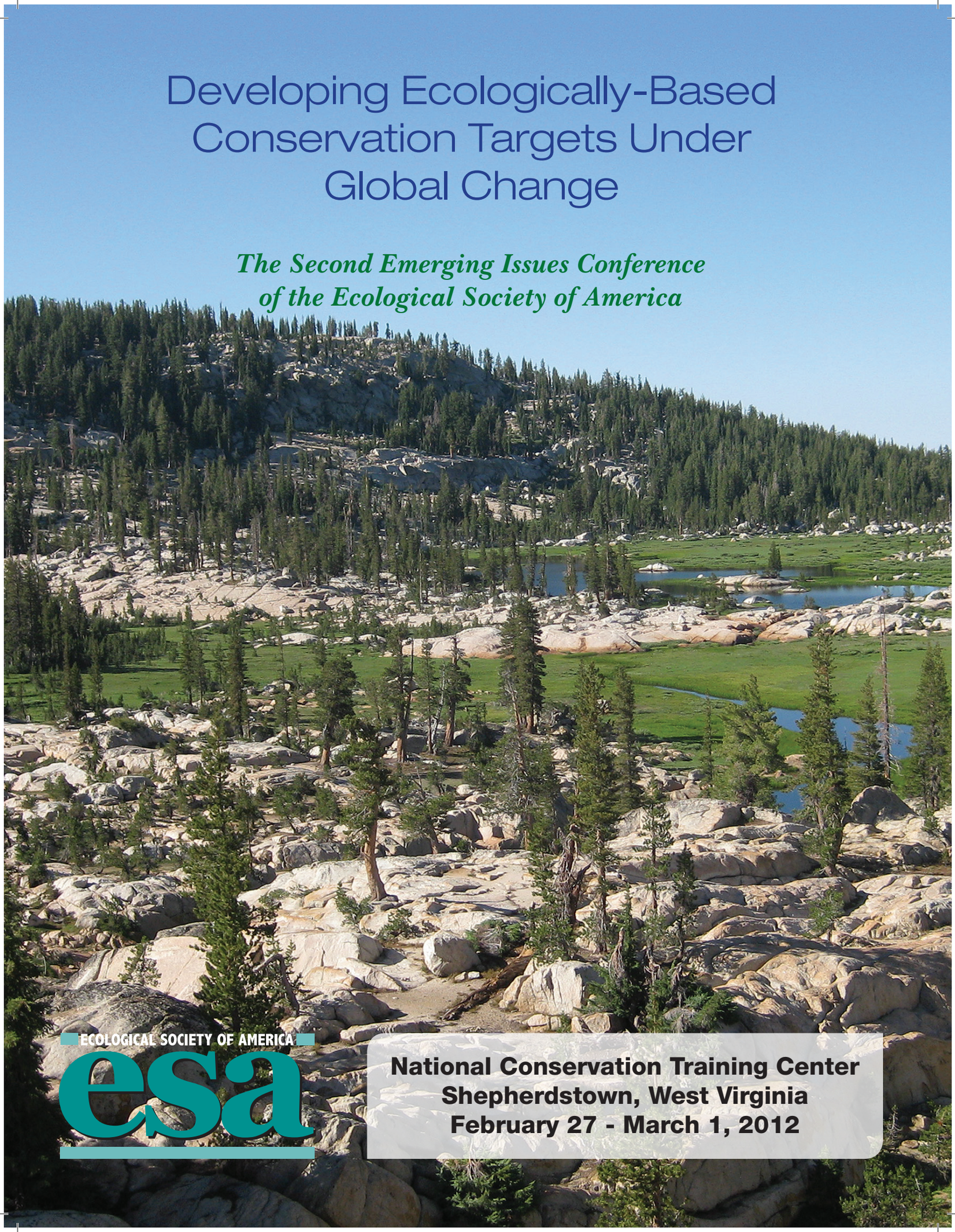
Developing Ecologically-Based Conservation Targets Under Global Change

The Second Emerging Issues Conference of the Ecological Society of America



ECOLOGICAL SOCIETY OF AMERICA

esa

National Conservation Training Center
Shepherdstown, West Virginia
February 27 - March 1, 2012

Conference Organizing Committee

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Cover photo: High Sierras, California.
Photo by Bernd Blossey.

February 27 – March 1, 2012
National Conservation Training Center

Conference Co-Chairs

Bernd Blossey

Cornell University

Dov Sax

Brown University

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ABOUT THE ECOLOGICAL SOCIETY OF AMERICA

The Ecological Society of America (ESA), with more than 10,000 members, is the nation's leading society for professional ecologists and publishes five premier journals.

Founded in 1915, the mission of ESA is to:

- promote ecological science by improving communication among ecologists;
- raise the public's level of awareness of the importance of ecological science;
- increase the resources available for the conduct of ecological science; and
- ensure the appropriate use of ecological science in environmental decision making by enhancing communication between the ecological community and policy makers.

Ecology is the scientific discipline that is concerned with the relationships between organisms and their past, present, and future environments. These relationships include physiological responses of individuals, structure and dynamics of populations, interactions among species, organization of biological communities, and processing of energy and matter in ecosystems.

ESA's members conduct research, teach, and use ecological science to address environmental issues that include:

- biotechnology;
- natural resource management;
- ecological restoration;
- ozone depletion and global climate change;
- ecosystem management;
- species extinction and loss of biological diversity;
- habitat alteration and destruction; and
- sustainable ecological systems.

This conference is designed to support ESA's mission of promoting the science of ecology and ensuring the appropriate use of ecological science in environmental decision making. The ESA Science Office has a 20-year history of bringing together researchers and managers from among the ESA membership and the wider biological sciences community to assess the state of the science in a wide range of environmental topics. Our Public Affairs Office is a key provider of ecological knowledge to Congress and others on emerging environmental issues, and our journals are the leading publishers of that knowledge. The Education and Diversity Programs Office works to increase diversity within ecology-related professions, to engage the public in a dialogue on ecological research and issues, and to improve the quality of ecology education at all levels.

Additional information about ESA programs and publications is available on our website, www.esa.org, and from our headquarters office at 1990 M Street NW, Suite 700, Washington, DC 20036 (tel. 202-833-8773).

Dear Attendees:

On behalf of the Ecological Society of America (ESA), the ESA Governing Board, and the ESA staff, we welcome you to ESA's Emerging Issues Conference, ***Developing Ecologically-Based Conservation Targets Under Global Change***. The Emerging Issues (formerly Millennium) Conference Series, originally proposed by former ESA President Nancy Grimm, is intended to address high-visibility issues of wide interest in the science community. Organizers are encouraged to work across disciplinary boundaries, to engage compelling speakers, and to produce high-quality publications.

Rapid global change challenges two key assumptions in conservation policy: the existence of pristine ecosystems, and the idea that establishing protected areas will preserve ecosystems and the human communities who depend on them. Land managers, policy makers, and scientists face multiple questions. For example, what conservation targets should we establish for changing ecosystems? Do we attempt to preserve existing communities or foster the development of novel ones that can preserve biodiversity and sustain human benefits? In response, this Conference brings together scientists, land managers, and policy makers to (1) identify both existing and novel conservation targets that are ecologically sound in light of rapid global change, and (2) develop a framework for assessing the inherent tradeoffs, risks, and benefits involved in achieving those conservation targets.

