National Center for Ecological Analysis and Synthesis

2001-2007
Report to the National Science Foundation

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Introduction

Ecologists seek to understand complex, dynamic biotic and abiotic interactions across many scales. Such understanding is fundamental to our ability to sustain, manage

and restore healthy, functioning ecological systems in the face of unprecedented human modifications and environmental change (Green et al. 2005, BioScience 55: 501-510). Although considerable progress has been made in advancing ecological knowledge, vast amounts of relevant information about ecological patterns and processes remain largely inaccessible because they exist in widely disparate locations and formats and the culture of synthesis is not widespread (Jones et al., 2006, Ann. Rev. Ecol. Evol. Syst., 37: 519-544).

Recognizing the potential value of existing complex data sets and the need for new approaches to assembling, accessing and synthesizing this information, the ecological community rallied around the notion of creating a synthesis center - a unique facility to promote access to ecological information, analytical tools, and collaborations among ecological scientists. In 1994, NSF initiated a special competition for a center for ecological analysis and synthesis. After extensive review, the award was made to the University of California, Santa Barbara. The National Center for Ecological Analysis and Synthesis (NCEAS) began operation May 1, 1995, under the guidance of the original PIs William Murdoch (who served as interim Director for the first year) and Michael Goodchild. NCEAS began with a specific mission and set of goals articulated by the ecological community through a series of national workshops. In just ten years, NCEAS has surpassed expectations for the number of people who would be directly influenced by NCEAS - for example, the original NCEAS proposal projected that NCEAS would receive 1,100 visitors by the end of this reporting period, and we have now surpassed 4,100 total unique visitors. The ISI Essential Science Indicators reported in 2005 that NCEAS placed #22 out of 38,000 institutions worldwide in terms of publication impact in ecology and environmental science, based on the large number of high-impact journal articles from NCEAS scientists (Appendix 1). The success of the postdoctoral program has been evident, with 90-95% placement of postdoctoral associates into career positions (Table 1) and multiple “young investigator” awards and high-profile publications. In this very short time, relative to the history of the discipline, NCEAS has enabled ecologists to overcome many intellectual and technical barriers to synthesis and has dramatically altered the culture of ecological research.

The vision for NCEAS has been to catalyze a new culture of synthesis. The NCEAS research model mixes junior and senior ecologists with scientists from other disciplines and resource managers in small, interactive groups. This model for collaboration has been particularly successful with 1) interdisciplinary syntheses that bring together people who have not collaborated before to focus on novel questions and approaches and 2) intensive, sustained investigations to make progress in core areas of ecology. Over the next 5 years we plan to continue to serve the ecological community by cultivating a new generation of ecologists who merge interdisciplinary interactions, intensive analysis or modeling, and the technology and culture of information management with their inherent intellectual curiosity and commitment to yield important, scholarly research.

Below, we provide information about the array of activities at the Center. We concentrate on the major features of the Center’s research activities. A comprehensive list of NCEAS projects (Appendix 1), and other documentation and ancillary information are available in

appendices and on the web (www.nceas.ucsb.edu/). All figures and tables cited in the text are provided in Appendix 2.

The Center's Mission

The Mission for the Center is quite broad and, as the name implies, its primary objectives are analysis and synthesis. Analysis includes the examination of large data sets, analytical work on ecological patterns and processes, computer models and simulations, and the development of theory. Synthesis includes the amalgamation of data and the integration of ideas. The nature of the Center's activities, which promote planned and serendipitous interactions, significantly increases the opportunities for novel solutions to important questions.

The Mission of NCEAS is to:

- *Advance the state of ecological knowledge through the search for general patterns and principles in existing data*
- *Organize and synthesize ecological information in a manner useful to researchers, resource managers, and policy makers addressing important environmental issues*
- *Influence the way ecological research is conducted and promote a culture of synthesis, collaboration, and data sharing*

This third aspect of the Mission was added to our website and documents at the end of the last reporting period. It may have been presumptuous to propose this when NCEAS began, but it now appears that NCEAS is having such an influence. Graduate students, interns, and Postdoctoral Associates are learning the skills of true synthesis and senior scientists are adopting readily the NCEAS model of collaboration. It is virtually impossible to convey in writing what may be the essence of NCEAS – that intense spark of insight and scholarship that can emerge when individuals from disparate disciplines focus on a question (Pickett, 1999, Oikos 87: 479-487). Indeed, across the sciences, teams increasingly dominate over solo authors in the production of highly cited research, suggesting that fundamental changes in knowledge production are taking place, and that synthetic work is increasingly valued (Wuchty et al., 2007, Scinece 316: 1036-1039).

NCEAS operates under five goals established early in the Center's development:

1. *Develop opportunities that accelerate and initiate paradigms* – it is difficult to identify *a priori* those areas or topics that will yield the next important advance in a discipline or ensure that advances will actually be made. However, an effective approach is to employ an operational model, establish an intellectual atmosphere and provide a physical setting that maximize the possibility that important research will be conducted. The caliber of research conducted by visitors to the Center, as revealed by publications and other products, provides evidence of the value of these unique opportunities.

2. *Make NCEAS the facility where scientists look to support analysis and synthesis of existing ecological information using creative approaches* – Over 4,100 scientists from 49 states and 49 countries have participated in NCEAS research activities. The Center now receives 100 or more proposals annually, 19% of which are supported (Figure 1). While the trend in Figure 1 is familiar to funding agencies – increasing proposals with a steady funding rate – NCEAS trends may suggest a slightly different interpretation; NCEAS does not support individuals' research programs (e.g., salaries, laboratory supplies, While it is difficult to assess who actually knows about NCEAS and who contemplates research at the Center, the increasing number of proposals submitted (Figure 1) , the increasing number of unique visitors (Figures 2 and 3), the breadth of the disciplines represented (Table 2, 3) across the increasing number of publications (Figure 4), and the range of their home institutions and countries (Tables 4, 5, and 6) suggest that the Center is broadly known and utilized. The Center continually strives to increase diversity of participants and to maintain gender balance (Figure 5).

3. *Maintain a Center with a national character and broad interests* – In addition to the breadth of participation, research at the Center spans all of ecology and many adjacent disciplines, from genetics to evolutionary ecology and ecological economics and 21% of the visitors are international. Every effort has been made to keep NCEAS from succumbing to one approach, sub-discipline, or view of ecology, and the Center has broad geographic, institutional, and intellectual representation.

4. *Provide information to scientists, managers, and policy makers* – By its very nature, NCEAS research depends on large amounts of data. Because ecological data are inherently complex and heterogeneous the Center has developed skills and tools to address many components of information management. Initially, this was done project-by-project and we expect this customized support to continue. Since the last reporting period, we have greatly expanded our efforts to facilitate data synthesis through the Ecoinformatics program at NCEAS. Along with several collaborating institutions, we are developing generic solutions to managing complex ecological information. The goal is to make all aspects of the data stream as coherent and convenient as possible by technologically and culturally promoting data access. In addition, the Center has supported several efforts to facilitate access to that information by managers and policy makers.

5. *Maintain a Center that provides flexible, convenient support for visiting scientists* – The Center is flexible both operationally (scheduling and supporting meetings and resident scientists and providing customized computing support) and scientifically (allowing projects to evolve toward newly discovered questions and approaches). This flexibility promotes an interest and willingness to take on a major research effort, and leads to effective collaboration.

Evidence of Progress

NCEAS should be judged by the scope and significance of the research it supports, and by the degree to which these activities influence the way we conduct our science. By traditional metrics, NCEAS has been a resounding success.

• In 2005, ISI's In-Cites contacted NCEAS for an interview with the Director, as they were reporting that NCEAS had reached the top 1% of institutions worldwide working in ecology and the environment (38,000 institutions in total) in terms of number of citations per articles, and that NCEAS was thus ranked #22 out of these 38,000 international institutions in publication impact in ecology and the environment. These numbers are very conservative, because they are based on institutional affiliations, rather than acknowledgements. Only 40% of NCEAS products have NCEAS listed as the institutional affiliation for one or more of the authors. (http://www.in-cites.com/institutions/NatCenterEcoAnalSynNCEAS.html)

• The 4,100+ scientists participating in NCEAS research activities since the Center's establishment have produced more than 1,100 peer-reviewed papers (Figure 3) in over 200 journals, including many leading publications.
• NCEAS continues to foster productive research collaborations – during this reporting period, 2,565 scientist participated in 124 Working Groups, 5 Distributed Graduate Seminars, 59 Postdoctoral Fellowships, and 45 Sabbatical Fellowships.
• NCEAS participants belong to more than 489 different scientific societies
• In addition to results from specific projects, numerous anticipated but unpredictable interactions have taken place between and among resident and visiting scientists, resulting in significant new research collaborations;
• A number of projects have developed major synthetic data sets that will have significance to the broader ecological community (Appendix 1);
• During this reporting period, Postdoctoral Associates have accepted positions at a variety of vibrant academic and non-academic institutions (Table 1);
• NCEAS has become a major participant in emerging informatics research efforts – for example, awards for which NCEAS Ecoinformatics has had significant involvement total approximately $25M;
• NCEAS' resident scientists are involved in the science curriculum of the Santa Barbara School District and the Center serves as the "database manager" for the 5th grade science classes;
• The results of Center research have received recognition in local, regional, and national press including SCIENCE, NATURE, the NY Times, LA Times, National Public Radio, Public Television, and other national television programs. The press release for a recent project on marine biodiversity (Worm et al., 2006, Science 314: 787-790) was the most downloaded press release from the NSF website for all of 2006, and possibly the most downloaded press release of all time for NSF;
• NCEAS projects have influenced public policy and resource management in many ways, from testimony before Congress to the development of analytical tools. Within the reporting period, Working Groups and resident scientists contributed to

California's planning process for establishing the Channel Islands Marine Protected Areas, and a Working Group's timely publication on pollinators' ecosystem services was used by the Congressional Research Service (Johnson, CRS Report for Congress: Recent Honeybee Declines, 31 May 2007) to inform lawmakers about Colony Collapse Disorder in 2007.

Overview and Highlights of Science Activities

Research Projects - NCEAS supports several types of research activities. The most distinctive are Working Groups – small groups that meet for several days to weeks multiple times a year. Unlike workshops, Working Groups actually conduct research at the Center. NCEAS also supports 4-6 Center Fellows (sabbatical visitors), 10-15 Postdoctoral Associates, and several graduate interns each year. A list of working groups, sabbatical, and postdoctoral research projects is provided in Appendix 1. Unlike the initial 5 years at NCEAS, in which the SAB requested up to 40% of the proposals submitted, nearly all of the proposals are submitted without the intervention of the SAB or NCEAS staff. The proposals are reviewed by the SAB and recommendations are made to the Director and Deputy Director.

Research at NCEAS stretches from genes to the biosphere and includes all levels of organization in between.

Here we highlight a few areas of research in which NCEAS groups have provided a great deal insight – these areas of research are also currently highlighted on our new website. Of course, these areas of research provide only a glimpse of the large breadth and body of work produced through NCEAS activities.

1. Highlighted Research - Ecological Effects of Climate Change

Scientists at NCEAS have been studying the ecological effects of climate change in-depth since the Center's establishment in 1995. NCEAS scientists are examining environmental, economic and social impacts of modern changes in temperature (global warming), atmospheric gases, precipitation, wind patterns, and the severity of storms.

The NCEAS approach is particularly useful in climate change research, because:

- analysis and synthesis of existing data allow researchers to understand the large-scale ecological responses to climate change that have already occurred, and to improve predictions of future change
- climate change topics are necessarily interdisciplinary, and benefit from the highly collaborative discourse among physical, biological and social scientists that can be facilitated by NCEAS
- Ecoinformatics principles and tools are especially useful for organizing and analyzing the large-scale, heterogeneous data used in climate change research

NCEAS scientists examine effects of climate change on plants and animals, and on important ecological processes like the flow of nutrients and gases through ecosystems. Scientists at NCEAS have used experimental data and long-term survey records, while also comparing recent climate change to the biological dynamics seen in "deep time" as represented by the fossil record. For example, NCEAS scientists have examined such diverse topics as:

- the expansion or shift of animal ranges in response to temperature changes (1)
- plant and soil responses to interactions of changing temperature, precipitation and CO2 (2,3)
- temperature and wind effects on ocean currents and marine life (4, 5)
- coral reef vulnerability to the severity of storms (6), direct effects of warming, and diseases that are favored by climate change (7)

The study of disease ecology has been a special area of research at NCEAS, particularly with respect to predicting disease dynamics under climate change scenarios.

Conservation biologists and natural resource managers increasingly want to know how climate change should factor into their management decisions. For example, NCEAS scientists have provided input for reserve design (8, 9) and wildlife management (10, 11). Many NCEAS researchers have integrated economic and sociopolitical concerns into ecological climate change studies, recognizing that management decisions must be based on many factors that are not strictly related to the natural sciences.

Databases pertinent to climate change research that has been done at NCEAS are freely available through the NCEAS Data Registry and Repository. For example:

- Greenhouse gas flux between the land and atmosphere for major regions of the world
- Carbon and nitrogen response to elevated CO2 in terrestrial systems - compilation of experimental results
- Hydrodynamics of vernal pools in central California

Selected Climate Change Citations

1. C. Parmesan et al., Nature 399, 579 (Jun 10, 1999).
2. G. R. Shaver et al., Bioscience 50, 871 (Oct, 2000).
3. B. A. Hungate et al., Science 302, 1512 (Nov 28, 2003).
4. G. M. Watters et al., Canadian Journal of Fisheries and Aquatic Sciences 60, 1161 (Sep, 2003).
5. M. I. O'Connor et al., Proceedings of the National Academy of Sciences in press (2007).
6. J. S. Madin et al., Nature 444, 477 (2006).
7. C. D. Harvell et al., Science 296, 2158 (Jun 21, 2002).
8. C. R. Pyke et al., Biological Conservation 125, 1 (Sep, 2005).
9. B. Halpern, in 10th International Coral Reef Symposium. (Okinawa, Japan, 2004).

10. N. Owen-Smith et al., in National Symposium on Global Change and Regional Sustainability in South Africa. (Cape Town, South Africa, 2003).
11. S. J. Martell, in 41st Annual Meeting of the Canadian Zoological Association. (Lethbridge, Canada, 2002)

2. Highlighted Research - Ecology of Infectious Disease

NCEAS has been a natural nucleus for disease ecology research as ecologists, evolutionary biologists, medical researchers, and social scientists increasingly seek crossdisciplinary collaboration to understand the interplay of disease, humans, and their environments. Many of these projects present challenges in data management since they frequently consider information as varied as disease reports, species interactions, and genetic data. Our Ecoinformatics team has worked closely with these groups to arrive at efficient solutions to data management, analysis and synthesis.

Human diseases
Many disease organisms that threaten humans worldwide have complex life histories that are affected by both human and non-human attributes of the ecosystems in which they occur. For example,

- Lyme disease is carried by ticks that move about on mammal hosts such as deer and mice - environmental parameters that affect these non-human hosts have implications for human exposure to Lyme disease (1)
- Rabies is a disease that is contracted by wildlife and can be passed on to humans. NCEAS researchers have assembled and analyzed an extensive database documenting rabid raccoons, refining predictions of rabies dynamics (2, 3)
- The bacterium causing the gastrointestinal disease cholera is waterborne and associated with microscopic crustaceans - climatic and environmental factors that affect hydrodynamics and the ecology of aquatic food webs can influence the dynamics of cholera (4-6)
- The brain parasite that causes toxoplasmosis is passed among rats, cats, and humans; in humans, infection is associated with lifelong personality changes that may influence human culture (7)
- NCEAS ecologists have formulated and applied cutting edge approaches in analysis and synthesis of human disease scenarios in recent years, improving our understanding of human disease risk (5, 8, 9)

Disease and ecosystems
Ecologists have a growing awareness of the importance of pathogens and parasites in the evolution and ecology of natural systems. Researchers at NCEAS have examined the evolutionary relationships between disease organisms and their hosts, as well as more modern alterations of pathogen and parasite dynamics by humans (10). For example:

- Introduced species have escaped many of the parasites of their native ranges (11, 12);
- The removal of predators that normally select sick individuals from prey groups may increase pathogen transmission among their populations, when diseased individuals continue living within groups (13);
- Primate researchers have examined the role of social and feeding behavior in moderating infection by sexually transmitted diseases and parasites in non-human primates (14-16);
- Disease is considered to be among the most significant causes of the modern coral reef decline, and warmer temperatures encourage some of the most common diseases on coral reefs (17);
- Environmental warming and human activities, such as fishing, may have complex disease effects as warm temperatures seem to favor some pathogens and parasites, while decreasing the prevalence or severity of others (18), and human activities alter host abundance, behavior and environment (19).

Climate change has been a special area of research at NCEAS as well, and several important projects have addressed the interactions of disease and climate change.

Databases related to pathogen and parasite ecology are freely available through the NCEAS Data Registry and Repository. For example:

- Prevalence of toxoplasmosis and associated personality traits in human populations
- The Global Mammal Parasite Database is a compilation of published parasite data for mammalian hosts

Selected Ecology of Infectious Disease Citations

1. B. J. Goodwin et al., Vector-Borne and Zoonotic Diseases 1, 129 (2001).
2. J. E. Childs et al., Proceedings of the National Academy of Sciences of the United States of America 97, 13666 (Dec 5, 2000).
3. C. Russell et al., Proceedings of the Royal Society B: Biological Sciences 271, 21 (2004).
4. K. Koelle et al., Proceedings of the Royal Society B: Biological Sciences 272, 971 (2005).
5. V. Guernier et al., PLoS Biology 2, e141 (June 01, 2004, 2004).
6. K. Koelle et al., American Naturalist 163, 901 (Jun, 2004).
7. K. D. Lafferty, Proceedings of the Royal Society B-Biological Sciences 273, 2749 (Nov 7, 2006).
8. J. M. Drake, PLoS Medicine 3, e3 (January 01, 2006, 2006).
9. K. F. Smith et al., Frontiers in Ecology and the Environment 3, 29 (Feb, 2005).
10. S. Altizer et al., Trends in Ecology & Evolution 18, 589 (Nov, 2003).
11. M. E. Torchin et al., Nature 421, 628 (Feb 6, 2003).
12. C. E. Mitchell et al., Nature 421, 625 (Feb 6, 2003).
13. C. Packer et al., Ecology Letters 6, 797 (2003).
14. C. L. Nunn, Animal Behaviour 66, 37 (Jul, 2003).

15. C. L. Nunn et al., American Naturalist 162, 597 (Nov, 2003).
16. C. L. Nunn et al., Proceedings of the Royal Society of London Series B-Biological Sciences 270, 347 (Feb 22, 2003).
17. K. D. Lafferty et al., Annual Review of Ecology, Evolution, and Systematics 35, 31 (2004).
18. C. D. Harvell et al., Science 296, 2158 (Jun 21, 2002).
19. J. R. Ward et al., PLoS Biology 2, 542 (Apr, 2004).

3. Highlighted Research – Economics and Ecology

Ecologists benefit from interactions with economists in at least two distinct ways: 1) ecology has historically borrowed and adapted analytical modeling approaches from economics, and 2) many of the environmental issue that ecologists work with are explicitly influenced by economics.

By bringing economists to work with ecologists and environmental scientists at NCEAS, we gain both analytical expertise and knowledge of the economic factors that play an important role in conservation and management decisions.

Together ecologists and economists collaborate to better understand human interactions with ecosystems. Natural environments provide important services to humans that may be lost when those systems are degraded. For example, coastal wetlands provide critical habitat for animals that are harvested, reduce shoreline erosion, filter water before it enters the ocean, and can buffer inland communities against storm surge. Ecologists and economists work together to identify and place values on such services for society. Where multiple management and conservation actions are being considered, economic expertise helps to identify the approach that achieves desired conservation and management goals while minimizing societal costs. Alternatively, economics provides a decision-making framework within which to maximize conservation benefits of an environmental policy given a fixed allocation of resources.

To catalyze greater collaboration among ecologists and economists, interdisciplinary teams of NCEAS researchers have engaged both research communities, publishing in the economics literature (1) and in the ecological literature (2). The fruits of such innovative cross-pollination are increasingly evident. For example:

- Large-scale management plans are evaluated in terms of both ecological and economic costs and benefits (3-5)
- Satellite imagery has been used to make large-scale estimates of the relative contributions of marketed products and ecosystem services to national economies, globally(6)
- A model has been developed to describe how declines of pollinators may affect markets for crops that require insect pollination(7)

- Alternative methods for extracting resources while minimizing environmental impacts can be evaluated with simultaneous consideration of ecological and economic factors(8)
- The value of a single species performing an ecosystem service, such as pest control in agriculture (9), can be calculated and compared to alternative methods of performing that service
- Applying ecosystem-based management in the oceans presents new challenges in ecology, economics and governance as the spatial scale at which we govern systems frequently does not match the spatial scale that is relevant to the organisms we manage(10)

This discourse between ecologists and economists has been invigorating for researchers at a fundamental level, as they break new ground in their respective fields, and provides management and conservation professionals with critical tools for decision making.

Selected Economics and Ecology Citations

1. Resource and Energy Economics 26 (Jun, 2004).
2. P. R. Armsworth et al., Trends in Ecology & Evolution 16, 229 (May, 2001).
3. S. Farber et al., Bioscience 56, 121 (Feb, 2006).
4. F. W. Davis et al., Ecology and Society 11 (Jun, 2006).
5. A. S. P. Pfaff et al., Ecological Economics 35, 203 (Nov, 2000).
6. P. C. Sutton et al., Ecological Economics 41, 509 (Jun, 2002).
7. P. G. Kevan et al., Conservation Ecology 5, art. no. (Jun, 2001).
8. J. F. Kitchell et al., Bulletin of Marine Science 74, 607 (May, 2004).
9. C. J. Cleveland et al., Frontiers in Ecology and the Environment 5, 238 (Jun, 2006).
10. L. B. Crowder et al., Science 313, 617 (August 4, 2006, 2006).

4. Highlighted Research - Marine Ecology and Conservation

Marine studies at NCEAS address fundamental questions about ecological and evolutionary processes, and provide information to resource management and conservation professionals. Hundreds of publications and presentations have been produced from NCEAS work in marine systems.

From the land to the deep sea

The rich marine habitats near the coast – such as estuaries (1), kelp forests (2), seagrass beds (3) and coral reefs (4) – provide important services to people, such as shoreline protection, water filtration, and key habitat for many organisms that are of commercial and cultural importance to humans. One concern where the land and fresh waters meet the ocean is the introduction of excess nutrients, which can lead to eutrophication of coastal waters and potentially to low oxygen levels, such as has happened in the “dead zone” of the Gulf of Mexico (5). Such connections increase the need for coordinated land and ocean conservation strategies (6). Fishing pressure in rich coastal habitats and in areas further offshore also can be substantial – the impacts of overfishing have been

examined at NCEAS through contemporary fishing records as well as historical and fossil records (7, 8).

At NCEAS, collaborations among ecological and social scientists (e.g., economists, political scientists, etc.) have used existing data to evaluate strategies that increase sustainability of marine fisheries (9, 10) and reduce unintentional fishing impacts on the environment, such as bycatch (11). Marine reserves have been proposed and established in many areas around the world with the aim of preserving biodiversity and ecosystem processes and potentially increasing local fish recruitment. A tremendous amount of research has been done at NCEAS to determine how the effectiveness of reserves can be maximized (12-14).

Deep sea research also has a home at NCEAS. The deep sea is the area of the ocean where no light penetrates. Once thought to be devoid of life, these remote ecosystems are surprisingly diverse, and NCEAS researchers have been synthesizing historical and emerging information and perspectives on these environments (15, 16). Many creatures in the deep sea are ancient, providing opportunities for rich evolutionary insights.

Similarly, the ocean floor holds vast records of past evolutionary patterns and ecological dynamics in the form of fossils. For example, by synthesizing available data from the marine fossil records, NCEAS researchers have found evidence for environmental controls on evolutionary rates (17) and intriguing patterns in the emergence of dominant and widespread biota following mass extinctions (18).

Marine species of concern

NCEAS has hosted many projects that examine the status of marine organisms of concern, from seagrasses to whales. The NCEAS research model brings together diverse researchers equipped with different data sources and perspectives, to examine threats to and recovery potential for marine species of management and conservation interest. For example, sophisticated population modeling of sea otters (19) allowed the comparison of likely results for several proposed management actions. In a retrospective analysis NCEAS researchers found that the removal of the North Pacific gray whale from the Endangered Species list, following its successful reestablishment, required a surprisingly modest economic investment from a managing agency (20), providing guidance to future conservation and management efforts.

Many marine studies at NCEAS have incorporated climate change scenarios and the dynamics of disease, and are discussed further in NCEAS research sections on climate change and ecology of disease.

Databases related to marine studies can be accessed through the NCEAS Data Registry and Repository. For example:

- Genetic data for foraminifera fossils
- Food web of Carpinteria Salt Marsh
- Marine disease and temperature

- Marine response to experimental nutrient enrichment

Selected Marine Ecology and Conservation Citations

1. M. W. Beck et al., Bioscience 51, 633 (August 01, 2001, 2001).
2. B. S. Halpern et al., Science 312, 1230 (May 26, 2006).
3. J. E. Duffy, Marine Ecology-Progress Series 311, 233 (2006).
4. J. M. Pandolfi et al., Science 301, 955 (Aug 15, 2003).
5. J. K. Craig et al., Marine Ecology-Progress Series 294, 79 (2005).
6. D. M. Stoms et al., Frontiers In Ecology And The Environment 3, 429 (Oct, 2005).
7. B. Worm et al., Science 314, 787 (Nov 3, 2006).
8. J. B. C. Jackson et al., Science 293, 629 (July 27, 2001, 2001).
9. J. F. Kitchell et al., Ecosystems 5, 202 (Mar, 2002).
10. D. E. Schindler et al., Ecological Applications 12, 735 (Jun, 2002).
11. J. F. Kitchell et al., Bulletin Of Marine Science 74, 607 (May, 2004).
12. Ecological Applications S13, 4 (February, 2003).
13. A. Hastings et al., Science 284, 1537 (May 28, 1999).
14. F. Micheli et al., Bulletin Of Marine Science 74, 653 (May, 2004).
15. R. J. Etter et al., Deep-Sea Research Part I-Oceanographic Research Papers 46, 1095 (Jun, 1999).
16. L. A. Levin et al., Annual Review Of Ecology And Systematics 32, 51 (2001).
17. A. P. Allen et al., Proceedings of the National Academy of Sciences of the United States of America 103, 9130 (Jun 13, 2006).
18. A. I. Miller et al., Science 302, 1030 (November 7, 2003, 2003).
19. L. R. Gerber et al., Ecological Applications 14, 1554 (Oct, 2004).
20. L. R. Gerber et al., Conservation Biology 13, 1215 (1999).

Overview of NCEAS Strengths

The NCEAS model provides three distinctive benefits:

1. Time – Productive scientists are extremely busy, and there is the sense that considerable time is being spent on unproductive activities at their home institutions. It is very difficult to find time to concentrate on intensive research for even a few hours without interruptions and various obligations. Visits to the Center isolate scientists from these responsibilities, allowing them to focus on research in creative, productive bursts of intellectual activity. Even the location of the Center allows scientists to optimize their time by moving between lodging, restaurants, and the meeting rooms on their own schedules, which often includes evenings and weekends.

2. Interactions – two types of interactions occur at NCEAS: organized and unanticipated interactions. While organized interactions through Working Groups represent the formal purpose of a NCEAS visit, the meetings are often loosely structured and most evolve rapidly toward productive aspects of the research question.
Perhaps even more important than organized interactions are the anticipated but unpredictable interactions that occur simply because people with overlapping interests are in the same place at the same time. This intellectual by-catch results when individuals

have coffee or lunch together and discover they have a shared interest in a topic that may not be associated with the purpose for which either came to NCEAS. In summer 2006, the NCEAS staff was delighted to find that 2 concurrent Working Groups were spontaneously conducting a "meta-Working-Group" meeting in the lounge, and the staff quickly organized their technical and hospitality support to facilitate this unexpected brain-storming session. These chance meetings can spin off into distinct projects and lasting collaborations, generating complex phylogenies of ideas and results.

3. Flexibility – an important characteristic of NCEAS research projects is that they rarely end up as proposed. The projects often move laterally as the investigators pursue the most pertinent and productive elements of their research questions. In the intellectually open atmosphere engendered at NCEAS, scientists naturally move toward the most interesting areas of inquiry. Some have wondered whether supporting risky or innovative projects would lead to high "failure" rates – projects that attempt truly new approaches should be more prone to failure than redundant research. The flexibility provided to NCEAS projects reduces the chance of true failures and actually fosters innovation and creativity. In addition, the Center often supports changes in the direction of a group by funding an additional participant(s) when the group discovers that one area of expertise is missing or supporting additional meetings. In a recent Distributed Graduate Seminar (De Clerck et al.), native Spanish-speaking students in Costa Rica began to fall behind in the weekly chat sessions conducted in English; NCEAS was able to reimburse payments for a translator to facilitate the chat sessions in Costa Rica. Because of the high involvement of Spanish-speaking participants in Central America, this group was able to synthesize both Spanish and English language literature, and has submitted their first publication in a Spanish language journal, with English language contributions to follow.

