of implementation of the Kyoto emissions limitations.

In order to achieve these goals we need to closely integrate the economic and ecology work creating dynamic feedbacks between physical and ecological characteristics of land and human land use choices. We also need to integrate the process-based and empirical ecological models to maximize the complementarities between them.

Stochastic demography for an increasingly variable world

William Morris, Catherine Pfister and Shripad Tuljapurkar – leaders

Agrawal, Anurag	Klironomos, John	Power, Alison
Bever, James	Maron, John	Seabloom, Eric
Callaway, Ragan	Mitchell, Charles	Torchin, Mark
Gilbert, Gregory	Morris, William	
Kareiva, Peter	Parker, Ingrid	

Both the means and the variances of such important environmental variables as growing-season temperature and rainfall are projected to increase in many regions over the 21st century. While effects on organisms of changes in mean conditions have often been anticipated, the potential effects of increasing variability have been relatively neglected. We propose a Stochastic Demography Working Group to assess how increasing environmental variability is likely to impact populations of plants and animals. Using unpublished demographic data for a diverse set of taxa and new theoretical tools developed by group members, we will compare the effects of changes in the means vs. the variances of environmental variables, as well as the pattern of sensitivity to environmental variability across species, life histories, and habitats. In addition, we will ask whether the demographic processes that most influence population growth are the least sensitive to environmental variation, a pattern that has been observed in the relatively small number of species previously tested and that would serve to buffer populations against increasing environmental variability. Our ultimate goal is to improve the ability of ecologists to forecast the consequences for the long-term viability of populations of not only overall trends in environmental conditions but also expected changes in year-to-year variability.

Serengeti: The origins and future of a complex ecosystem (Extended)

Craig Packer and Stephen Polasky – leaders

Abrams, Peter	Hilborn, Ray	Packer, Craig
Costello, Christopher	Holt, Robert	Polasky, Stephen
Coughenour, Michael	Hopcraft, Grant	Ritchie, Mark
Dobson, Andrew	McNaughton, Samuel	Sinclair, Anthony
Fryxell, John	Mlingwa, Charles	
Galvin, Kathy	Olff, Han	

The Serengeti ecosystem exemplifies a number of general features of terrestrial food web dynamics and can therefore be viewed as a model system for studying a complex interplay of basic ecological principles. These include: (1) the diverse roles of generalist top predators in governing coexistence in prey communities, (2) the importance of omnivory and intraguild predation in modulating the magnitude of 'top-down' impacts of predators, (3) trophic cascades; (4) the implications of movement, landscape pattern, and spatial heterogeneity for food web dynamics, and, (5) the impact of temporal variation on stability and species composition of local communities. The Serengeti, like many ecosystems, is subject to increasing human use. Understanding human behavior and the links between humans and the ecosystem provides a necessary foundation for conservation.

A synthetic analysis of the scientific basis of ecological restoration of stream ecosystems

Margaret Palmer and J. David Allan – leaders

Alexander, Gretchen	Carr, Jamie	Galat, David
Allan, J. David	Clayton, Steve	Gloss, Steven
Bernhardt, Emily	Dahm, Cliff	Goodwin, Peter
Bowman, Margaret	Follstad-Shah,	Hassett, Brooke
Brooks, Shane	Jennifer	Jenkinson, Robin

Kondolf, G.	O'Donnel, Kevin	Ridenour, Clayton
Lake, P.	Pagano, Laura	Srivastava, Puneet
Meyer, Judy	Palmer, Margaret	Sudduth, Elizabeth
Miller, Peter	Powell, Bruce	Wright, Justin

We will assess the quality of the science underlying ecological restoration activities using stream ecosystems as model restoration systems. We will assemble a unique data set that spans multiple ecoregions and many different types of restoration activities performed by diverse groups with various stakeholder interests. Specifically, our data set will address: what kinds of restoration activities, at what scale, and by what means, are taking place; how goals were set and success measured in these restoration efforts; the extent to which scientific criteria were used; the extent to which adaptive management was an explicit component of the restoration activity; and the extent to which scientists are forming partnerships with restorationists in order to use restoration projects as opportunities for scientific experimentation. Our synthesis will facilitate the linkage between the practice of ecological restoration and the science of restoration ecology and will attempt to establish standards for data gathering to scientifically assess restoration methods and success.

Conservation planning tools

Robert Pressey – leader

Andelman, Sandy	Groves, Craig	Rodrigues, Ana
Bakarr, Mohamed	Machado, Ricardo	Sarkar, Sahotra
Cowling, Richard	Polasky, Stephen	Stoms, David
Crist, Patrick	Possingham, Hugh	Williams, Paul
Davis, Frank	Pressey, Robert	Wilson, Kerrie
Faith, Dan	Revelle, Chuck	

For the purposes of this working group, planning tools are software packages, including simple algorithms as well as decision-support systems, that are used to guide decisions about conservation action. These tools use data on the distribution of biodiversity within planning regions but might also use other data such as geographic adjacency or proximity, past land use, threats, and expected costs of conservation. The main goals of the working group are to: (1) produce a review of conservation planning tools and techniques to inform present and potential users about their applications, advantages, limitations and appropriateness for particular planning problems and circumstances; (2) review current and potential approaches to combining expert judgments and data analysis in the application of planning tools; and (3) make planners and managers aware of the potential and limitations of planning tools for dealing with the problems they encounter.

Dynamics of large mammalian herbivores in changing environments: Alternative modeling approaches

Norman Owen-Smith, N. Thompson Hobbs, Andrew Illius, Per Lundberg – leaders

Boone, Randall
Cope, David
Coulson, Tim
Festa-Bianchet, Marco
Fryxell, John
Gaillard, Jean-Michel
Gordon, Iain
Gross, John
Hilborn, Ray
Hobbs, N.
Illius, Andrew
Kendall, Bruce
Lundberg, Per
Moehlman, Patricia
Ogutu, Joseph
Owen-Smith, Norman
Stenseth, Nils
Vucetich, John
Wang, Guiming

The world's populations of large herbivores have shown dramatically different dynamics during the last two decades. The abundance and distribution of some ungulate species has declined abruptly, while other species have become excessively abundant, and still others have shown complex, oscillatory dynamics. These patterns seem to result from a composite of influences, including those operating at global and local scales. Conventional population models are rooted in assumptions about steady state and do not adequately incorporate environmental variability. We propose a working group that will exploit data sets and expertise from different regions to develop new models of ungulate population dynamics, capable of accommodating the complexity of environmental interactions at different spatial and temporal scales.

Linking marine biodiversity to ecosystem functions and services
Boris Worm and Enric Sala – leaders
Baron, Nancy
Beaumont, Nicola
Duffy, Emmett
Folke, Carl
Jackson, Jeremy
Lotze, Heike
Micheli, Fiorenza
Muthiga, Nyawira
Palumbi, Stephen
Sala, Enric
Stachowicz, Jay
Worm, Boris

Biodiversity, or biological diversity, is the variation of life at all levels of organization, from the level of genetic variation within and among species to the level of variation within and among communities, ecosystems and biomes. It is well-documented how human impacts are changing biodiversity in terrestrial (Wilson 1999) and marine ecosystems (NRC 1995). Historical studies in marine systems have further shown that long-term impacts often lead to the simplification of food webs, as species and species groups are driven to such low abundances that they become functionally extinct (Jackson et al. 2001, Lotze and Milewski 2002). The general consequences of these trends and changes for ecosystem functions, such as primary and secondary productivity, carbon and nutrient cycling, food and habitat provision are little understood in marine systems. The recent research focus on biodiversity, however, has generated a significant, albeit diffuse body of theory and empirical studies. Without synthesis, it is difficult to communicate to the public and to environmental managers why marine biodiversity matters, what the ecological and economic consequences of species loss and changes in biodiversity are, and how dramatic consequences can be prevented. The proposed working group aims to fill this gap. In addition to quantifying the link between marine biodiversity and ecosystem functioning, we will analyze the potential for the disruption of marine ecosystem services, which are those functions that are vital to our food supply, economies, and human health (see Fig. 1). Finally, we will use the results from our analyses to evaluate the costs and benefits of maintaining the status quo versus implementing significant global conservation measures. In three consecutive workshops we will (1) collate experimental and observational evidence on how marine biodiversity and ecosystem functions are linked in a web-accessible database, (2) conduct and publish a series of meta-analyses to derive generalizations about the effects of species loss, ecological simplification and changes in marine biodiversity on ecosystem functions and services, (3) write a policy paper that translates our results into management strategies.