Over the next several days, you will hear presentations from nationally recognized experts, hear a keynote address from Dan Ashe, Director of the U.S. Fish and Wildlife Service, and see poster presentations from many of your fellow participants. You will also be invited to contribute your ideas for bold, interdisciplinary approaches to solving future conservation problems in breakout groups and in a concluding general plenary. Finally, we plan to develop several publications to which participants can contribute, and we invite you to develop your own based on the ideas discussed at this Conference, with the intent that the results be widely disseminated to conservation scientists, practitioners, and policy makers.

This Conference would not be possible without the support of our sponsors and volunteers, to whom we extend our deepest gratitude. They include the Doris Duke Charitable Foundation, the U.S. Geological Survey, the U.S. Fish and Wildlife Service, Defenders of Wildlife, the U.S. National Park Service, our hosts here at the National Conservation Training Center, and the members of our Conference Organizing Committee. Finally, we welcome you and thank you for your energy, your ideas, and your participation in exploring this critical emerging issue in ecology.

Sincerely,

Bernd Blossey,
Conference Co-Chair

Dov Sax,
Conference Co-Chair

ABOUT THE SECOND ESA EMERGING ISSUES CONFERENCE

Background:

In 2007, ESA's Governing Board announced a new conference series to provide members the opportunity to organize special conferences highlighting emerging, exciting ideas in ecology with the endorsement and support of the Society. The Emerging Issues (formerly Millennium) Conference Series is intended to address high-visibility issues of wide interest in the science community. Organizers are encouraged to work across disciplinary boundaries, to engage compelling speakers, and to produce high-quality publications. The first conference, *Water-Ecosystem Services, Drought, and Environmental Justice*, was held at the University of Georgia in November 2009.

In May 2010, a review committee appointed by ESA President Mary Power selected *Developing Ecologically-Based Conservation Targets Under Global Change* as the topic for the second conference. Co-chaired by Bernd Blossey of Cornell University and Dov Sax of Brown University, this Conference brings together scientists, land managers, and policy makers to discuss key questions, challenge assumptions, and explore potential solutions for conservation management in the face of global change. These explorations will be facilitated through a series of oral and poster presentations, breakout sessions, and informal discussions here at the National Conservation Training Center, an ideal venue for such a conversation.

The Issue:

Climate change, species introductions, and other types of global change have challenged two long-standing paradigms in ecology and conservation biology: the idea that there are pristine ecosystems, and the idea that establishing protected areas is sufficient to preserve biological diversity. The assumptions that species and ecosystems are "fixed" in place and can be protected where they currently occur do not reflect the dynamic changes that have been and will continue to be the hallmark of life on earth. As a static worldview is replaced with a more dynamic one, ecologists, conservationists, restoration biologists, land managers, and policy makers are left without an obvious or agreed-upon way forward. For example, what conservation targets should we establish for ecosystems that are in flux? Should we attempt to preserve "historically intact" communities in perpetuity? Should we foster the development of novel communities that can preserve biological diversity or provide ecosystem services? These important questions can and should be informed by ecological science.

The Response:

At the core of *Developing Ecologically-Based Conservation Targets Under Global Change* lies the question of how ecological researchers, practitioners, and policy makers can (1) identify both existing and novel conservation targets that are ecologically sound in light of rapid global change, and (2) develop a