Other Important Features of NCEAS

Research Scope - Research results represent the most important aspect of NCEAS' activities. The evaluation of research presented above indicates that the Center's scientists have made major intellectual contributions that are broadly representative in terms of topic, geography, gender, and institutions represented.

Postdoctoral Research - One measure of the effectiveness of NCEAS is reflected by the Postdoctoral Associates. Their extraordinary success (in terms of publications and positions accepted) no doubt is due both to the quality of postdoctoral applicants and their scholarship once they arrive at NCEAS. Initially there was some concern that the NCEAS postdoctoral associates were "mentorless". Accordingly, we provide funds to allow them to visit a mentoring scientist or bring them to the Center for short visits. However, this has not been a problem and the Associates essentially have access to dozens of possible mentors from among the hundreds of visitors to NCEAS. This innovative postdoctoral program was highlighted in a recent Nature feature (Powell, 2007, Nature 446: 226-228).

Graduate Interns have been much more important to the Center than was originally imagined. Interns often develop and maintain data sets for Working Groups, and participate in their intellectual activity. Interns have come from a variety of

Departments on the UCSB campus. In addition, we sometimes support Interns at the home institutions of the Group Leaders. This is advantageous because it uses less space at NCEAS and provides effective local supervision.

Outreach – The major outreach activity at NCEAS involves scientific publications and presentations at scientific meetings. The Center is almost entirely web-based, and we receive contacts from numerous domains through the web. In addition, the Center is involved in a myriad of outreach activities to other audiences. Perhaps the most intriguing involves the Kids Do Ecology program, in which NCEAS scientists contribute to the science curriculum for the 5th grade in the local school district. The Center's scientists work with classes to develop experiments and observations, to foster enthusiasm for ecology and to understand the scientific process. Data gathered in the projects, as well as other community projects for kids (e.g., classifying and quantifying trash on beaches) are hosted on our web site under Kids Do Ecology.

Relationship with Campus - NCEAS has broad support from scientists and the administration on the UCSB campus. Regular contact is maintained with campus scientists, 281 of whom have participated in NCEAS research activities between 2001 and 2007. In addition, NCEAS scientists provide a substantial portion of the seminar speakers for the Ecology, Evolution, and Marine Biology Department and hold weekly EcoLunch seminars at NCEAS that are open to the scientific community. During the reporting period, NCEAS hosted approximately 200 EcoLunch Seminars that were attended by UCSB and other local scientists (e.g., National Marine Sanctuary). With hundreds of visiting scientists passing through each year, NCEAS is in a unique position to showcase diverse research efforts in these seminars; the Postdoctoral Associates have extended invitations to speakers ranging from renowned ecological statisticians (e.g., Pierre Legendre) to experimental ecologists (e.g., Sebastian Diehl, Sally Hacker) and theoretical ecology (e.g., Pablo Marquet) to those working on social dimensions of science (e.g., Chris Costello, Ed Hackett). The Director and Deputy Director organize career development discussions and analytical workshops, primarily for Postdoctoral Associates, to which UCSB and other local scientists are invited. The university's administration has assisted the Center in many ways and frequently acknowledges the Center's contributions to campus and the University of California.

The Science Advisory Board, whose 19 members are drawn from appropriate disciplines and organizations, plays a major role in the success of the Center (Table 7). The SAB provides advice on specific proposals and research activities, and on more strategic matters. The SAB is independent from the Director, and nominates and elects its own members. The SAB makes an explicit effort to include non-ecologists (e.g., economists) and agency scientists in addition to academic ecologists.

Education of senior scientists – a number of senior scientists highlight their learning experiences in NCEAS research activities. Specifically, they note that while short term visits with scientists and listening to seminars are beneficial, participation in a working group or spending a sabbatical visit at the Center provides a much deeper learning experience. Thus, unlike workshops that rely on combined wisdom and expert opinion,

the activities at NCEAS seem to promote true learning and new understanding, even among the experts.

Management and conservation oriented research activities – Conservation and Resource Management projects are clearly a rapidly increasing component of the NCEAS research and training portfolio. External funding for these projects has increased to the extent that NCEAS has created a special Conservation and Resource Management program to manage these projects, while continuing to support such applied work through the NSF funding.

The traditional model of information transfer involves scientists handing off the results of a study to resource managers for application. Many attempts have been made by agencies and institutions to promote this type of transfer, but logistic and cultural characteristics of the entities and individuals involved make it difficult. Rather than employing the typical information transfer format, Center research results and recommendations have been passed on through less traditional routes, often with scientists getting directly involved.

Training – Although the original NCEAS proposal contained training workshops, a majority of the training efforts have been less traditional (e.g., the Distributed Graduate Seminars). Graduate interns are full collaborators in Working Groups, gaining insights into research and its culture that cannot be obtained in a traditional setting. Postdoctoral Associates also develop collaborative skills, and the recognition that synthesis is a valid form of research. As noted earlier, senior scientists often gain new insights and skills at NCEAS rather than simply learning new facts. In addition to these less formal training activities, NCEAS does provide training workshops in response to requests by resident scientists – primarily postdocs – on topics such as statistics, modeling, and career development. Occasionally, sabbaticals initiate workshops by offering to teach a short workshop on a topic in which they have distinctive knowledge, such as ecological modeling or scientific writing or publishing.

Location – NCEAS was initially located off campus in downtown Santa Barbara because space was not available on campus, and there was interest in developing it as a national rather than university-specific center. Many imagined that NCEAS would move to campus as soon as space was available. In the meantime however, the downtown location has become an important part of the NCEAS model. At one level, the convenience and ambiance of the location promotes a productive atmosphere. Visitors can walk from their hotels to the Center, and meals are available at all hours, unlike locations near campus. More importantly, visitors often state that by being off campus the Center has a different "feel" – that coming to this location promotes the sense that something distinctive is happening. Even scientists on campus now seem to appreciate the opportunity to come to the center and get away from their daily responsibilities. Originally there was concern about reduced access to campus resources such as the library. With electronic library resources in much higher demand than hardcopy, proximity to such campus resources became essentially a "non-issue" during this reporting period. In any event, visiting scientists do not use library material as much as we originally imagined, since the NCEAS Working Group participants often deal with

data rather than publications. We also provide a courier service that will obtain articles and books as needed and resident scientists are given full library privileges.

Several aspects of NCEAS' activities need improvement. In a few cases, chronic situations have been difficult to resolve, such as involvement of underrepresented groups and release of data to the public by NCEAS scientists. Further, we and others recognize untapped potential for greater synergy between the Ecoinformatics research group and core research activities at the Center. These issues and appropriate plans for action that are being undertaken under the present award (i.e., 2007 – 2012) are described in much greater detail in the NCEAS renewal proposal submitted for Award #DEB-0553768.

Significance of NCEAS

Evidence suggests that the National Center for Ecological Analysis and Synthesis is meeting its mission and has exceeded the goals imagined for such a Center. Numerous scientific contributions have been published in major journals, over four thousand scientists have visited NCEAS, the Postdoctoral Associates are having remarkable success securing good academic positions, and non-traditional approaches are being employed for research, education, and outreach. Visitors appreciate the opportunities provided by the NCEAS model, and testimonials abound as to the effectiveness of this approach.

It is reasonable to ask whether the results of NCEAS projects could have happened in the absence of the Center. In some cases, the answer clearly is no. In other cases, where projects could have happened under other circumstances, the real question is, would they have? At the very least, it appears that synthetic efforts occur sooner and more efficiently with the opportunities at NCEAS and that the Center promotes a new way of conducting scientific research in our discipline and of generating distinctive, significant results.

As important as the research conducted at Center is, a longer lasting legacy may come from the nature of the research process at NCEAS. The essence of this approach is to bring together individuals who have much to learn from each other and facilitate their opportunities to interact intellectually. This is actually a very simple model that provides time, flexibility and opportunities for interactions. While most scientists probably imagined these would be aspects of the intellectual life they were joining, these elements are difficult to secure in circumstances filled with many ancillary obligations that impinge on scholarship. Scientists need a place like NCEAS that is dedicated to these intellectual ideals.

Appendix 1 – Projects, People, Publications, and Products 2001-2007

Project descriptions, NCEAS scientists, and major products from NCEAS research.

Working Groups

Primary Working Group leader, titles, and abstracts for Working Groups supported between 2001 and 2007.

Abrams, Peter
Extending, synthesizing, and applying recent advances in competition theory

Theoretical work on interspecific competition over the past 15 years has been characterized by the inclusion of an increasing amount of detail regarding the mechanism of population interaction. In comparison with previous work, recent theory has included more explicit descriptions of: (1) spatial and temporal variability; (2) adaptive behavior and/or evolution; and (3) between-individual differences in characteristics affecting competition. These studies have been undertaken largely independently, and many have been based on specific systems or assumptions. This proposal has two goals: (1) to explore the relationships between, and the interaction of these three components of the mechanism of competition; and (2) to determine if there is empirical evidence for the more general predictions uncovered by work related to the first goal. The second goal will also encompass plans for future empirical studies if evidence is lacking in past work. The working group will include investigators who have been actively involved in developing recent theory as well as empirical biologists who have had experience in meta-analysis of published experiments. The tangible results of the working group will be several joint theoretical papers and meta-analyses of published work, and proposals for empirical studies to apply the theory developed here.

Altizer, Sonia
Understanding the ecology and evolution of infectious diseases in mammalian mating and social systems

Variation in animal mating and social behavior has important consequences for the origin and persistence of infectious diseases. These behavioral processes determine local host density and govern the type and frequency of contacts that occur within and among groups of animals. Ecologists have made great progress in understanding infectious disease dynamics operating on ecological time scales, yet next to nothing is known about patterns of disease at broad evolutionary scales. Given the increasing availability of

information on socio- ecological parameters and disease in wild populations, along with robust phylogenies, the time is right to integrate efforts across these levels of analysis. Thus, our interdisciplinary working group will coordinate empirical and theoretical approaches to investigate how host social organization and mating behavior affect the maintenance and spread of infectious diseases in mammals. We will use large datasets and phylogenies in three groups of mammals, primates, ungulates, and carnivores, to conduct phylogenetically controlled comparative studies and formulate predictive models of the consequences of variation in socio-ecological parameters for disease risk. Simultaneously, we will use computer simulations and population modeling techniques to generate predictions that can be examined with the comparative data. By filling the enormous gaps in our knowledge regarding the links between disease and mating and social systems, our study will identify key factors responsible for the dynamics and evolution of infectious diseases in animal populations.

Alroy, John
Paleobiology Database (Hosted by NCEAS)

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.

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

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.

Andelman, Sandy
Review of Forest Service Viability Assessment Processes

The regulations implementing the National Forest Management Act (NFMA) direct the National Forests to provide habitat that will support viable populations of native and desired non-native vertebrate species well-distributed across National Forest lands. A proposed revision of these regulations would extend this requirement to additional species in the plant and animal kingdoms, but provide for significant qualifications in the way the requirement is applied to many species in recognition of the natural history and existing condition of those species and their habitat. Since the existing regulation went into effect in 1982, a variety of approaches has been used to meet the viability requirement. Approaches have ranged from opinon-based assessments of individual resource specialists to detailed habitat and demographic modeling. many Forest Plans have been challenged on either the adequacy of the management guidelines for species, or the adequacy of the process used to demonstrate that viability requirements have been met. The Forest Service is now making a renewed effort to provide consistent and high

quality input to forest plans related to viability. The results of this external review will be used in the development of guidance to National Forests for addressing species viability in land and resource management plans.

Andelman, Sandy
Kruger National Park and NCEAS collaboration on the KNB (Hosted by NCEAS)

Ashman, Tia-Lynn
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.

Aukema, Juliann
Economic impacts of non-native forest pests and pathogens in North America (TNC)

The ecological effects of many non-native forest pests and pathogens in North America have been well documented. The economic costs of these effects, however, have not been estimated credibly. NCEAS will synthesize ecological data on forest invaders and conduct complementary economic analyses. This will allow us to inform decisions regarding alternative strategies for controlling forest invaders. The project will examine the extent to which current knowledge allows credible prediction of the effects of emerging pests and pathogens. We also will investigate the economic impacts of non-native forest insects and diseases on ecosystem services provided by forests. Integration of ecological and economic data will lead to development of least cost / greatest benefit approaches that can be implemented by practitioners.

Beck, Michael

Evaluation of the nursery role of wetlands and seagrasses for better conservation and management

Wetland (herein, estuarine marsh and mangrove) and seagrass habitats are extraordinarily productive, and are believed to play a nursery role in which juvenile fish and shellfish occur at high densities, avoid predation, grow quickly, and then migrate offshore to appropriate adult habitat. The nursery role of these habitats is a pervasive concept, and it is important in research, conservation, and management. There is, however, growing recognition that the evidence that supports this paradigm is not cohesive and sometimes weak or contradictory. A clear understanding of the importance of seagrass and wetland habitats in the life cycles of marine species is urgently needed, because these habitats are declining rapidly worldwide. In the USA, the recently revised Magnuson Fishery Conservation and Management Act requires all eight Regional Fishery Management Councils to define, protect, and restore "Essential Fish Habitat". If seagrasses and wetlands are nursery grounds then new measures can and should be directed towards their conservation as Essential Fish Habitat.

Our goal is to form three small working groups to critically evaluate the nursery role concept for seagrass and wetland habitats. We will determine the extent to which the density, survival, and growth of animals are greater in these habitats than elsewhere and examine the characteristics of these habitats that most affect secondary productivity. We will also use bioenergetic simulation models to estimate the contribution of seagrasses and wetlands to offshore secondary production and examine the predicted effects of the continued loss of these habitats. We plan to synthesize and make these results useful not only to scientists but also to NGO's, and state and government agencies to better inform management and conservation of coastal environments.

Bohannan, Brendan
Patterns in microbial biodiversity

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.

Bohannan, Brendan
Patterns in microbial biodiversity (Extended)

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.

Brooks, Thomas
Synthesis of the biodiversity knowledge base: Towards a global database of terrestrial vertebrate distributions

We propose a working group of ecologists, species experts and NGO representatives to establish a synthesis of global terrestrial vertebrate distributions. Distributions of vertebrates have been mapped by various authors and institutions at different taxonomic and geographic extent, resolution and accuracy. The amount of information and the techniques to handle large quantities of spatial data have now reached a level, which would allow data synthesis for this group at a global scale. The aims of the proposed working group are to facilitate accessibility of currently non-public datasets, to identify and act on filling the remaining gaps of distributional knowledge, and to analyze the resulting databases. The benefits are many-fold. The synthesis will enable standardized quantification of threat of extinction from small range size alone for all terrestrial vertebrates. It will boost efficiency of large-scale conservation priority setting by an unbiased identification of patterns of between- site complementarity in species representation. It will allow rapid assessment of vertebrate diversity of regions under threat of change. It will act as a coarse-resolution basis for deductive modeling of species' fine-scale distribution. Furthermore it will allow methodologically rigorous scrutiny of traditional hypotheses of determinants of species distributions and is likely to trigger significant advancement of the field of large-scale ecology. The proposed working group shall act as a base for both the necessary data synthesis and subsequent collaborative analysis and dissemination of the compiled data.

Brown, Gardner
Biggest Bang for the Buck: Really melding demographic theory with economics

Because society has limited resources, the recovery of endangered species must contend with scarcity. Ecologists may be able to identify a host of beneficial management actions, but economics resources (and political will) are rarely sufficient to pursue all of those actions. An important question to address, then, is the following: Among the many possible actions that can aid the recovery of a species, which ones should be given higher priority? In practice, these decisions are informed by an ad hoc mixture of

biological data, demographic theory, economic information, and politics. Although we cannot improve the political process, there is room for substantial improvements in how the economics and ecology are combined when addressing the issue of priorities.

First it is worth noting that both ecologists and economists often feel they do address priorities within the context of their own disciplines. For example, when ecologists calculate so-called elasticities in demographic matrix models the implication is that in doing so, they are identifying those opportunities for management that will yield the largest improvements in annual rate of population growth (l) per unit increase in survival. The prominence (and limitation) of this ecological theory aimed at priority-setting is highlighted by a recent collection of papers in Ecology (Heppell et al. 2000). Unfortunately, examinations that focus only on demographic parameters and do not explicitly include economics really do not get at the question of "biggest bang for the buck" (BBB). Conversely, economists make eminently reasonable-sounding recommendations about conservation priorities using cost-benefit analyses, or perhaps even formal economic optimization algorithms. Unfortunately, these purely economic analyses, which consider costs and benefits without regard to demographic responses, cannot really provide an apt description of net ecological benefits. A gap needs to be closed. We intend to bring together a small group of economists and ecologists to develop formal analytical tools that combine ecological and demographic processes into the same framework, and form the question "where do we get the biggest bang for the buck?" in the way we think it should be asked. To ground the theory in the real world we will apply our analyses to two important ecological case studies: managing for the recovery of loggerhead sea turtles in southeastern United States, and managing for the recovery of chinook salmon in Northwestern United States. Our project will provide both practical results for real-world decisions, and the development of methods and theory that combine demographic matrix theory with economic approaches.

Burgman, Mark

Developing and testing methods for classifying species conservation status and estimating risk

Decisions about species conservation status have critical implications for allocation of public and private funding, land use planning decisions, and regulatory actions. Currently, a broad range of methods is used to classify species conservation status at a variety of geographic scales (e.g., local, national, international). Different methods produce very different results, yet there is no rationale or benchmark for judging their adequacy or appropriateness. Existing systems also are incomplete because they lack rules that allow decisions to be made when the data are uncertain. No systematic testing of any such system has been undertaken. In this project, we will synthesize and evaluate existing protocols for classifying species conservation status applied in the United States, Australia, and internationally. We will measure their performance in three ways: first, by comparing the classifications resulting from individual protocols with assessments of extinction risk from detailed population and metapopulation studies for specific species;

second, by comparing classifications with simulations of hypothetical species for which "true" underlying dynamic processes are known; and third, by comparing classifications with the conservation outcomes for a large number of existing species, for which some populations have gone extinct. The synthesis of these lines of evidence will allow us to evaluate critically the current techniques, and to recommend new approaches and testing procedures.

Burgman, Mark
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.

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

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 l1000m 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.

Carroll, Carlos
Landscape and population connectivity (Hosted by NCEAS)

Conservation area design (CAD) is being used by many landscape-scale conservation efforts in western North America to establish geographic priorities and to raise awareness within the scientific, practitioner, and lay communities of the importance of critical areas. However, CAD techniques currently cannot evaluate factors that allow species and their resources to persist over time. These factors include land-cover connectivity and the resilience of reserve networks to ecological processes such as fire. Several new methods for CAD are emerging that have the potential to improve greatly on past methods. These new methods are unfamiliar to most practitioners, and no comparative evaluation of their usefulness in different contexts exists. Participants will test and compare new tools by applying them to conservation-planning challenges in several geographic areas in North America. Participants also will develop a manual that evaluates new software tools for connectivity analysis, with guidelines for use of those tools. Ultimately, the group will develop a software toolkit and guidelines for its use that would be applicable to landscape-scale conservation planning in any region.

Caswell, Hal
A new synthesis of demography and dispersal

Our understanding of demography has improved tremendously over the past 50 years. So has our understanding of dispersal and its erects. However, our understanding of how demography and dispersal interact to determine spatiotemporal population dynamics is relatively poor. Recent theoretical advances provide tools that can bridge this gap, but because demographic and dispersal data are rarely presented together, they have yet to be applied. We propose to remedy this by forming a working group of empirical ecologists who have (or might obtain) both demographic and dispersal data and theoreticians interested in demography and dispersal. We will thus bring together and analyze combinations of data that otherwise would not be combined, and jump-start the process of unifying the theory of demography and dispersal.

Chazdon, Robin
Biodiversity and conservation value of agricultural landscapes of Mesoamerica

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

Christie, Patrick
Governance feasibility of marine ecosystem-based management: A comparative analysis (EBM)

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

Cole, Jonathan
Integrating the aquatic with the terrestrial component of the global carbon budget

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.

Costello, Christopher
Working Group, Matching property rights institutions with fishery characteristics

The objective of this working group is to synthesize, extend, and bridge gaps in the state of knowledge with economics research on property rights. The group is focusing on the design of effective and efficient institutions and governance structures and exploring the conditions under bioeconomic dimensions along which different property rights regimes may be most effective.

Cottenie, Karl
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.

Cuddington, Kim
Habitat modification in conservation problems: Modeling invasive ecosystem engineers

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

Davidson, Diane
Ecological stoichiometry and the spatial distributions and temporal dynamics of arthropods

Stoichiometry, the study of the balance of multiple elements in living systems, is increasingly recognized as an integrative axis within ecology and across biological disciplines. We seek to characterize a series of little- explored links between stoichiometry and the spatial distributions and temporal dynamics of arthropods. These issues lie at the interface of macroecology and macrophysiology. We focus on four arthropod groups where different stoichiometric mechanisms likely help determine species-level spatial distributions and/or temporal dynamics. These include three taxonomically defined groups (the Orthoptera [grasshoppers and crickets], the Lepidoptera [butterflies and moths], and the Hymenoptera [ants and bees]) plus one ecologically defined group (troglobites [obligate cave dwellers]). Mechanisms link an arthropod's stoichiometry with its capacities for growth, reproduction, and dispersal. We use these linkages as springboards for testing three hypotheses. First, focusing on orthopterans and lepidopterans, we will characterize how a species' stoichiometry is linked to its tendency to exhibit "outbreak" dynamics and what elements are most important. Second, focusing on hymenopterans and troglobites, we will test how an arthropod's stoichiometric content relates to the breadth of habitats it exploits. Lastly, focusing on orthopterans, hymenopterans, lepidopterans and other arthropods, we will test whether these same stoichiometric mechanisms imply that the elemental content of some species will predispose them to respond to global change via shifts in their geographic ranges. We will address these three issues by characterizing the "intersections" of several ecological databases. Our work will be primarily from an empirical, ecoinformatic perspective; however, we will complement these efforts with theoretical modeling of insect outbreak dynamics in stoichiometrically explicit population models.

Davis, Frank
California Legacy Project (Hosted by NCEAS)

Systematic conservation planning is concerned with developing scientifically-guided conservation strategies over large planning areas. It requires formal measures of biodiversity, explicit conservation goals, recognition of trade-offs between biological conservation and other social goals, and explicit and repeatable procedures for producing alternative plans. The goal of this workgroup is to assist the State of California by bringing systematic conservation planning theory and methods to bear on the design and implementation of the California Continuing Resource Investment Strategy Project (CCRISP). CCRISP, an initiative of The Resources Agency of California, is a cooperative, comprehensive planning effort to develop a set of policy and strategy recommendations on protecting California's diverse biological and natural resources (http://ceres.ca.gov/biodiversity/newsletter/v7n1/ccrisp.html).

Doak, Daniel
Conservation planning for ecosystem functioning: Testing predictions of ecological effectiveness for marine predators (EBM)

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

Dobson, Andy
Infectious diseases and conservation biology

Infectious diseases present a special challenge to conservation biologists: they form a largely unexplored component of biodiversity that from one perspective helps promote coexistence and diversity; at the other extreme, there are several examples of pathogens contributing to the extinction of threatened and endangered species. This working group will examine three topics that are central to our understanding of the role pathogens play in conservation biology. Central to the theme of the workshop is the development of a quantitative understanding of how pathogens effect the dynamics of communities that contain more than one potential hosts species. Here we will primarily be concerned with developing empirical and theoretical analysis that examine the role that pathogens play in mediating the coexistence of potentially competing species (or in maintaining genetic diversity within a single host species). We will then examine whether the diversity of host species tends to either buffer, or amplify, disease outbreaks. In particular, we will

explore the ecological interactions between transmission route, host diversity and pathogen persistence. This section of the working group will examine empirical data for a number of systems in which we can dissect the relative roles played by host abundance, host resource utilization and host spatial distribution in determining rates of intra- and inter- specific transmission. In conjunction with these largely deterministic and analytical exercises, we shall also examine data for epidemic outbreaks in small (endangered) populations. These analysis will allow us to develop stochastic models that determine the impact of pathogens on populations that are too small to sustain a long-term persistent source of infection. In particular, we will focus on examining the costs and benefits of intervention to prevent further spread of the disease, particularly in the limiting case where small host population size always leads to the pathogens eventual extinction.

2. Problem Statement

Pathogens and infectious diseases create special problems for both the protection of endangered species and for the maintenance of biodiversity. There are several examples of cases where the introduction of a pathogen has produced a significant further decline in the numbers of an already threatened species (black-footed ferrets, hunting dogs in Serengeti, endemic Hawaiian birds). In all of these examples the pathogens involved were ones that utilize common or domestic species as reservoir hosts. There is increasing evidence that species diversity per se may provide an important buffer that minimizes the impact of a pathogen on any individual host species pathogens. Paradoxically pathogens may also play a role in both maintaining biodiversity and in driving processes that lead to increases in local diversity (refs).

This workgroup will focus on examining these problems by examining seven different ecological communities for which significant volumes of epidemiological data are also available. Each of the data sets provide important insights into at least one of our main research questions, but we do not expect to apply all of the questions to each of the data sets. We are interested in addressing three general classes of questions:

1) What are the dynamics of a recently introduced pathogen in a small population? In particular, how do deterministic and stochastic factors interact to determine the persistence and extinction of pathogens in small populations? In conjunction with this we will also examine how different types of pathogens contribute to further declines in the abundance of potentially endangered host species?

2) In pathogens that utilize a range of host species, what roles do relative abundance, susceptibility, and overlap in spatial distribution play in determining interspecific rates of pathogen transmission? In particular, how much does ecological information on the behavior and spatial distribution of potential host species complement aetiological information and allow us to identify species that are most likely to act as reservoir hosts for pathogens that provide a significant threat to rare or endangered species?

3) Does the diversity of species used by a pathogen tend to buffer or increase either its persistence or rate of spread? Under what conditions will a pathogen enhance the diversity of species that co-exist in any community?

Data sets that will, or potentially could, be used are:

Question 1

(1) long term data sets on carnivores, ungulates and their pathogens in the Serengeti;
(2) data for a measles outbreak in mountain gorillas in Rwanda;
(3) data for avian malaria in introduced and native bird species in Hawaii;

Questions 2 & 3

(4) data for the ticks, deer mice, white-tailed deer and Lyme disease in New England;
(5) data for ticks, Louping ill, grouse, sheep, blue hares and deer in Scotland;
(6) data for racoon rabies in the eastern United States
(7) data for duck plague from the National Center for Wildlife Diseases

Initially we shall use data sets 1-3 to address question 1. Data sets 4-7 will be used to examine questions 2 & 3. In each case we will examine empirical data for the dynamics of a specific pathogen, this will be used as the basis for first constructing fairly general ecological-epidemiological models. These will then be parameterized using the available empirical data. A variety of analysis will then be undertaken then examine sensitivity of the model to parameterization, initial conditions, and the presence of alternate hosts. We will also examine the consequences of modifying the transmission terms of the models in an attempt to examine how different methods of transmission might modify our conclusions.

An important additional exercise will be the development of some stochastic simulation models for pathogens in small populations. These shall be used to examine whether intervention is likely to have a significant impact, and how rapidly it needs to be applied in order to have an effect. This exercise will provide an important set of guidelines for veterinary workers and conservation biologists who frequently disagree on the relative value of disease intervention when dealing with endangered species.

The main results of the workshop will be presented in a series of scientific papers which will provide a better understanding of three crucial problems in ecological epidemiology as applied to the management and conservation of endangered species. The first set of these papers will explore the dynamics of infectious diseases in small populations. The second will provide a deeper understanding of the role that ecological interactions play in mediating interspecific diseases transmission. While the third set will develop an understanidng of the role that biodiversity plays in buffering disease outbreaks for some pathogens.

The beneficiaries of this will obviously be the participants in the workshop, but we expect the additional 'community benefits' to extend well beyond the marginal boosting of citation indices. There is a considerable need in both the wildlife veterinarian and conservation biology community for a coherent body of work that explains with specific examples the twin role that pathogens play threat and mediator of biodiversity. Thus we can expect the work we produce to be used not only for teaching purposes, but also in helping inform government agencies, and NGO's about how best to respond to parasites and infectious diseases in natural ecological communities. If we examine examples of the recent responses of NGO's and government agencies to challenges presented by infectious diseases, we tend to find that ignorance has led to either extreme and irrational control measures or hard to substantiate 'ad-hoc' measures. (Examples - bison and brucellosis, toxin in Monk seals, malaria in Hawaii). The least we can hope for from our workshop is to firmly refute the commonly held opinion that disease outbreaks are chance random events. If fairly lucky we should be able to provide a set of examples that illustrate the underlying deterministic nature of the ecology of infectious diseases, while also illustrating the crucial, and not entirely random, role that stochastic forces play. Ultimately, this will lead to the development of more rational policies for the management of pathogens in ecological communities.