Meetings Hosted by NCEAS

Leader	Project Title
Margaret Cavanaugh	National Science Foundation Advisory Committee for Environmental Research and Education
Chuck Cook	Conservancy Marine Workshop of California Nature Conservancy
Frank Davis	Coastal Reserves
Katherine L. Gross	National Parks Fellowships
Kathy Hibbard	Ecosystem model-data intercomparison working group IV
Rick Hooper	Scoping A Synthesis Facility for the Hydrologic Sciences

Scientific Visitors

Name	
Jordi Bascompte	CSIC-Consejo Superior de Investigaciones Científicas
Michael Bonsall	Imperial College, London
Sarah Gaichas	University of Washington
Steve Jackson	University of Wyoming
Andrew Liebold	USDA Forest Service
Patricia Moehlman	The Wildlife Trust
Christina Tague	San Diego State University
John Vucetich	Michigan Technological University

Research Training Activities

Seven graduate student interns and seven undergraduate interns were involved with research activities at NCEAS during the reporting period. They are listed below, along with the titles of the projects they worked on.

Graduate Student Interns

Intern	Sponsor and Project Title
Sarah Abramson	Jim Reichman Kids Do Ecology
Britta Bierwagen	Jim Reichman Kids Do Ecology
Andrea Chadden	Jim Reichman Mellon Informatics (Hosted by NCEAS)
Erin Leckey	John Alroy Paleobiology Database
Julie Love	Jim Reichman Integrating Marine Ecology Data for Scientific Analysis and Resource Management: A Community Database Prototype
Jill Wertheim	John Alroy Paleobiology Database

Robin Whatley	John Alroy Paleobiology Database
Mary Wisz	A. Townsend Peterson Testing Alternative Methodologies for Modeling Species' Ecological Niches and Predicting Geographic Distributions

Undergraduate Student Interns

Intern	**Sponsor and Project Title**
Valerie Bullard	Jim Reichman Kids Do Ecology
Helen Claudio	John Gamon SpecNet
Jeremy Goldberg	Diego Vázquez Null Models for Specialization and Asymmetry in Plant-Pollinator Systems
Rupech Naik	Diego Vázquez Null Models for Specialization and Asymmetry in Plant-Pollinator Systems
Ben Turner	Chris Pyke Climate, ecosystems, and land-use: Understanding environmental variability in human-dominated landscapes

Education and Outreach Activities

NCEAS' Kids Do Ecology (KDE) program continues as our primary means of outreach to the K-12 Santa Barbara schools. Sarah Abramson, a graduate student intern, coordinates KDE activities. Visits by NCEAS and UCSB-associated scientists to 5th-grade classrooms remain the core of our local outreach activities. During these visits, scientists help students formulate and execute an ecological experiment, including data analysis and presentation.

Ten Santa Barbara classes and ten scientists participated in the "Scientist in the Classroom" program during the past year. A total of 205 students participated, including 135 minority students (65.7%). Examples of this year's projects include: Why do some flowers get visited by pollinators more than others; Spider contests over a web: are winners larger; How does pollution affect fairy shrimp; Moldy Bread: looking at mold growth on bread that has been handled by dirty and clean hands; How degrading: How fast do different types of trash biodegrade; Mussel predation by sea stars: does size

matter; The role of dispersal in determining species assemblages on islands; Can We Test Water Quality By Observing Macroinvertebrate Community Composition; Examining seed germination and plant growth along a water gradient. The students will present their projects at a poster session at NCEAS 24 May, 2004, to share what they learned with each other and NCEAS residents.

In response to the 2002 site review we have updated the Kids Do Ecology web site. The new version of the site contains a simpler front page where students can select the topics of interest. The topics for kids are: Learn about Ecology, World Biomes, Marine Mammals, Kids Do Ecology in Santa Barbara, EcoLinks, and Conservation Projects. Learn about Ecology contains information describing what ecology is, what ecologists do, as well as information about how to become an ecologist and what type of preparation is required. This part of the site also explains the general purpose of Kids Do Ecology and where to find more information, organized for different grade levels. World Biomes contains information about different biomes geared towards a 5th grade level. This section also contains information about research that NCEAS residents do in different biomes. Marine Mammals pages describe the marine mammal species found in the Santa Barbara Channel and archives the data collected by students in the Los Marineros program. These pages also contain learning activities pertaining to data collection and graphing results. KDE in Santa Barbara is devoted to the projects that the local 5th grade classes do each yea,r as well as pictures and descriptions from the poster session. EcoLinks provides students with further links to learn about Ecology on other web sites. Conservation Projects is devoted to the Common Ground in Conservation program and showcases the species that students learn about, as well as the projects that they have exchanged each year.

There are separate links to find out about NCEAS and the entire Kids Do Ecology project, teachers, and contact information. The section for teachers contains information about Kids Do Ecology projects, how to get involved, and links to other sites (e.g. ESA's educators web site) where they can find curriculum information. The Kids Do Ecology web site (before its update) is featured in the 2003 Educators Road Map to the Web released by T.H.E. Journal.

We plan to implement a Spanish language version of the Kids do Ecology web site in the coming year.

Publications

Below we list publications for the reporting period 1 May, 2003 – 31 April, 2004. 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. * *Previously reported as in press.*

Aguirre, A., R.S. Ostfeld, C.A. House, G. Tabor, and M. Pearl, editors. 2002. Conservation medicine: Ecological health in practice. New York, Oxford University

Press.

Alroy, J. 2003. Cenozoic bolide impacts and biotic change in North American mammals. Astrobiology 3:119-132.

Alroy, J. 2003. Global databases will yield reliable measures of global biodiversity. Paleobiology 29(1):26-29.

Alroy, J. 2003. Taxonomic inflation and body mass distributions in North American fossil mammals. Journal of Mammalogy 84(2):431-443.

Alroy, J. 2004. Are Sepkoski's evolutionary faunas dynamically coherent? Evolutionary Ecology Research 6:1-32.

Altizer, S., C.L. Nunn, P. Thrall, J.M. Gittleman, J. Antonovics, A.A. Cunningham, A.P. Dobson et al. 2003. Social organization and parasite risk in mammals: Integrating theory and empirical studies. Annual Review of Ecology and Systematics 34:517-547.

Andelman, S.J., C.M. Bowles, M.R. Willig, R.B. Waide. 2004. Understanding environmental complexity through a distributed knowledge network. BioScience 54(3):240-246.

Andelman, S.J., H.M. Regan, and C. Groves. In press. A review of protocols for selecting species at risk in the context of U.S. Forest Service viability assessments. Acta Oecologica.

*Andelman, S.J., and M.R. Willig. 2003. Present patterns and future prospects for biodiversity in the Western Hemisphere. Ecology Letters 6:818-824.