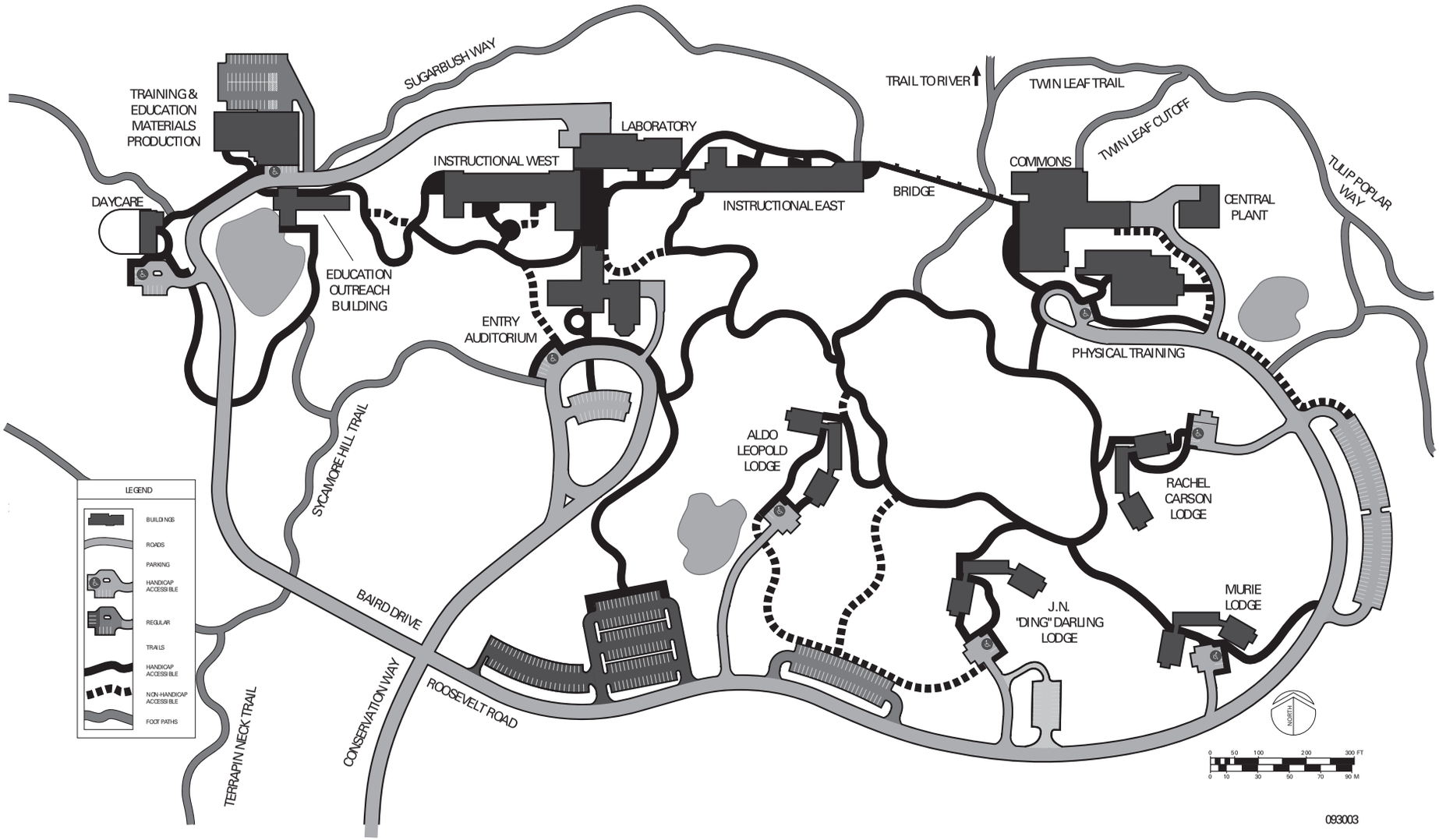
ABOUT THE SECOND ESA EMERGING ISSUES CONFERENCE

framework for assessing the inherent tradeoffs, risks, and benefits involved in achieving those conservation targets. At present, many government agencies and conservation organizations manage landscapes with a particular "reference community" in mind. However, the process of identifying a "pristine" reference community has recently been critiqued by ecologists, historians, and social scientists. Challenges posed by global change have only highlighted the shortcomings of conservation approaches informed by fixed reference communities. Reference communities are often based on paleobotanical records, but these data are often biased or incomplete (sampling the most abundant species or those best preserved in the fossil record). Furthermore, biotic communities change over time, making it unclear which period should be used as the reference. In other situations, reference communities are based upon arbitrary historical records; the possibility of biases in recorded observations aside, it is unclear whether records written by colonial settlers should be the ones used to provide baseline conditions. During European settlement, much of North America was a cultural landscape managed by indigenous peoples – the displacement of these peoples may have significantly altered species abundances and landscape forces (e.g., fire and hunting regimes) that created biotic communities described by colonists. Furthermore, extinctions of many species in the Pleistocene or in response to human colonization some 12-15,000 years ago, or more recent species and functional extinctions, have dramatically changed community compositions and selection regimes. Consequently, no matter which reference community is selected, we must make subjective decisions. This is not to imply that such reference scenarios should not be chosen – but rather to emphasize that our assumptions and decisions about the past must now be aligned with our decisions and assumptions about the future when planning for the management of ecological systems.

This Conference will critically address the need for conservation decisions in the face of rapid global change to be informed by ecological science. Using case studies, we will examine whether current selection regimes are able to maintain "historical" communities that evolved under very different selection pressures. We will also examine whether the dominant "reference community" and "museum approaches" are ecologically and evolutionarily sustainable or desirable. Moving into the 21st century, it is important to develop a process and a research agenda that will examine critical shortcomings in our conservation philosophy and practice, so that we are positioned to develop management goals and approaches that are desirable, achievable, and sustainable. Our ultimate goal is to provide science-based, practical decision tools for those charged with implementing conservation strategies throughout North America and internationally.

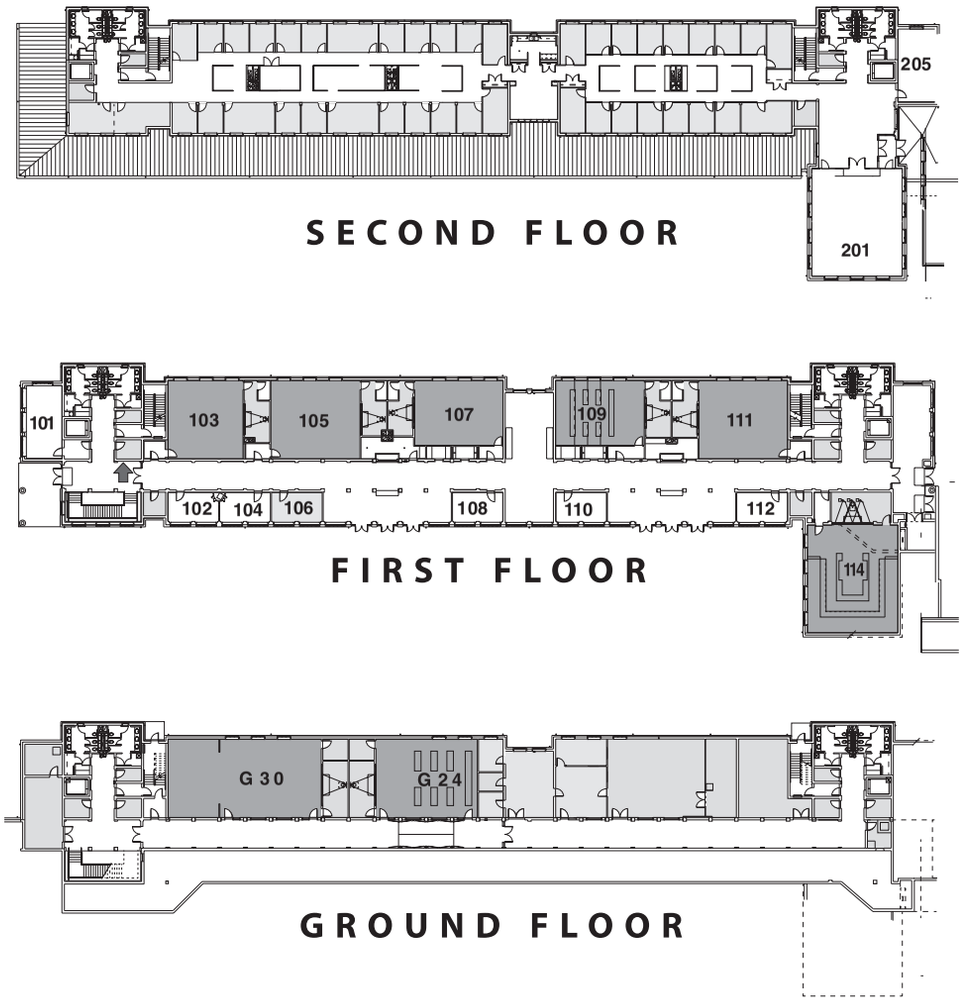
Insights from the Conference will be made widely available for a range of audiences including educators, conservation scientists, practitioners, and policy makers. Participants are invited to contribute curricular materials suitable for high school and college use to a special collection of teaching resources in ESA's EcoEd Digital Library; see http://ecoed.esa.org/index.php?P=EmergingIssues for details. Participants also will be invited to contribute to publications based on the ideas discussed at the Conference and to an online collection of resources for land and conservation managers making conservation decisions in the face of global change.