Donoghue, Michael
Phylogenies and community ecology

There exists a long history in ecology of examining communities in terms of their taxonomic structure (e.g., species/genus ratios), with the expectation that this will shed light on both histori-cal community assembly and contemporary ecological structure. Modern phylogenies now offer far more precision in the analysis of community taxonomic structure, and an increasing number of studies are aimed at incorporating phylogenetic information into community ecology. Conversely, studies of speciation are increasingly trying to incorporate information about the com-munity context under which lineages separated. The time is ripe for a meeting that draws researchers together, from ecology, phylogenetics and paleobiology, who have considered these issues, but who may not otherwise interact. We thus propose an NCEAS working group focused on the question, How can phylogenetic knowledge help answer community ecology questions, and vice versa? Meetings will be structured to identify answers to this question, and present datasets and analysis tools useful for exploring new avenues. Independent work between meetings would apply these methods, and would be reported at subsequent meetings, and in a final, edited book. We expect that such a working group would catalyze the development of this promising field.

Drake, John
Machine learning for the environment

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

Eldredge, Niles
Ecological processes and evolutionary rates

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.

Farber, Stephen
Understanding, valuing, and managing dynamic ecosystem services under stress: Synthesizing across the LTER Network

This project utilizes the LTER site network to develop understanding of the biogeophysical dynamics in stressed ecosystems and the implications of those dynamics for the valuation and management of ecosystem services and underlying ecological support systems. It uses a variety of LTER sites, in different ecological and economic contexts but all subject to existing or potential human stressors. It addresses the appropriateness of valuation methods, how valuations can be transferred among different contexts, and how databases can be developed consistently across sites to assist in ecological management. It also addresses the special management needs demanded of complex, dynamic systems.

Field, Christopher
The carbon balance of Eurasia and North America

We propose a working group, including an NCEAS postdoc, configured to fill a series of critical gaps in our ability to quantify and understand the carbon balance of large regions. The working group will focus on three topics that are ripe for progress and where the current state of the science falls far short of the requirements for useful practical application or basic understanding. The focal topics are current land use, past land use, and disturbance. The working group will meet in one workshop on each of these topics, with a fourth workshop on integrated estimates of the carbon balance of Eurasia and North America. At each workshop, we will (1) review the status of the data (2) evaluate strategies for integrating to the continental scale, and (3) consider approaches for constraining estimates with observations. We propose an approach that is synthesis at a number of levels. It will synthesize the role in carbon balance of three factors in time and space. And it will expand the suite of processes represented in large-scale carbon balance models.

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This activity is a component of the GCTE Terrestrial Carbon Initiative.

Field, Christopher
Vulnerability of carbon in permafrost: Pool size and potential effects on the climate system

Ecosystem responses that cause carbon loss to the atmosphere in a warming climate could greatly accelerate climate change during this century. Potentially vulnerable carbon pools that currently contain hundreds of billion tons of carbon could be destabilized through global warming and land use change. Some of the most vulnerable pools on land and oceans are: soil carbon in permafrost, soil carbon in high and low-latitude wetlands, biomass-carbon in forests, methane hydrates in the coastal zone, and ocean carbon concentrated by the biological pump. The risk of large losses from these pools is not well known, and is not included in most climate simulations. Preliminary analyses indicate a risk over the coming century that may be larger than 200 ppm of atmospheric CO2, rivaling the expected release from fossil fuel combustion. This proposal will quantify the carbon content of the vulnerable pools in permafrost soils and analyze the risk of large releases of carbon from these pools over this century.

Flannigan, Michael
Global change impacts on landscape fires

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 modelling environment, LAMOS, to conduct this research. LAMOS (a LAndscape Modelling Shell) is an interactive and flexible landscape modelling 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.

Fleishman, Erica
Analysis and Conservation Prioritization of Landscape Connectivity in Nevada (Hosted by NCEAS)

We will develop a rigorous scientific assessment of landscape connectivity from the perspective of multiple system components that can be used to inform management and policy in Nevada. The Southern Nevada Public Land Management Act and the Lincoln County Conservation, Recreation, and Development Act are examples of specific, current opportunities to use science to prioritize land acquisition and allocation of multiple land uses. We will examine natural and, especially, anthropogenic drivers that may affect connectivity for riparian systems, sagebrush steppe, sage grouse, and pronghorn. This process, and its application to management and policy, will be enhanced by participation of a multidisciplinary group of approximately 20 scientists and practitioners who are dedicating their time and expertise to the effort. We anticipate that products of geospatial analyses will be used to explore alternative scenarios of land use, climate change, and management options in Nevada. We anticipate that the products will be used by scientists, land managers, policy makers, and other stakeholders.

Fleishman, Erica
Climate change and conservation (WCS) (Hosted by NCEAS)

Fleishman, Erica
Wild salmon ecosystems

Climate is a major driver of the geographic distribution and abundance of salmon. Climate change is occurring globally, but there has been no organized effort to evaluate the potential effects of climate change on populations of salmon and the ecosystems they inhabit. Sufficient data and expertise exist to conduct such an assessment. Developing and implementing a process to synthesize the data is the critical step toward achieving this evaluation. This effort initiated the process of prioritizing research questions and approaches on the potential effects of climate change on salmon. In late February and early March 2007, a multidisciplinary group of more than 30 scientists and practitioners with relevant expertise convened in Santa Barbara. These experts identified the most important topics related to the potential effects of climate change on salmon and their ecosystems and began to develop a strategic framework for conducting targeted analyses and syntheses of existing data.

Francis, Robert

Models of alternative management policies for marine ecosystems

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.

Gamon, John
SpecNet

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.

Gergel, Sarah
Kuznet's Curve (Hosted by NCEAS)

Gittleman, John
Phylogeny and conservation: Problems in the quantification of biodiversity

We propose a working group to assess the usefulness of algorithms and quantitative approaches to measuring biodiversity in terms of 'taxonomic distinctiveness' or 'independent evolutionary units'. We will critically evaluate whether and how

phylogenetic information can be used to measure species value. Specifically, we will analyze the effects of sample size, topology, branch lengths and model of evolutionary change on various quantitative measures of phylogenetic diversity. Measures of phylogenetic diversity will then be applied to various conservation problems such rarity, species' conservation status, and extinction risk. The working group will provide a collaborative effort among ecologists, evolutionary biologists, paleontologists, systematists (both molecular and morphological) and conservation biologists, all of whom deal with synthetic comparative data in their respective fields. The end product will be a series of papers and an edited volume, Phylogeny and Conservation.

Gotelli, Nicholas
Synthetic macroecological models of species diversity

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

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

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

and disseminate information about short-term vs. long-term values to help managers determine conservation zones, and (3) use data and modeling to plan EBM strategies that incorporate the interface nature of these systems.

Grimm, Nancy
Aquatic-terrestrial Biogeochemistry (ATBGC)

Rationale: There is very little interaction among terrestrial and aquatic biogeochemists except where the water meets the land. Thus, research in riparian ecotones has been critical in getting ecologists from both groups to think along different lines than they are accustomed to. Yet, it seems there is a missed opportunity to blend conceptual models of material cycling in streams and terrestrial ecosystems. For example, my colleagues and I have been thinking of how models of nutrient processing along stream, riparian, and hyporheic flowpaths can be extended up into the catchment in aridland streams, and how this might differ from patterns in temperate watersheds (Fisher et al. 1998).

Objectives: The overall aim of this project is to broaden generalities about nutrient cycling beyond the habitat chauvinism that is prevalent today. We will ask whether a common approach, for example one centered on hydrologic models of transport and retention, is reasonable for both terrestrial and lotic ecosystems. A working group or series of working groups will consider this question, and will include biogeochemists who work in diverse ecosystems, modelers, hydrologists, and other physical scientists.

Hackett, Edward
Ecology transformed? A proposed working group to study new forms of scientific collaboration

We propose to examine the organization, functioning and products of selected NCEAS working groups, placing them within the larger contexts of the disciplinary development of ecology and the emergence of new patterns of scientific collaboration. We would do this in two ways. First, we would examine the characteristics and consequences of NCEAS working groups, using interviews, observations and examination of documents (such as publications, proposals, and participants' vitae). Second, we would organize a working group to study new forms of scientific collaboration, placing the NCEAS experience within the context of the history of ecology and the contemporary experience of other fields of science. The group would include historians, philosophers, and social scientists currently working on scientific collaboration, electronic communication and related topics. Two main results are anticipated: a specific analysis of NCEAS and its influence on collaboration within the field of ecology, and a coordinated research and writing effort on larger issues in the changing pattern of scientific collaboration.

Halpern, Ben
Putting ocean wilderness on the map: Building a global GIS atlas of pristine marine environments

Terrestrial conservation has long recognized the need for setting global priorities, and a common strategy for such efforts has been to focus on wilderness, or pristine, areas. Only recently have conservation groups begun to consider marine ecosystems, and efforts to take a global approach remain nascent at best. In order to move forward, conservation groups need global-scale data on which to base their priority models, but such data are currently highly dispersed and poorly synthesized. We propose a working group to address two questions that should greatly help close this gap: first, what is a pristine marine ecosystem, and second, where are the remaining pristine areas of the world's oceans? The definition of pristine will be based on an ecologically rigorous assessment of anthropogenic influences on marine ecosystems, and will guide us in identifying existing global-scale datasets that we will use to map the distribution of pristine areas across all marine environments. Our final product will be a GIS-based, interactive atlas of the pristine and impacted areas of the ocean that can be used as a practical tool by conservation groups in developing marine conservation priority models, by academic scientists in future ecological and biogeographic research, and by educators in efforts to increase awareness of ocean conservation needs.

Halpern, Ben
Ranking and mapping human threats and impacts to marine ecosystems in the California current (Moore Foundation)

Building on a similar global effort (Mapping current threats and impacts of human activities on global marine ecosystems this project will map current threats and impacts of human activities on the California Current marine ecosystem. The project will first survey experts in six subregions of the California Current to explore geographic variation in the effects of threats. A workshop will then be held to use decision theory to evaluate the tradeoffs of using expert opinion to assess threats and associated impacts. Data on ecosystems and threats will be gathered at resolutions of approximately one square kilometer. By synthesizing information and inferences regarding anticipated impacts of threats, project participants will develop a spatially-explicit understanding of the distribution and magnitude of human threats in the California Current. Project collaborators are based at University of California, Santa Cruz; The Nature Conservancy; University of California, Santa Barbara; and the Monterey Bay National Marine Sanctuary.

Harmon, Mark

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

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.

Harvell, Drew
The ecology of marine diseases

The working group on marine diseases will bring together researchers working with diverse diseases of marine organisms with theoreticians and statisticians. Epidemiological studies of diseases in marine systems have been rare and there is a paucity of information regarding even the most basic properties of marine pathogens (e.g. identity, host-specificity) and factors (e.g. environmental correlates) affecting disease processes (Harvell et al. 1999). In particular, little is known about the mechanisms of either disease transmission or host resistance and their roles in facilitating disease outbreaks. Although theoretical and experimental practices developed to model infectious disease in humans (Anderson & May 1991),wildlife (Daszak et al. 2000) and agricultural systems (Real 1996) have provided some useful insight, the applicability of these "terrestrial" models to comparatively more open system like the ocean is not known. Moreover, knowledge of mechanisms of host resistance among marine invertebrates is effectively a black box; we lack understanding of basic disease resistance mechanisms and their interaction with environmental stressors. Using a few well studied host-pathogen interactions or those with long-term monitoring data, we will 1) synthesize what is currently know about marine diseases and their environmental drivers, 2) develop new epidemiological theory for analysis of marine diseases, and 3) review differences between disease ecology in marine and terrestrial habitats, including the consequences of spill- over of infectious micro-organisms from farmed into wild populations.

Harvell, Drew
The ecology of marine diseases (Extended)

I am requesting funding for one more meeting of the Marine Disease Working Group. The 3 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 whats known of characteristics of terrestrial and marine disease), (3) develop statistical and modelling approaches for marine diseases.

Hastings, Alan
Development of tools for the practical design of marine reserves

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.

Hawkins, Bradford
Energy and geographic variation in species richness

Understanding the latitudinal gradient in species diversity presents ecology with one of its greatest challenges. Despite the complexities that must be involved, the "energy hypothesis" may provide a parsimonious explanation for much of the gradient. However, there are a number of unresolved issues related to the energy hypothesis that need to be addressed, including (1) the relationship between energy and other determinants of diversity and how to distinguish them, (2) which of two versions of the energy hypothesis, the "productivity hypothesis" or the "ambient energy hypothesis" may apply to different taxa, (3) the relative roles of currently operating climatic factors and historical forces, (4) the probability that different factors operate in different latitudinal zones. (5) possible scale dependence of energy-diversity relationships, and (6) the most appropriate statistical methodology for testing the hypothesis. The proposed working

group will address these issues, with the goal of providing a rigorous statement of what the energy hypothesis claims and providing a standardized format for the generation of data to test it. A further goal is to use the new format to generate a data base comprising all existing data related to the energy hypothesis. Finally, we will analyze this database to determine the current state of the hypothesis and identify areas requiring additional research. Our general goal is to convert what is currently a haphazard approach to testing geographic variation in species diversity into a systematic search for underlying causes.

Hibbard, Kathy
Intercomparison of global scale ecological models and field data: EMDI II (Hosted by NCEAS)

Understanding global-scale ecosystem responses to changing environmental conditions is important both as a scientific question and as the basis for making policy decisions. The confidence in regional models depends on how well the field data used to develop the model represent the region of interest, how well the environmental driving variables represent the region of interest, and how well regional model predictions agree with observed data for the region. To assess the accuracy of global model forecasts of terrestrial carbon cycling, the first Ecosystem Model-Data Intercomparison (EMDI) workshop was held in December 1999.

We propose that the National Center for Ecological Analysis and Synthesis (NCEAS) co-sponsor with the Global Analysis, Interpretation and Modeling Task Force (GAIM) of the International Geosphere Biosphere Program the EMDI II Working Group to be held at Santa Barbara in mid-April 2001. This request describes the EMDI I progress, past NCEAS support, and outlines the EMDI II activities.

The EMDI I workshop included 12 biogeochemical, satellite-driven, detailed process, and dynamic vegetation global model types. Extensive worldwide net primary productivity (NPP) data were assembled; model driver data, including vegetation, climate, and soils, were associated with each site; model simulations were performed; and the model-data differences analyzed. NPP and model driver data were compiled for 1200 study sites and for over 2100 0.5-degree grid cells. Initial results showed general agreement between model predictions of NPP and field measurements of NPP but with obvious differences that indicated areas for potential data and model improvement. Comparing the input data with an average NPP from an ensemble of model outputs provided a unique tool to improve NPP data, model driver data, and model processes. The workshop demonstrated that model-data intercomparison is an important new direction in model evaluation; but one that is an extraordinarily complex task.

NCEAS has provided significant support for EMDI and NPP data compilation. The workshop to analyze the first EMDI was hosted by the GAIM office (see http://gaim.sr.unh.edu/Structure/Intercomparison/EMDI), however, NCEAS provided support for a student intern to organize the data and an FTP site for distribution (see

https://www2.nceas.ucsb.edu/admin/db/web.ppage?projid_in=2042). Much of the NPP data for EMDI came directly from the "Development of a Consistent Worldwide Net Primary Production (NPP) Database" funded by NCEAS (see http://www.nceas.ucsb.edu/fmt/doc?https://www2.nceas.ucsb.edu/admin/db/web.plist). Ten papers and four global data sets were generated from the series of three Working Groups (see http://daacl.esd.ornl.gov/npq/nceas/nceas_des.html). This and the preliminary Web page describing EMDI (http://daacl.esd.ornl.gov/npq/nceas/EMDI_des.html - soon to become part of the ORNL DAAC publicly browsable Web pages) demonstrate how NCEAS-supported data synthesis/analysis activities have resulted in new ecological data that are available for the wider scientific community and that will be used for the proposed EMDI II Working Group.

The EMDI II Working Group will include all initial models except one (model is no longer supported) and has expanded to include 5 additional global groups. The group now includes 16 models, primarily from Europe and North America, but one in China and one in Australia. The participating models will utilize data sets that have been improved through outlier analysis and perform new model runs for a set of approximately 4000 0.5¿ grid cells. Whereas the analysis in EMDI I was based on comparing ensemble values averaged from all 12 models strictly for total (above and belowground) NPP, EMDI II will compare model results with NPP data for individual models and also require models to supply above and belowground NPP estimates to assess how models allocate carbon in various biomes relative to the data. In addition, we plan to assemble multi-year NPP estimates for a variety of sites to compare to multi-year model estimates. In addition to the analysis of differences between models and data, EMDI will produce an enhanced multi-layered data collection, again that will be made available for additional use by the wider scientific community. The enhancements include associating climate, soils, NDVI, and vegetation characteristics with each of the NPP measurements, and performing an outlier analysis to address data quality concerns.

We propose a co-funded workshop by IGBP/GAIM and NCEAS. Total estimated costs for 20 participants for 5 days is $25k, of which, GAIM will supply $15k. We are requesting additional support from NCEAS for $10k to cover additional costs. The proposed timetable is as follows:

(1) Driver data is posted for a 50% 'blind' comparison of grid cells (as of 3 January)
(2) NPP values for the 50% 'blind' cells will be provided to models that submit their results by 7 February
(3) Driver data for additional 50% data cells posted 7 February
(4) Model results are requested by 28 March
(5) Post model results to UNH website for models to view by 4 April.

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Hochberg, Michael
Analyzing pattern and process in human cultural diversity

A major challenge for ecology is to understand the role of humans in the future of life on Earth. Meeting this challenge is a tremendous and, in many ways, obscure enterprise because our species is extraordinarily complex and rapidly changing, and since assessing many aspects of human biology is fraught with social taboos and political impediments. Answers from the ecological sciences will form a small, but important part of the corpus. If we are willing to accept the analogy that humanity is comprised of an ensemble of communities, then many of the concepts of community ecology should apply to human society. As long as one is very clear about the limitations of this analogy, community ecology can be used as a constructive tool in understanding our species (Diamond 1999), its impact on its environment (Moses & Brown 2003), and the future.

Hoeksema, Jason
Narrowing the gap between theory and practice in mycorrhizal management

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

Hoeksema, Jason

Bridging the gap between theory and practice in mycorrhizal management (Extended)

We are hoping that NCEAS would consider extending our working group. We feel strongly that if given the opportunity, we would continue to be productive through three additional working group meetings. Our next meeting (the 4th overall, proposed for January, 2007) would focus on Activity 6 above: 1) Conducting and interpreting initial meta-analyses, 2) modifying aspects of the data-base to facilitate further analyses, and 3) adding more data in areas of weakness in the database. That meeting would also allow follow-up work on the three outstanding manuscripts we will have at that point (from Activities 2-5 above), as needed. Specifically, the goal would be to generate a draft of the manuscript from Activity 5, and to finish revisions of the manuscripts from Activities 3 & 4 if needed. The final two meetings (October, 2007 and January, 2008) would then be focused on final meta-analyses and writing manuscripts from those (Activity 6), including papers for scientific audiences and also for practitioners of mycorrhizal management, and on finishing the manuscript from Activity 5. Throughout the next three meetings, we would also appreciate the opportunity to work with the staff at NCEAS to adapt our database model into a more general format, and to tailor the Engauge digitizer program, as described above.

Holl, Karen
Restoration in a Landscape Context

Current restoration activities often focus narrowly on sites actively being restored. The success of these restorations, however, will often depend on their position in the landscape, relative to the condition, land use, and community composition of land in the surrounding area. Restoration ecologists have often discussed landscape-level processes in general. Nonetheless, theory has rarely led to recommendations that are put to use on the ground. We propose to address the process of the exchange of information from academic theory to applied management in the following ways. First we will synthesize what has been written about landscape- level processes that affect restoration, and about statistical and modeling tools that can be used to judge restoration success. Then we will use the synthesis to address two landscape-level restoration projects - one population-focused habitat restoration and the second a community-focused ecosystem restoration. We will develop new quantitative methods to prioritize what landscape-level concerns will significantly affect the success of restoration efforts in these and other projects. The purpose of this working group will be to move beyond broad generalizations and ask how we can apply relevant ecological knowledge to large-scale restoration activities.

Houlahan, Jeff
Spatial and temporal community dynamics: Sharing data to answer questions

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.

Howarth, Robert
Nitrogen transport and transformations: A regional and global analysis

On behalf of the Scientific Committee on Problems in the Environment (SCOPE), we request funds to partially support the final synthesis activities of the SCOPE International Nitrogen Project. This project was established in 1993 to improve our understanding of the global nitrogen cycle via a focus upon changes at the scale of large regions; since that time four regional workshops have been held in the U.S., Chile, Taiwan, and Japan, with a fifth planned for China this October. Here, we describe a two year plan aimed at synthesizing and completing the Nitrogen Project. We have secured funds from the Mellon Foundation for a final symposium and for a book to be published in the SCOPE series. Our request to NCEAS is for support for 3 major activities that will lead up to and/or expand the final symposium and book. These include: 1) a number of small working groups that will focus on specific uncertainties in the global N cycle and will meet at the Center 2-3 times over an 18 month period; 2) a sabbatical as an NCEAS fellow for the co-chair of the SCOPE Nitrogen Project, Bob Howarth; and 3) the creation of a web site at the Center devoted to providing data and information on regional to global scale N cycling.

Huenneke, Laura
Analysis of diversity reduction experiments to address the ecosystem consequences of biodiversity loss

A diversity reduction working group will examine the relationship between species diversity and ecosystem functioning in a wide range of natural and managed ecosystems. We will evaluate the results of field experiments in which species diversity and composition of plants, animals, and/or microbes have been reduced and ecosystem processes have been measured. We propose two approaches: (1) a meta-analysis of the species-removal literature and (2) a synthesis of comparative measurements to be made in ongoing species- removal experiments in a diverse array of natural ecosystems.

Jackson, Jeremy
Long-term ecological records of marine environments, populations and communities

Ecological time series across large spatial and temporal scales are essential for resolving and understanding anthropogenic and natural sources of variability and change in the oceans and prediction of their consequences. However, virtually all marine ecological observational records are too short or infrequent for useful time series analysis, so that prediction of ecological responses to further perturbations is difficult or impossible. Paleoecological, archeological and historical data (hereafter referred to as paleo data) are the only hope for obtaining the necessary long-term perspective. Paleo data are necessarily descriptive rather than experimental, and differ from most observational ecological data in terms of the parameters measured and the common use of geochemical and paleontological proxies to estimate environmental and biological change. Consequently there is much misunderstanding and suspicion of the potential rigor of paleo data among ecologists that hinders their application to help solve ecological problems. The purpose of the proposed working group is to critically examine the potential of paleo records to extend marine ecological time series through a series of concrete examples.

Jones, Matthew
Management and analysis of environmental observatory data using the kepler scientific workflow system

Jones, Matthew
Science Environment for Ecological Knowledge (SEEK) (Hosted by NCEAS)

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).

Kareiva, Peter
EPA Risk Analysis

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

The delineation of biodiversity hotspots that protect as many species as possible with as little land as possible has been the dominant paradigm in conservation science. Recently, however, this paradigm has been challenged on two accounts. The first challenge is that the burgeoning human population will make it impossible to adequately secure biodiversity in "protected areas", and that instead we must turn to working landscapes with substantial human use as places of biodiversity value. Second, with so much of the world impoverished, there is a need for land management that first and foremost ensures that basic natural services (or "ecosystem services") are provided to people. We intend to explore the spatial congruence between ecosystem services and biodiversity at multiple spatial scales, and in so doing ask to what extent the provision of ecosystem services and biodiversity protection can be aligned, and what are the tradeoffs where they are not aligned?

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

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

Our working group will start with a mapping and valuation exercise entailing the Upper Yangtze River in China because of the many critical resource decisions this biodiversity

rich region is currently facing. We will then extend our analyses to other systems, as well as different spatial scales. Our working group will be fluid with membership varying depending on the systems and analyses under discussion; however the two hallmarks of this effort are its mix of on-the- ground conservation experience from international conservation NGO's and academic scholars, including

Kelly, Dave
Evolutionary causes and ecological consequences of mast seeding in plants

Mast seeding, the intermittent production of large seed crops by perennial plants, is an ecologically important phenomenon. For plants, masting interrupts reproduction and periodically depletes resources. For animals, masting causes temporal pulses in potentially nutritious food. Despite improved understanding of mast seeding in the 1990's, we only now have the tools to investigate several important avenues. First, the temporal and spatial scales. Secondly, the interaction between evolutionary benefits of masting (e.g., pollination efficiency) and the resource constraints operating within individual plants have not been explored. Third, to what extent do pulses in plant reproduction result in "ripple" effects through higher trophic levels? While direct effects on some organisms are known (e.g., small mammal densities may increase after mast years), indirect ecosystem-level effects are not well understood, especially whether ripples normally create stable (well-damped) or unstable ecosystem dynamics. These ripple effects are important to applied problems (e.g., forest pest outbreaks), and also for understanding the evolutionary origins of masting. Thus, we propose an interdisciplinary working group (plant evolutionary ecologists, animal population ecologists, community ecologists, modelers)that will use long term datasets on both seed crops and animal densities to formulate predictive models of the nature and consequences of mast seeding. The results will be important both to evolutionary theory and to understanding ecosystem functioning.

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

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.

King, Aaron
Unifying approaches to statistical inference in ecology

In the face of ecological complexity, it has very often proved useful to formulate mathematical models, which allow us to examine the consequences of specific sets of assumptions. While this approach has generated interesting and important ideas, progress has been frustrated by a fundamental hurdle: direct confrontation of models and data in a

statistically robust way. We propose a working group aimed at overcoming this hurdle by synthesizing numerous state-of-the-art techniques. The approaches we will consider explicitly take into account common causes of mismatch between models and data such as process noise (demographic and environmental stochasticity), measurement error, unobserved variables, and nonstationarity. The end result of this working group will be a thorough review of the strengths and weaknesses of the various approaches under different circumstances and a set of easy-to-use statistical tools for use by non-specialists.

Kolstad, Charles
The economics of biodiversity

The impetus for this workshop is the importance that environmental economists understand better what biodiversity is and how it functions and contributes to goods and services that society values. Economists also need to know better whether and in what ways market and non-market mechanisms can realize some of the economic value of biodiversity, and provide incentives for its conservation.
To progress on these goals, in April 2000, the convenors invited a select group of economists working in related areas to prepare papers on the subject for presentation at the workshop. We have also arranged for these papers to be published in a special issue of the journal Resource and Energy Economics.
It is important to emphasize that this is a novel research area; consequently, we have given authors approximately a year to develop their ideas, culminating in a workshop to be held in the Spring of 2001. Because of the unusual nature of the topic, it would seem highly productive to expose authors to working versions of all the papers as well as discussion. Furthermore, we hope to involve ecologists as discussants in order to assure realistic representation of non-economics processes. As an incentive, the papers will ultimately be refereed and published (assuming the refereeing process is positive) in one of the leading field journals in the environmental and resource economics field: Resource and Energy Economics.

Koricheva, Julia
Meta-analysis in ecology: Lessons, challenges and future

Meta-analysis represents a set of statistical methods for quantitative research synthesis developed in medicine and social sciences in late 1970s and introduced to ecology in early 1990s. It provides a more objective and informative alternative to narrative reviews and “vote-counting” approaches traditionally used for research synthesis in ecology. Despite its great potential in addressing both basic and applied research questions, the progress in meta-analytic applications in ecology is still hindered by the limited availability of meta-analytic training for ecology students, limited palette of meta-analytic techniques and tools available in ecology compared to that available in medicine and social sciences, and the need to adjust these techniques to account for the structure

of ecological data and the nature of ecological questions. The aims of our working group are to facilitate and to promote the thoughtful and critical use of meta-analysis for research synthesis in ecology, and to improve the power and rigour of ecological meta-analysis. These aims will be achieved by writing a handbook of meta-analysis for ecologists, by updating existing statistical software for ecological meta-analysis, by creating an online forum on ecological meta-analysis containing bibliography and teaching aids, by taking advantage of recent methodological developments in quantitative research synthesis in medicine and social sciences, and by adjusting standard meta-analytical procedures to address specific ecological issues and problems.

Kremen, Claire
Restoring an ecosystem service to degraded landscapes: Native bees and crop pollination

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

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

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.

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

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.

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

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.

Loik, Michael
PrecipNet: Analysis and synthesis of precipitation and ecosystem change

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.).

Lomolino, Mark
Foundations and future of biogeography

Project Objectives:

The working group will address three objectives. First, to compile a set of seminal research papers, provide original commentary on their relevance, and organise them into a book, "The Foundations of Biogeography." This book is to be published by the University of Chicago Press. Second, to organize an international society of biogeography, along with supporting activities, such as the initiation of society meetings and the development of a web page. Third, to develop and establish future working groups and workshops on biogeography.

Rationale and Strategies:

The field of biogeography has a long and distinguished history. In the past several decades it has experienced renewed interest, with a greatly increased volume of work. It

is, therefore, both timely and important that we develop a more thorough understanding of the foundations of this field, including all of its subdisciplines. The compilation of a book on this subject should greatly facilitate this endeavour. To accomplish this we have invited a distinguished group of biogeographers and ecologists from a variety of geographic regions and subdisciplines to join us in this project.