Armsworth, P.R., B.E. Kendall, and F.W. Davis. 2004. An introduction to biodiversity concepts for environmental economists. Resource and Energy Economics 25(2):115-136.

*Ashley, M. V., J. A. Wilk, S. M. Styan, K. J. Craft, K. L. Jones, J. L., K. A. Feldheim, K. S. Lewers, and T. L. Ashman. 2003. High variability and dosomic segregation of microsatellites in the octaploid Fragaria virginiana (Rosaceae). Theoretical and Applied Genetics 107:1201-1207.

*Bartell, S. M., R. A. Pastorok, H. R. Akcakaya, H. M. Regan, S. Ferson and C. Mackay. 2003. Realism and relevance of ecological models used in chemical risk assessment. Human and Ecological Risk Assessment 9:907-938.

Beck, M.W., K.L. Heck, Jr., K.W. Able, D.L. Childers, D.B. Eggleston, B.M. Gillanders, B. Halpern, C.G. Hays, K. Hoshino, T.J. Minello, R.J. Orth, P.F. Sheridan, and M.P. Weinstein. 2003. The role of nearshore ecosystems as fish and shellfish nurseries. Issues in Ecology 11:1-12.

Bininda-Emonds, O.R.P., K.E. Jones, S.A. Price, R. Grenyer, M. Cardillo, M. Habib, A Purvis, and J.L. Gittleman. 2003. Supertrees are a necessary not-so-evil: A comment on Gatesy et al. Systematic Biology 52:724-729.

Birkland, T.A. R.J. Burby, D. Conrad, H. Cortner, and W.K. Michener. 2003. River ecology and flood hazard mitigation. Natural Hazards Review 4(1):46-54.

Bjørnstad, O.N., M. Peltonen, A.M. Liebhold, and W. Baltensweiler. 2002. Waves of Larch Budmoth outbreaks in the European Alps. Science 298:1020-1023.

Buonaccorsi, J.P., J. Elkinton, W. Koenig, R.P. Duncan, D. Kelly, and V. Sork. 2003. Measuring mast seeding behavior: Relationships among population variation, individual variation and synchrony. Journal of Theoretical Biology 224(1):107-114

*Buston, P.M. 2003. Forcible eviction and prevention of recruitment in the clown anemonefish. Behavioral Ecology 14:576-582.

*Buston, P.M. 2003. Mortality is associated with social rank in the clown anemonefish. Marine Biology 143:811-815.

*Buston, P.M. 2003. Size and growth modification in clownfish. Nature 424:145-146.

*Buston, P.M., and S.T. Emlen. 2003. Cognitive processes underlying human mate choice: The relationship between self-perception and mate preference in Western society. Proceedings of the National Academy of Sciences 100:8805-8810.

Brown, J.H., E.J. Bedrick, S.K.M. Ernest, J-L.E. Cartron, and J.F. Kelly. 2004. Constraints on negative relationships: Mathematical causes and ecological consequences. In M.L. Taper, and S.R. Lele, editors. The Nature of Scientific Evidence: Statistical, Philosophical, and Empirical Considerations. Johns Hopkins University Press.

Brown, J.H., J.F. Gillooly, G.B. West, and V.M. Savage. 2003. The next step in macroecology: From general empirical patterns to universal ecological laws. In T.M. Blackburn and K.J. Gaston, editors. Macroecology: Concepts and Consequences. Blackwell.

Brown, J.H., V.K. Gupta, B-L. Li, B.T. Milne, C. Restrepo, and G.B. West. 2002. The fractal nature of nature: power laws, ecological complexity, and biodiversity. Proc. Royal Soc. B. 357:619-626.

Brown, J.H., D.A. Kelt, and B.J. Fox. 2002. Assembly rules and competition in desert rodents. American Naturalist 160:815-818.

*Chalcraft, D.R., and W. J. Resetarits. 2003. Mapping functional similarity of predators on the basis of trait similarities. American Naturalist 162(4):390-402.

*Chalcraft, D.R., and W. J. Resetarits. 2003. Predator identity and ecological impacts: Functional redundancy or functional diversity? Ecology 84(9):2407-2418.

Chalcraft, D.R., and W. J. Resetarits. 2004. Metabolic rate models and the substitutability of predator populations. Journal of Animal Ecology 73:323-332.

Childs J.E., A.T. Curns, M.E. Dey, L.A. Real, L. Feinstein, O.N. Bjørnstad, and J.W. Krebs. 2000. Predicting the local dynamics of epizootic rabies among raccoons in the United States, Proceedings of the National Academy of Sciences, 97:13666-13671.

Childs, J.E., A.T. Curns, M. Dey, L. Real, C. Rupprecht, and J.W. Krebs. 2001. Rabies epizootics among raccoons vary along a north-south gradient in the eastern United States. Vector Borne and Zoonotic Diseases 1:253-267.

*Church, R.L., R.A. Gerrard, M. Gilpin, and P. Stine. 2003. Constructing cell-based species territories useful in conservation planning. Annals of the American Association of Geographers 93:814-827.

*Clark, A., J. Hoekstra, D. Boersma, and P. Kareiva. 2003. Improving U.S. Endangered Species Act recovery plans: Key findings and recommendations of the SCB recovery plan project. Conservation Biology 17:655.

*Cohen, G.M., and J.B. Shurin. 2003. Scale-dependence and mechanisms of dispersal in freshwater zooplankton. Oikos 103:603-617.

*Cornell, H. V., and B. A. Hawkins. 2003. Herbivore responses to secondary compounds: A test of phytochemical coevolution theory. American Naturalist 161:507-522.

Coulson, T., F. Guinness, J. Pemberton, and T. Clutton-Brock. 2004. The demographic consequences of releasing a population of red deer from culling. Ecology 85(2):411-422.

Coulson, T., L.E.B. Kruuk, G. Tavecchia, J.M. Pemberton, and T. Clutton-Brock. 2003. Estimating selection on neonatal traits in red deer using elasticity path analysis. Evolution 57(12):2879-2892.

Cottenie, K., and L. De Meester. In press. Local interactions and local dispersal in a zooplankton metacommunity. In M. Holyoak, M.A. Leibold and R.D. Holt, editors. Metacommunities: Spatial dynamics and ecological communities.

Cottenie, K., and L. De Meester. 2004. Metacommunity structure: Synergy of biotic interactions as selective agents and dispersal as fuel. Ecology 85(1)114-119.

*Day, T., P. A. Abrams, and J. M. Chase. 2002. The role of size-specific predation in the evolution and diversification of prey life histories. Evolution 56:877-887.

*de Valpine, P. 2003. Better inferences from population-dynamics experiments using Monte Carlo state-space likelihood methods. Ecology 84:3064-3077.

de Valpine, P. In press. Monte Carlo state-space likelihoods by weighted posterior kernel density estimation. Journal of the American Statistical Association.

Dobson, A.P., and J. Foufopoulos. 2001. Emerging infectious pathogens of wildlife. Phil. Trans. R. Soc. Lond. B 356:1001-1012.

Ernest, S.K.M., and J.H. Brown. 2001. Homeostasis and compensation: the role of resources in ecosystem stability. Ecology 82:2118-2132.

Ernest, S.K.M., B.J. Enquist, J.H. Brown, E.L. Charnov, J.F. Gilloy, V. Savage, E.P. White, F.A. Smith, E.A. Hadly, J.P. Haskell, S.K. Lyons, B.A. Maurer, K. Niklas, and B. Tiffney. 2003. Thermodynamic and metabolic effects on the scaling of production and abundance. Ecology Letters 6:990-995.

Etter, R.J., and L.S. Mullineaux. 2001. Deep-sea communities. In M.D, Bertness, S.D. Gaines and M.E. Hay, editors. Marine community ecology. Sinauer Associates, Sunderland, MA, USA.