NATIONAL CONSERVATION TRAINING CENTER CAMPUS MAP

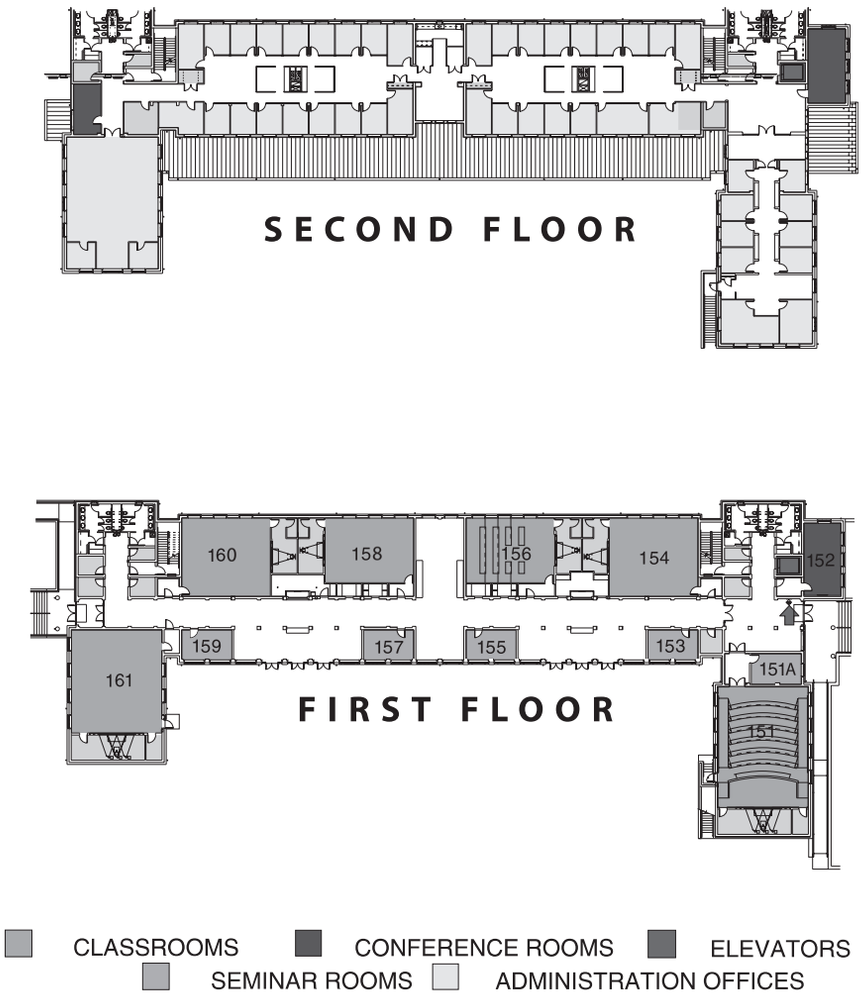


NATIONAL CONSERVATION TRAINING CENTER FLOORPLANS

Instructional East



Instructional West



Agenda

Monday, February 27

6:30 AM – 8:00 AM	**Breakfast**
8:00 AM – 8:15 AM	**Welcome Address** *Katherine McCarter, Ecological Society of America* *Steward Pickett, Cary Institute of Ecosystem Studies*
8:15 AM – 8:45 AM	**Introduction** **Conservation and global change: Setting the stage for a new paradigm** *Bernd Blossey, Cornell University* *Dov Sax, Brown University* *Laura Martin, Cornell University*
8:45 AM – 9:45 AM	**Symposium I** **Protected Areas: Fostering Museums, Way Stations, and Endpoints**
	8:45 AM **Intervention, protection and restoration: Are we guardians or gardeners?** *Richard Hobbs, University of Western Australia*
	9:15 AM **Is history "just history"? Uses of the ecological past for global-change risk assessment** *Stephen Jackson, University of Wyoming*
9:45 AM – 10:15 AM	**Break**
10:15 AM – 11:45 AM	**Symposium I continued**
	10:15 AM **Landscape corridors for a changing world** *Nick Haddad, North Carolina State University*
	10:45 AM **Marine reserve networks: Are they pre-adapted for a changing climate?** *Steve Gaines, University of California, Santa Barbara*
	11:15 AM **Discussion**
11:45 AM – 1:00 PM	**Lunch**
1:00 PM – 2:30 PM	**Symposium II** **Preventing Extinctions: Balancing Tradeoffs**
	1:00 PM **Government adaptation planning for wildlife** *Mark Shaffer, U.S. Fish and Wildlife Service*
	1:30 PM **Structured decision making and the management of endangered species** *Michael Runge, U.S. Geological Survey*
	2:00 PM **Finding hope for conservation and endangered species because we must** *Ronald Swaisgood, San Diego Zoo Institute for Conservation Research*
2:30 PM – 3:00 PM	**Break**

Monday, February 27, continued

3:00 PM – 4:30 PM **Symposium II continued**

- 3:00 PM **What would Leopold do? Reconsidering conservation ethics under rapid environmental change**
  Ben Minteer, Arizona State University
- 3:30 PM **Managed relocation (a.k.a. assisted colonization): Risks, opportunities, guidelines, and policy**
  Dov Sax, Brown University
- 4:00 PM **Discussion**

4:30 PM – 5:00 PM **Symposium III**
Managing Ecosystem Services: Balancing Utility and Preservation

- 4:30 PM **Managing and restoring ecosystem services: Formal and informal institutional constraints**
  Margaret Palmer, National Socio-Environmental Synthesis Center & University of Maryland

5:00 PM – 6:30 PM **Poster Session I**

6:30 PM – 7:30 PM **Dinner**

7:30 PM – 8:30 PM **Keynote Address**
Conserving the future vision: The role of U.S. Fish and Wildlife and its National Wildlife Refuge System
Daniel Ashe, U.S. Fish and Wildlife Service

Tuesday, February 28

6:30 AM – 8:30 AM **Breakfast**

8:30 AM – 10:00 AM **Symposium III continued**

- 8:30 AM **Ecology of the Anthropocene terrestrial biosphere**
  Erle Ellis, University of Maryland, Baltimore County
- 9:00 AM **Balancing the need for conservation of biodiversity and provision of services for human wellbeing**
  Michelle Marvier, Santa Clara University
- 9:30 AM **Natural capital: Learning hard lessons and getting it right**
  Taylor Ricketts, University of Vermont

10:00 AM – 10:30 AM **Break**

10:30 AM – 11:30 AM **Symposium III continued**

- 10:30 AM **The spirit of conservation and the idolatry of management**
  Karim-Aly Kassam, Cornell University
- 11:00 AM **Discussion**

11:30 AM – 1:00 PM **Lunch**

Agenda

Tuesday, February 28, continued

1:00 PM – 2:30 PM **Symposium IV**
Management Outside of Protected Areas: Approaching Alternative Choices

- 1:00 PM **Integrating ecology and economics in the design of conservation strategies for a changing world**
  Paul Armsworth, University of Tennessee, Knoxville
- 1:30 PM **Conserving working landscapes through collaborative partnerships**
  Gabriela Chavarria, U.S. Fish and Wildlife Service
- 2:00 PM **The impact of introduced plants on food webs in managed ecosystems**
  Doug Tallamy, University of Delaware

2:30 PM – 3:00 PM **Break**

3:00 PM – 5:00 PM **Symposium IV continued**

- 3:00 PM **Tweak, adapt, or transform: How to build a resilient future for agriculture**
  Lisa Schulte-Moore, Iowa State University
- 3:30 PM **The power of the crowd: Socially networked citizen science as an integrative tool for emergent conservation research and management**
  Janis Dickinson, Cornell University
- 4:00 PM **Pleistocene rewilding: Lessons for the future?**
  Harry Greene, Cornell University
- 4:30 PM **Discussion**

5:00 PM – 6:30 PM **Poster Session II**

6:30 PM – 7:30 PM **Dinner**

Wednesday, February 29

6:30 AM – 8:00 AM **Breakfast**

8:00 AM – 8:30 AM **Plenary**

8:30 AM – 10:00 AM **Working Groups: Parallel Processing**
Participants will be assigned to small groups to identify emergent themes from the conference. Example questions to be explored include:

- Does global change require a slight modification, major modification, or total overhaul of current conservation approaches?
- Can we imagine a bold new way of "doing conservation"?
- What are our conservation targets and how do we get there?