As much as any field, the new biogeography that has emerged is interdisciplinary, international, and spans a broad range of spatial and temporal scales. To better foster interactions among the diverse group of scientists who do biogeography, we believe it is important to establish an international society of biogeography. By bringing eminent biogeographers from diverse backgrounds and locations together we plan to do the initial work in establishing such a society.

We also believe that there are a number of interesting and very important questions that can best be addressed by small groups of highly motivated and interactive biogeographers. By bringing biogeographers together for the first time we hope to stimulate the advancement of the field of biogeography and the many disciplines that interact and overlap with biogeography.

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

Progress in a scientific discipline is normally achieved through publication and dissemination of knowledge. Number of publications and their citation frequency are also widely used for academic evaluation of individual researchers, departments, and universities. Therefore, any bias in publication and dissemination of scientific content may potentially affect the development of a field in terms of what kind of information is available for synthesis, who is successfully employed, and where funding is allocated . We will specifically focus on publication bias in ecology in this working group using meta-analysis techniques (and other standard statistics) on several sizeable collections of published papers and related online resources such as citation frequencies and impact factors. We have loosely identified three levels of attributes of the publication and dissemination process in ecology: characteristics of the study (number of hypotheses, effect size, support for main hypothesis), attributes of the publication itself (merit, length, number and gender of authors), and attributes of the journal (reputation, impact factor, circulation). General publication biases identified in medicine and ecology include the file drawer problem, overinterpretation bias, dissemination bias, status bias, visibility bias, and gender bias. Few synthetic studies however have quantitatively tested the importance of these proposed biases nor related these biases to specific attributes of the publication process. Furthermore, there has been no quantitative evaluation of the relative importance and potential interactions between these factors.

Losos, Jonathan
Comparative study of adaptive radiation

Despite intensive study over the past half century, our conceptual understanding of adaptive radiation has advanced relatively little. A primary reason is that there has been no synthetic, integrative study of adaptive radiation across different evolutionary lineages. The result is that our database on adaptive radiation is composed of a hodgepodge of studies. Disparities among studies in approach, methodology, and organisms mean that each study is unique and that, as a result, testing general hypotheses, much less deriving new generalities, is difficult. This working group will bring together experts in ecology and evolutionary biology with different taxonomic specialties to develop appropriate methods to conduct a comparative study of adaptive radiation. Group members will gather data from both their own studies and from other studies on related taxa, thus amassing a large base of comparable data, allowing for the testing of general questions about adaptive radiation, as well as leading to the development of new approaches and questions. Members of current working groups focusing on related questions will be invited to participate in some of this working group's activities, leading to mutually beneficial advances and synthesis.

Luo, Yiqi
Progressive nitrogen limitation of plant and ecosystem responses to elevated CO2

This working group will address the issue: why don't most field experimental results support model predictions that progressive ecosystem nitrogen (N) limitation leads to downregulation of primary production in elevated CO2? Ecosystem models that link nutrient cycling with plant production generally predict long-term photosynthetic downregulation and reduced stimulation in plant production caused by progressive N constraints in elevated CO2. The conceptual model is that increased carbon (C) influx under elevated CO2 will immobilize more N in plant biomass and soil organic matter, progressively leading to less N available for plant uptake. However, the predicted downregulation in primary production has not been confirmed by most of the free-air CO2 enrichment (FACE) and open-top chamber (OTC) experiments. The discrepancy between model predictions and experimental data apparently results from a fundamental knowledge gap concerning ecosystem C and N interactions, which lie at the core of ecosystem ecology. The proposed working group will address the issue of progressive N limitations by (1) compilation and synthesis of experimental data from the on-going FACE and OTC projects as well as from the literature; (2) synthesis of published modeling results and comparison of mechanisms incorporated into various models; (3) identification of possible mechanisms causing the discrepancy between model predictions and experimental results; and (4) defining future research need for both experimental and modeling studies.

This project has the potential to make a critical contribution to ecosystem ecology. Moreover, a solid understanding of C:N interactions extends beyond ecology. Models

increasingly applied to policy questions appear to have major problems matching the aspects of experimental results. The latter are most relevant to the policy applications. The ability of the ecological community to provide useful information on the future carbon dynamics of the terrestrial biosphere (including the terrestrial sink) depends critically on resolving the question of progressive N limitation.

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

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-Manrr¿quez & 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.

One important objective of this proposal is to develop statistical approaches and to offer suggestions for analyses that other investigators will find useful for the ecological and evolutionary interpretation of community- level data. We propose to bring to NCEAS investigators representing seven neotropical rainforest locations (Los Tuxtlas, Mexico; Chajul, Mexico; La Selva, Costa Rica; Mabura Hill, French Guyana; BCI, Panama; Tambopata Wildlife Reserve and Manu National Park, Peru). Collectively, data sets currently available from well-monitored one- to fifty-hectare plots in these locations include information on seed size, seedling demography, survivorship, growth rates, growth form, reproductive phenology, dispersal mode, adult abundances, and/or size distributions of hundreds of plant species. Not all data are available for all sites and species, but we have identified a set of questions and hypotheses to which these data are

well-suited. Naturally, we fully expect the working group to identify additional theoretical and applied questions to be addressed.

To conduct cross-community studies of ecological and evolutionary patterns, we have chosen to focus on the tree species of Neotropical moist forest communities for several reasons. First, the adaptive significance of life history and functional traits is strongly dependent on environment. For example, the role of seed size in seedling establishment is quite different in open and xeric environments than in the light-limited, mesic forest understory. Similarly, the ecological factors influencing community structure vary across contrasting environments. By focusing on tropical forests, we can assess the generality of adaptive hypotheses across communities, and test evolutionary hypotheses regarding species differentiation in relation to life history under broadly similar conditions. Secondly, in some cases there are strong floristic affinities among Neotropical forests (e.g. the dominant genera or families of trees are shared among sites). This facilitates tests of evolutionary hypotheses because we can extract data on diverse groups of closely related species in different communities. In comparisons of New World and Old World forests, such analyses of closely related species (e.g., congeners) are often difficult or impossible.

The timing is right to develop a joint, concerted effort to analyze cross-community data to detect ecologically and evolutionarily significant patterns and processes. First, a number of research groups have successfully constructed data sets each characterizing hundreds of species, but there currently exists no coordinated data set to allow the comparative analysis of these data across communities. Second, theoretical and empirical work in the analysis of comparative data have increased our understanding of the value of methods for incorporating phylogenetic information into the quantitative study of multivariate data sets. Third, phylogenies describing inter- and intra-familial relationships are now available for many tropical taxa, allowing the use of phylogenetically independent contrasts that can assist in the detection of: (a) traits associated with high rates of diversification, (b) the correlated evolution of multiple traits, and (c) the joint evolution of traits and habitat requirements. Fourth, our list of participants includes several investigators who have not met before. Finally, an NCEAS working group established at this time would capitalize on the temporary residence in the U.S. of two of our participants (Drs. Miguel Martinez-Ramos and Horacio Paz), who offer an exceptional data set from Los Tuxtlas and from Chajul (Mexico) and are currently collaborating with Dr. David Ackerly and Dr. Susan Mazer.

McCullough, Deborah
Pathways of non-indigenous plant pest introductions: How exotic insects, pathogens and weeds arrive in the United States

Non-indigenous weeds, phytophagous insects and plant pathogens have had dramatic effects on ecosystems in North America and threaten nearly half of all endangered species in the United States. Introductions of non- indigenous species are expected to

continue and will likely increase as global trade expands. The U.S. Department of Agriculture, Animal and Plant Health Inspection Service (USDA, APHIS) is responsible for excluding non-indigenous phytophagous insects, plant pathogens and noxious weeds. Since 1985, APHIS personnel have maintained a database of non-indigenous species detected at ports, border inspection stations and airports. This database, known as the Port Interception Network or "PIN" data, exists on an aging mainframe computer in Maryland. Over 50,000 reports are entered into the PIN database annually. The PIN database, which has not been made available to the public, is unwieldy and queries must be carefully designed to extract appropriate data. APHIS personnel have used the PIN data for internal assessments and training, but intensive and multidisciplinary analysis of these data has not been attempted. Detailed and intensive analysis of the entire PIN database will greatly increase our understanding of precisely how unwanted organisms are entering the United States. In addition, results of our pathway analysis coupled with literature reviews should enable us to evaluate potential patterns or attributes of successful invaders. An interdisciplinary team of entomologists, pathologists, and botanists will analyze the PIN database. Our objectives are to: 1. Summarize historical trends in the groups of plant-feeding insects and related arthropods, plant pathogens and undesirable plants that arrive at the borders of the U.S.; 2. Evaluate potential associations or patterns that involve taxa from two or more groups; e.g. determine whether plant species or commodities are consistently associated with specific arthropod or pathogen introductions; 3. Identify the frequency that specific guilds or taxa arrive and the rate of establishment of members of those groups; 4. Determine whether attributes such as host breadth, size of native range, reproductive rate, mating system, dispersal method or other traits are related to the frequency of introduction or establishment of selected taxa.

McGill, Brian

Tools and fresh approaches for species abundance distributions

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

Micheli, Fiorenza

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

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

Michener, William
Partnership for Biodiversity Information (Hosted by NCEAS)

Mitchell, Charles
The roles of natural enemies and mutualists in plant invasions

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.

Mittelbach, Gary
Gradients in biodiversity and speciation

The diversity of life varies predictably with climate and is greatest where it is warm and wet (the humid tropics). But, the question "why" has puzzled biologists for over a century. Recent attention has focused on evolutionary mechanisms, in particular whether speciation rates may vary predictably with climate/latitude, whether such variation in speciation rates can account for higher species richness in tropical environments, and what mechanisms might cause geographical variation in speciation rates. We propose to bring together an interdisciplinary team of ecologists, evolutionary biologists, and paleontologists to address the conceptual issues of how climate interacts with ecological and physiological processes to affect speciation rates. Our goal is to test whether speciation/diversification rates vary with climate/latitude using phylogenetic and paleontological data. However, formidable challenges stand in the way of these tests. Therefore, our group will work to identify ways to meet these challenges and to address methodological issues of how to use phylogenetic analysis, as well as paleontological data, to estimate rates of speciation and evolutionary diversification across geographical gradients.

Moore, John
Detritus and dynamics of populations, food webs and communities

Food web theory was developed in large part on the pathway of primary production from plants to herbivores to predators even though most primary productivity is uneaten by herbivores and enters the food web as detritus. What happens to this dominant chunk of the world's productivity? Is the detrital food web a self-contained sink internally recycling energy and nutrients or a link that affects the population dynamics of classic herbivore webs? Do these dynamics differ with system productivity or among habitats, e.g., aquatic versus terrestrial? Whatever the case, we should understand much more about this fundamental component of communities. This working group will focus on the role of detritus in the dynamics and structure of communities; determine systematic differences in its production, quality, and use among habitats; and delineate a framework to integrate detrital and classic food webs.

Morris, William
Stochastic demography for an increasingly variable world

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.

Naiman, Robert
The ecology and uses of riparian zones

The unique role of riparian zones in regulating watershed scale processes has received enormous attention in the last two decades. It is now known that riparian zones strongly influence land-water interactions, provide habitat for an unusual number of species, adjust community level characteristics to specific landforms, and are well adapted to physical as well as biological disturbance regimes. These, and other characteristics, have resulted in the widespread use of riparian zones as prescriptions for landscape management. The purpose of this proposal is to seek support, as a Center Fellow, to prepare a synthesis volume on "The Ecology and Uses of Riparian Zones." The synthesis would be published as a book suitable for instruction at the University level as well as a reference for professional managers. Henri D¿camps (Centre National de la Recherche Scientifique, France) will co-author the synthesis volume while the overall activity will be guided by a working group of five colleagues. The project would start October, 2001 and be completed by July, 2002.

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

Seagrasses are a group of flowering plants that have evolved a unique set of characteristics to live, grow, and reproduce in marine underwater habitats (Les et al., 1997), with key ecosystem services that they provide to coastal areas of the world (Costanza et al., 1997). During the past two decades there has been a significant increase in the number of studies on the distribution, abundance, biology and ecology of seagrasses, including the recent publication of a seagrass atlas (Green and Short, 2003); methods book (Short and Coles, 2001) and research synthesis (Larkum et al., in press). However, the need for a better understanding of seagrasses today has taken on a new meaning and increased urgency. The rate of ecosystem alteration in coastal regions where seagrasses reside is accelerating (Cohen et al., 1997), and these alterations are occurring globally (Short and Wyllie-Echeverria, 1996). The very survival of seagrasses,

which have been present for the past 100 million years, depends on their ability to cope with these natural and anthropogenic alterations. The goal of the "Global Seagrass Trajectories" working group, and the designated sub-groups, will be to use quantitative approaches to critically evaluate the types of changes that seagrasses are experiencing and evaluate likely causes. A previous qualitative examination of the literature indicates that seagrasses are experiencing loss rates (Green and Short, 2003) which match or exceed those of other threatened coastal habitats, such as salt marshes, mangrove forests, and coral reefs (e.g., Pandolfi et al., 2003), for which there is ample scientific and social awareness. Yet, a global assessment with quantitative data for seagrasses is lacking and is the focus of this effort. Synthesizing available information and conveying them to the broader scientific community and society in an effective way will be a key outcome of this project.

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

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

advance our understanding of marine ecosystems and our ability to implement scientifically based and effective ecosystem management.

Owen-Smith, Norman
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.

Packer, Craig
Serengeti: The origins and future of a complex ecosystem

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.

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

At a third NCEAS meeting, we would finalize the chapters for Serengeti III and keep to a schedule whereby we submitted our manuscript to Chicago Press by Jan. 2004. The first Serengeti books were well regarded in their time, but Serengeti III will be one of the most innovative studies of a single ecosystem ever written. Every chapter forms an

integral part of a unified approach to the study of complex ecosystem, starting with soils, working through plants, herbivores and carnivores. And at every level, we fully explore the feedback loop with human activities that are based on the decisions of individuals, of villages, regions, nations and the international community. And to top it off, we close the book with a new paradigm for sustaining a place like the Serengeti in a country as poor as Tanzania.

Palmer, Margaret
A synthetic analysis of the scientific basis of ecological restoration of stream ecosystems

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.

Pascual, Mercedes
Seasonality and the population dynamics of infectious diseases

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.

Peet, Robert
An information infrastructure for vegetation science (Hosted by NCEAS)

Vegetation classification is of central importance to biological conservation for plannning 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 persisitence 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.

Through the combined efforts of The Nature Conservancy (TNC), the Ecological Society of America Vegetation Panel (ESA-VP), and the Federal Geographic Data Committee (FGDC), the United States is on the verge of having its first fully functional, widely-applied vegetation classification system. The federal government has declared the need for a single standard, and on October 22, 1997, the Secretary of Interior, acting as Chair of the Federal Geographic Data Committee, approved the Vegetation Information and Classification Standard (http://biology.usgs.gov/fgdc.veg) which is now the standard vegetation classification for U.S. Federal agencies and their cooperators. Yet, there are still major obstacles ot overcome to make such a system operational and broadly accepted. ESA-VP is working in close collaboration with TNC and FGDC to draft standards for field data acquisition, type, definition, and peer review of proposed additions and changes. A fourth component, an information infrastructure to manage the anticipated 107 plots and 104 plant associations required for a national system, and to distribute this information across the web in a continually revised but perfectly archived format, represents a major intellectual and practical obstacle to the realization of the system. It is this final piece that our proposal addresses.

We propose to convene at NCEAS a working group to design, construct and test prototypes of two core components of the information infrastructure necessary to support the U.S. National Vegetation Classification (US-NVC): a stand-alone vegetation plots database system with internet access tools, and an addition to the TNC Heritage Data Management System that will allow the national classification database to be both continually revised and perfectly archived. Subsets of this working group would meet at intervals over a 2-yr period to develop and test components of the system. A postdoctoral associate employed by NCEAS would work in consultation with project coordinators, TNC and federal government analysts, and NCEAS staff to complete most of the actual design and programming. The prototypes would be demonstrated using a variety of data from the greater Yosemite vegetation mapping project. Subsequently, additional datasets would be used to explore and demonstrate the robustness of the system. Once developed

and peer reviewed, the modules of the working prototype would be adopted and maintained, by some combination of TNC, USGS (NBII), FGDC and ESA.

Peterson, A
Testing alternative methodologies for modeling species' ecological niches and predicting geographic distributions

Knowledge of world biodiversity remains sparse, with millions of species left to be described, most species' geographic distributions poorly understood and the ecological and evolutionary processes that underpin geographic patterns of diversity still far from resolved. Many large-scale conservation projects, however, depend critically on more complete descriptions of species' distributions and there is increasing interest in incorporating process as well as pattern into biodiversity evaluation. The inferential step that leads from incomplete present knowledge to a explicit prediction of geographic distribution is presently made via diverse methods which have not been tested against each other to establish which would provide the greatest predictive ability for different types of questions and data. We propose a NCEAS working group that will review and compare diverse predictive modeling approaches with the goal of producing an ideal strategy for modeling parameters related to ecological niches and predicting geographic distributions.

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

Interactions between predators and their prey are the cornerstone of food-web ecology. Ecologists have traditionally thought of such interactions in terms of the number of prey consumed by predators. A mounting array of evidence suggests that prey are far from helpless victims, however, and that they employ a wide array of defensive strategies. The costs of these strategies can include reduced energy income, lower mating success, or increased vulnerability to other predators. Predators can thus reduce prey density both through direct consumption (density-mediated interactions,"DMIs") and through the costs arising from anti-predator strategies (trait-mediated interactions, "TMIs"). The presence of TMIs can introduce nonlinearities into species interactions that profoundly affect both short-term interactions and longterm population dynamics. We will use meta-analysis to evaluate patterns of TMIs across a range of ecosystems, taxa, and as a function of predator, prey, and resource density, and to determine the relative importance of different forms of TMIs (reductions in feeding, mating opportunities, reproductive allocation, etc) in shaping predator-prey interactions. Our empirical results will be used to help develop models of predator-prey interactions incorporating both density-mediated and a range of trait-mediated effects, in turn allowing us to generate new hypotheses testable by meta-analysis. We will produce: 1) a series of articles, including one which

proposes TMIappropriate experimental methodologies; 2) an article for the general public; and 3) a comprehensive database of TMI research.

Pressey, Robert
Conservation planning tools

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 judgements 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.

Real, Leslie
North American Rabies Database

Real, Leslie
Spatial ecology of infectious disease

The ecology of infectious diseases is receiving increased attention from both public health officials and traditional population biologists. It is clear that the ability to predict and forecast disease outbreaks will require a greater understanding of spatial dynamics and the analysis of spatial patterns of spread. The goal of this Working Group is to analyze large spatial data sets of disease occurrence and spread drawn from natural, agricultural, and public health databases. By comparing the spatial ecology of disease across these different systems we hope to arrive at some basic generalizations about spatially-dependent disease dynamics.

Regan, Helen
Making decisions on complex environmental problems

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

Reichman, O.
A Knowledge Network for Biocomplexity: Building and evaluating a metadata-based framework for integrating heterogeneous scientific data (Hosted by NCEAS)

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.

Knowledge Networking:

We propose to integrate the distributed and heterogeneous information sources required for the development and testing of theory in ecology and its sister fields into a standards-based, open architecture, knowledge network. The network will extend recent advances in metadata representation to provide conceptually sophisticated access to integrated data products drawn from distributed, autonomous data repositories. In addition, the knowledge network will include advanced tools for exploring complex data sets from which multiple formulations of hypotheses can be tested.

The existence of such a network will lead to broadened understanding of biocomplexity and ecological systems, and allow the application of that understanding to societal issues. In developing this network, we will create a new community of environmental scientists who will be able to focus on complex, multi-scale problems that, to date, have proven to be intractable. We will perform foundational research in computer science and informatics to create new tools for discovering, retrieving, interpreting, integrating, and analyzing data from these diverse sources. Our prototype network will be useful across a variety of disciplines and will provide a basis for the growth of multidisciplinary research groups focused on biocomplexity.

Collaboration

To accomplish these goals, we have created an intellectual consortium that comprises the National Center for Ecological Analysis and Synthesis (NCEAS), the Long-Term Ecological Research Network (LTER) and the San Diego Supercomputer Center (SDSC). Our partnership has a successful history and includes (1) advanced expertise in ecology, informatics, and computer science, (2) a comprehensive understanding of the critical obstacles that data heterogeneity and dispersion create for advancing synthesis and understanding, and (3) strong commitments to addressing those obstacles that deter broad-scale and synthetic analyses. Impact The results of the proposed research will have broad implications for our ability to understand and manage sustainably the complex ecological systems and biological resources on which all humans depend. Information on biocomplexity is voluminous and complex, but currently is inaccessible to research scientists and policy makers. The intellectual advances in information science that we propose will, for the first time, provide an accessible infrastructure for identifying, integrating, managing, and, ultimately, synthesizing the nation's ecological and biodiversity information resources.

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Reichman, O.
Knowledge and capacity-building to support ecosystem-based management (EBM) for sustainable coastal-marine systems

The recent U.S. Commission for Ocean Policy Report (2004) calls for a new national ocean policy that balances use with sustainability, and moves towards ecosystem-based management (EBM) founded on sound science. But, as yet, there is no scientific consensus on (1) the basic elements or processes involved in ecosystem- based management; (2) the scientific understanding of coastal-marine systems that it will require; or (3) how best to integrate that scientific understanding into decision-making processes. The David and Lucile Packard Foundation has developed a strategic vision to

fill this urgent need ¿ a carefully designed science program to help create and ensure the use of the knowledge, tools, and skills needed for EBM of sustainable coastal- marine systems.

In June 2004, the Packard Foundation awarded $2,060,292 to the National Center for Ecological Analysis and Synthesis (NCEAS), at the University of California, Santa Barbara for a three year program of activities, involving the analysis and synthesis of existing data and development of new tools to address gaps in knowledge that are critical to successful implementation of ecosystem-based management. The NCEAS activities will include support for working groups, postdoctoral fellowships, graduate student support, and a distributed graduate seminar.

In this program, NCEAS will go beyond publishing academic papers to devise specific strategies to make the scientific knowledge developed through the project directly useful for practitioners and policy makers. Previous attempts to implement ecosystem-based management have been hindered by the failure to effectively incorporate scientific understanding into the decision-making process, and by neglecting to include the stakeholders whose support will be essential to action. We expect that this set of NCEAS activities will lead to the development of a coherent body of knowledge that will change the conceptual foundations for managing coastal-marine ecosystems and help develop the necessary capacity among individuals and institutions to catalyze this sea-change.

Both goals and approaches for EBM vary, depending on geographic location, social values, institutional settings, economic constraints, etc. Nonetheless, it is clear that EBM entails some level of understanding of the scale, complexity and dynamic nature of both ecological and human systems.

Sagarin, Rafe
Ecological and evolutionary models for homeland security strategy

Biological organisms have developed a remarkable number of strategies to mitigate conflict with a broad range of adversaries in their environment. The diversity and success of these strategies, as illustrated by the millions of extant species on the Earth today, suggests that biological evolution may be a field rich with lessons for guiding societal conflict resolution and security strategy. The working group will bring leading security policy analysts together with evolutionary biologists, anthropologists and ecologists to draw on their expertise and identify evolutionary strategies that are applicable to security challenges faced by people, institutions and nations in the 21st century. These biological analogies will be developed into models of decision-making and behavior to explore alternative hypotheses related to strategies for security planning. The combination of biological and policy-oriented perspectives will allow both a rich theoretical discussion and a realistic assessment of the barriers to practical applications of theory.

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

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.

Schildhauer, Mark
Towards a unified model for describing ecological and environmental observation data

Schimel, Josh
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?

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.

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

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

Shurin, Jonathan
Comparing trophic structure across ecosystems

Trophic structure, the partitioning of biomass among organisms at different positions in a food web, varies both within and among ecosystems. However, the causes of this variation are poorly understood. Elton's "pyramid of numbers", where primary producers dominate and consumer densities decrease as trophic levels become more remote from the base of production, applies well to most terrestrial systems. However, many aquatic ecosystems apparently violate Elton's rule with inverted biomass pyramids, or ratios of heterotroph-to- autotroph biomass (H:A) greater than one. In this proposal, we describe synthetic work aimed at understanding differences in trophic

structure and the relative strength of bottom-up and top-down inputs between diverse freshwater, marine and terrestrial ecosystems. We will test candidate hypotheses for this variation based on factors known to distinguish food webs in the two habitats, such as nutrient limitation and turnover rates, productivity (quantity) and nutrient stoichiometry (quality). Meta-analysis of local-scale herbivore manipulation experiments will be integrated with theoretical development of food web models, and with larger-scale temporal and spatial patterns from resource gradients. This work will move us closer to a comprehensive trophic-dynamic theory, unified across taxa and ecosystem types. It will also increase our mechanistic understanding of how human impacts, such as eutrophication or predator extirpation, propagate or attenuate in ecosystems through trophic interactions.

Shurin, Jonathan
Comparing trophic structure across ecosystems (Extended)

Silander, John
Macro-ecology and biogeography: Hierarchical (Bayesian) model development using data from South Africa

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 ¿ 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.

Smith, Felisa
Body size in ecology and paleoecology: Linking pattern and process across spatial, temporal and taxonomic scales

Body size has long been a central area of research in both ecology and paleoecology. With few exceptions however, ecologists have focused on spatial relationships and/or short time spans, and paleoecologists on long time scales. Little cross-linkage has existed between the two disciplines. Additionally, most studies of ecogeographic or evolutionary phenomena are restricted to single taxa. We propose to form a working group consisting of paleoecologists and ecologists, studying organisms as diverse as marine invertebrates, terrestrial woody plants and mammals. Our aim is to synthesize the patterns of body size distribution across local to broad geographic space and from contemporary to "deep" time, and then to examine the processes that lead to the observed patterns.

Taper, Mark
The Evidence Project: Supporting scientific claims

Scientists strive to understand the operation of natural processes. To this end, they collect data both experimental and observational. The objective and quantitative interpretation of data as evidence for one hypothesis over another hypothesis is an integral part of the scientific process. None of the existing schools of statistical inference fully addresses the needs of working scientists. Scientists are forced to twist their thinking to pigeon hole their analyses into existing paradigms. We believe that a revision of statistical theory is in order, reflecting the needs of practicing ecologists. Through a dialog amongst working scientists, statisticians and philosophers this working group will seek to construct a new statistical approach focused on the quantification of evidence, which will supplement traditional paradigms. We will hone and demonstrate our approach through applications to difficult problems of ecological data analysis.

Templer, Pamela
The fate of nitrogen inputs to terrestrial ecosystems

Recent technical innovations in the use of 15N stable isotopic tracers at the ecosystem scale have produced a wealth of data on the fate of N inputs to terrestrial ecosystems. Although this analytically intensive technique has been used at over 20 sites world wide, there have been few attempts at cross-site synthesis. Here we propose a series of working group activities to synthesize ecosystem-scale 15N tracer experiments across a wide geographic range of ecosystem types. While at NCEAS, we propose to develop three products: (1) a standardized protocol for application and analysis of 15N tracer studies, (2) a meta-analysis of the fate and redistribution of N across sites and ecosystem types, and (3) an inter-site comparison with the TRACE model, a simulation model that predicts the fate of N inputs over long time scales. Through these activities, we will address questions about controls over the fate of N inputs in terrestrial ecosystems and the consequences of increased N deposition.

Urban, Mark
Evolutionary and ecological sorting in space

The last fifteen years have witnessed an increasing realization that ecological dynamics operating at coarse spatial scales have important ecological consequences. One of the more exciting ideas that has ensued is the "metacommunity" (Figure 1), a concept that has contributed significant insights about population, community and ecosystems ecology (see Leibold et al. 2004 for a recent review, Holyoak et al. 2005 for the scope of this idea). To date, however, the metacommunity concept has been evaluated in a purely ecological context. Nevertheless, close parallels and obvious interrelations exist between ecological and evolutionary dynamics at multiple spatial scales (McPeek and Gomulkiewicz 2005). Mounting evidence suggests that evolutionary dynamics can occur on time scales similar to those involving ecological dynamics (Cousyn et al. 2001, Kinnison and Hendry 2001, Grant and Grant 2002, Yoshida et al. 2003). If so, metacommunity and evolutionary dynamics may interact strongly. Yet, we are only now beginning to understand this interaction. While metacommunity ecology will continue to contribute interesting insights about a diverse array of ecological phenomena, we foresee that these insights will soon be constrained by our limited knowledge about how ecological and evolutionary processes interact in metacommunities. We seek to bring together scientists from diverse backgrounds to synthesize current knowledge and generate new understanding about evolutionary and metacommunity dynamics. We intend to 1) develop and refine an evolving metacommunity framework, 2) explore the potential for emergent dynamics by incorporating evolution into existing metacommunity models; 3) evaluate how multi-species interactions impact community evolution and dynamics; and 4) develop tools to test and apply the theory. The proposed synthesis of evolutionary and metacommunity theory promises to improve our understanding of species coexistence and provide strategies

Venable, D.
Population and community dynamics of desert annuals

Ecology has made significant strides in scaling up spatially, with the development of metapopulation and landscape approaches and new types of data and techniques of analysis (GIS, Landsat data, spatial statistics). There has also been some progress in scaling up temporally with recent developments of paleoecology, palynology, and tree ring research. However, the relative difficulty of obtaining temporal data as compared to spatial data, has slowed the rate of advance of temporal scaling. I have collected a 19-year data set on the population and community dynamics of a guild of Sonoran Desert annuals at the Desert Laboratory in Tucson, Arizona. These data provide a valuable window on demographic variability in arid ecosystems that should be of interest to scientists studying climate-vegetation interactions, adaptations to variable environments

and species coexistence in variable environments. I propose to spend my 12-month sabbatical at NCEAS to analyze this data and synthesize the results with respect to these three conceptual frameworks. While at NCEAS I intend to interact with other ecologists with long temporal data sets on population and community dynamics of desert organisms to explore the climate-population-community linkages in temporal dynamics. I also intend to interact with investigators interested in exploring the population dynamic functions shared by seed banks and other partially substitutable traits from an evolutionary ecological theoretical perspective and with investigators interest in temporal variance based species coexistence in desert annuals.