*Faith, D.P. 2002. Quantifying biodiversity: A phylogenetic perspective. Conservation Biology 16:248-252

Ferrari, M.J., O. Bjørnstad, and A.P. Dobson. In press. Estimation and inference for R0 of an infectious pathogen using a removal method. Ecology.

Festa-Bianchet, M., J.-M. Gaillard, and S.D. Côté. 2003. Variable age structure and apparent density-dependence in survival of adult ungulates. Journal of Animal Ecology 72:640-649.

Foote, M. 2003. Origination and extinction through the Phanerozoic: A new approach. Journal of Geology 111:125-148.

Frank, J.D., T.H. Kunz, J. Horn, C. Cleveland, and S. Petronio. 2003. Advanced infrared detection and image processing for automated bat censusing. Infrared Technology and Applications XXIX. Proceedings of SPIE 5074:261-271.

Gabet, E.J., O.J. Reichman, and E.W. Seabloom. 2003. The effects of bioturbation on soil processes and sediment transport. Annual Review of Earth and Planetary Sciences 31:249-273.

*Gavin, D. G., W. W. Oswald, E. R. Wahl, and J. W. Williams. 2003. A statistical approach to evaluating distance metrics and analog assignments for pollen records. Quaternary Research 60:356-367.

Gelfand, A.E., A.M. Schmidt, S. Wu, J.A. Silander, Jr., A. Latimer and A.G. Rebelo. In press. Modelling species diversity through species level hierarchical modeling. Journal of the Royal Statistical Society, Section C: Applied Statistics.

Gelfand, A.E., J.A. Silander, Jr., S. Wu, A. Latimer, P. Lewis, A. G. Rebelo and M. Holder. 2003. Explaining species distribution patterns through hierarchical modeling. Bayesian Analysis 1(1):1-47.

Gerber, L.R. In press. Biological Uncertainty and Extinction Risk for Steller sea Lions (Eumetopias jubatus) In R.A. Akcakaya, editor. Developing Models for Conservation and Management using RAMAS GIS. Island Press, Washington, DC.

*Gerber, L.R, L. Botsford, A. Hastings, H. Possingham, S. Gaines, S. Palumbi and S. Andelman. 2003. Population models for reserve design: A retrospective and prospective synthesis. Ecological Applications (Special Issue on Marine Reserves) 13:S47-64.

*Gerber, L.R., and L.T. Hatch. 2002. Are we recovering? An evaluation of recovery criteria under the U.S. Endangered Species Act. Ecological Applications 12(3):668-673.

Gerber, L.R., O.J. Reichman, and J. Roughgarden. In press. Food hoarding: Future value in optimal foraging decisions. Ecological Modelling.

Gerber, L.R, E.W Seabloom, R. Burton, and O.J. Reichman. 2003. Translocation of an imperiled woodrat population: Integrating spatial and habitat patterns. Animal Conservation 6(4)309-316.

Gerber, L.R., M.T. Tinker, D. Doak, and J. Estes. In press. Mortality sensitivity in life-stage simulation analysis: A case study of Southern sea otters. Ecological Applications.

Gergel, S.E., E.M. Bennett, B.K. Greenfield, S. King, C.A. Overdevest, and B. Stumborg. 2004. A test of the Environmental Kuznets Curve using long-term watershed inputs. Ecological Applications 14(2):555-570.

Gerrard, R., P. Stine, R. Church, and M. Gilpin. 2001. Habitat evaluation using GIS: A case study applied to the San Joaquin kit fox. Landscape and Urban Planning 52:239-255.

Gillanders, B.M., K.W. Able, J.A. Brown, D.B. Eggleston, and P.F. Sheridan. 2003. Evidence of connectivity between juvenile and adult habitats for mobile marine fauna: An important component of nurseries. Marine Ecology Progress Series 247:281–295.

Gillooly, J.F., J.H. Brown, G.B. West, V.M. Savage, and E.L. Charnov. 2001. Effects of size and temperature on metabolic rate. Science 293:2248-2251.

Gillooly, J.F., E.L. Charnov, G.B. West, V.M. Savage, and J.H. Brown. 2002. Effects of size and temperature on developmental time. Nature 417:70-73.

Goodwin, B.J., R.S. Ostfeld, and E.M. Schauber. 2001. Spatiotemporal variation in a Lyme disease host and vector: black-legged ticks on white-footed mice. Vector-Borne and Zoonotic Diseases 1:129-138.

Gordon, E.R., A.T. Curns, J.W. Krebs, C.E. Rupprecht, L.A. Real, and J.E. Childs. In press. Temporal dynamics of rabies in a wildlife host and the risk of interspecific transmission. Epidemiology and Infection.

*Gram, W.K., and V.L. Sork. 2001. Association between environmental and genetic heterogeneity in forest tree populations. Ecology 82(7):2012-2021.

*Gram, W.K., V.L. Sork, R.J. Marquis, R.B. Renken, R.L. Clawson, J. Faaborg, D.K. Fantz, J. LeCorff, J. Lill, and P.A. Porneluzi. 2001. Evaluating the effects of ecosystem management: A case study in a Missouri Ozark Forest. Ecological Applications 11(6):1667-1679

Greene, C.H., R.D. Kenney, and J.W. Jossi. 2003. Impact of climate variability on the recovery of endangered North Atlantic Right Whales. Oceanography 16:98-103.

Grimm, N.B., S.E. Gergel, W.H. McDowell, E.W. Boyer, C.L. Dent, P.M. Groffman, S. Hart, J. Harvey, C.A. Johnston, E. Mayorga, M.E. McClain, and G. Pinay. 2003. Merging aquatic and terrestrial perspectives of nutrient biogeochemistry. Oecologia 442:485-501.

*Gross, K. L. 2004. Promoting ecological research in National Parks by investing in the next generation of scientists. Ecological Applications 14:15-17.

*Haight, R.G., B. Cypher, P.A. Kelly, S. Phillips, H. Possingham, K. Ralls, A.M. Starfield, P.J. White, and D. Williams. 2002. Optimizing habitat protection using demographic models of population viability. Conservation Biology 16:1386-1397

Haight, R.G., B. Cypher, P.A. Kelly, S. Phillips, K. Ralls, and H.P. Possingham. 2004. Optimizing reserve expansion for disjunct populations of San Joaquin kit fox. Biological Conservation 117(1):61-72.

Harding, E.K., E.E. Crone, B.D. Elderd, J.M. Hoekstra, A.J. McKerrow, J.D. Perrine, J. Regetz, L.J. Rissler, A.G. Stanley, E.L. Walters and the NCEAS Habitat Conservation Plan Working Group. 2001. The scientific foundations of habitat conservation plans: A quantitative assessment. Conservation Biology 15(2):488-500.

Harmon, L.J., J.A. Schulte II, A. Larson and J.B. Losos. 2003. Tempo and mode of evolutionary radiation in iguanian lizards. Science 301:961-964.

Haskell, J. 2001. The latitudinal gradient of diversity through the Holocene as recorded by fossil pollen in Europe. Evolutionary ecology research 3:345-360.

*Hawkins, B.A., R. Field, H.V. Cornell, D. Currie, J-F.Guegan, D. Kaufman, J.T. Kerr, G. Mittelbach, T. Oberdorff, E.M. O'Brien, E.E. Porter, J. Turner. 2003. Energy, water, and broad-scale geographic patterns of species richness. Ecology 84(12):3105-3117.

Heck, K.L. Jr., C. Hays, and R.J. Orth. 2003. A critical evaluation of the nursery role hypothesis for seagrass meadows. Marine Ecology Progress Series 253:123-136.