Each group in this session will work with the same set of questions. Discussion outcomes will be shared in a plenary and will inform product development.

10:00 AM – 10:30 AM **Break**

10:30 AM – 11:30 AM **Working Groups Report**

11:30 AM – 1:00 PM **Lunch**

Wednesday, February 29, continued

1:00 PM – 2:30 PM	**Working Groups: Conference Products** Participants will be invited to join working groups that will initiate specific products identified in the morning plenary, e.g., articles for peer-reviewed journals, input to an online managers' resource being developed by ESA staff, and products for educators and policy makers.
2:30 PM – 3:00 PM	**Break**
3:00 PM – 5:00 PM	**Working Groups continued**
6:00 PM – 7:30 PM	**Dinner**

Thursday, March 1

6:30 AM – 8:00 AM	**Breakfast**
8:00 AM – 10:00 AM	**Plenary** Product ideas from Wednesday will be shared and small working groups will form to develop products.
10:00 AM – 10:30 AM	**Break**
10:30 AM – 11:30 AM	**Working Groups continued** Groups will work on products identified during the Wednesday discussions and the Thursday morning plenary.
11:30 AM – 1:00 PM	**Lunch**
1:00 PM – 2:30 PM	**Working Groups continued**
2:30 PM – 3:00 PM	**Break**
3:00 PM – 4:00 PM	**Closing Session**

Breakfasts, lunches, and dinners will be served in the Dining Room in the Commons Building.

The Monday and Tuesday Symposia, the Wednesday Working Groups Report, and the Thursday Plenary will convene in the Auditorium in the Entry/Auditorium Building.

The Wednesday and Thursday Working Groups will convene in the Instructional East and Instructional West Buildings. Specific room numbers will be announced onsite.

Morning and Afternoon Breaks will be served in the lobby areas closest to the location of the session following the break. Specific locations will also be announced onsite.

Abstracts and Speaker Biographies

Keynote Address

Conserving the future vision: The role of U.S. Fish and Wildlife and its National Wildlife Refuge System

Daniel M. Ashe, U.S. Fish and Wildlife Service

The role of the National Wildlife Refuge System will be discussed to address the opportunities we anticipate refuges and other reserves will play given species movement and future changes in species composition of those areas. The current regulatory framework will be discussed to see if it is sufficient for the Fish and Wildlife Service to maintain its objectives in the context of climate change.

Daniel Ashe was confirmed on June 30, 2011, as the 16th Director of the U.S. Fish and Wildlife Service, the nation's principal Federal agency dedicated to the conservation of fish and wildlife and their habitats. His appointment by President Obama is the culmination of a lifetime spent within the Fish and Wildlife Service family.

Ashe was born and spent his childhood in Atlanta, Georgia, where his father began his 37-year career with the Service. Much of his childhood was spent on national wildlife refuges and fish hatcheries in the Southeast, where he learned to band birds, fish, hunt and, most importantly, simply enjoy the outdoors. Prior to his appointment as Director, he served as the Service's Deputy Director for Policy beginning in 2009, where he provided strategic program direction and developed policy and guidance to support and promote program development and fulfill the Service mission.

Ashe also served as the Science Advisor to the Director of the Fish and Wildlife Service. Appointed to this position in March, 2003, he advised the Service Director and provided leadership on science policy and scientific applications to resource management. As Science Advisor, he led an organizational renaissance for science and professionalism, leading the Service's efforts to respond to changes in the global climate system; shaping an agency agenda for change toward a science-driven, landscape conservation business model; defining an agency Code of Scientific and Professional Conduct; authoring new guidelines for scientific peer review and information quality; building state-of-the-art, electronic literature access for employees; and reinstituting internal scientific publication outlets. He was also responsible for leading efforts to build stronger relationships with the U.S. Geological Survey and scientific professional societies.

Symposium I
Protected Areas: Fostering Museums, Way Stations, and Endpoints

Intervention, protection and restoration: Are we guardians or gardeners?

Richard J. Hobbs, University of Western Australia

The basic principles and tenets of restoration ecology and conservation biology are currently being debated and reshaped in the face of escalating global change and changing understanding of how ecological systems work. How do we make progress in applying rapidly-evolving ideas from ecology to the practice of conservation and restoration? The sciences of conservation biology and restoration ecology are both relatively young and have built up a battery of concepts and approaches that are now being questioned or modified. How far do we have to go with adapting current concepts to match the realities now being faced, and, indeed, do current concepts need to be abandoned and replaced?

These questions are being asked on many fronts; for example, in relation to:

- rapid, extensive and ongoing environmental change;
- the impacts and benefits of non-native species;
- the increasing proportion of the world's ecosystems that no longer occur in a "historic" state and are instead in some novel biotic and abiotic configuration;
- the increasing need for active intervention rather than passive protection;
- the decreasing relevance of concepts such as "naturalness" in conservation decision making;
- the likelihood that restoration to historic or reference conditions may not be possible or desirable;
- the increasing need to consider both biodiversity and human well-being in decision making.

Some of the discussions revolve more around normative value-based aspects and perceptions than around ecology. However, the normative aspects often shape the way science is contextualised, conducted, and interpreted, and hence need to be understood.

Should humanity be guardians or gardeners of the world's species and ecosystems? I argue that from the perspectives of both values and ecological realities, it will be increasingly hard to be one without the other.

Richard Hobbs is Professor of Restoration Ecology in the School of Plant Biology at the University of Western Australia (UWA), where he holds an ARC Australian Laureate Fellowship and leads the Ecosystem Restoration and Intervention Ecology Research Group. Originally from Scotland, he spent 3 years in California and has been in Western Australia since 1984, working with CSIRO and at Murdoch University before joining UWA in 2009. His particular interests are in vegetation dynamics and management, invasive species, ecosystem restoration, conservation biology, and landscape ecology. He has several long-term ecological studies underway including a 29-year study of California grassland dynamics.

He is the author of over 300 scientific publications, many magazine articles and other publications, and author/editor of 18 books. He serves or has served in executive positions in a number of learned societies and on numerous editorial boards and is currently Editor in Chief of the journal Restoration Ecology. He was elected to the Australian Academy of Science in 2004, is an ISI Highly Cited Researcher, and was awarded the Ecological Society of Australia Gold Medal in 2010. His current research focuses on "Intervention ecology: Managing ecosystems in the 21st century."