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

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

Wilson, Mark
Global change and infectious disease

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).

Worm, Boris
Linking marine biodiversity to ecosystem functions and services

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.

Zhuang, Qianlai

Toward an adequate quantification of CH4 emissions from land ecosystems: Integrating field and in-situ observations, satellite data, and modeling

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

emissions; and 3) to couple process-based estimates with inversion modeling approaches to constrain the uncertainty with air-borne, satellite, and in-situ observed datasets and to identify the factors, mechanisms, and controls to the uncertainty of emissions at large-scales.

Zilov, Evgeny
The 60-year data set of plankton dynamics in Lake Baikal: Examining facets of the jewel of Siberia

This international working group will use time-series analysis to analyze a 60-year data set describing the plankton community of Lake Baikal (Siberia) ¿ the deepest, oldest, and most biotically diverse lake on the planet. Due to financial constraints on scientific research in Russia during the post-Soviet era, an extraordinary data set describing the dynamics of the plankton community in Lake Baikal has been greatly underutilized, and it is nearly unknown by the international scientific community. Using this high-resolution data set, we will explore spatial-temporal patterns in plankton abundance and community structure, and compare effects of perturbations on plankton dynamics. This work will increase our understanding of ecosystem functioning in one of the world's great lakes, and it will bring the Lake Baikal dataset to international recognition, encouraging future exploitation of this rich scientific resource.

Sabbatical Fellows

5/1/2001 – 7/30/2007

Ashley, Mary
8/1/2001 - 7/31/2002
New analytical methods in molecular ecology

Becerra, Judith
8/1/2001 - 7/31/2002
Landscape coevolution of bursera plants and its herbivores

Brown, Jim
7/1/2007 – 12/31/2007
The scale of Life

Burgman, Mark
7/1/2002 - 6/30/2003
Setting priorities and making decisions for conservation risk management

Condit, Richard
12/9/2005 - 12/8/2007

Geographic distribution of neotropical tree species: Pattern and process

Covich, Alan
9/1/2000 - 8/31/2001
Drought effects on riparian forests and reorganization of nested stream food webs

Crowder, Larry
1/1/2004 - 6/30/2004
Marine conservation: Integrating science and policy

Cunningham, Clifford
9/1/2002 - 6/30/2003
The North Atlantic Project: Comparative ecology of the temperate Northwestern and Northeastern Atlantic benthic communities

Gross, Katherine
11/1/2002 - 6/30/2003
Developing a predictive framework for the maintenance and restoration of native plant diversity in grasslands

Groves, Craig
1/1/2001 - 5/30/2001
Drafting a conservation blueprint: A practitioner's guide to regional planning for biodiversity

Hackett, Edward
8/15/2004 - 8/14/2005
Ecology transformed: Social and intellectual change in ecological research

Harlan, Sharon
8/15/2004 - 8/1/2005
Urban ecology, social inequality, and climate: Building an integrative framework at the neighborhood scale

Harvell, Drew
8/8/2000 - 6/30/2001
The ecology of marine diseases

Hochberg, Michael
7/1/2006 - 8/31/2006; 3/8/2007 - 3/11/2007; 6/1/2007 - 8/31/2007
A life-history theory of animal groups

Kodric-Brown, Astrid
7/1/2007 – 12/31/2007
The role of acoustic communication in premating isolation in pupfish

Juanes, Francis
8/25/2006 - 5/31/2007
Comparing globally-distributed population of Pomatomus saltatrix: Life histories and fisheries

Kinnaird, Margaret
9/1/2003 - 8/31/2004
Functional relationships of Asian Hornbills in changing forest landscapes

Kitchell, James
10/1/2003 - 4/30/2004
Food web models for aquatic ecosystems

Krivan, Vlastimil
2/1/2005 - 1/31/2006
Merging adaptive behavior and population dynamics

Leavitt, Peter
2/1/2007 - 1/31/2008
Ecological variability of lakes in time: Integrated insights from paleolimnology and long-term ecological research

Lodge, David
8/4/2004 - 6/30/2005
Biology and policy of invasive species

Lovvorn, James
1/5/2006 - 1/4/2007
Physiological limits on realized patch structure and trophic coupling from krill to diving seabirds

Lundberg, Per
9/1/2002 - 8/31/2003
Dynamics of large mammalian herbivores in changing environments: Alternative modeling approaches

Marquet, Pablo
9/1/2006 - 4/30/2007
Power laws in ecology

Marsh, David
11/10/2006 - 8/9/2007
Optimal design of population monitoring programs

Martinez, Neo
12/4/2006 - 12/3/2007

Synthesizing and analyzing complex ecological networks with ecoinformatics

Menzel, Susanne
5/23/2006 - 9/20/2006
A synthetic approach to the science of ecosystem-based management of coastal marine ecosystems (EBM)

Mittelbach, Gary
11/1/2002 - 6/30/2003
Determinants of species diversity at varying spatial scales

Moehlman, Patricia
10/1/2001 - 9/30/2002
The evolution of cooperative breeding in Canidae: Implications for extinction risk

Murdoch, William
4/4/2005 - 9/30/2005
International conservation: Expanding the decision framework

Naiman, Robert
10/1/2001 - 3/31/2002
The ecology and uses of riparian zones

O'Brien, Timothy
9/1/2003 - 8/31/2004
Functional relationships of Asian Hornbills in changing forest landscapes

O'Brien, W. John
1/1/2004 - 6/17/2004
Global change and eutrophication: Modeling of arctic lake ecosystems

Padilla, Dianna
1/17/2005 - 1/16/2006
Non-native species introductions in marine reserves and protected areas

Parrish, Julia
1/1/2004 - 9/30/2004
Marine conservation

Peet, Robert
9/1/2001 - 2/28/2002
Tools for vegetation classification and analysis

Porter, Warren
7/1/2001 - 9/30/2001
Putting physiology on a landscape scale

Ritchie, Mark
9/1/2005 - 8/31/2006
Thermodynamics of trophic interactions: Toward a reconciliation of energy and elements

Roberts, David
8/1/2000 - 7/31/2001
Synthesizing the new vegetation ecology

Shachak, Moshe
7/1/2004 - 9/30/2004; 1/28/2005 - 4/7/2005
The role of plants as landscape modulators in controlling biodiversity

Stockwell, David
10/1/2005 - 7/31/2006
Preparation of a book and accompanying CD of programs and data entitled Ecological Niche Modeling: Ecoinformatics in application to biodiversity

Tilman, David
1/1/2001 - 5/15/2001
The causes and consequences of biodiversity and composition

Venable, Larry
8/1/2001 - 7/31/2002
Population and community dynamics of desert annuals

Wiens, John
9/1/2000 - 6/30/2001
A conceptual synthesis of landscape ecology

Wilson, Will
7/1/2002 - 6/30/2003
A broad look at organismal interactions: Linking intraspecific social interactions to an interspecific resource- consumer framework

Postdoctoral Associates

May 1, 2001 – July 31, 2007

Adler,Peter
9/1/2005 - 6/30/2006
Coexistence in a changing environment: Evaluating the role of climatic variability in semiarid plant communities

Allen, Andrew
3/1/2005 - 2/28/2008

The role of temperature in the origin and maintenance of biodiversity

Alroy, John
9/1/1998 - 8/31/2001
Paleoecology of North American mammals: Large-scale patterns and processes

Baskett, Marissa
9/13/2006 - 9/12/2007
Can coral reefs survive climate change?

Borer, Elizabeth
9/1/2003 - 7/16/2004
Synthesizing intraguild predation theory and data

Broitman, Bernardo
1/15/2006 - 11/16/2007
Bottom-up ecosystem-based management of coastal systems: Social drivers of ecological and economic factors in EBM (EBM)

Brooks, Marjorie
1/5/2006 - 1/4/2007
Anthropogenic stressors on aquatic ecosystems: Modeling links between UV radiation, geochemistry, bioaccumulation, and invertebrate communities at a landscape scale

Budden, Amber
5/1/2007 – 4/39/2008
Occurrence of Publication Bias in Ecology

Buston, Peter
10/1/2002 - 9/30/2005
The ecology of hermaphroditic breeding systems

Cadotte, Marc
6/15/2007 - 6/14/2009
Using phylogenetic information to predict the relative importance of equalizing versus stabilizing mechanisms on species coexistence

Chalcraft, David
6/10/2002 - 12/31/2003
A Knowledge Network for Biocomplexity: Building and evaluating a metadata-based framework for integrating heterogeneous scientific data

Cleland, Elsa
8/1/2005 - 7/31/2007

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

Cottenie, Karl
2/1/2003 - 6/15/2005
Local versus regional processes: Integrating space and environment

Cowling, Sharon
9/15/2000 - 9/14/2002
The carbon balance of Eurasia and North America

Cox, Stephen
6/1/2000 - 6/30/2001
A Knowledge Network for Biocomplexity: Building and evaluating a metadata-based framework for integrating heterogeneous scientific data

Davies, Jonathan
2/1/2007 - 1/31/2008
Coexistence, competition, and character evolution in carnivores and primates

de Valpine, Perry
9/1/2000 - 8/31/2001
Analysis of insect population data with structured population models
InsectPopulation

Drake, John
6/1/2004 - 6/30/2006
Risk analysis for alien species and emerging infectious diseases

Floeter, Sergio
9/1/2003 - 1/31/2006
Diversity, biogeography and macroecological patterns of Atlantic reef fishes

Franz, Nico
12/15/2003 - 12/16/2005
Postdoctoral training in the management of environmental information

Gergel, Sarah
9/1/2000 - 5/31/2003
Protecting water by conserving land: The importance of spatial arrangement in influencing ecosystem processes

Halpern, Ben
9/1/2003 - 12/15/2004
Predicting community-level responses to disturbance: Implications for reserve design

Hurlbert, Allen
9/1/2005 - 8/31/2007
Exploring the Swiss Cheese Effect: The causes and consequences of patchily occupied species ranges

Kappel, Carrie
1/25/2006 - 1/24/2007
A synthetic approach to the science of ecosystem-based management of coastal marine ecosystems (EBM)

Knight, Tiffany
1/5/2004 - 12/3/2004
Beyond hand-pollinations: Linking pollen limitation to plant population biology
Postdoctoral Fellowship

Langford, Bill
2/1/2002 - 1/31/2005
Evaluation functions for ecological image segmentation

Luttbeg, Barney
7/1/1999 - 6/30/2002
The Evidence Project: Supporting scientific claims

Lyons, Sara Kate
8/1/2003 - 7/31/2006
Temporal and spatial dimensions of mammalian community structure: Pattern and process

Madin, Josh
9/1/2005 - 9/30/2006
Postdoctoral training in the management of environmental information

McCain, Christy
1/13/2004 - 1/12/2007
Elevational trends in biodiversity: Examining theoretical predictions across taxa

McRae, Brad
11/1/2005 - 10/31/2008
Linking landscape ecology and population genetics using algorithms from circuit theory

Melian, Carlos
2/22/2005 - 2/21/2008
The evolution of behavior and the structure of ecological networks

Moe, Jannicke
10/1/2003 – 4/1/2004
Stoichiometry and population dynamics of consumer-resource systems: A combined experimental and modelling approach

Moles, Angela
8/25/2003 - 6/26/2004
The radiation of seed mass strategies worldwide

Muller-Landau, Helene
1/1/2002 - 12/31/2003
Landscape-scale variation in forest communities and the distribution of tree life history strategies

Murray, Jill
3/5/2001 - 12/31/2003
Bridging microbial and theoretical ecology to investigate cooperative strategies in bacteria

Orrock, John
6/1/2004 - 6/30/2007
Interactions between mammalian herbivores and associated plant communities

Post, David
9/1/2000 - 8/31/2002
How does turnover time structure affect ecosystem stability?
EcosystemStability

Pyke, Chris
10/1/2002 – 12/31/2004
Climate, ecosystems, and land-use: Understanding environmental variability in human-dominated landscapes

Regan, Helen
12/4/2000 - 12/3/2002
Developing and testing methods for classifying species conservation status and estimating risk

Richards, Shane
12/5/2000 - 12/4/2001
Spatial ecology of infectious disease

Sandlin, Elizabeth
6/1/2000 - 8/31/2001
A Knowledge Network for Biocomplexity: Building and evaluating a metadata-based framework for integrating heterogeneous scientific data

Schultz, Cheryl
3/1/1999 - 6/30/2002
Managing natural areas: How do we select among land management options?

Seabloom, Eric
6/1/1997 - 7/16/2004
Restoration of invaded California grasslands

Shurin, Jonathan
9/1/2000 - 5/31/2003
Detecting species interactions in survey data: New approaches and applications
DetectingInteraction

Smith, Melinda
6/17/2002 - 12/31/2003
A Knowledge Network for Biocomplexity: Building and evaluating a metadata-based framework for integrating heterogeneous scientific data

Smith, Jennifer
10/1/2005 - 9/30/2007
Coral reef degradation: Determining the relative role of top-down and bottom-up factors in the global decline of coral reefs

Stephens, Patrick
10/4/2005 - 10/3/2007
The effects of lineage age on the species richness of regional assemblages

Stevens, Richard
12/15/2002 - 12/14/2004
Environmental determinants of biodiversity

Tao, Jing
6/1/2003 - 5/31/2007
Science Environment for Ecological Knowledge (SEEK)

Thompson, Lisa
7/1/1999 - 8/31/2001
Fresh water and environmental change: The ecological consequences of altered hydrological regimes

Torchin, Mark
10/1/2003 - 8/31/2004
Using biological invasions to test predictions of population control by parasites

Towner, Mary

7/1/1999 - 6/30/2002
The Evidence Project: Supporting scientific claims

Urban, Mark
9/15/2006 - 9/14/2007
Interaction traits and metacommunity gene flow

Vazquez, Diego
10/1/2002 - 6/30/2005
Null models for specialization and asymmetry in plant-pollinator systems
Diego Vazquez

Vellend, Mark
9/1/2004 - 7/31/2005
Forest plant metapopulations in fragmented and dynamic landscapes: Synthesizing models and data

Verburg, Piet
7/16/2004 - 7/15/2006
Climate forcing of lacustrine energy fluxes

Williams, Jack
6/17/2002 - 8/20/2003
A Knowledge Network for Biocomplexity: Building and evaluating a metadata-based framework for integrating heterogeneous scientific data

Williams, John
9/20/1999 - 9/19/2001
Integrating satellite and pollen data with biogeochemical modeling to reconstruct long-term trends in the productivity and carbon sequestration of terrestrial ecosystems

Williams, Rich
5/1/2003 - 4/30/2005
Science Environment for Ecological Knowledge (SEEK)

Visiting Scientists

May 1, 2001 – July 30, 2007
Short-term visitors who come to work with resident scientists, or take advantage of workshops or other scientific opportunities. This list is comprised of only those individuals who stay in residence for significant interactions.

Amarasekare, Priyanga, University of California, Los Angeles
6/6/2006 - 6/9/2006

Barker, Kristin, NatureServe

6/6/2006 - 4/26/2003

Bonsall, Michael, Imperial College, London
6/6/2006 - 4/1/2004

Busch, Jonah, University of California, Santa Barbara
6/6/2006 - 5/15/2005

Caballero Vazquez, Adan, Centro de Investigacion y de Estudios Avanzados
6/6/2006 - 2/21/2007

Cressman, Ross, Wilfrid Laurier University
8/12/2005 - 8/15/2005

Deacon, Robert, University of California, Santa Barbara
5/8/2005 - 5/15/2005

DeFries, Ruth, University of Maryland
5/8/2005 - 5/15/2005

Gaichas, Sarah, University of Washington
2/1/2004 - 2/28/2004

Gerber, Leah, Arizona State University
7/24/2006 - 8/18/2006; 7/10/2007 - 8/15/2007

Holmes, Elizabeth, NOAA Fisheries
7/11/2005 - 7/26/2005

Jackson, Stephen, University of Wyoming
5/7/2003 - 5/9/2003

Kareiva, Peter, The Nature Conservancy
5/8/2005 - 5/15/2005

Kinnaird, Margaret
5/8/2005 - 5/15/2005

Koellner, Thomas, Swiss Federal Institute of Technology
11/14/2005 - 11/23/2005

Kondoh, Michio, Ryukoku University
7/27/2007 - 8/31/2007

Kremen, Claire, University of California, Berkeley
5/14/2002 - 5/15/2002

Krivan, Vlastimil, Academy of Sciences of the Czech Republic, Biological Research Center
6/6/2006 - 6/9/2006; 3/5/2007 - 3/10/2007

Laney, Christine, New Mexico State University
10/10/2005 - 10/12/2005

Liebhold, Andrew, USDA Forest Service
7/7/2003 - 7/12/2003; 7/12/2005 - 7/15/2005

Lovvorn, James, University of Wyoming
7/1/2007 - 7/31/2007

Moe, Jannicke, University of Oslo
11/23/2004 - 12/4/2004

Moehlman, Patricia,
4/1/2003 - 4/30/2003

Moss, Cynthia, Amboseli Elephant Research Project
10/7/2001 - 10/21/2001

Murdoch, William, University of California, Santa Barbara
5/8/2005 - 5/15/2005

O'Brien, Timothy, -
5/8/2005 - 5/15/2005

Polasky, Stephen, University of Minnesota, St. Paul
5/8/2005 - 5/15/2005

Possingham, Hugh, University of Queensland
5/8/2005 - 5/15/2005

Ruger, Nadja, Helmholtz Centre for Environmental Research - UFZ
7/25/2007 - 8/25/2007

Sabo, John, Arizona State University
7/11/2005 - 7/26/2005; 7/24/2006 - 8/18/2006; 7/10/2007 – 3/2/2007

Seminet-Reneau, Elizabeth, University of Idaho
2/27/2007 - 3/2/2007

Slayback, Dan, National Aeronautics and Space Administration
2/24/2003 - 2/28/2003

Smith, Felisa, University of New Mexico
5/22/2004 - 5/28/2004

Srivastava, Diane, University of British Columbia
12/14/2004 - 12/17/2004

Sugden, Andrew, Science International
4/26/2004 - 4/28/2004

Swenson, William
2/22/2006 - 2/23/2006

Tague, Christina, San Diego State University
5/20/2003 - 5/22/2003

Talley, Drew, San Francisco Bay National Estuarine Research Reserve
5/7/2006 - 5/10/2006

Ulanowicz, Robert, University of Maryland
1/24/2006 - 1/27/2006

Usio, Nisikawa, Colorado State University
6/1/2001 - 8/31/2001

Verheyen, Kris, Katholieke Universiteit Leuven
11/7/2004 - 11/12/2004

Viscido, Steven
7/11/2005 - 7/26/2005

Vucetich, John, Michigan Technological University
4/21/2003 - 4/25/2003

Zalewski, Marcin, Polish Academy of Sciences
3/9/2007 - 3/14/2007

Publications – Journal Articles, Books and Book Chapters

List of Journal Articles, Books, and Book Chapters
for Reporting period May 1, 2001 – July 31,2007

* - Indicates publication was listed in NSF 1995-2001 Report as “Accepted”, “In-press”, or “Submitted”

*Abrams, Peter A. 1999. The adaptive dynamics of consumer choice. American Naturalist. Vol:153, Pages 83-97.

Abrams, Peter A.. 2000. Character shifts of prey species that share predators. American Naturalist. Vol: 156. Pages S45-S61.

Abrams, Peter A.. 2001. The effect of density independent mortality on the coexistence of exploitative competitors for renewing resources. American Naturalist. Vol: 158. Pages 459-470.

Abrams, Peter A.. 2004. When does periodic variation in resource growth allow robust coexistence of competing consumer species?. Ecology. Vol:85. Pages 372-382.

Abrams, Peter A.; Chen, Xin. 2002. The evolution of traits affecting resource acquisition and predator vulnerability: Character displacement under real and apparent competition. American Naturalist. Vol: 160.Pages 692-704.

Abrams, Peter A.; Wilson, Will G.. 2004. Coexistence of competitors inmetacommunities due to spatial variation in resource growth rates: DoesR* predict the outcome of competition?. Ecology Letters. Vol: 7. Pages929-940.

Adler, Fred; Muller-Landau, Helene C.. 2005. When do localized natural enemies increase species richness?. Ecology Letters. Vol: 8. Pages 438-447.

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

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

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

Agapow, Paul-Michael; Bininda-Emonds, Olaf R. P.; Crandall, Keith A.;Gittleman, John L.; Mace, Georgina; Marshall, Jonathon G.; Purvis, Andy.2004. The impact of species concept on biodiversity studies. Quarterly Review of Biology. Vol: 79(2). Pages 161-179.

Aguirre, A. A.; Ostfeld, Richard S.; House, C. A.; Tabor, Gary; Pearl, M.. 2002. Conservation Medicine: Ecological Health in Practice. Oxford University Press. New York.

Airame, Satie; Dugan, Jenifer E.; Lafferty, Kevin; Leslie, Heather; McArdle, Deborah; Warner, Robert R.. 2003. Applying ecological criteria to marine reserve design: A case study from the California Channel Islands. Ecological Applications (Supplement: The Science of Marine Reserves). Vol: 13(1). Pages S170-S184.

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

Akcakaya, H. Resit; Regan, Helen. 2001. Population models: Meta populations. /Edited by / Pastorok, R. A.; Bartell, S. M.; Ferson,S.; Ginzburg, L. R.. Ecological Modeling in Risk Assessment: Chemical Effects on Populations, Ecosystems and Landscapes. Lewis Publishers. Boca Raton, FL. Pages 83-95.

Alcamo, J.; Leemans, Rik; Kreileman, E.. 1998. Global Change Scenarios of the 21st Century: Results from the IMAGE 2.1 Model. Elsevier. Oxford.

Alexander, Richard B.; Johnes, Penny; Boyer, Elizabeth W.; Smith, Richard A.. 2002. A comparison of models for estimating the river in export of nitrogen from large watersheds. Biogeochemistry. Vol: 57&58.Pages 295-339.

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

Allen, Andrew P.; Gillooly, James F.; Brown, James H.. 2005. Linking the global carbon cycle to individual metabolism. Functional Ecology. Vol: 19. Pages 202-213.

Allen, Andrew P.; Gillooly, James F.; Savage, Van M.; Brown, James H..2006. Kinetic effects of temperature on rates of genetic divergence and speciation. Proceedings of the National Academy of Sciences. Vol:130(24). Pages 9130-9135.

Allen, Craig R.; Garmestani, A. S.; Havlicek, Tanya; Marquet, Pablo A.; Peterson, Garry; Restrepo, Carla; Stow, Craig; Weeks, B. E.. 2006.Patterns in body mass distributions: Sifting among alternative hypotheses. Ecology Letters. Vol: 9. Pages 630-643.

Allen, Craig R.; Holling, Crawford S.. 2002. Cross-scale structure and scale breaks in ecosystems and other complex systems. Ecosystems (Special feature on Discontinuous Structure in Ecological Systems). Vol:5(4). Pages 315-318.

Allen, Craig R.; Saunders, Denis A.. 2002. Variability between scales: Predictors of nomadism in birds of an Australian Mediterranean-climate ecosystem. Ecosystems (Special feature on Discontinuous Structure in Ecological Systems). Vol: 5(4). Pages 348-359.

Allison, Gary; Gaines, Steven D.; Lubchenco, Jane; Possingham, Hugh P..2003. Ensuring persistence of marine reserves: Catastrophes require adopting an insurance factor. Ecological Applications (Supplement: The Science of Marine Reserves). Vol: 13(1). Pages S8-S24.

Alroy, John. 1999. Putting North America's end-Pleistocene megafaunal extinction in context: Large scale analysis of spatial patterns, extinction rates, and size distributions. /Edited by / MacPhee, Ross D.E.; Sues, Hans-Dieter. Extinctions in Near Time: Causes, Contexts, and Consequences. Plenum. New York. Pages 105-143.

Alroy, John. 1999. The fossil record of North American mammals: Evidence for a Paleocene evolutionary radiation. Systematic Biology.Vol: 48. Pages 107-118.

Alroy, John. 2000. New methods for quantifying macro evolutionary patterns and processes. Paleobiology. Vol: 26(4). Pages 707-733.

Alroy, John. 2000. Successive approximations of diversity curves: Ten more years in the library. Geology. Vol: 28. Pages 1023-1026.

Alroy, John. 2000. Understanding the dynamics of trends within evolving lineages. Paleobiology. Vol: 26(3). Pages 319-329.

Alroy, John. 2001. A multispecies overkill simulation of the end-Pleistocene megafaunal mass extinction. Science. Vol: 292. Pages1893-1896.

Alroy, John. 2002. How many named species are valid? Proceedings of the National Academy of Sciences. Vol: 99. Pages 3706-3711.

Alroy, John. 2002. Stratigraphy in phylogeny reconstruction - reply to Smith (2000). Journal of Paleontology. Vol: 76. Pages 587-589.

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

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

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

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

Alroy, John; Koch, P. L.; Zachos, J.C.. 2001. Global climate change and North American mammalian evolution. /Edited by / Wing, Scott L.; Erwin, Douglas H.. Deep Time: Paleobiology's Perspective. University of Chicago Press. Chicago. Pages 259-288.

Alroy, John; Marshall, Charles R.; Bambach, Richard K.; Bezusko, Karen; Foote, Michael; Fursich, Franz T.; Hansen, Thor A.; Holland, Steven M; Ivany, Linda; Jablonski, David; Jacobs, David; Jones, D.C.; Kosnik, Matthew; Lidgard, Scott; Low, Sofy; Miller, Arnold I.; Novack-Gottshall, P.M.; Olszewski, Tom; Patzkowsky, Mark E.; Raup, David; Roy, Kaustuv; Sepkoski, J. John; Sommers, Michael; Wagner, Peter J.; Webber, Andrew J. 2001. Effects of sampling standardization on estimates of Phanerozoic marine diversification. Proceedings of the National Academy of Sciences. Vol: 98. Pages 6261-6266.

Altizer, Sonia; Harvell, Drew; Friedle, Elizabeth. 2003. Rapid evolutionary dynamics and disease threats to biodiversity. Trends in Ecology and Evolution. Vol: 18(11). Pages 589-596.

Altizer, Sonia; Nunn, Charles L.; Thrall, Peter; Gittleman, John L.; Antonovics, Janis; Cunningham, Andrew A.; Dobson, Andrew P.; Ezenwa,Vanessa; Jones, Kate; Pedersen, Amy; Poss, Mary; Pulliam, Juliet. 2003. Social organization and parasite risk in mammals: Integrating theory and empirical studies. Annual Review of Ecology, Evolution, and Systematics. Vol: 34. Pages 517-547.

* Amarasekare, Priyanga. 2000. Coexistence of competing parasitoids on a patchily distributed host: Local vs. spatial mechanisms. Ecology. Vol:81. Pages 1286-1296.

* Amarasekare, Priyanga. 2000. Spatial dynamics in ahost-multiparasitoid. Journal of Animal Ecology. Vol: 69. Pages 201-213.

Amarasekare, Priyanga. 2000. The geometry of coexistence. Biological Journal of the Linnean Society. Vol: 71. Pages 1-31.

Amarasekare, Priyanga; Hoopes, Martha F.; Mouquet, Nicolas; Holyoak, Marcel. 2004. Mechanisms of coexistence in competitive metacommunities. American Naturalist. Vol: 164. Pages 310-326.

Amarasekare, Priyanga; Nisbet, Roger M. 2001. Spatial heterogeneity, source-sink dynamics, and the local coexistence of competing species. American Naturalist. Vol: 158. Pages 572-584.

Amarasekare, Priyanga; Possingham, Hugh P. 2001. Patch dynamics and metapopulation theory: The case of successional species. Journal of Theoretical Biology. Vol: 209. Pages 333-344.

Andelman, Sandy J.; Bowles, Christy; Willig, Michael R.; Waide, Robert B.. 2004. Understanding environmental complexity through a distributed knowledge network. BioScience. Vol: 54(3). Pages 240-246.

* Andelman, Sandy J.; Fagan, William F.. 2000. Umbrellas and flagships: Efficient conservation surrogates or expensive mistakes? Proceedings of the National Academy of Sciences. Vol: 97. Pages 5954-5959.