Hinke, J.T., I.C. Kaplan, K. Aydin; G.M. Watters, R.J. Olson, and J.F. Kitchell. 2004. Visualizing the food-web effects of fishing for tunas in the Pacific Ocean. Ecology and Society 9(1):10.

Holt, R.D., A.P. Dobson, M. Begon, R.G. Bowers, and E.M. Schauber. 2003. Parasite Establishment in host communities. Ecology Letters 6:837-842.

*House, J.I., S.R. Archer, D.D. Breshears, and R.J. Scholes. 2003. Conundrums in mixed woody-herbaceous plant systems. Journal of Biogeography 30:1763-1777.

* Howarth, R. W., A. Sharpley and D. Walker. 2002. Sources of nutrient pollution to coastal waters in the United States: Implications for achieving coastal water quality goals Estuaries 25:656-676.

*Huettmann, F., and J. Linke. 2003. An automated method to derive habitat preferences of wildlife in GIS and telemetry studies: A flexible software tool and examples of its application. Z. Jagdwiss 49:219-232.

*Huettmann, F., and J. Linke. 2003. Assessment of different link functions for modeling binary data to derive sound inferences and predictions Lect Notes Comput Sc 2669:43-48.

* Hughes, T. P., A. H. Baird, D. R. Bellwood, M. Card, S. R. Connolly, C. Folke, R. Grosberg, O. Hoegh-Guldberg, J. B. C. Jackson, J. Kleypas, J. M. Lough, P. Marshall, M. Nystrom, S. R. Palumbi, J. M. Pandofi, B. Rosen, and J. Roughgarden. 2003. Climate change, human impacts, and the resilience of coral reefs. Science 301:929-933.

Hungate, B., J. Dukes, M.R.Shaw, Y. Luo, and C.B. Field. 2003. Nitrogen and climate change. Science 302:1512-1513.

Huxman, T.E., M.D. Smith, P.A. Fay, A.K. Knapp, M.R. Shaw, M.E. Loik, S.D. Smith, D.T. Tissue, J.C. Zak, J.F. Weltzin, W.T. Pockman, O.E. Sala, B. Haddad, J. Harte, G.W. Koch, S. Schwinning, E.E. Small, and D.G. Williams. In press. Convergence across biomes to a common rain-use efficiency. Nature.

Jacobson, A.R., A. Provenzale, A. Von Hardenberg, B. Bassano, and M. Festa-Bianchet. In press. Climate forcing and density-dependence in a mountain ungulate population. Ecology.

Juanes, F. 2003. The allometry of cannibalism in piscivorous fishes. Canadian Journal of Fisheries and Aquatic Sciences 60:594-602

Keane, R.E., Cary, G.J., and Parsons, R. 2003. Using simulation to map fire regimes: an evaluation of approaches, strategies and limitations. International Journal of Wildland Fire 12:309-322.

Keith, D.A., and M.A. Burgman. 2004. The Lazarus effect: Can the dynamics of extinct species lists tell us anything about the status of biodiversity? Biological Conservation 117:41-48.

Kelly, D., and V.L. Sork. 2002. Mast seeding in perennial plants: Why, how, where? Annu. Rev. Ecol. Syst. 33:427-447.

Koenig, W.D., D. Kelly, V.L. Sork, R.P. Duncan, J.S. Elkinton, M.S. Peltonen, and R.D. Westfall. 2003. Dissecting components of population-level variation in seed production and the evolution of masting behavior. Oikos 102(3):581-591.

Koenig, W.D., and A.M. Liebhold. 2003. Regional impacts of periodical cicadas on oak radial increment. Can. J. For. Res. 33:1084-1089.

Lafferty, K.D. In press. Fishing for lobsters indirectly increases epidemics in sea urchins. Ecological Applications.

Lafferty, K.D., and L. Gerber 2002. Good medicine for conservation biology: The intersection of epidemiology and conservation theory. Conservation Biology 16:593-604.

Lafferty, K.D., and R.D. Holt. 2003. How should environmental stress affect the population dynamics of disease? Ecology Letters 6:797-802.

Lamoreux, J., H.R. Akçakaya, L. Bennun, N.J. Collar, L. Boitani, D. Brackett, A. Bräutigam, T.M. Brooks, G.A.B. da Fonseca, R.A. Mittermeier, A.B. Rylands, U. Gärdenfors, C. Hilton-Taylor, G. Mace, B.A. Stein, and S. Stuart. 2003. Value of the IUCN Red List. Trends in Ecology and Evolution 18:214-215.

Laurie, H., and J.A. Silander, Jr. 2002. Geometric constraints and spatial pattern of species richness: Critique of range-based null models. Diversity and Distributions. 8:351-364.

Lee, Y.F., and G.F. McCracken. 2002. Foraging activity and food resource use of Brazilian free-tailed bats (Molossidae). Ecoscience 9:306-313.

*Levin, S., H.C. Muller-Landau, J. Chave, and R. Nathan. 2003. The ecology and evolution of dispersal: A theoretical perspective. Annual Review of Ecology and Systematics 34:575-604.

Liebhold, A., V. Sork, M. Peltonen, W. Koenig, O. Bjørnstad, R. Westfall, J. Elkinton, J. Knops. 2004. Within-population spatial synchrony in mast seeding of North American oaks. Oikos 104: 156-164.

*Lockwood, J.L., G.J. Russell, J.L. Gittleman, C.C. Daehler, M.L. McKinney and A. Purvis. 2002. A metric for analyzing taxonomic patterns of extinction risk. Conservation Biology 16:1137-1142.

* Lockwood, D.L., A. Hastings and L.W. Botsford. 2002. The effects of dispersal patterns on marine reserves: does the tail wag the dog? Theoretical Population Biology 61:297-309.

Lomolino, M.V., Sax, D.F., and J.H. Brown. 2004. Foundations of Biogeography. University of Chicago Press.

Lucey, B.T., D. Smith, C. Russell, M.L. Wilson, A. Long, L. Waller, J. Childs, and L.A. Real. 2002. Spatio-temporal analysis of epizootic raccoon rabies propagation in Connecticut, 1991-1995. Vector Borne and Zoonotic Diseases 2:77-86.

*Luttbeg, B. 2002. Assessing the robustness and optimality of alternative decision rules with varying assumptions. Animal Behaviour 63:805-814.

Luttbeg, B., and T.A. Langen. 2004. Comparing alternative models to empirical data: Cognitive models of Western Scrub-jay foraging behavior. American Naturalist 163(2):263-276.

*Luttbeg, B., L. Rowe, and M. Mangel. 2003. Prey state and experimental design affect relative size of trait-mediated and density-mediated indirect effects. Ecology 84:1140-1150.

Lyons, S.K., F.A. Smith, and J.H. Brown. 2004. Of mice, mastodons, and men: Human mediated extinctions on four continents. Evolutionary Ecology Research 6(3):339-358.

Marshall, D., T. Work, and J.F. Cavey. 2003. Invasion pathways of karnal bunt of wheat into the United States. Plant Disease 87(8):999-1003.

Maurer, B.A. 2003. Adaptive diversification of body size: The roles of physical constraint, energetics, and natural selection. In T.M. Blackburn, and K.J. Gaston, editors. Macroecology: Concepts and consequences. Blackwell Science, Oxford.

McCallum, H., and A.P. Dobson. 2002. Disease, habitat fragmentation and conservation. Proc. Roy. Soc. B. 269:2041-2049.

McCallum, H., C.D. Harvell, and A. Dobson. 2003. Rates of spread of marine pathogens. Ecology Letters 6(12):1062-1067.