Is history "just history"? Uses of the ecological past for global-change risk assessment

Stephen T. Jackson, University of Wyoming

Climate change, even rapid climate change, is nothing new to earth and its biota. In the past 40,000 years, the earth system has undergone several rapid warmings and coolings, a transition from a glacial to an interglacial state, and climate variability at timescales from decades to millennia. These particular changes will not be repeated in the future, but lessons and case studies from the past are highly relevant to the coming decades. Species, populations, and ecological communities have responded to past climate changes in a variety of ways: *in situ* toleration, local habitat shift, regional to subcontinental migration, adaptive evolution, altered interspecific interactions, and community disassembly and reassembly into new configurations. These responses are not mutually exclusive; for example, species can tolerate climate change in some parts of their range while colonizing new territories and relinquishing former habitats. Local and regional extirpations have occurred routinely as part of these dynamics, as have invasions and expansions. At least a few species have undergone extinction, and many extant species have gone through severe genetic bottlenecks recently, suggesting they came close to the brink of extinction. Most species living today have natural capacity for coping with climate change, given their persistence through the global changes of the recent past. These capacities are poorly understood, but can potentially be leveraged by conservation managers for more effective and efficient conservation efforts in a rapidly changing world. Although prediction is likely to be elusive in any detailed sense, we can minimize losses and use limited conservation resources efficiently by identifying adaptive capacities and vulnerabilities.

Stephen Jackson studies effects of environmental change on forests, woodlands, and wetlands. A native of southern Illinois, he received a Ph.D. in Ecology and Evolutionary Biology from Indiana University in 1983. He was a National Science Foundation Post-Doctoral Fellow in Environmental Biology in residence at Brown University, and is currently Professor of Botany at the University of Wyoming, where he served as founding Director (2004-2011) of the Program in Ecology. He has served on numerous advisory panels and editorial boards, most recently *Ecosystems*, *Frontiers in Ecology and the Environment*, and *Trends in Ecology and Evolution*. Jackson is a 2006 Fellow of the Aldo Leopold Leadership Program, a 2009 Fellow of the American Association for the Advancement of Science, and a 2012 Visiting Fellow at Merton College, University of Oxford. His research employs tree-rings, fossil rodent middens, and sediments from lakes and bogs to investigate how past climatic changes and human activities have affected species distributions, biodiversity, and ecosystem properties. His study sites range from wilderness areas in the Rocky Mountain and upper Great Lakes regions to agricultural landscapes in the Southeast and urban/industrial settings in the Midwest. He is committed to effective engagement with stakeholders in environmental and conservation policy and management.

Landscape corridors for a changing world

Nick M. Haddad, North Carolina State University

I will discuss how and when landscape corridors can provide a general strategy to promote plant and animal dispersal in the face of the two largest threats to biodiversity, habitat fragmentation, and climate change. I will discuss two case studies. First, drawing on nearly 20 years of data from the Savannah River Site Corridor Experiment, I will show how corridors increase dispersal generally across a diversity of plant and animal species. These higher rates of dispersal have consequences for populations, species interactions, and community diversity. Evidence from our and other studies

shows that the ecological benefits of corridors far outweigh their potential ecological costs. Second, drawing on detailed studies of dispersal within a larger and threatened landscape in which we studied the major animal species of conservation concern, we show how the umbrella species concept may be applied to connectivity conservation for a variety of imperiled species. Our three focal species – a forest-dwelling bird, a pond-breeding amphibian, and a wetland butterfly – have divergent natural histories and habitat affiliations. Yet, when designed using behaviorally informed models, connectivity can be conserved simultaneously for all species. Taken together, our results demonstrate the broad potential for applications of reserve designs based on corridors and connectivity to counteract the negative effects of habitat fragmentation in a changing world.

Nick Haddad is interested in the causes and consequences of biodiversity loss, and he studies strategies to protect biodiversity. His research has focused on how to overcome the leading cause of species extinction, the loss and fragmentation of native habitats. His experiments have focused on the role of habitat corridors as the most prominent landscape-scale strategy to protect biodiversity. His group's work has shown that corridors increase dispersal across a variety of plant and animal species, and that corridors increase the diversity of plants. As efforts to reconnect landscapes accelerate to adapt to habitat loss and a changing climate, his group continues to spearhead empirical and theoretical efforts to test how and when corridors will work for biodiversity conservation. Haddad's group also studies the restoration and recovery of critically endangered species, especially the world's rarest butterfly species.

Marine reserve networks: Are they pre-adapted for a changing climate?

Steven D. Gaines, University of California, Santa Barbara

Although the fraction of the ocean set aside in fully protected areas is small relative to the land, some networks of multiple reserves have recently been implemented at large geographic scales. These networks build on terrestrial conservation principles but increasingly incorporate features driven by patterns of connectivity among reserves and unprotected areas in between. Unlike on land, marine network designs commonly have dual goals of achieving conservation outcomes while enhancing resource use (typically fishing) between reserves. The rapid growth in sophistication of our models of ocean circulation have led to parallel increases in the sophistication of network designs that can enhance conservation and fisheries benefits. Connectivity driven by ocean currents differs from connectivity in terrestrial habitats in both qualitative and quantitative ways. In addition, many aspects of the turbulent complexity of ocean dynamics create strong source-sink dynamics in dispersal of offspring. Understanding these spatial dynamics is critical to the success of network design.

Ocean ecosystems are in many ways changing faster in response to climate change than other habitats. Yet, to date most efforts in marine reserve networks have focused on present day threats. There is often little more than lip service paid to pending changes in climate. I will explore whether the current design approaches that attempt to enhance connectivity in marine reserve networks may coincidentally enhance their effectiveness in conservation under a changing climate. Do present designs facilitate geographic shifts in species distributions? Are the spatial patterns of source and sink sites today likely to be the same sites in the future? Can networks of reserves help us better manage fished areas beyond their borders by providing a more isolated picture of population and ecosystem changes in response to climate change?

Steve Gaines is Professor and Dean of the Bren School of Environmental Science and Management at the University of California, Santa Barbara. He is a marine ecologist who seeks conservation solutions by connecting new innovations in ocean science with effective marine policy and management. His scientific work has most recently focused on the design of marine reserve networks, our understanding of how climate change impacts ocean ecosystems, and more sustainable fisheries management using market based reforms.

Gaines helped develop several major programs in conservation science that bring together interdisciplinary teams to tackle problems in novel ways. Two noteworthy examples include PISCO (Partnership for Interdisciplinary Studies of Coastal Oceans), a long-term consortium studying marine ecosystems of the west coast of the U.S., and the Sustainable Fisheries Group, a collaboration between academia, non-governmental organizations, fishermen, and managers that promotes the development and implementation of innovative fisheries reforms. In addition to his science contributions, Gaines has a passionate focus on more effective communication of ocean science through international courses on the Ocean Science Policy Interface, the Luce Science to Solutions program, and the Digital Ocean project, which employs social networking tools to promote more effective exchanges of ideas.

Gaines holds a Ph.D. from Oregon State University. He is a Pew Fellow in marine conservation, a Fellow of the American Association for the Advancement of Science, and was the inaugural recipient of the Marc Hirshman Award presented by the Joint Ocean Commission for excellence in student mentoring.