Andelman, Sandy J.; Regan, Helen; Groves, Craig. 2004. A review of protocols for selecting species at risk in the context of U.S. Forest Service viability assessments. Acta Oecologica. Vol: 26. Pages 75-83.

Andelman, Sandy J.; Willig, Michael R.. 2002. Alternative configurations of conservation reserves for Paraguayan bats: Consideration of spatial scale. Conservation Biology. Vol: 16. Pages1352-1363.

Andelman, Sandy J.; Willig, Michael R.. 2003. Present patterns and future prospects for biodiversity in the Western Hemisphere. Ecology Letters. Vol: 6. Pages 818-824.

Andelman, Sandy J.; Willig, Michael R.. 2004. Networks by design: A revolution in ecology. Science. Vol: 305. Pages 1565-1567.

Anderson, Kristina J.; Allen, Andrew P.; Gillooly, James F.; Brown, James H. 2006. Temperature-dependence of biomass accumulation rates during secondary succession. Ecology Letters. Vol: 9. Pages 673-682.

Antonovics, Janis; Thrall, Peter; Jarosz, Andrew M.. 1997. Genetics and the spatial ecology of species interactions. /Edited by / Tilman, David; Kareiva, Peter. Spatial Ecology: The Role of Space in Population Dynamics and Interspecific Interactions. Princeton University Press. Princeton. Pages 158-180.

Armsworth, Paul R.; Kendall, Bruce E.; Davis, Frank W.. 2004. An introduction to biodiversity concepts for environmental economists. Resource and Energy Economics (Special issue on the economics of biodiversity). Vol: 26(2). Pages 115-136.

Armsworth, Paul R.; Roughgarden, Joan. 2001. An invitation to ecological economics. Trends in Ecology and Evolution. Vol: 16. Pages229-234.

Arneberg, Per. 2001. An ecological law and its macroecological consequences as revealed by studies of relationships between host densities and parasite prevalence. Ecography. Vol: 24. Pages 352-358.

Arneberg, Per. 2002. Host population density and body mass as determinants of species richness in parasite communities: Comparative analyses of directly transmitted nematodes of mammals. Ecography. Vol:25. Pages 88-94.

Ashley, Mary V.; Wilk, J. A.; Styan, S. M.; Craft, K. J.; Jones, Kate; Feldheim, K. A.; Lewers, K. S.; Ashman, Tia-Lynn. 2003. High variability and disomic segregation of microsatellites in the octaploid Fragariavirginiana Mill (Rosaceae). Theoretical and Applied Genetics. Vol:107(7). Pages 1201-1207.

Ashley, Mary V.; Willson, Mary F.; Pergams, Oliver R.W.; O'Dowd, Dennis J.; Gende, Scott M.; Brown, Joel. 2003. Evolutionarily enlightened management. Biological Conservation. Vol: 111. Pages 115-123.

Ashman, Tia-Lynn; Knight, Tiffany; Steets, Janette; Amarasekare, Priyanga; Burd, Martin; Campbell, Diane; Dudash, Michele R.; Johnston, Mark O.; Mazer, Susan J.; Mitchell, Randall; Morgan, Martin; Wilson, Will G.. 2004. Pollen limitation of plant reproduction: Ecological and evolutionary causes and consequences. Ecology. Vol: 85(9). Pages 2408-2421.

Ashman, Tia-Lynn; Morgan, Martin. 2004. Explaining phenotypic selection on plant attractive characters: Male function, gender balance or ecological context?. Proceedings of The Royal Society: Biological Sciences. Vol: 271(1539). Pages 553-559.

Austerlitz, Frederic; Dick, Christopher W.; Dutech, Cyril; Klein, Estienne K.; Oddou-Muratorio, Sylvie; Smouse, Peter; Sork, Victoria L..2004. Using genetic markers to estimate the pollen dispersal curve. Molecular Ecology. Vol: 13. Pages 937-954.

Baillie, J.; Bennun, L.; Brooks, Thomas; Butchart, S.H. M.; Chanson, Janice S.; Cokeliss, Z.; Hilton-Taylor, C.; Hoffmann, M.; Mace, Georgina; Mainka, S. A.; Pollock, C. M.; Rodrigues, Ana S. L.; Stattersfield, Ali; Stuart, Simon. 2004. A Global Species Assessment. IUCN - The World Conservation Union. Gland, Switzerland.

Baldocchi, Dennis; Kelliher, Francis M.; Black, T. A.; Jarvis, P..2000. Climate and vegetation controls on boreal zone energy exchange. Global Change Biology. Vol: 6(S1). Pages 69-83.

Balser, Teri; Kinzig, Ann P.; Firestone, Mary. 2002. Linking soil microbial communities and ecosystem functioning. /Edited by / Kinzig, A.; Pacala, S.; Tilman, D.. Functional Consequences of Biodiversity: Empirical Progress and Theoretical Extensions. Princeton University Press. Princeton. Pages 265-293.

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

Barton, A. D.; Greene, Charles H.; Monger, Bruce; Pershing, Andrew J..2003. The Continuous Plankton Recorder survey and the North Atlantic Oscillation: Interannual- to multidecadal-scale patterns of phytoplankton variability in the North Atlantic Ocean. Progress in Oceanography. Vol: 58(2). Pages 337-358.

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Bascompte, Jordi; Melian, Carlos J.; Sala, Enric. 2005. Interaction strength combinations and the overfishing of a marine food web. Proceedings of the National Academy of Sciences. Vol: 102(15). Pages5443-5447.

Bascompte, Jordi; Possingham, Hugh P.; Roughgarden, Joan. 2002. Patchy populations in stochastic environments: Critical number of patches for persistence. American Naturalist. Vol: 159(2). Pages 128-137.

Bascompte, Jordi; Rodriguez, Miguel A.. 2001. Habitat patchiness and plant species richness. Ecology Letters. Vol: 4. Pages 417-420.

*Bascompte, Jordi; Sole, Ricard V.. 1998. Effects of habitat destruction in a prey-predator metapopulation model. Journal of Theoretical Biology. Vol: 195. Pages 383-393.

Bashkin, Vladimir; Park, S. U.; Choi, M. S.; Less, C. B.. 2002. Nitrogen budgets for the Republic of Korea and the Yellow Sea region. Biogeochemistry. Vol: 57&58. Pages 387-403.

Bastviken, David; Cole, Jonathan J.; Pace, Michael; Tranvik, Lars.2004. Methane emissions from lakes: Dependence of lake characteristics, two regional assessments, and a global estimate. Global Biogeochemical Cycles. Vol: 18. Pages 10.1029/2004GB002238.

Becerra, Judith X.. 2003. Evolution of Mexican Bursera (Burseraceae) inferred from ITS, ETS, and 5S nuclear ribosomal DNA sequences. Molecular Phylogenetics and Evolution. Vol: 26. Pages 300-309.

Becerra, Judith X. 2003. Synchronous coadaptation in an ancient case of herbivory. Proceedings of the National Academy of Sciences. Vol:100(22). Pages 12804-12807. Online version<http://eebweb.arizona.edu/Faculty/Becerra/pubs/pnas2.pdf>

Becerra, Judith X.. 2004. Molecular systematics of Blepharida beetles(Chrysomelidae: Alticinae) and relatives. Molecular Phylogenetics and Evolution. Vol: 30(1). Pages 107-117. Online version<http://eebweb.arizona.edu/Faculty/Becerra/pubs/MPE2.pdf>

Beck, Michael W.; Heck, Kenneth L.; Able, Kenneth; Childers, Dan L.;Eggleston, David B.; Gillanders, Bronwyn; Halpern, Ben; Hays, Cynthia; Hoshino, Kaho; Minello, Thomas; Orth, Robert J.; Sheridan, Pete; Weinstein, Michael. 2001. The identification, conservation and management of estuarine and marine nurseries for fish and invertebrates. BioScience. Vol: 51. Pages 633-641.

Beck, Michael W.; Heck, Kenneth L.; Able, Kenneth; Childers, Dan L.; Eggleston, David B.; Gillanders, Bronwyn; Halpern, Ben; Hays, Cynthia; Hoshino, Kaho; Minello, Thomas; Orth, Robert J.; Sheridan, Pete; Weinstein, Michael. 2003. The role of near shore ecosystems as fish and shellfish nurseries. Issues in Ecology. Vol: 11. Pages 1-12.

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*Benkman, C. W., The selection mosaic and diversifying co-evolution between crossbills and lodgepole pine. American Naturalists, Vol:153, S75-S91.

Bernhardt, Emily; Palmer, Margaret A.; Allan, J. David; Alexander, Gretchen; Barnas, K.; Brooks, Shane; Carr, Jamie; Clayton, Steve; Dahm, Cliff; Follstad-Shah, Jennifer; Galat, David L.; Gloss, Steven P.; Goodwin, Peter; Hart, David; Hassett, Brooke; Jenkinson, Robin; Katz, Stephen L.; Kondolf, G. Mathias; Lake, P. S.; Lave, Rebecca; Meyer, Judy; O'Donnell, T. Kevin; Pagano, Laura; Powell, Bruce; Sudduth, Elizabeth. 2005. Synthesizing U.S. river restoration efforts. Science. Vol: 308(5722). Pages 636-637.

Bininda-Emonds, Olaf R. P.; Gittleman, John L.; Steel, M. A.. 2002. The (super) tree of life: Procedures, problems, and prospects. Annual Review of Ecology, Evolution, and Systematics. Vol: 33. Pages 265-289.

Bininda-Emonds, Olaf R. P.; Jones, Kate; Price, Sam; Grenyer, Richard; Cardillo, Marcel; Habib, Mike; Purvis, Andy; Gittleman, John L.. 2003. Supertrees are a necessary not-so-evil: A comment on Gatesy et al. Systematic Biology. Vol: 52. Pages 724-729.

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Bjornstad, Ottar N.; Bascompte, Jordi. 2001. Synchrony and second order spatial correlation in host-parasitoid systems. Journal of Animal Ecology. Vol: 70. Pages 924-933.

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* Bjornstad, Ottar N.; Falck, W.. 2001. Nonparametric spatial covariance functions: Estimation and testing. Environmental and Ecological Statistics. Vol: 8. Pages 53-70.

* Bjornstad, Ottar N.; Fromentin, J.; Stenseth, Nils; Gjosaeter, J..1999. A new test for density-dependent survival: The case of coastal cod populations. Ecology. Vol: 80. Pages 1278-1288.

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Appendix 2 – Figures and tables

Figures and Tables cited in the text of this report.

Figure 1. Proposals submitted and supported.

Number of proposals submitted to and supported by NCEAS each year since its establishment in 1995.

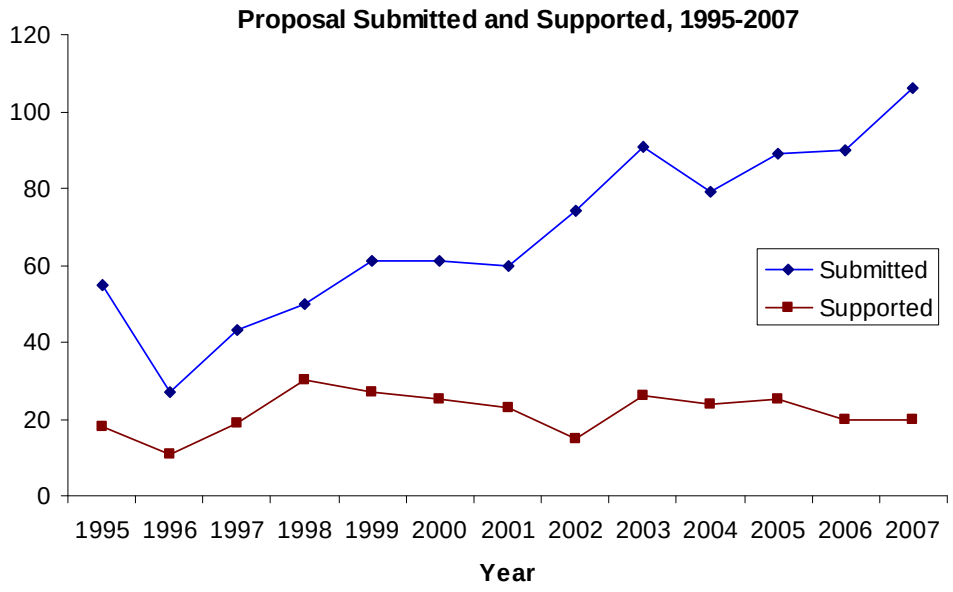


Figure 2. Percent of First Time Visitors by Year.

Percent of NCEAS Working Group participants in each year who have never visited NCEAS before, since the establishment of NCEAS.

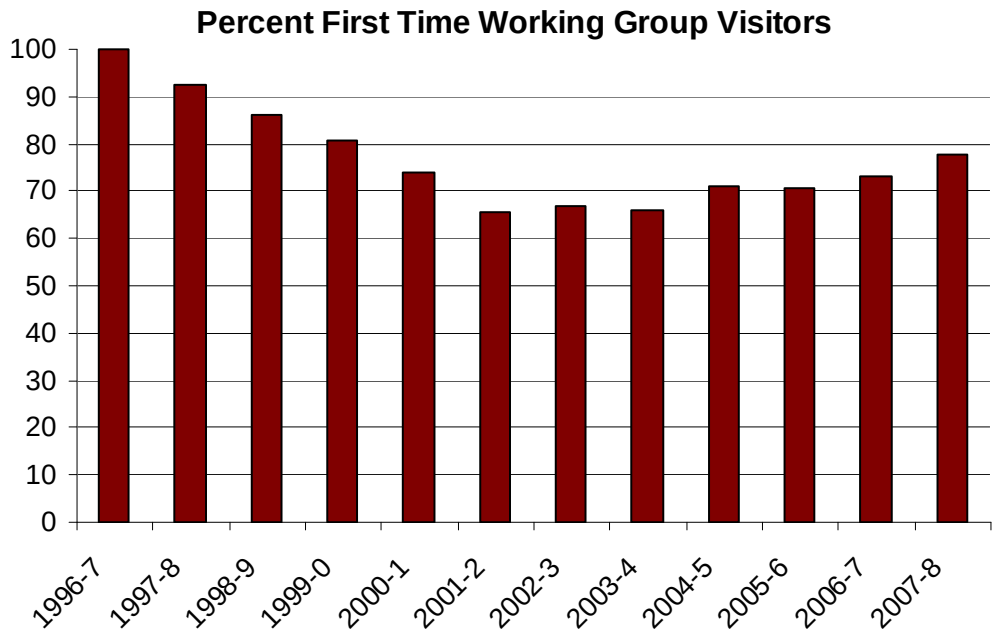
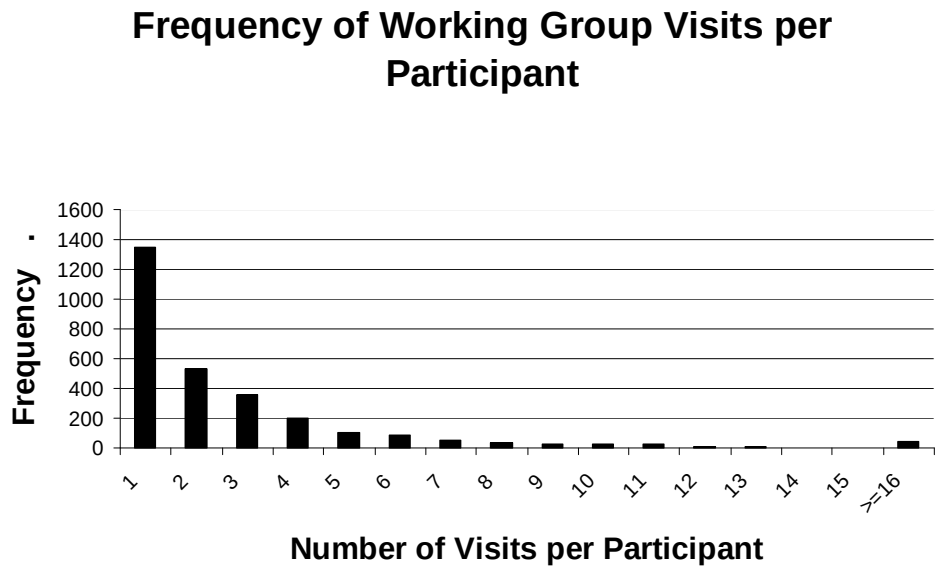


Figure 3. Frequency of Visits by Participants

Most visitors to NCEAS visit only one or two times; with more than 1,000 visits to NCEAS each year (a), the network of ecologists who are using NCEAS continues to grow rapidly (b).

a)



b)

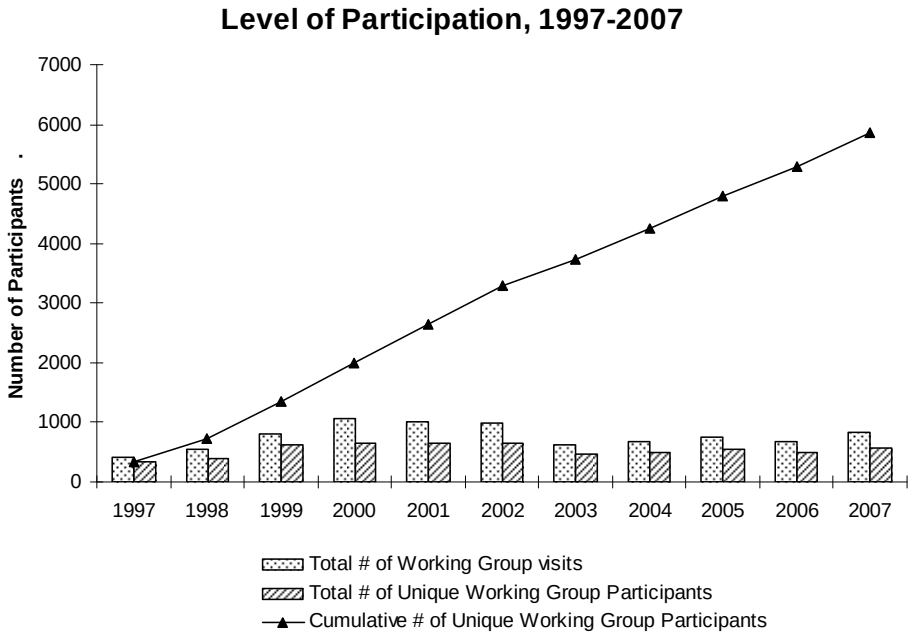


Figure 4. Number of Publications

Number of publications by year reported to NCEAS (by participants) as NCEAS products. A previous survey demonstrated that NCEAS publications were underreported by approximately 60% (i.e., NCEAS was cited in the acknowledgement of papers in Ecology that had not been reported to us). The years 2006 and 2007 are presently underreported because we have not yet issued our request for product reporting for these years. This request may increase 2005 reporting significantly as well.

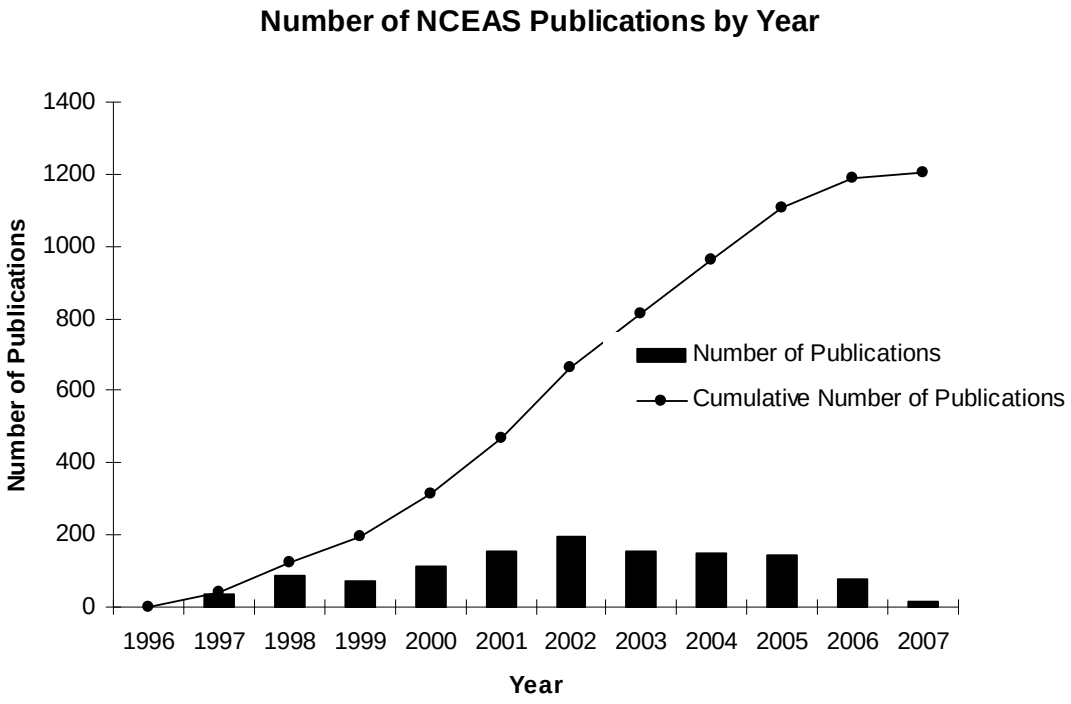


Figure 5. Gender Balance

Representation by women in each category of activity at NCEAS from 1995 to 2007. Recent figures from the faculty in the Ecology Evolution and Marine Biology department at UCSB and ESA's 2006 WAMIE II report are shown for comparison.

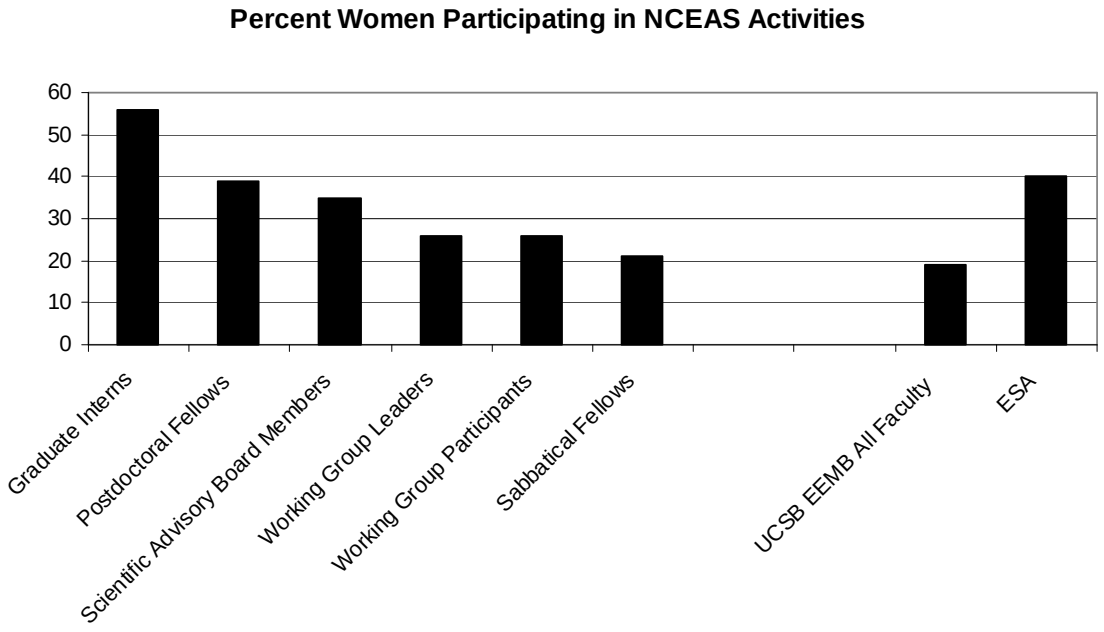


Table 1. Jobs for Former Postdocs

Institutions in which former NCEAS Postdoctoral Associates accepted positions during this reporting period.

City of Santa Barbara
East Carolina University*
Instituto Argentino de Investigaciones de las Zonas Aridas*
Louisiana State University*
Old Dominion University*
Oregon State University (2)*
San Diego State University*
Smithsonian Tropical Research Institute*
Texas Tech University*
Universidade Federal de Santa Catarina*
University of British Columbia (3) 3*
University of Calgary*
University of California, Berkeley*
University of California, Davis (3) 1*
University of California, Santa Barbara (2)
University of Colorado, Boulder*
University of Georgia (2) 1*
University of Guelph*
University of Minnesota, St. Paul*
University of New South Wales*
University of Oslo*
University of Puerto Rico*
University of Toronto*
University of Wisconsin, Madison*
US Environmental Protection Agency
USDA Forest Service, PSW, Sierra Nevada Research Center, Davis
Utah State University*
Washington State University*
Washington University (2)*
Yale University (2)*

*Career Positions

Table 2. Breadth of Journals

Journals in which NCEAS scientists have published since the establishment of NCEAS. The total number of journals is 202.

LIST OF DISTINCT JOURNALS OF NCEAS PUBLISHED ARTICLES AS OF OCT. 1, 2007

African Journal of Aquatic Science
African Journal of Marine Science
Agricultural and Forest Meteorology
Ambio
American Fisheries Society Symposium
American Journal of Botany
American Midland Naturalist
American Naturalist
American Scientist
American Sociological Review
American Zoologist
Amphibia Reptilia
Animal Behaviour
Animal Conservation
Annales Zoologici
Annals of Forest Science
Annals of the Association of American Geographers
Annual Review of Earth and Planetary Sciences
Annual Review of Ecology, Evolution, and Systematics
Annual Review of Environment and Resources
Applied and Environmental Microbiology
Aquatic Sciences
Astrobiology
Austral Ecology
Australian Journal of Botany
Australian Zoologist
Bayesian Analysis
Behavioral Ecology
Behavioral Ecology and Sociobiology
Biodiversity and Conservation
Biodiversity Informatics
Biogeochemistry
Biogeosciences
Biogeosciences Discussions
Biological Conservation
Biological Invasions
Biological Journal of the Linnean Society
Biology Letters
BioScience
BioTechniques
Biotropica
Bird Conservation International
Bulletin of Marine Science
Bulletin of the Ecological Society of America
Bulletin of the Geological Society of France
Canadian Journal of Fisheries and Aquatic Sciences
Canadian Journal of Forest Research
Concurrency and Computation: Practice and Experience
Conservation Biology
Conservation Biology in Practice
Conservation Ecology
Coral Reefs
Deep Sea Research I
Deep-Sea Research II
Diversity and Distributions
Ecography
Ecological Applications
Ecological Economics
Ecological Entomology
Ecological Modelling
Ecological Monographs
Ecological Society of America Bulletin
Ecology
Ecology and Society
Ecology Letters
Ecoscience
Ecosystems
Encyclopedia of Biodiversity
Endangered Species UPDATE
Environment
Environmental and Ecological Statistics
Environmental Conservation
Environmental Modelling and Software
Environmental Toxicology and Chemistry
Epidemiology and Infection
European Journal for Wildlife Research
Evolution
Evolutionary Ecology
Evolutionary Ecology Research
Fisheries
Forest Ecology and Management
Forest Science
Fractals
Frontiers in Ecology and the Environment
Functional Ecology
Geoderma
Geological Society of America Bulletin
Geology

Geomorphology
Global Biogeochemical Cycles
Global Change Biology
Global Ecology and Biogeography
Global Environmental Research
Global Planetary Change
Heredity
Human and Ecological Risk Assessment
Hydrological Processes
ICCSA
ICES Journal of Marine Science
IEEE Internet Computing
Imprint
Integrative and Comparative Biology
Integrative Biology: Issues, News and Reviews
Inter-American Tropical Tuna Commission, Bulletin
Interciencia
International Journal of Approximate Reasoning
International Journal of Wildland Fire
Issues in Ecology
Issues in Science and Technology
Journal of Animal Ecology
Journal of Applied Ecology
Journal of Applied Meteorology
Journal of Biogeography
Journal of Ecology
Journal of Evolutionary Biology
Journal of Fish Biology
Journal of Geology
Journal of Hydrologic Engineering
Journal of Mammalogy
Journal of Mathematical Biology
Journal of Paleontology
Journal of Plankton Research
Journal of Socio-economics
Journal of the American Statistical Association
Journal of the American Water Resources Association
Journal of the Geological Society of London
Journal of the Royal Statistical Society: Series C (Applied Statistics)
Journal of Theoretical Biology
Journal of Tropical Ecology
Journal of Vegetation Science
Journal of Zoology
Landscape and Urban Planning
Landscape Ecology
Limnology and Oceanography
Location Science
Mammal Review
Marine Biology
Marine Ecology Progress Series
Marine Policy
Microbes and Infection
Molecular Ecology
Molecular Phylogenetics and Evolution
Natural Areas Journal
Natural Hazards Review
Nature
Nature Reviews Microbiology
Neues Jahrbuch fur Geologie und Palaontologie Abhandlungen
Neues Jahrbuch fur Geologie und Palaontologie, Monatshefte
Oceanography
Oceanography and Marine Biology: An Annual Review
Oecologia
Oikos
Palaeogeography, Palaeoclimatology, Palaeoecology
Palaeontology
PALAIOS
Paleobiology
Papers in Regional Science
Parks
Philosophical Transactions of the Royal Society of London B: Biological Sciences
Physica D
Plant and Soil
Plant Disease
Plant Ecology
Plant, Cell and Environment
PLOS Biology
PLOS Medicine
Population Ecology
Proceedings for the Royal Society B
Proceedings of the National Academy of Sciences
Progress in Oceanography
Quarterly Review of Biology
Quarternary Science Reviews
Quaternary Research
Regulation
Remote Sensing Environment
Researches on Population Ecology
Resources and Energy Economics
Restoration and Management Notes
Restoration Ecology
Science
Scientific American
Scientist
Social Science and Medicine
Social Studies of Science
Society for Conservation Biology Newsletter
Spatial Ecology
Systematic Biology
The Australian Zoologist

The George Wright Forum
The Holocene
Theoretical and Applied Genetics
Theoretical Population Biology
Toxicology and Industrial Health
Transactions in GIS
Tree Physiology
Trends in Ecology and Evolution
Vector Borne and Zoonotic Diseases
Wetlands
Wild Earth
Wings
Yale School of Forestry and Environmental Studies Bulletin Series
Yellowstone Science

Table 3. Home Institutions for Visitors

Home institutions for visitors to NCEAS since its establishment in 1995. The total number of institutions is approximately 1,100.