*McCarthy, M. A., S. J. Andelman, and H. P. Possingham. 2003. Reliability of relative predictions in population viability analysis. Conservation Biology 17(4):982-989.

McCarthy, M.A., D. Keith, J. Tietjen, M.A. Burgman, M. Maunder, L. Master, B.W. Brook, G. Mace, H.P. Possingham, R. Medellin, S.J. Andelman, H. Regan, T. Regan, and M. Ruckelshaus. *In press*. Model predictions are superior to subjective estimates of risk. Acta Oecologica.

McCauley, E., B.E. Kendall, A. Janssen, S. Wood, W.W. Murdoch, P. Hosseini, C.J. Briggs, S.P. Ellner, R.M. Nisbet, M.W. Sabelis, and P. Turchin. 2000. Inferring colonization processes from population dynamics in spatially-structured predator-prey systems. Ecology 81:3350-3361.

*McClain, M.E., E.W. Boyer, C.L. Dent, S.E. Gergel, N.B. Grimm, P.M. Groffman, S.C. Hart, J.W. Harvey, C.A. Johnston, E. Mayorga, W.H. McDowell, and G. Pinay. 2003. Biogeochemical hot spots and hot moments at the interface of aquatic and terrestrial ecosystems. Ecosystems 6:301-312.

Meiri, S., and T. Dayan. 2003. On the validity of Bergmann's rule. Journal of Biogeography 30:331-351.

Miller, A.. 2003. On the importance of global diversity trends and the viability of existing paleontological data. Paleobiology 29(1):15-18.

Miller, A. I., and M. Foote. 2003. Increased longevities of post-Paleozoic marine genera after mass extinctions. Science 302:1030-1032.

*Miller, W., III, 2001. The structure of species, outcomes of speciation and the 'species problem': ideas for paleobiology. Palaeogeography, Palaeoclimatology, Palaeoecology 176:1-10.

Miller, W., III, 2003. A place for phyletic evolution within the theory of punctuated equilibria: Eldredge pathways. Neues Jahrbuch fur Geologie und Palaontologie Monatshefte 2003:463-476.

Minello, T.J., Able, K.W., Weinstein, M.P., Hays, C.G. 2003. Salt marshes as nurseries for nekton: Testing hypotheses on density, growth and survival through meta-analysis. Marine Ecology Progress Series 246:39–59.

Mitchell, W.A., and W.P. Porter. 2001. Foraging games and species diversity. Annales Zoologici 38(1):89-98.

Mittelbach, G., S.M. Scheiner, and C.F. Steiner. 2003. What is the observed relationship between species richness and productivity: Reply. Ecology 84(12):3390-3395.

Muller-Landau, H.C. 2004. Interspecific and intersite variation in wood specific gravity of tropical trees. Biotropica 36:20-32.

Muller-Landau, H.C., and Hardesty, B.D. In press. Seed dispersal in tropical forests. In D. Burslem, M. Pinard, and S. Hartley, editors. Biotic Interactions in the Tropics. Cambridge University Press.

*Muller-Landau, H.C., S.A. Levin, and J.E. Keymer. 2003. Theoretical perspectives on the evolution of long-distance dispersal and the example of specialized pests. Ecology 84(8):1957-1967.

Murdoch, W.W., C.J. Briggs, R.M. Nisbet, B.E. Kendall, and E. McCauley. 2003. Natural enemy specialization and the period of population cycles: Reply. Ecology Letters 6:384-387.

*Murdoch, W.W., B.E. Kendall, R.M. Nisbet, C.J. Briggs, E. McCauley, and R. Bolser. 2002. Single-species models for many-species food webs. Nature 417:541-543.

*Niklas, K.J., and B.J. Enquist. 2002. On the vegetative biomass partitioning of seed plant leaves, stems and roots. American Naturalist 159:482-497.

* Nilsson, C., J. E. Pizzuto, G. Moglen, M. A. Palmer, E. H. Stanley, and L. C. Thompson. 2003. Ecological forecasting and running water systems: Challenges for economists, hydrologists, geomorphologists, and ecologists. Ecosystems 6:659-674.

Nunn, C.L. 2003. Behavioural defences against sexually transmitted diseases in primates. Animal Behaviour 66(1):37-48.

Nunn, C.L., and Altizer, S.M. In press. Sexual selection, behavior and sexually transmitted diseases. In P.M. Kappeler and C.P. van Schaik, editors. Sexual Selection in Primates: New and Comparative Perspectives.

Nunn, C.L., Altizer, S.M., Jones, K.E., and Sechrest, W. In press. Comparative tests of parasite species richness in primates. American Naturalist.

Nunn, C.L., J.L. Gittleman, and J. Antonovics. 2003. A comparative study of white blood cell counts and disease risk in carnivores. Proceedings of the Royal Society London Series B. Biological Sciences 270:347-356.

Ogutu, J.O., and N. Owen-Smith. 2003. ENSO, rainfall and temperature influences on extreme population declines among African savanna ungulates. Ecology Letters 6:412-419.

*Olson, R.J., and G.M. Walters. 2003. A model of the pelagic ecosystem in the eastern tropical Pacific Ocean. Inter-American Tropical Tuna Commission, Bulletin 22(3):133-218.

Olszewski, T. In press. A unified mathematical framework for the measurement of richness and evenness within and among multiple communities. Palaios.

*Osenberg, C. W., C. M. St. Mary, J. A. Wilson, and W. J. Lindberg. 2002. A quantitative framework to evaluate the attraction-production controversy, with application to marine ornamental fisheries. ICES Journal of Marine Science 59:s214-s221.

Ostfeld, R.S., F. Keesing, E.M. Schauber, and K.A. Schmidt. 2002. The ecological context of infectious disease: Diversity, habitat fragmentation, and Lyme disease risk in North America. Pages 207-219 In A. Aguirre, R.S. Ostfeld, C.A. House, G. Tabor, and M. Pearl, editors. Conservation medicine: ecological health in practice. Oxford University Press, New York.

Ostfeld, R.S., M. Pearl, and G. Meffe. 2002. Conservation medicine: The birth of another crisis discipline. Pages 17-26 In A. Aguirre, R.S. Ostfeld, C.A. House, G. Tabor, and M. Pearl, editors. Conservation medicine: Ecological health in practice. Oxford University Press, New York.

Pacala, S., and A.P. Kinzig. 2002. Introduction to theory and the common ecosystem model. Pages 169-174 In A.P. Kinzig, S. Pacala, and D. Tilman, editors. Functional Consequences of Biodiversity: Empirical Progress and Theoretical Extensions. Princeton University Press.

Packer, M.J., R.D. Holt, P.J. Hudson, K.D. Lafferty, and A.P. Dobson. 2003. Keeping the herds healthy and alert: Implications of predator control for infectious disease. Ecology Letters 6:797-802.

* Pandolfi, J. M., R. H. Bradbury, E. Sala, T. P. Hugles, K. A. Bjorndal, R. C. Cooke, D. McArdle, L. McClenachan, M. J. H. Newman, G. Paredes, R. R. Warner, J. B. C. 2003. Global trajectories of the long-term decline of coral reef ecosystems. Science 301:955-958.

* Pastorok, R. A., H. R. Akcakaya, H. M. Regan, S. Ferson, and S. M. Bartell. 2003. Role of ecological modeling in risk assessment. Human and Ecological Risk Assessment 9:907-938.

Patzkowsky, M.E., and S.M. Holland. 2003. Lack of community saturation at the beginning of the Paleozoic plateau: The dominance of regional over local processes. Paleobiology 29(4):545-560.

*Peltonen, M., A.M. Liebhold, O.N. Bjørnstad, and D.W. Williams. 2002. Spatial synchrony in forest insect outbreaks: Roles of regional stochasticity and dispersal. Ecology 83:3120-3129.