Symposium II: Preventing Extinctions: Balancing Tradeoffs

Government adaptation planning for wildlife

Mark Shaffer, U.S. Fish and Wildlife Service

Because the physical reality of climate change has been disputed in American society, domestic U.S. conservation agencies (federal, state, and tribal) have been slower to address the potential impacts of climate change on their trust resources than in some other countries. Moreover, when climate change adaptation planning began in earnest, it was at the state and tribal level. More recently, the federal government, in collaboration with the states and the tribes has undertaken a collaborative effort on national, government-wide adaptation planning for our wild living resources. The National Fish, Wildlife, and Plants Climate Adaptation Strategy has just completed its public review phase and is scheduled to be released by June 1, 2012. It is one of a family of sectoral adaptation plans being coordinated by CEQ (at the federal level) and is an example of a unique partnership between the three levels of government that have authority and responsibility for wildlife in the United States. It also exemplifies and embodies guiding principles that have emerged from several inclusive processes. This presentation will discuss the origins of the strategy, the process for its development, and the major recommendations contained in the current draft, as well as the opportunities for its implementation.

Mark Shaffer is a biodiversity conservationist with extensive experience in population viability analysis, conservation biology, resource economics, and environmental philanthropy. As Program Director for the Environment at the Doris Duke Charitable Foundation, he provided strategic direction for the investment of nearly $100 million in conservation investments. As Senior Vice President of Programs for Defenders of Wildlife, Shaffer provided direction, oversight, and administration of the organization's species, habitat, and legal work. Prior to his work with Defenders of Wildlife, he worked with three other major conservation organizations: The Nature Conservancy, The Wilderness Society, and the U.S. Fish and Wildlife Service. Shaffer received a Bachelor of Science degree from Indiana University of Pennsylvania, and his Ph.D. from Duke University School of Forestry and Environmental Studies. His doctoral research on grizzly bears helped to pioneer population viability analysis in conservation biology.

Structured decision making and the management of endangered species

Michael C. Runge, U.S. Geological Survey

Management of endangered species is hard, in particular because we, as a society, often have competing objectives. We care about endangered species, but we also care about economic opportunity, energy independence, recreation, ecosystem services, and other values. When these competing objectives, which are often only vaguely articulated, are combined with a system that is poorly understood, the result can be conflict, confusion, and decision paralysis. Decision makers, stakeholders, and scientists can become deeply frustrated. I believe a valuable approach lies in recognizing these problems as decision problems, not as scientific problems. Decision analysis, sometimes called "structured decision making" (SDM), provides a rich set of tools for framing decisions, eliciting the fundamental objectives, integrating scientific understanding to evaluate alternative management options, and finding a solution that balances the tradeoffs. In endangered species management, conflict over objectives is often conflated with uncertainty about the response of the ecosystem to management; SDM provides a way to disentangle and separately analyze these challenges. In particular, multi-criteria decision analysis is a valuable framework for engaging stakeholders, understanding the tradeoffs among a multitude of objectives, and seeking a way to balance those objectives. Likewise, the value of information and adaptive management are decision analytical tools for understanding and coping with uncertainty that impedes management. In 2010, the Bureau of Reclamation, working with several other federal agencies, the State of Arizona, and five Native American tribes, employed a number of these tools in a structured process to find a way to control non-native fish to support recovery of the endangered humpback chub (*Gila cypha*) in the Colorado River, while recognizing a range of cultural, spiritual, ecological, recreational, and economic objectives.

Abstracts and Speaker Biographies

Michael Runge is a research ecologist with the U.S. Geological Survey, Patuxent Wildlife Research Center, where he was worked since 1999. His research focuses on the use of decision theory and population modeling to inform wildlife management, with particular emphasis on the use of formal decision analytical tools to integrate scientific and policy considerations.

Most of his research involves collaboration with the U.S. Fish and Wildlife Service on some level, and he has worked on projects with migratory birds, National Wildlife Refuges, and endangered species (including manatees, wolves, and polar bears). He co-designed the "Introduction to Structured Decision Making" and "Adaptive Management" courses for the USFWS National Conservation Training Center and co-leads the joint USGS/FWS Structured Decision Making Workshops.

He received a B.A. in biology and philosophy from the Johns Hopkins University, an M.A.T. (Master of Arts in Teaching) in biology from Spalding University, and a Ph.D. in wildlife science from Cornell University.

Finding hope for conservation and endangered species because we must

Ronald R. Swaisgood, San Diego Zoo Institute for Conservation Research

The results from the field of conservation psychology are in: cultivating low expectations for future success promotes giving up, not meaningful conservation action. Call it hope as a convenient label. This is not Panglossian hope: envision Churchill, sleeves rolled up, determined to prevail against the Nazis while much of his country lay in ruin. It is hope-inspired determination. While hope may not be the logical alternative, it is the necessary alternative – for if we extrapolate the legion scenarios of despair to their conclusion then we are merely fighting with time over an inevitably bleak future. How can we call to action the next generation of conservation heroes in an atmosphere of defeat?

I contend that each of us much find our own personal reasons for hope. In the latter part of my talk, I will present three brief examples from my own work where I struggled with despair but ultimately found real reason for hope. I once despaired and complained about society becoming disconnected from nature and the implications of that disconnect for the future of environmental stewardship. My solution was to join the movement to reconnect people to nature. I also once believed that prospects for one of my primary study species – the giant panda – were poor. I redoubled my efforts to conduct conservation-relevant research and contributed to a rapidly growing body of biological knowledge that has helped put the panda on more secure footing. In my own backyard of Southern California, I noted with pessimism the rapid loss of habitat and record-setting numbers of endangered species. I helped my organization establish a growing local conservation program with a focus on developing ecologically-relevant animal translocation programs to assist in the recovery of these vanishing ecosystems. These examples characterize some of my struggles with conservation despair – what are yours?

Ronald Swaisgood serves San Diego Zoo Global as the Brown Endowed Director of Applied Animal Ecology. He also heads the Giant Panda Conservation Unit and is the General Scientific Director of Cocha Cashu Biological Station in Manu National Park in the Peruvian Amazon. Swaisgood earned a bachelor's degree from the University of North Carolina at Chapel Hill and a Ph.D. in Animal Behavior from the University of California, Davis. His work focuses on the conservation of species in their native habitats, with an emphasis on reintroduction and translocation programs. He oversees conservation programs for species such as California condors, burrowing owls, terns, plovers, desert tortoises, mountain yellow-legged frogs, giant pandas, Andean bears, and kangaroo rats. He has served as an adjunct professor at University of California at Los Angles, San Diego State University, and the Chinese Academy of Science. He is active on several national and international conservation committees and chairs the IUCN's Giant Panda Expert Team and the Animal Behavior Society's Conservation Committee. As an advocate for reconnecting children to nature, he serves on committees for the Children & Nature Network and San Diego Children & Nature Collaborative, and is co-founder of the Family Adventures in Nature Club.

What would Leopold do? Reconsidering conservation ethics under rapid environmental change

Ben A. Minteer, Arizona State University

There is no more authoritative voice in conservation philosophy than Aldo Leopold, the forester-ecologist whose 1949 book *A Sand County Almanac* is widely viewed as one of the most important works ever written about the human-nature relationship. Leopold's "land ethic" is perhaps the most significant statement of societal responsibility to wild species and landscapes in the conservation tradition; his directive to promote the "integrity, beauty, and stability of the biotic community" has become a kind of "golden rule" of conservation in the modern era.