INTSTITUTE NAME

A.F. Clewell, Incorporated
Academia Sinica
Academy of Natural Sciences
Academy of Sciences of the Czech Republic, Biological Research Center
Advanced Conservation Strategies
Advancing National Strategies and Enabling Results
African Wildlife Foundation
AgResearch
Agricultural Research Center
Agricultural Research Service
Agricultural University of Norway
Agriculture and Agri-Food Canada
Alameda County Community Development Agency
Alaska Department of Fish and Game
Alaska Fisheries Science Center
Aldo Leopold Wilderness Research Institute
Alfred Wegener Institute for Polar and Marine Research
Allegheny Power Company
ALTERRA, Green World Research
Alverno College
Amboseli Elephant Research Project
American Cyanamid Company
American Institute of Biological Sciences
American Land Conservency
American Museum of Natural History
American Rivers
American University
Amherst College
Andrew W. Mellon Foundation
ANH Canberra
Animal Disease Research Institute
APHL-NCID/CDC
Applied Biomathematics
Archbold Biological Station
Argonne National Laboratory
Arizona State University
Arnold Arboretum of Harvard University
Arthur Rylah Institute for Environmental Research
Association for Biodiversity Information
Association of State Wetland Managers, Inc.
AT&T Labs-Research
ATCC
Auburn University, Alabama
Audubon Appleton-Whittell Research Ranch Sanctuary
Australian Institute of Marine Science
Australian Museum
Australian National University
Avian Systems
Balboa Bldg Management
Ball State University
Barnard College
Baruch College
Bates College
Ben-Gurion University of the Negev
Bennington College
Bermuda Biological Station for Research
Binghamton University
Biological Resources Division, U.S. Geological Survey

BIOSIS
BIOSIS UK
Biotechnology Regulatory Services Organization
Birdlife International
Bishop Museum
Boise State University
Boston University
Botanic Garden and Botanical Museum Berlin-Dahlem
Bowling Green State University
Brigham Young University
British Trust for Ornithology
Brown University
Bryn Mawr College
Bureau of Fisheries Management and Habitat Protection

Bureau of Land Management
Bureau of Reclamation
Bureau of Rural Sciences
Busgenweg 2

CA Ocean Protection Council
Cal State University
CALFED Bay Delta Program
CALFED Science Program
California Academy of Sciences
California Coastal Commission

California Coastal Conservancy
California Department of Fish and Game
California Department of Forestry and Fire Protection
California Department of Water Resources
California Environmental Protection Agency
California Institute of Technology
California Ocean Science Trust
California Polytechnic State University
California Resources Agency
California State University
California State University, Chico
California State University, Fresno
California State University, Fullerton
California State University, Hayward
California State University, Long Beach
California State University, Los Angeles
California State University, Monterey Bay
California State University, Northridge
California State University, Sacramento
California State University, San Marcos
California State University, Stanislaus
California Tahoe Conservancy
California Trade and Commerce Agency
CALTRANS
Cambridge University
Canada Centre for Remote Sensing
Canadian Forest Service
Canadian Wildlife Service
Cardiff University
Carl Hayden Bee Research Center
Carleton University
Carmabi Marine Biological Station
Carnegie Institution
Carnegie Mellon University
Cary Arboretum
Case Western Reserve University
Catalina Island Conservancy
CDC
CEFE - CNRS UPR 9056
Center for Applied Biodiversity Science
Center for Applied Biodiversity Science

Center for Ecology and Hydrology
Center for Limnology
Center for Natural Lands and Management
Center for Sustainable Economy
Centers for Disease Control and Prevention
Centre de Biologie Alpine
Centre d'Ecologie Functionnelle et Evolutive, CEFE-CNRS
Centre d'Etude sur le Polymorphisme des Micro-Organismes
Centre for Ecology and Hydrology Banchory
Centre for Ecology and Hydrology Bangor
Centre for Environment, Fisheries and Aquaculture Science
Centre for Resource and Environmental Studies
Centre National de la Recherche Scientifique (CNRS)
Centro Agronomico Tropical de Investigacion y Ensenanza
Centro Cientifico Tropical
Centro de Ecologia UNAM
Centro de Investigacion en Matematicas
Centro de Investigacion y de Estudios Avanzados
Centro de Investigaciones Biologicas del Noroeste (CIBNOR)
Centro de Investigaciones y Estudios Superiores en Antropolog¿a Social del Sureste
Centro de Refer¿ncia em Informa¿¿o Ambiental - CRIA
Centro di Ecologia Alpina
Centro Nacional Patagonico (CENPAT)
Channel Islands National Marine Sanctuary
Channel Islands National Park
Charles Darwin Research Station
Chiba University
Chinese Academy of Forestry
Chinese Academy of Sciences
Chinese Research Academy of Environment Sciences
CIBNOR
CIET/UNESCO
City of Santa Barbara
City University of New York, City College
Claremont Graduate University
Clark University
Clemson University
Climate Impacts and Grazing Systems
CNMFS Tiburon Laboratory
Coastal Conservation and Education Foundation
Coastal States Organization
Coevolution Institute
Colby College
Collaborative Large-scale Engineering Analysis Network for Environmental Research.
College of Charleston
College of William and Mary
Collegium Budapest
Colorado State University
Columbia University
Comisi¿n Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO)
Committee on Health, Education, Labor and Pensions
Commonwealth
Commonwealth Scientific and Industrial Research Organisation

COMPASS
Comunidad y Biodiversidad A.C.
Conception Coast Project
Congressional Research Office
Consejo Superior de Investigaciones Científicas
Conservation Biology Institute
Conservation Ecology
Conservation International
Consortium for Conservation Medicine
Consortium of Universities for the Advancement of Hydrologic Science, Inc.
Consultative Biological Diversity Group
Contra Costa County Community Development Department
Cornell University
Corvallis Forestry Sciences Laboratory
County of Santa Barbara
CPTEC/INPE
Cranbrook Institute of Science
Cranfield University
CSIC-Consejo Superior de Investigaciones Cient¿ficas
CSIR
CSIRO
CSIRO European Laboratory
Dagjamningsgatan 1
Dalhousie University
Dangermond and Associates
Dartmouth College
Dauphin Island Sea Laboratory
Defenders of Wildlife
Delft University of Technology
Denver Museum of Nature and Science
Denver Water
Denver Zoo at City Park
Department of Conservation
Department of Agriculture, Chatuchak
Department of Conservation
Department of Fisheries and Oceans Canada
Department of Natural Resources
Department of Wildlife and Fisheries Sciences
Desert Research Institute
Discovery Institute
DivDat Consulting
Division of Coastal Resources
Division of Environmental Biology
Don Maruska and Company, Inc.
Dos Pueblos High School
Downing College
Drexel University
Duke University
Earth Economics
Earth Systems Institute
East Bay Regional Park District
East Carolina University
Eastern Cereal and Oilseed Research Centre
Ecole Normale Superieure de Lyon
Ecological Research Associates NZ
Ecological Society of America
Ecosystem Management Research Institute
Ecuador Conservation Data Center
Edmund Niles Huyck Preserve and Biological Research Station
El Colegio de la Frontera Sur (ECOSUR)
Electric Power Research Institute (EPRI)
Elkhorn Slough Foundation
Elkhorn Slough Reserve
Emory University
Empresa Brasileira de Pesquisa Agropecu¿ria
Endangered Species Recovery Program
Engineering Planning Consultants
ENS labo d'Ecologie
Entrix Corporation
Enviroment Australia
Environment and Development Group
Environment Canada
Environment Protection Authority
Environmental Defense Center
Environmental Defense Fund
Environmental Law Institute
Environmental Protection Agency
Environmental Systems Research Institute
Eurasia Group
European Educational Research Association (EERA)
Everglades National Park
Evergreen State College
Faculty of Forestry
Federal Agency for Nature Conservation
Federal Environment Agency
Finnish Environment Institute
FIOCRUZ Oswaldo Cruz Foundation
Fisheries and Oceans Canada
Fisheries and Wildlife and Environmental Sciences
Fisheries Improved for Sustainable Harvest Project
Flathead Lake Biological Station
Florida Department of Environmental Protection
Florida Institute of Oceanography
Florida Institute of Technology
Florida International University
Florida Keys National Marine Sanctuary
Florida State University
Food and Agriculture Organization of the United Nations

Forest and Landscape, Denmark
Forestek/CSIR

Forestry Sciences Laboratory
Fogarty International Center, NIH
Fort Lewis College
Foundations of Success (FOS)
Frankfurt Zoological Society
Fraunhofer Institute for Atmospheric Environmental Research
Free University
Freshwater Institute
Friday Harbor Labs
Fundacao Andre Tosello
Gaylord and Dorothy Donnelley Foundation
GCTE Core Project Office
GEMI/UMR CNRS-IRD 2724
GenBank
Gene Conservation Laboratory
Geofolio
Geologisk Museum
Georgia Institute of Technology
Georgia State University
Gesellschaft f¿r Organisation und Entscheidung m.b.H. (GOE)
Global Reef Project
Goethe Univserity of Frankfurt
Goleta Valley Middle School
Goleta Valley Voice
Gothenburg University
Government of Western Australia
Grand Canyon Monitoring and Research Center
Great Barrier Reef Marine Park Authority
Grinnell College
Gulf of Maine Research Institute
H.T. Harvey and Associates Ecological Consultants
Hadley Centre for Climate Prediction and Research
Hampshire College
Hancock Biological Station
Harvard Medical School
Harvard University
Harvard University
Heal the Bay
Helmholtz Centre for Environmental Research - UFZ
Heriot Watt University
High Desert Ecological Research Institute
Hokkaido Fish Hatchery
Hokkaido University
Hood College
Hope College
Humboldt State University
Humboldt-University Berlin
Hunter College, CUNY
Hutton Foundation
IBW
Ichauway Incorporated
ICLARM
Idaho Department of Fish and Game
Idaho State University
Illinois Natural History Survey
Illinois State Water Survey
Imperial College, London
Imperial College, Silwood Park
Indian Institute of Science
Indiana State University
Indiana University
Indigo Systems Corporation
Information International Associates, Inc.
Institut fuer Landnutzungssysteme und Landschaftftsoekologie
Institut fur Palaeontologie
Institut National de la Recherche Agronomique (INRA)
Institute for Coastal Research
Institute for Environment Studies
Institute for Forestry and Nature
Institute for Horticultural Development
Institute for International Studies
Institute for Social Research
Institute for Wildlife Studies
Institute Horsholm
Institute of Botany
Institute of Ecosystem Studies
Institute of Marine Sciences
Institute of Pacific Island Forestery
Institute of Plant Sciences
Institute of Soil Science
Institute of Terrestrial Ecology
Institute of Tropical Forestry, Puerto Rico
Institute of Zoology
Instituto Argentino de Investigaciones de las Zonas ¿ridas
Instituto de Biologia, UNAM
Instituto de Ecologia, UNAM
Instituto de Matematica - UFRJ
Instituto de Zoologia Tropical
Instituto Mediterraneo de Estudios Avanzados
Instituto Nacional de Pesquisas Amazonas
Instituto Tecnol¿gico de Cd. Victoria
Instituto Tecnologico de Costa Rica
Instituto Trentino Di Cultura
Instituto Venezolano de Investigaciones Cientificas (IVIC)

InterAmerican Tropical Tuna Commission
Intercultural Center for the Study of Deserts and Oceans, Inc.

Inter-Fluve Inc.
International Council for Science (ICSU)
International Institute for Applied Systems Analysis
International Institute for Strategic Studies
International Livestock Research Institute
International Pacific Halibut Commission
International Paper
International Paper Company
International School of Advanced Studies (ISAS)
Iowa State University
IRIS Consortium
Irkutsk State University
ISERA Group, Inc.
Island Press
Israel Oceanographic and Limnological Research
Istituto di Ecologia Applicata
ITESM-Campus Monterrey
IUCN
IUCN/Species Survival Commission
James Cook University
James San Jacinto Mountains Reserve
Jatun Sacha US
Jawaharlal Nehru University
Johns Hopkins University
Joseph W. Jones Ecological Research Center
Jozef Stefan Institute
K and AES, Inc.
Kansas Biological Survey
Kansas State University
Katholieke Universiteit Leuven
Keck Geology Consortium
Kellogg Biological Station
Kenya Wildlife Service
Kern River Research Center
KEYT Television Station
Kiel University
King's College London
Kirstenbosch Research Centre
Klamath Center for Conservation Research
Komarov Botanical Institute
Kyoto University
Kyushu University
L.C. Lee and Associates, Inc.
La Trobe University
Laboratoire Ecosystemes et Changements Environmentaux
Landcare Research
Landfills and Inc.
Laval University
Lawrence J. MacDonnell, P.C.
LIEY
Life Works
Lincoln Park Zoo
Lincoln University
London School of Hygiene and Tropical Medicine
Los Alamos National Laboratory
Lotusland Foundation
Louisiana State University
LTER
Ludwig-Maximilians-Universitat
Lund University
Lynchburg College
Maastricht University
Macalester College
Macaulay Land Use Research Institute
Macquarie University
Manaaki Whenua Landcare Research
Marine Biological Laboratory
Marine Conservation Biology Institute
Marine Conservation Biology Institute
Marine Mammal Center
Maryland Department of Natural Resources
Massachusetts Division of Marine Fisheries
Massachusetts Environmental Trust
Massachusetts Institute of Technology
Massey University
Matopos Research Station
Max-Planck Institute for Biogeochemisty
Max-Planck Institute for Meteorology
McGill University
McMaster University
Medical College of Wisconsin
Memorial University of Newfoundland
Merlewood Research Station
Merrimack Consultants, LLC
Met Office
Miami University
Michigan Department of Natural Resources
Michigan State University
Michigan Technological University
Middlebury College
Milone and MacBroom
Ministry of Resources and Development
Minnesota Department of National Resources
Mission Research Corporation
Missouri Botanical Garden
Missouri State University
Monash University
Monash University
Monsanto Company
Montana State University
Monterey Bay Aquarium Research Institute

Montwood High School
Morro Bay National Estuary Program
Moss Landing Marine Laboratory
Motu Economic and Public Policy Research Trust
Mount Holyoke College
Mount Hood National Forest
Mountain Studies Institute
MPI f¿r Biogeochemie
Murray State University
Mus¿um National d'Histoire Naturelle
Napier University
NASA Ames Research Center
National Aeronautics and Space Administration
National Association of Communication Systems Engineers (NACSE)
National Audubon Society
National Botanical Institute, Kirstenbosch
National Botanical Services
National Cancer Institute
National Center for Atmospheric Research
National Center for Environmental Decision-Making Research
National Center for Supercomputing Applications
National Climatic Data Center
National Council for Air and Stream Improvement, Inc.
National Environmental Research Institute
National Evolutionary Synthesis Center
National Fish and Wildlife Foundation
National Institute for Public Health and the Environment
National Institute of Health
National Institute of Oceanography (NIO)
National Institute of Water and Atmospheric Research
National Marine Fisheries Service
National Marine Mammal Laboratory
National Ocean Service
National Oceanic and Atmospheric Administration
National Park Foundation
National Park Service
National Public Radio
National Research Council
National Resources Conservation Service
National Science Foundation
National Tsing Hua University
National University of Mexico
National University of Singapore
National Water Research Institute
National Wetlands Research Center
National Wildlife Federation
National Zoological Park
Natural Environment Research Council
Natural History Museum
Natural History Museum of Los Angeles County
Natural Resources Canada
Natural Resources Defense Council
Natural Resources Research Institute
NatureServe
Navajo Nation
Naval Postgraduate School
Nebraska Wesleyan University
Nelson Resources Consulting, Incorporated
NERC Centre for Ecology and Hydrology
NERC Centre for Population Biology
NERC Institute of Terrestrial Ecology
Netherlands Institute of Ecology
Nevada Wilderness Project
New Jersey Marine Sciences Consortium
New Mexico Department of Game and Fish
New Mexico Institute of Mining and Technology
New Mexico State University
New South Wales National Parks and Wildlife Service
New York Botanical Garden
New York College of Osteopathic Medicine
New York Institute of Technology
New York State Department of Environmental Conservation
New Zealand Pastoral Agricultural Research Institute
NFSNC Supervisor's Office
Ngorongoro Conservation Authority

NOAA Fisheries Laboratory
NOAA National Marine Fisheries Center
NOAA, Center for MPA Science
NOAA, National Marine Fisheries Service
NOAA, National Marine Sanctuary Program
NOAA/Alaska Fisheries Science Center
North Carolina Ecosystem Enhancement Program
North Carolina Natural Heritage Program
North Carolina State University
Northeastern University
Northern Arizona University
Northern Forestry Center
Northern Global Change Program
Northern Territory University
Northwest Fisheries Science Center
Northwest Indian College
Northwestern University
Norwegian Institute for Water Research
Nossaman Gunther Knox & Elliott LLP
NTU, School of Forestry and Resource Conservation
Oak Ridge National Laboratory

Ocean Studies Board, HA-470
Ocean Visions
Oceana
Odion Consulting
Office of Governor
Ohio State University
Ohio University
Okayama University
Oklahoma State University
Old Dominion University
Ontario Ministry of Natural Resources
Ontario Ministry of the Environment and Energy
Open University
OPeNDAP
Oracle Industries, Europe, Middle-East and Africa
Oregon Health and Sciences University
Oregon Natural Heritage Program
Oregon State University
Organización de Palangeros Guardeses (ORPAGU
Organization for Tropical Studies
Orstom
Orta Dogu Teknik Universitesi
Pacific Ecoinformatics and Computational Ecology Lab
Pacific Fisheries Environmental Laboratory
Pacific Gas and Electric Company
Pacific Northwest National Laboratory
Pacific Northwest Research Station
Pacifica Graduate Institute
Padova University
Palau Conservation Society
Pangaea Environmental, LLC
Pearland High School
Pennsylvania State University
Philip Williams And Associates, Ltd.
Pima County Department of Transportation and Flood Control District
Pima County Development Services
Pima County Flood Control District
Plymouth Marine Laboratory
Point Reyes Bird Observatory
Polish Academy of Sciences
Pondicherry University
Pontificia Universidad Catolica de Chile
Pontificia Universidad Catolica Del Ecuador
Portland State University
Potomac Electric Power Company
Potsdam Institute for Climate Impact Research
Premier Tech Biotechnologies
Prescott College
Princeton University
Program for the Advancement of Geoscience Education
Puente Hills Landfill Native Habitat Preservation Authority
Purdue University
Pure Fishing
Queen's University
Radford University
Range and Forage Institute
RECON Environmental, Inc.
Reef Check California
Reef Environmental Education Foundation (REEF)
Resources for the Future
Resources Law Group, LLP
Resources Legacy Fund
Rhode Island Natural History Survey
Rice University
Risoe National Laboratory
RMIT University
Rockefeller University
Rocky Mountain Biological Laboratory
Rocky Mountain Experiment Station
Rocky Mountain Research Station
Roger Williams University
Romberg Tiburon Center
Rothamsted Experimental Station
Rothamsted Research
Royal Botanic Gardens Sydney
Royal Danish School of Pharmacy
Royal Holloway, University of London
Royal Swedish Academy of Science
Royal Veterinary and Agricultural University
Russian Academy of Sciences
Rutgers, State University of New Jersey
Sage Publications, Incorporated
Saint Louis University
Saint Louis Zoo
Sakhalin Research Institute of Fisheries and Oceanography
SalvaNATURA
San Diego Natural History Museum
San Diego State University
San Diego Supercomputer Center
San Francisco Bay National Estuarine Research Reserve
San Francisco Estuary Institute
San Francisco State University
San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy
San Marco High School
Santa Barbara Botanic Garden

Santa Barbara County Planning and Development
Santa Barbara Independent
Santa Barbara Museum of Natural History
Santa Barbara News-Press
Santa Barbara Sea Center
Santa Barbara Zoological Gardens
Santa Clara University
Santa Fe Institute
Savannah River Ecology Laboratory
Save the Elephants
Science International
Science Magazine
Scientific American
Scripps Institution of Oceanography
Seamair Farms
SeaWeb
SeaWeb/COMPASS
Secretary for Environmental Protection
Seoul National University
Sheffield Center for Arctic Ecology
Shingwedzi Camp
Siemon, Larsen & Marsh
Simon Fraser University
Simpson Investment Company
Sir Wilfred Grenfell College, Memorial University of Newfoundland
Smithsonian Environmental Research Center
Smithsonian Institution
Smithsonian National Museum of Natural History
Smithsonian Tropical Research Institute
Social Science Research Council
Sokoine University of Agriculture
Solimar Research Group
Sonoma State University
South African National Biodiversity Institute
South African National Parks
South Dakota State University
South Florida Management District
South Florida Water Management
Southampton Oceanography Center
Southeast Asian Fisheries Development Center
Southeast Fisheries Science Center
Southeastern Louisiana University
Southern Illinois University
Southern Nevada Water Authority
Southern Oregon University
Southwest Fisheries Science Center
Southwest Wetlands Interpretive Association
Spitfire Strategies
St. Francis Xavier University
Stanford University
State Hydrological Institute
State of Nevada
State of New Mexico
State University of New York (SUNY)
State University of New York, ESF
Stockholm University
Stony Brook University, State University of New York
Stratacon Incorporated
Stratus Consulting Incorporated
SUNY Binghamton
Sustainable Ecosystems Institute
Swedish Environmental Research Institute
Swedish Museum of Natural History
Swedish University of Agricultural Sciences
Swiss Federal Institute for Environmental Science and Technology (ETH)
Swiss Federal Institute for Forest, Landscape and Snow Research
Syracuse University
Taiwan Forestry Research Institute
Tanzania National Parks
Tanzania Wildlife Research Institute
Technion - Israel Institute of Technology
Tel Aviv University
Tetra Tech EM Inc. (EMI)
Texas A and M University
Texas Melittological Institute
Texas Tech University
The American Zoo and Aquarium Association
The Antaeus Group
The Boeing Company
The David and Lucile Packard Foundation
The Ecosystems Center
The Field Museum
The Getty Museum
The Gordon and Betty Moore Foundation
The Horniman Museum
The Hybrid Vigor Insitute
The Irvine Company
The John D. and Catherine T. MacArthur Foundation
The Nature Conservancy
The Ocean Channel, Inc.
The Ocean Conservancy
The Pacific Institute
The Research Group
The Southern Company
The Urban Wildlands Group
The Wetlands Initiative
The Wilderness Society
The Wildfowl and Wetlands Trust
Thomas Reid Associates
Tijuana River National Estuarine Research Reserve

TMC Communities
TOVA Applied Science and Technology
Trent University
Trinity University
Tropical Agricultural Centre for Research and Higher Education (CATIE)
Tropical Science Center
Trout Lake Station
Trout Unlimited
TRW Space and Electronics Group
Tufts - New England Medical Center
u.Waldernarung
UC Cooperative Extension
UCLA Institute of the Environment
Umea University
UNAM Campus Morelia
UNESCO
UNICAMP
United Nations Educational, Scientific and Cultural Organization (UNESCO)
United States Department of Agriculture
United States Environmental Protection Agency
United States Geological Survey
Universidad Autonoma Nacional de Mexico
Universidad de Buenos Aires
Universidad de Chile
Universidad de Concepci¿n
Universidad del Mar
Universidad Nacional Autonoma de Mexico
Universidad Nacional de Colombia
Universidad Nacional de Cordoba - CONICET
Universidad Nacional del Comahue
Universidad National de Costa Rica
Universidad Simon Bolivar
Universidade de Bras¿lia
Universidade de S¿o Paulo
Universidade Estadual do Norte Fluminense
Universidade Federal Fluminense
Universit¿ de Bourgogne
Universit¿ de Montpellier II
Universit¿ de Poitiers
Universit¿ Paul Sabatier
Universit¿ Pierre et Marie Curie
Universit¿t Potsdam
Universita degli Studi di Parma
Universita' di Pisa
Universitaet am Mainz
Universitat Basel
Universitat de Barcelona
Universitat de les Illes Balears
Universitat Politecnica de Catalunya
Universitat Wurzburg, Germany
Universite Claude Bernard
Universite de Montpellier II
Universite de Montreal
Universite de Paris
Université de Poitiers
Universite de Rennes I
Universite de Sherbrooke
Universite du Quebec, Montreal
Universite Lyon I
Universite Paris 6
Universities Space Research Association
University at Albany, State University of New York
University at Buffalo, State University of New York
University College Cork
University College London
University College, University of New South Wales
University Corporation for Atmospheric Research
University J. Fourier, Grenoble I
University Libre de Bruxelles
University of Aberdeen
University of Adelaide
University of Adelaide, Roseworthy
University of Adelaide, Waite Campus
University of Akron
University of Alabama
University of Alaska
University of Alaska Southeast
University of Alaska, Anchorage
University of Alaska, Fairbanks
University of Alberta
University of Amsterdam
University of Arizona
University of Arkansas
University of Auckland
University of Barcelona
University of Basel
University of Bath
University of Bayreuth
University of Bergen
University of Bern
University of Birmingham
University of Bras¿lia
University of Bristol
University of British Columbia
University of Buenos Aires
University of Calgary
University of California Sea Grant Extension Program
University of California, Berkeley
University of California, Davis
University of California, Davis Extension
University of California, Irvine
University of California, Los Angeles

University of California, Merced
University of California, Office of the President
University of California, Riverside
University of California, San Diego
University of California, San Francisco
University of California, Santa Barbara
University of California, Santa Cruz
University of Cambridge
University of Canterbury
University of Cape Town
University of Central Florida
University of Central Oklahoma
University of Chicago
University of Chicago Press
University of Cincinnati
University of Cologne
University of Colorado
University of Colorado Museum
University of Colorado, Boulder
University of Connecticut
University of Copenhagen
University of Dar-es-Salaam
University of Delaware
University of Dundee
University of Edinburgh

University of Exeter, Cornwall
University of Florida
University of Florida
University of Fort Hare
University of G¿ttingen
University of Georgia
University of Goteborg
University of Gothenburg
University of Groningen
University of Guelph
University of Hawaii
University of Hawaii, Manoa
University of Helsinki
University of Houston
University of Hull
University of Idaho
University of Illinois, Chicago
University of Illinois, Urbana Champaign
University of Iowa
University of Kansas, Lawrence
University of Kentucky
University of Lausanne
University of Leeds
University of Leicester
University of Leiden
University of Leipzig
University of Liverpool
University of London
University of Louisiana, Lafayette
University of Maine
University of Maryland Center for Environmental Science
University of Maryland School of Medicine
University of Maryland, Baltimore
University of Massachusetts, Amherst
University of Melbourne
University of Miami
University of Michigan, Ann Arbor
University of Minnesota, St. Paul
University of Minnesota, Twin Cities
University of Mississippi
University of Missouri, Columbia
University of Missouri, St. Louis
University of Montana
University of Munich
University of Natal
University of Nebraska
University of Nebraska, Lincoln
University of Nebraska, Omaha
University of Nevada, Las Vegas
University of Nevada, Reno
University of New Brunswick, Saint John
University of New England
University of New Hampshire
University of New Mexico
University of New Orleans
University of New South Wales
University of New York
University of Newcastle
University of North Carolina, Chapel Hill
University of North Texas
University of Northern Colorado
University of Notre Dame
University of Nottingham
University of Oklahoma
University of Oregon
University of Oslo
University of Otago
University of Ottawa
University of Oulu
University of Oxford
University of Pennsylvania
University of Pisa, Italy
University of Pittsburgh
University of Port Elizabeth
University of Professional Education Larenstein
University of Puerto Rico
University of Queensland

University of Reading
University of Regina
University of Rhode Island
University of Rhode Island, Narragansett
University of Rochester
University of Rome
University of San Francisco
University of Sao Paulo
University of Saskatchewan
University of Sheffield
University of South Alabama
University of South Carolina, Aiken
University of South Florida
University of Southampton
University of Southern Alabama
University of Southern California
University of Southwest Louisiana
University of St. Andrews
University of Stirling
University of Sussex
University of Sydney
University of Tampere
University of Tennessee
University of Tennessee, Knoxville
University of Texas
University of Texas at Austin
University of Texas, Arlington
University of Texas, Austin
University of the Philippines in the Visayas
University of the West Indies
University of the Witwatersrand
University of Tokyo
University of Toledo
University of Toronto
University of Tromso
University of Tulsa
University of Turku
University of Utah
University of Vermont
University of Victoria
University of Virginia
University of Wales
University of Washington
University of Waterloo
University of Western Australia
University of Windsor
University of Wisconsin, Eau Claire
University of Wisconsin, Madison
University of Wisconsin, Milwaukee
University of Wisconsin, Stevens Point
University of Wyoming
University of York
University of Zurich
UPMC
Uppsala University
Urban Streams Restoration Program
US Army Cold Regions Research and Engineering Laboratory
US Army Cold Regions Research and Engineering Laboratory
US Army Corps of Engineers
US Army Engineer Research and Development Center
US Bureau of Reclamation
US Department of Agriculture
US Department of Agriculture
US Department of Agriculture
US Department of Agriculture
US Department of Agriculture
US Department of Agriculture
US Department of Energy
US Department of the Interior
US Environmental Protection Agency
US Environmental Protection Agency
US Environmental Protection Agency
US Environmental Protection Agency
US Fish and Wildlife Service
US Forest Service
US Geological Survey
US National Biological Service
US National Park Service
USDA Forest Service
USDA, APHIS
USDA, APHIS, PPQ
USDA-ARS
USGS Patuxent Wildlife Research Center
Utah State University
Utah Water Research Laboratory
Utrecht University
Vanderbilt University
Virginia Division of Natural Heritage
Virginia Institute of Marine Science
Virginia Polytechnic Institute and State University
Volcani Center
Vrije Universiteit
Vulcan, Inc.
W.K. Kellogg Biological Station
Wageningen Agricultural University
Wageningen University
Wake Forest University
Wallis Foundation
Washington and Lee University
Washington Department of Natural Resources
Washington State University

Washington State University, Vancouver
Washington University
Watershed Environmental
Wellesley College
West Virginia Geology and Economic Survey
West Virginia Natural Heritage Program
West Virginia University
Western Australian Herbarium
Western Washington University
Wetlands International
White House Office of Science and Technology Policy
Wilburforce Foundation
Wild Salmon Center
Wildlife Conservation Society
Wildlife Conservation Society Canada
Wilfrid Laurier University
Williams College
Winrock International
WIRED NextFest
Wisconsin Department of National Resources
Woods Hole Oceanographic Institution
Woods Hole Research Center
World Conservation Monitoring Center
World Federation for Culture Collections (WFCC-MIRCEN)
World Resources Institute
World Trade Center
World Wildlife Fund
Wyoming State Engineers Office
Yale University
Yellowstone National Park
York University
Zentralinstitut der Humboldt-Universitaet zu Berlin
Zentralstelle fur Agrardokumentation (ZADI)
Zoological Society of London

Table 4. Scientific Societies to which NCEAS participants belong

NCEAS participants self-report the scientific societies to which they belong.