Petchey, O., A.L. Downing, G. Mittelbach, L. Persson, C.F. Steiner, P.H. Warren, and G. Woodward. 2004. Species loss and the structure and functioning of multitrophic aquatic ecosystems. Oikos 104(3):467478.

Porter, W.P., S. Budaraju, W.E. Stewart, and N. Ramankutty. 2000. Calculating climate effects on birds and mammals: Impacts on biodiversity, conservation, population parameters, and global community structure. Am. Zool. 40(4):597-630.

Porter, W.P., J. Sabo, C.R. Tracy, J. Reichman, and N. Ramankutty. 2002. Physiology on a landscape scale: Plant-animal interactions. Integrative and Comparative Biology 42(3):431-453.

Post, D.M.. 2003. Individual variation in the timing of ontogenetic niche shifts in largemouth bass. Ecology 84(5):1298-1310.

Purvis, A., Gittleman, J.L., and T.M. Brooks (editors). In press. Phylogeny and Conservation. Cambridge University Press.

Purvis, A., P.-M. Agapow, J.L. Gittleman, and G.M. Mace. 2000. Nonrandom extinction and
the loss of evolutionary history. Science 288:328-330.

Quattro, J.M., M.R. Chase, M.A. Rex, T.W.Greig, and R.J. Etter. 2001. Extreme mitochondrial DNA divergence within populations of the deep-sea gastropod Frigidoalvania brychia (Verrill, 1884). Marine Biology 139:1107-1113.

*Rees, M., D. Kelly, and O.N. Bjørnstad. 2002. Snow tussocks, chaos and the evolution of mast seeding. American Naturalist 160:44-59.

* Regan, H. M., H. R. Akcakaya, S. Ferson, K. V. Root, S. Carroll, and L. R. Ginzburg. 2003. Treatments of uncertainty and variability in ecological risk assessment of single-species populations. Human and Ecological Risk Assessment 9:889-906.

Reiners, W.A., and K.L. Driese. 2001. The propagation of ecological influences across heterogeneous environmental space. BioScience 51(11):939-950.

Reiners, W.A., and K.L. Driese. 2003. Transport of energy, information and material through the biosphere. Annual Review of Environment and Resources 28:107-135.

Reiners, W.A., and K.L. Driese. In press. Transport processes in nature. Ecological Propagations Through Environmental Space. Cambridge University Press.

Reiners, W.A., S. Liu, K.G. Gerow, M. Keller, and D.S. Schimel. 2002. Historical and future land use effects on N2O and NO emissions using an ensemble modeling approach: Costa Rica's Caribbean Lowlands as an example. Global Biogeochemical Cycles 16(4):223-240.

Rex., M.A., C.T. Stuart, and G. Coyne. 2000. Latitudinal gradients of species richness in the deep-sea benthos of the North Atlantic. Proceedings of the National Academy of Sciences 97:4082-4085.

*Roberts, C.M., S. Andelman, G. Branch, R.H. Bustamante, J.C. Castilla, J. Dugan, B.S. Halpern, K.D. Lafferty, H. Leslie, J. Lubchenco, D. McArdle, H.P. Possingham, M. Ruckelshaus, and R. R. Warner. 2003. Ecological criteria for evaluating candidate sites for marine reserves. Ecological Applications 13:S199-S214.

Roberts, C.M., G. Branch, R.H. Bustamante, J.C. Castilla, J. Dugan, B.S. Halpern, K.D. Lafferty, H. Leslie, J. Lubchenco, D. McArdle, M. Ruckelshaus, and R.R. Warner. 2003. Application of ecological criteria in selecting marine reserves and developing reserve networks. Ecological Applications 13:S215-S228.

Rodrigues, A.L., S.J. Andelman, M.I. Bakarr, L. Boitani, T.M. Brooks, R.M. Cowling, L.D.C. Fishpool, G. da Fonseca, K.J. Gaston, M. Hoffmann, J. Long, P.A. Marquet, J.D. Pilgrim, R.L. Pressey, J. Schipper, W. Sechrest, S. N. Stuart, L.G. Underhill, R.W. Waller, M.E.J. Watts, and X. Yan. 2004. Effectiveness of the global protected area network in representing species diversity. Nature 428:640-643.

Rodrigues, A.L., S.J. Andelman, M.I. Bakarr, L. Boitani, T.M. Brooks, R.M. Cowling, L.D.C. Fishpool, G. da Fonseca, K.J. Gaston, M. Hoffmann, J. Long, P.A. Marquet, J.D. Pilgrim, R.L. Pressey, J. Schipper, W. Sechrest, S. N. Stuart, L.G. Underhill, R.W. Waller, M.E.J. Watts and X. Yan. 2003. Global Gap Analysis: Towards a representative network of protected areas. Advances in Applied Biodiversity Science, No. 5. Center for Applied Biodiversity Science, Conservation International.

Russell, C.A., D.L. Smith, L.A. Waller, J.E. Childs, and L.A. Real. 2003. A priori prediction of disease invasion dynamics in a novel environment. Proceeding of the Royal Society London, Series B 271(1534):21-25.

Schenk, H.J., and R.B. Jackson. 2002. Rooting depths, lateral spreads, and below-ground/above-ground allometries of plants in water-limited ecosystems. Journal of Ecology 90:480-494.

Schenk, H.J., and R.B. Jackson. 2002. The global biogeography of roots. Ecological Monographs 72:311-328.

Schenk, H.J., and R.B. Jackson. In press. Mapping the global distribution of deep roots in relation to climate and soil characteristics. Geoderma.

* Schindler D. E., T.E. Essington, J. F. Kitchell, C. Boggs, and R. Hilborn. 2002. Sharks and tunas in the central Pacific: Fisheries impacts on predators with contrasting life histories. Ecological Applications 5:735-748.

*Schultz, C., and L.R. Gerber. 2002. Are endangered species act recovery plans on the road to recovery? Ecological Applications 12(3):641-647.

*Seabloom, E.W., E.T. Borer, V.L. Boucher, R.S. Burton, K.L. Cottingham, L. Goldwasser, W. K. Gram, B.E. Kendall, and F. Micheli. 2003. Competition, seed limitation, disturbance, and reestablishment of California native annual forbs. Ecological Applications 13:575-592.

Seabloom, E.W., A.P. Dobson, and D.M. Stoms. 2002. Extinction rates under nonrandom habitat loss. Proceedings of the National Academy of Sciences 99:11229-11234.

Seabloom, E.W., W.S. Harpole, O.J. Reichman, and D. Tilman. 2003. Invasion, competitive dominance, and resource use by exotic and native California grassland species. Proceedings of the National Academy of Sciences 100:13384-13389.

Sheridan, P.F., and C. Hays. 2003. Are mangroves nursery habitat for transient fishes and decapods? Wetlands 23(2):449-458.

Shurin, J.B., P. Amarasekare, J.M. Chase, R.D. Holt, M.F. Hoopes, and M.A. Leibold. In press. Alternative stable states and regional community structure. Journal of Theoretical Biology.

*Shurin, J.B., and J.E. Havel. 2002. Hydrologic connections and overland dispersal in an exotic freshwater crustacean. Biological Invasions 4:431-439.

Shurin, J.B., and D.S. Srivastava. In press. New perspectives on local and regional diversity: Beyond saturation. In M. Holyoak, R. Holt, and M. Leibold, editors. Metacommunities: Spatial dynamics and ecological communities.

Smith, D., B. Lucey, L.A. Waller, J. E. Childs, and L. A. Real. 2002. Predicting the spatial dynamics of rabies epidemics on heterogeneous landscapes. Proceedings of the National Academy of Sciences 99:3668-3672.