Academy of Management
Academy of Royal Sciences
Acoustical Society of America
African Mountains Association
African Studies Association
Alaska Anthropological Association
American Academy of Arts and Sciences
American Academy of Microbiology
American Academy of Underwater Sciences
American Agricultural Economics Association
American Alpine Club
American Anthropological Association
American Association for the Advancement of Science
American Association for the History of Medicine
American Association of Advanced Sciences
American Association of Environmental Engineers
American Association of Geographers
American Association of Geologists
American Association of State Climatologists
American Avalanche Association
American Avalanche Association
American Botanical Society
American Chemical Society
American Congress on Surveying and Mapping
American Economic Association
American Ethnohistory Society
American Evaluation Association
American Fisheries Society
American Genetic Association
American Geophysical Union
American Institute of Biological Sciences
American Institute of Fishery Research Biologists
American Institute of Physics
American Malacological Society
American Mathematical Society
American Meteorological Society
American Microscopical Society
American Naturalist Society
American Ornithologists' Union
American Philosophical Association
American Physiological Society
American Phytopathological Society
American Planning Association
American Political Science Association
American Psychological Association
American Public Health Association
American Quaternary Association
American Society for Engineering Education
American Society for Microbiology
American Society for Photogrammetry and Remote Sensing
American Society for The Study of Evolution
American Society for Virology
American Society of Agricultrual and Biological Engineers
American Society of Agricultural Engineering
American Society of Agronomy
American Society of Botanists
American Society of Civil Engineers
American Society of Human Genetics
American Society of Ichthyologists and Herpetologists
American Society of International Law
American Society of Limnology and Oceanography
American Society of Mammalologists
American Society of Naturalists
American Society of Nephrology
American Society of Parasiologists
American Society of Plant Taxonomists
American Society of Tropical Medicine and Hygiene
American Sociological Association
American Statistical Association
American Water Resources Association
American Women in Science

American Zoo and Aquarium Association
Amnesty International
Animal Behavior Society
Antelope Specialist Group
Argentine Ecological Society
Argentine Society of Botany
Arizona Riparian Council
Asociación Cultural Universitaria Palentina
Asociacion Espanolade Ecologia Terrestre
Associaion of Marine Laboratories of the Caribbean
Association for Computing Machinery
Association for Evolutionary Economics
Association for International Agriculture and Rural Development
Association for Mathematics Education of South Africa
Association for The Advancement of Artificial Intelligence
Association for The Study of Animal Behavior
Association for Theoretical Biology
Association for Tropical Biology and Conservation
Association for Women in Science
Association of American Physicians
Association of Environmental and Resource Economists
Association of Environmental Engineers
Association of North American Geographers
Association of Psychological Science
Association of Southeastern Biologists
Association of Teachers of Technical Writing
Audobon Society
Australasian Society for Computers in Learning in Tertiary Education
Australian Academy of Science
Australian Academy of Technological Sciences and Engineering
Australian and New Zealand Industrial and Applied Mathematics
Australian Association of Logic
Australian Association of Philosophy
Australian Conservation Foundation
Australian Coral Reef Society
Australian Council for Computers in Education
Australian Psychological Society
Australian Rangeland Society
Australian Society for Fish Biology
Australian Society for Limnology
Australian Society for the Study of Animal Behaviour
Australian Society of Herpetologists
Australian Systematic Botany Society
Australina Evolutionary Society
Aves Argentinas/Asociación Ornitológica del Plata
Bernoulli Society
Biogeography Society
Birds Australia
Bodega marine Sciences Association
Botanical Society of America
British Biological Society
British Computer Society
British Deer Society
British Ecological Society
British Micropalaeontological Society
British Mycological Society
British Ornithologists' Club
British Ornithologists' Union
British Society for Parasitology
British Society of Soil Science
Califonia Botanical Society
California Abalone Association
California Botanical Society
California Estuarine Research Society
California Fisheris Coalition
California Forest Soils Council
California Invasive Plant Council
California National Association of Environmental Professionals
California Native Grasslands Association
California Native Plant Society
Canadian Biosphere Reserve Association
Canadian Institute of Advanced Research
Canadian Rivers Institute
Canadian Science Writers' Association
Canadian Society for Ecology and Evolution

Canadian Society of Zoologists
Canidian Geophysical Union
Center for Applied Biodiversity Science
Center for Tropical Forest Science
Chilean Ecological Society
China Association of Environmental Law
China National Committee of International Geosphere-Biosphere Programme
Coastal Society
Colegio de Agronomos de Costa Rica
Community of Science
Conchologists of America
Cooper Ornithological Society
Corallus û Soc. Brasileira para Estudos de Recifes de Coral
Crustacean Society
Cushman Foundation for Foraminiferal Research
D.C. Bar Association
Decision Analysis Soceity
Desert Fishes Council
Dragonfly Society of America
East Africa Natural History Society
East African Wildlife Society
East-West Center
Ecological Society of America
Ecological Society of Australia
Ecological Society of Austria
Ecological Society of Chile (Sociedad de Ecologia de Chile)
Ecological Society of China
Ecological Society of Germany
Ecological Society of Switzerland
Entomological Society of America
Environmental and Engineering Geophysical Society
Environmental Long-Term Observatories of Southern Africa
Estuarine Research Federation
European Geophysical Union
European Society for Ecological Economist
European Society for Evolutionary Biology
European Society for Mathematical and Theoretical Biology
European Society of Nematologists
Fauna and Flora International
Federal European Microbial Society
Federation of European Microbiological Societies
Finish Scientific Societies
Fisheries Society of the British Isles
Florida Academy of Sciences
Florida Exotic Pest Plant Council
Florida Native Plant Society
French Geological Society
French Palaeontological Association
Freshwater Mollusk Conservation Society
Fundacion para el Desarrollo Ecologico Nacional y de la Amazonia
Gamma Sigma Delta (Agricultral Honor Society)
Genetics Society of America
Genetics Society of Australia
Geological Society of America
George Wright Society
German Society of Plant Nutrition
German Soil Science Society
German Zoological Society
Global Health Council
Helmintholgical Society
Herpetologists' League
Herptological Society
History of Science Society
Human Behavior and Evolution Society
Human Biology Council
IEEE Computer Society
Indian Botanical Society
Indian Sciene Congress Association
INFORMS
Institute of Civil Engineers
Institute of Electrical and Electronics Engineers
Institute of Foresters of Australia
Institute of Mathematical Statistics
Institute of Medicine
Integrated Bar of the Philippines
International Association for Ecology
International Association for Great Lakes Research
International Association for Hydraulic Engineering and Research

International Association for Hydrological Sciences
International Association for Landscape Ecology
International Association for Plant Taxonomy
International Association for Society and Resource Management
International Association for the Study of Common Property
International Association for Vegetation Science
International Association of Meiobenthologists
International Association of Paleontology
International Association of Radiolarian Palentologists
International Association of Sedimentologists
International Association of Theoretical and Applied Limnology
International Association of Vegetation Science
International Association of Wildland Fire
International Association of Wood Anatomists
International Biometric Society
International Cannabinoid Research Society
International Coral Reef Society
International Council for the Exploration of the Sea
International Environmetrics Society
International Globec SSC
International Humic Substance Society
International Organization for Biological Control
International Paleontological Association
International Paleontological Union
International Palm Society
International Phycological Society
International Society for Bayesian Analysis
International Society for Artificial Intelligence in Education
International Society for Behavioural Ecology
International Society for Conservation Biology
International Society for Diatom Research
International Society for Ecological Economics
International Society for Ecological Modelling
International Society for Ecosystem Health
International Society for History, Philosophy, and Social Studies of Biology
International Society for Landscape Ecology
International Society for Microbial Ecology
International Society for Reef Studies
International Society for the Study of Evolution
International Society for the Study of Harmful Algae
International Society for Tropical Forestry
International Society of Biogeography
International Society of Chemical Ecology
International Society of Environmental Medicine
International Society of Hymenopteristis
International Society of Limnology
International Society of Microbial Ecology
International Society of Soil Science
International Society of Theoretical and Applied Limnology
International Society of Tropical Ecology
International Society of Tropical Foresters
International Statistical Institute
International Studies Association
International Symposium on Microbial Ecology
International Union for Conservation of Nature and Natural Resource / World Commission on Protected Areas
International Union for the Scientific Study in Population
International Union for the Study of Social Insects
International Union of Soil Sciences
International Water Academy
Italian Society of Ecology
Italian Society of Ecopathology
Japanese Geomorphological Union
Japanese Society of Fisheries Science
Latin American Studies Association
Lepidopterists' Society
Linnean Society
LTER
Marine Biological Association of the United Kingdom
Marine Interests Group of San Luis Obispo County
Mesoamerican Society for Biology and Conservation
Mexican Society of Botany
Mexican Society of Mammalogists
Mexican Society of Phytogenic Resources
Micropalaeontological Society

Modelling and Simulation Society of Australia and New Zealand
Modern Language Associaton
Mycological Society of America
National Academy of Sciences
National Association of Biology Teachers
National Association of Geoscience Teachers
National Association of Science Writers
National Biodiversity Council (Australia)
National Geographic Society
National Ground Water Association
National Institute of Ecology
National Science Teachers Association
National Shellfisheries Association
National Speleological Society
National Water Resources Association
National Wildlife Rehabilitators Association
Natonal Association of Geoscience Teachers
Natural Areas Association
Natural Resource Modelling Association
Nature Conservation Society of South Australia
Netherlands-Flemish Ecological Society
New World Ecoloy and Agriculture Group
New York Academy of Sciences
New Zealand Association of Economists
New Zealand Ecological Society
New Zealand Marine Sciences Society
New Zealand Statistical Association
New Zeland Association of Economists
New Zeland Ecological Society
New Zeland Freshwater Sciences Society
Noorwegian Academy of Science and Letters
Nordic Benthological Society
Nordic Ecological Society
North American Benthological Society
North American Benthological Society
North American Butterfly Association
North American Lake Management Society
North American Management Society
Northeastern Ecosystem Regional Cooperative
Oikos
Organization for Tropical Studies
Organization of Biological Field Stations
Organization of Tropical American Nematologists
Orion
Pacific Coast Shellfish Growers Association
Pacific Estuarine Research Society
Pacific Seabird Group
Palaeontological Association
Paleontological Research Institution
Paleontological Society
Pennsylvania Academy of Sciences
Phi Beta Kappa
Phi Kappa Phi
Philosophy of Science Association
Phycological Society of America
Plant Society of China
Population Association of America
Primate Society of Great Britian
Psychologists for the Ethical Treatment of Animals
Remote Sensing Society
Renaissance Society of America
Resilience Network
Resource Modeling Association
Rhode Island Natural History Survey
Royal Anthropological Institute
Royal Danish Academy of Sciences and Letters
Royal Entomological Society
Royal Physiographic Society
Royal Society of Canada
Royal Society of Chemistry
Royal Society of London
Royal Society of New Zealand
Royal Society of Sciences in Uppsala
Royal Society of Tropical Medicine and Hygiene
Royal Statistical Society
Royal Sweedish Academy of Agriculture and Forestry
Sailors for Seas
Scandinavian Society of Plant Physiology
Scientific Exploration Society
Scientific Research Society of North America
Sigma Delta Epsilon
Sigma Xi, The Scientific Research Society

Singapore Institute of Biology
Sociedad Botanica de Mexico
Sociedade Brasileira de Ornitologia
Society for Applied Anthropology
Society for Behavioural Ecology
Society for Comparative and Integrative Biology
Society for Conservation Biology
Society for Conservation GIS
Society for Ecological Restoration
Society for Engineering in Agriculture
Society for Environmental Toxicology and Chemistry
Society for Human Ecology
Society for Industrial and Applied Mathematics
Society for Integrative and Comparative Biology
Society for Judgement and Decision Making
Society for Literature and Science
Society for Marine Mammalogy
Society for Mathematical Biology
Society for Molecular Biology and Evolution
Society for Natural Resource Modeling
Society for Population Ecology
Society for Range Management
Society For Research in Synthesis and Methodology
Society for Restoration Ecology
Society for Risk Analysis
Society for Scientific Exploration
Society for Sedimentation Geology
Society for Social Studies of Science
Society for the Advancement of Chicanos and Native Americans in Science
Society for the Conservation and Study of Caribbean Birds
Society for the Study of Amphibians and Reptiles
Society For The Study of Evolution
Society For The Study of Evolution
Society for the Study of Mammalian Evolution
Society for Vector Ecology
Society for Vertebrate Paleontology
Society of American Foresters
Society of American Naturalists
Society of Applied & Theoretical Limnology
Society of Australian Biologists
Society of Australian Biologists
Society of Canadian Limnologists
Society of Ecological Restoration
Society of Mathematical Biology
Society of Molecular Biology and Evolution
Society of Nematologists
Society of Systematic Biologists
Society of Vertebrate Paleontology
Society of Wetland Scientists
Soil and Water Conservation Society
Soil Science Society of America
Soil Science Society of China
Soil Water Conservation Society
South African Association of Botanists
Southern Appalachian Botanical Society
Southern California Academy of Sciences
Southwestern Association of Naturalists
Southwestern Entomological Society
Statistical Society of Canada
Surfrider Foundation
Swedish Ecological Society
Swedish Society of Soil Science
Tanzania Association for Forestry
Tanzania Wildlife Conservation Society
Texas Rivers and Reservoirs Management Society
Texas Society of Mammalogists
The Dragonfly Society of The Americas
The Explores Club
The Mammal Society
The Nature Conervancy
The Oceanography Society
The Paleontological Association
The Paleontological Society
The Renaissance Society of America
The Society for Marine Mammalogy
The Society for Molecular Biology and Evolution
The Soil Ecology Society
The Wildlife Society
Torrey Botanical Society
Tropical Biology Association
Tropical Science Center

U.S. Committee for the Israel Environment
Union of Concerned Scientists
United Nations Educational, Scientific and Cultural Organization
United States Permafrost Association
United States Regional Association of the International Association for Landscape Ecology
United States Society for Ecological Economics
Utah Academy of Sciences Arts and Letters
Washington Ornothological Society
Western Agricultural Economics Association
Western Society of Malacologists
Western Society of Naturalists
Wetland Society
Wildlife Conservation Society of Tanzania
Wildlife Conservation Society of the Philippines
Wildlife Disease Association (WDA)
Wildlife Society
Will Henning Society
Wilson Ornithological Society
Wisconsin Arborist Association
Women in Science and Engineering

World Association of Copepodologists
World Seagrass Association
World Sturgeon Conservation Society
World Wildlife Fund
Xerces Society for Invertebrate Conservation
Xi Sigma Pi
Zoological Society of London

Table 5. International Participation since 1995.

Country of residence for participants at NCEAS since the establishment of the Center in 1995.

Geographic Representation by Participants by Country, 1995-2007

COUNTRY	Frequency	Percent	Cumulative Frequency	Cumulative Percent
ARGENTINA	10	0.23	10	0.23
AUSTRALIA	94	2.17	104	2.40
AUSTRIA	2	0.05	106	2.45
BARBADOS	1	0.02	107	2.47
BELGIUM	3	0.07	110	2.54
BERMUDA	1	0.02	111	2.56
BOLIVIA	2	0.05	113	2.61
BRAZIL	15	0.35	128	2.96
BRITISH VIRGIN ISLANDS	1	0.02	129	2.98
CANADA	158	3.65	287	6.63
CHILE	8	0.18	295	6.81
CHINA	14	0.32	309	7.14
COLOMBIA	2	0.04	311	7.18
COSTA RICA	11	0.25	322	7.44
CZECH REPUBLIC	1	0.02	323	7.46
DENMARK	11	0.25	334	7.71
ECUADOR	3	0.07	337	7.78
EL SALVADOR	1	0.02	338	7.81
FIJI	2	0.04	340	7.85
FINLAND	13	0.30	353	8.15
FRANCE	36	0.83	389	8.98
GERMANY	47	1.09	436	10.07
HUNGARY	1	0.02	437	10.09
INDIA	4	0.09	441	10.18
INDONESIA	6	0.14	447	10.32
IRELAND	3	0.07	450	10.39
ISRAEL	10	0.23	460	10.62
ITALY	10	0.23	470	10.85
JAPAN	9	0.21	479	11.06
KENYA	8	0.18	487	11.25
MEXICO	28	0.65	515	11.89
NETHERLANDS	39	0.90	554	12.79
NETHERLANDS ANTILLES	1	0.02	555	12.82
NEW ZEALAND	16	0.37	571	13.19
NICARAGUA	1	0.02	572	13.21
NORWAY	8	0.18	580	13.39
PANAMA	2	0.05	582	13.44
PHILIPPINES	5	0.12	587	13.56
POLAND	2	0.05	589	13.60
PALAU	3	0.07	592	13.67
RUSSIA	12	0.28	604	13.95
SCOTLAND	9	0.21	613	14.16
SINGAPORE	1	0.02	614	14.18
SLOVENIA	1	0.02	615	14.20
SOUTH AFRICA	28	0.65	643	14.85
SOUTH KOREA	1	0.02	644	14.87
SPAIN	9	0.21	653	15.08
SWEDEN	30	0.69	683	15.77
SWITZERLAND	14	0.32	697	16.10
TAIWAN	5	0.12	702	16.21
TANZANIA	7	0.16	709	16.37
THAILAND	1	0.02	710	16.40
TURKEY	1	0.02	711	16.42
UNITED KINGDOM	128	2.96	839	19.38
USA	3487	80.53	4326	99.91
VENEZUELA	3	0.07	4329	99.98
ZIMBABWE	1	0.02	4330	100.00

TOTAL PARTICIPANTS ALL COUNTRIES: 4330
TOTAL USA: 3487
PERCENT FOREIGN: 19.45%

Table 6. International Participation 2001-2007.

Country of residence for participants at NCEAS for the reporting period 2001 - 2007.

Geographic Representation by Participants by Country
May 1, 2001 – July 31, 2007

COUNTRY	Frequency	Percent	Cumulative Frequency	Cumulative Percent
ARGENTINA	6	0.23	6	0.23
AUSTRALIA	66	2.50	72	2.73
AUSTRIA	2	0.08	74	2.80
BARBADOS	1	0.04	75	2.84
BELGIUM	2	0.08	77	2.92
BOLIVIA	2	0.08	79	2.99
BRAZIL	11	0.42	90	3.41
CANADA	105	3.98	195	7.38
CHILE	4	0.15	199	7.54
CHINA	7	0.27	206	7.80
COLOMBIA	1	0.04	207	7.84
COSTA RICA	11	0.42	218	8.25
CZECH REPUBLIC	1	0.04	219	8.29
DENMARK	6	0.23	225	8.52
ECUADOR	1	0.04	226	8.56
EL SALVADOR	1	0.04	227	8.60
FIJI	2	0.08	229	8.67
FINLAND	7	0.27	236	8.94
FRANCE	22	0.83	258	9.77
GERMANY	27	1.02	285	10.79
HUNGARY	1	0.04	286	10.83
INDIA	2	0.08	288	10.90
INDONESIA	6	0.23	294	11.13
IRELAND	3	0.11	297	11.25
ISRAEL	8	0.30	305	11.55
ITALY	9	0.34	314	11.89
JAPAN	4	0.15	318	12.04
KENYA	3	0.11	321	12.15
MEXICO	27	1.02	348	13.18
NETHERLANDS	18	0.68	366	13.86
NEW ZEALAND	10	0.38	376	14.24
NICARAGUA	1	0.04	377	14.27
NORWAY	4	0.15	381	14.43
PANAMA	2	0.08	383	14.50
PHILIPPINES	4	0.15	387	14.65
POLAND	1	0.04	388	14.69
PALAU	3	0.12	391	14.80
RUSSIA	9	0.34	400	15.15
SCOTLAND	7	0.27	407	15.41
SINGAPORE	1	0.04	408	15.45
SLOVENIA	1	0.04	409	15.49
SOUTH AFRICA	27	1.02	436	16.51
SPAIN	9	0.34	445	16.85
SWEDEN	11	0.42	456	17.27
SWITZERLAND	8	0.30	464	17.57
TAIWAN	5	0.19	469	17.76
TANZANIA	7	0.27	476	18.02
TURKEY	1	0.04	477	18.06
UNITED KINGDOM	85	3.22	562	21.28
USA	2079	78.72	2641	100.00

TOTAL COUNTRIES: 50
TOTAL PARTICIPANTS ALL COUNTRIES: 2,621
TOTAL FOREIGN PARTICIPANTS: 542
TOTAL USA PARTICIPANTS: 2079
PERCENT FOREIGN VISITORS: 20.68%

Table 7. Science Advisory Board

Cumulative list of Science Advisory Board members since the establishment of NCEAS.
List of Science Advisory Board Members
1995 - 2007

Members	Institutions	Term
Baron, Jill	US Geological Survey	2005-2008
Berenbaum, May	University of Illinois at Urbana	1995
Bronstein, Judith	University of Arizona	2002-2005
Chazdon, Robin	University of Connecticut	2000-2003
Clark, Deborah	University of Missouri, St. Louis	2003-2006
DeFries, Ruth	University of Maryland, College Park	2001-2004
Ewel, Katherine	USDA Forest Service	2000-2003
Goldberg, Deborah	University of Michigan	1999-2002
Graumlich, Lisa	Montana State University	2003-2006
Grimm, Nancy	Arizona State University	1997-1999
Gross, Katherine	Michigan State University	1995-1997
Hacker, Sally	Oregon State University	2006-2009
Harrison, Susan	University of California, Davis	2000-2002
Hobbie, Sarah	University of Minnesota, Twin Cities	2002-2005
Huntly, Nancy	Idaho State University	2002-2005
Kidwell, Susan	University of Chicago	2000-2003
Kinzig, Ann	Arizona State University	2001-2004
Martiny, Jennifer Hughes	University of California, Irvine	2007-2010
Micheli, Fiorenza	Stanford University	2005-2008
Naylor, Roz	Stanford University	1996-2000
Palmer, Margaret	University of Maryland, College Park	2001-2003
Pfister, Cathy	University of Chicago	2007-2010
Power, Alison	Cornell University	1997-2000
Power, Mary	University of California, Berkeley	1996-1999
Pringle, Cathy	University of Georgia	2004-2007
Rathcke, Bev	University of Michigan	2005-2006
Ruckelshaus, Mary	NOAA Fisheries	2003-2004
Shaw, Rebecca	The Nature Conservancy of California	2004-2007

Tank, Jennifer	University of Notre Dame	2007-2010
Turner, Monica	University of Wisconsin	1995-1997
Voytek, Mary	US Geological Survey	2004-2007
Wall, Diana	Colorado State University	1995-1998
Arita, Hector	Universidad Nacional Autonoma de Mexico	2006-2009
Bever, Jim	Indiana University	2007-2010
Brown, James	University of New Mexico	1997-2000
Brown, Joel	University of Illinois at Chicago	2000-2003
Carpenter, Steve	University of Wisconsin, Madison	1995
Carson, Walter	University of Pittsburgh	2004-2007
Case, Ted	University of California, San Diego	1995-1996
Chapin, F. Stuart	University of Alaska, Fairbanks	1995-1998
Clark, James	Duke University	1995-1999
Costanza, Robert	University of Vermont	2001-2004
Crowder, Larry	Duke University	2002-2005
Crowley, Philip	University of Kentucky	1995-1998
Denno, Robert	University of Maryland	2007-2010
Estes, James	University of California, Santa Cruz	1999-2002
Field, Chris	Carnegie Institute of Washington	1999-2002
Folke, Carl	Stockholm University	2000-2003
Godfray, Charles	Imperial College, Silwood Park	2000-2002
Gotelli, Nicholas	University of Vermont	2002-2005
Grenfell, Bryan	Pennsylvania State University	2005-2008
Hanski, Ilkka	University of Helsinki	1997-2000
Harms, Kyle E.	Louisiana State University	2007-2010
Hastings, Alan	University of California, Davis	1996; 2004-2007
Hochberg, Michael	Université de Montpellier II	2004-2007
Holt, Robert	University of Florida	1997-2000
Howarth, Robert	Cornell University	2000-2003
Hungate, Bruce	Northern Arizona University	2006-2009
Ives, Anthony	University of Wisconsin, Madison	2001-2004
Jackson, Jeremy	University of California, San Diego	1997-2000
Jackson, Steve	University of Wyoming	2006-2009
Kareiva, Peter	University of Washington	1995-1998
Kendall, Bruce	University of California, Santa Barbara	2006-2009

Lawton, John	Imperial College, Silwood Park	1996-1997
Leibold, Mathew	University of Texas, Austin	1999-2002
Levin, Phil	National Oceanographic and Atmospheric Administration	2006-2009
Losos, Jonathan	Washington University	1999-2002
Mangel, Marc	University of California, Santa Cruz	1998-2001
Marquet, Pablo	Pontifica Universidad Cathólica de Chile	2003-2006
Menge, Bruce	Oregon State University	2003-2006
Morin, Peter	Rutgers, The State University of New Jersey	1998-2001
Morris, Bill	Duke University	2005-2008
Murdoch, William	University of California, Santa Barbara	1997-2000
Neff, Jason	University of Colorado	2002-2005
Nisbet, Roger	University of California, Santa Barbara	2003-2006
Pace, Michael	Institute of Ecosystem Studies	1998-2000
Pastor, John	University of Minnesota, St. Paul	1998-1999
Peterson, Charles	University of North Carolina, Chapel Hill	1995-1997
Pfaff, Alex	Columbia University	2004-2007
Pickett, Steward	Institute of Ecosystem Studies	1995-1997
Pulliam, Ronald	University of Georgia	1998-2000
Running, Steven	University of Montana	1996-1998
Schimel, David	National Center for Atmospheric Research	1996-1999
Simberloff, Daniel	University of Tennessee, Knoxville	1998-2000
Strong, Donald	University of California, Davis	1995-1999
Thrall, Peter H.	CSIRO Agricultural Sustainability Initiative	2007-2010
Townsend, Alan	University of Colorado, Boulder	1999-2002
Travis, Joseph	Florida State University	1999-2001
Turchin, Peter	University of Connecticut	1995-1997
Vitousek, Peter	Stanford University	1995
Warner, Robert	University of California, Santa Barbara	2000-2003
Werner, Earl	University of Michigan	1996-1997
Westoby, Mark	Macquarie University	2001-2004