Smith, F.A., J.H. Brown, J.P. Haskell, J. Alroy, E.L. Charnov, T. Dayan, B.J. Enquist, S.K.M. Ernest, E.A. Hadly, D. Jablonski, K.E. Jones, D.M. Kaufman, S.K. Lyons, P. Marquet, B.A. Maurer, K. Niklas, W. Porter, K. Roy, B. Tiffney, and M.R. Willig. In press. Similarity of mammalian body size across the taxonomic hierarchy and across space and time. American Naturalist.

Smith, F.A., S.K. Lyons, S.K.M. Ernest, K.E. Jones, D.M. Kaufman, T. Dayan, P.A. Marquet, J.H. Brown, and J.P. Haskell. 2003. The body mass of late Quaternary mammals. Ecology, 84:3403 and Ecological Archives E084-094.

Smith, K.F., and J.H. Brown. 2002. Diversity range and body size among pelagic fishes along a gradient of depth. Global Ecol. Biogeog. 11:313-322.

Snelgrove, P.V.R., and C.R. Smith. 2002. A riot of species in an environmental calm: The paradox of the species-rich deep-sea floor. Oceanography and Marine Biology: An Annual Review 40:311-342.

* Stevens, R. D. 2004. Untangling latitudinal richness gradients at higher taxonomic levels: familial perspectives on the diversity of New World bat communities. Journal of Biogeography 31:665-674.

Stevens, R.D., S.B. Cox, M.R. Willig, and R.E. Strauss. 2003. Patterns of functional diversity across an extensive environmental gradient: vertebrate consumers, hidden treatments, and latitudinal trends. Ecology Letters 6:1099-1108.

Stevens, R.D., M.R. Willig, and I. Gamarra de Fox. In press. Comparative community ecology of bats in Eastern Paraguay: Taxonomic, ecological, and biogeographic perspectives. Journal of Mammalogy.

*Strausberger, B.M., and M.V. Ashley. 2003. Breeding biology of brown-headed cowbirds characterized by parent-offspring and sib-group reconstruction. Auk 120:433-445.

* Strayer, D. L., R. E. Beighley, L. C. Thompson, S. Brooks, C. Nilsson, G. Pinay, and R.J. Naiman. 2003. Effects of land-cover change on stream ecosystems roles of empirical models and scaling issues. Ecosystems 6:407-423.

Stuart, C.T., M.A. Rex, and R.J. Etter. 2003. Large-scale spatial and temporal patterns of deep-sea benthic species diversity. Pages 295-311 In P.A. Tyler, editor. Ecosystems of the World: Ecosystems of the Deep Oceans, Elsevier, Amsterdam.

Tabor, G.M., R.S. Ostfeld, M. Poss, A.P. Dobson, and A.A. Aguirre. 2001. Conservation biology and the health sciences: research priorities of conservation medicine. Pages 155-174 In M.E. Soule and G.H. Orians, editors. Conservation biology: Research priorities for the next decade. Island Press, Washington, DC.

Torchin, M.E., K.D. Lafferty, A.P. Dobson, A.P. Mckenzie, and A.M. Kuris. 2003. Introduced species and their missing parasites. Nature 421:628-630.

Townsend, A.R., R.W. Howarth, F.A. Bazzaz, M.S. Booth, C.C. Cleveland, S.K. Collinge, A.P. Dobson et al. 2003. Human health effects of a changing global nitrogen cycle. Frontiers in Ecology 1:240-246.

Turchin, P., C.J. Briggs, S.P. Ellner, A. Fischlin, B.E. Kendall, E. McCauley, W.W. Murdoch, and S.N. Wood. 2002. Population cycles of the larch budmoth in Switzerland. Pages 130-141 In A.A. Berryman, editor. Population Cycles: the Case for Trophic Interactions. Oxford University Press, New York.

Turchin, P., S.N. Wood, S.P. Ellner, B.E. Kendall, W.W. Murdoch, A. Fischlin, J. Casas, E. McCauley, and C.J. Briggs. 2003. Dynamical effects of plant quality and parasitism on population cycles of larch budmoth. Ecology 84:1207-1214.

Vázquez, D.P., and M.A. Aizen. In press. Asymmetric specialization: a pervasive feature of plant-pollinator interactions. Ecology.

Vázquez, D.P., and M.A. Aizen. Community-wide patterns of specialization in plant-pollinator interactions revealed by null models. In press. In N.M. Waser, and J. Ollerton, editors. Specialization and generalization in plant-pollinator interactions. University of Chicago Press.

Vázquez, D.P., and D. Simberloff. 2003. Changes in interaction biodiversity induced by an introduced ungulate. Ecology Letters 6:1077-1083.

Vegi, S., and G.F. McCracken. Microsatellite genotypes if bug brown bats (Eptesicus fuscus: Vespertilionidae, Chiroptera) obtained from feces. Acta Chiroptologica 3:237-234.

Vucetich, J.A., and R.O. Peterson. In press. The influence of top-down, bottom-up, and abiotic factors on the moose (Alces alces) population of Isle Royale. Proceedings of the Royal Society of London, B.

Wagner, F.H. 2001. Freeing agency research from policy pressures: A need and an approach. BioScience 51:445-450.

Waller, L., D. Smith, J. Childs, and L. Real. 2003. Monte carlo assessments of goodness of fit for ecological simulation models. Ecological Modeling 164:49-63.

Walters, C., and J.F. Kitchell. 2001. Cultivation/depensation effects on juvenile survival and recruitment: implications for the theory of fishing. Canadian Journal of Fisheries and Aquatic Sciences 58:39-50.

Ward, J., and K. Lafferty. 2004. The elusive baseline of marine disease: Are diseases in ocean ecosystems increasing? Public Library of Science 2(4):542-547.

Watchman, L.H., M. Groom, and J.D. Perrine. 2001. Science and uncertainty in habitat conservation planning. American Scientist 89(4):351-359.

Walters, G.M., R.J. Olson, R.C. Francis, P.C. Fiedler, J.J. Polovina, S.B. Reilly, K.Y. Aydin, C.H. Boggs, T.E. Essington, C.J. Walters, and J.F. Kitchell. 2003. Physical forcing and the dynamics of the pelagic ecosystem in the eastern tropical Pacific: Simulations with ENSO-scale and global-warming climate drivers. Canadian Journal of Fisheries and Aquatic Sciences 60(9): 1161-1175.

West, G.B., Woodruff, W.H., and J.H. Brown. 2002. Allometric scaling of metabolism from molecules and mitochondria to cells and mammals. PNAS 99:2473-2478.

Wilf, P., and K. Johnson. In press. Land plant extinction at the end of the Cretaceous: A quantitative analysis of the North Dakota megafloral record. Paleobiology.

*Williams J.W. and S.T. Jackson. 2003. Palynological and AVHRR observations of modern vegetational gradients in eastern North America. Holocene 13:485-497.

*Willig, M.R., D.M. Kaufman, and R.D. Stevens. 2003. Latitudinal gradients of biodiversity: Pattern, process, scale, and synthesis. Annual Review of Ecology, Evolution, and Systematics 34:273-309.

Wilson, W.G., P. Lundberg, D. Vazquez, J.B. Shurin, M. Smith, B.T. Langford, K.L. Gross, and G. Mittelbach. 2003. Biodiversity and species interactions: Extending Lotka-Volterra community theory. Ecology Letters 6: 944-952.

* Wright, S. J., H. C. Muller-Landau, R. Condit, S. P. Hubbell, and R. B. Foster. 2003. Gap-dependent recruitment, realized vital rates, and size distributions of tropical trees. Ecology 84:3174-3185.