Recently, however, Leopold's land ethic seems to have been stripped of much its ethical and rhetorical power. The appeal to "integrity" and "stability" as standards for conservation action appears to be untenable in rapidly changing environments, especially those expected to bear little resemblance to historical systems. The land ethic's position as the philosophical cornerstone for conservation policy and practice thus seems to be in jeopardy. This is especially true to the degree that traditional norms favoring historical baselines and native species move to accommodate a very different conservation landscape composed of novel ecosystems and species assemblages.

Yet, a broader analysis of Leopold's philosophy of conservation that places the land ethic in the wider context of his thinking about conservation motives and goals suggests that his work is still directly relevant to current discussions about our responsibilities to species and ecosystems on a rapidly changing planet. For example, Leopold's understanding of "land health," a scientific and value-laden concept, remains useful for debates over shifting conservation goals under climate change. Among other things, the reconsideration of Leopold's work in the context of rapid environmental change could contribute to the development of a revised conservation philosophy capable of guiding ethical interventions in rapidly changing ecosystems, and to the creation of an ecological ethics appropriate to life in the Anthropocene.

Ben Minteer is an Associate Professor in the School of Life Sciences at Arizona State University (ASU) and a Senior Sustainability Scholar in the Global Institute of Sustainability at ASU. He is an environmental ethicist who studies issues at the intersection of environmental philosophy, environmental policy, and ecology. His work focuses on the ethical justification of environmental policy goals, including the value foundations of policies and practices relating to biological conservation and ecological management. Minteer also studies the history and philosophy of American conservation and environmentalism. He teaches courses on environmental ethics and policy, and the human dimensions of conservation biology.

His work has appeared in a wide array of publications, including *Environmental Ethics*, *Conservation Biology*, *Biological Conservation*, *PNAS*, *Ecological Applications*, and *Frontiers in Ecology and the Environment*, as well as many other journals and collections. Minteer is also author or editor of numerous books, including most recently *Refounding Environmental Ethics: Pragmatism, Principle, and Practice*; *Nature in Common? Environmental Ethics and the Contested Foundations of Environmental Policy*; and *The Landscape of Reform: Civic Pragmatism and Environmental Thought in America*. Before arriving at ASU, he held faculty positions at Georgia Tech, Bucknell University, and Columbia University.

Managed relocation (a.k.a. assisted colonization): Risks, opportunities, guidelines, and policy

Dov F. Sax, Brown University

Synergies among climate change, habitat fragmentation, and barriers to species dispersal are expected to facilitate extinctions over the next 100 years. These extinctions will reduce global biodiversity and may impair ecosystem functioning both locally and regionally.

One adaptation strategy that has been proposed to combat these threats is managed relocation (a.k.a assisted colonization and assisted migration). Managed relocation is defined as the intentional act of moving species, populations or genotypes (targets) to a location outside a known historic distribution for the purpose of maintaining biological diversity or ecosystem functioning as an adaptation strategy for climate change. Evaluating the potential costs and benefits of this strategy are limited by three general knowledge gaps: (1) risks of local and global extinctions facilitated by climate change are poorly understood; (2) methods for conducting the strategy are poorly developed; and (3) likely impacts, both positive and negative, of targets on recipient regions need additional study.

Despite these knowledge gaps, managed relocation is currently being conducted on a limited basis and there is potential for this to become a commonly applied strategy. Currently, no published guidelines or official agency or governmental policies exist for managed relocation. Here I outline draft guideline suggestions that consider which species should be moved, locations they should be moved to, and when such actions should be initiated; these guidelines include the need to discourage the use of managed relocation as a general strategy until key knowledge gaps are filled and a more complete evaluation of the strategy can be conducted.

Going forward it is important to initiate a broader societal discourse on managed relocation and adaptation strategies in general. We must also move towards official agency and NGO policies on managed relocation and consider the need for additional legislation.

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Dov Sax studies species invasions, species responses to climate change, and climate adaptation strategies. He received his Ph.D. in Biology from the University of New Mexico in 1999, was a postdoctoral researcher at the University of California, Santa Barbara, a faculty member at the University of Georgia, and is Assistant Professor of Ecology and Evolutionary Biology at Brown University. He is co-founder of the International Biogeography Society (2000) and was Secretary and Director-at-Large of the society (2001-2009). He is co-editor of two books, *Foundations of Biogeography* (2004) and *Species Invasions: Insights into Ecology, Evolution and Biogeography* (2005). He has led working groups on species invasions and managed relocation. He is a 2009 Fellow of the Aldo Leopold Leadership Program. His research on species invasions employs field work, synthesis, and review of patterns of distribution and abundance of naturalized species at local, regional, and global scales. His work on species responses to climate change focuses on understanding which species will need to shift their geographical distributions to survive and on the factors that will limit those shifts. He is committed to advancing our understanding of the pros, cons, and limitations of alternative adaptation strategies and to using this information to inform policy decisions.

Symposium III: Managing Ecosystem Services: Balancing Utility and Preservation

Managing and restoring ecosystem services: Formal and informal institutional constraints

Margaret A. Palmer, National Socio-Environmental Synthesis Center

As humans have adapted natural systems to their needs, the fundamental properties and historic characteristic of ecosystems have been dramatically altered. This is particularly true in urban environments where natural systems are often manipulated to conform to rigid specifications that meet specific human needs while eliminating other ecosystem services. In many cases, the manipulations maximize one specific ecosystem service and in the process eliminate other services, which later creates problems and eliminates future options. This may happen for a variety of reasons such as: there is inadequate understanding of the biophysical processes that support potential ecosystem services; regulatory requirements are narrowly designed and difficult to implement given the complexity of natural systems; gaming the legal or regulatory systems is too easy; ecosystem services are treated as market commodities but do not conform to market principles; etc. Thus managing and restoring ecosystems is becoming increasingly difficult. I will use aquatic resources – especially running-water ecosystems – to provide examples of these problems and open a dialogue on what types of formal and informal institutional changes could help remedy the problems.

Margaret Palmer is Director of the National Socio-Environmental Synthesis Center (SESYNYC), an NSF-supported research center dedicated to creating synthetic, actionable science related to the structure, functioning, and sustainability of socio-environmental systems. In addition, as a Professor of Entomology at the University of Maryland, she oversees a research group focused on watershed science and restoration ecology. Having worked on streams, rivers, and estuaries for more than 25 years, she has more than 150 publications and many ongoing collaborative projects. She is past Director of the Chesapeake Biological Laboratory, serves as an editor for the journal *Restoration Ecology*, and co-authored the book *The Foundations of Restoration Ecology*. Palmer is also well known for her work at the interface of environmental science and policy, having published in the journals *Science*, *Nature*, as well as, in popular outlets. She has been honored as a AAAS Fellow, an Aldo Leopold Leadership Fellow, a Lilly Fellow, and a Distinguished Scholar Teacher. She has received a Distinguished Service Award from the Ecological Society of America and a Faculty Award of Excellence from the University System of Maryland Board of Regents.

Ecology of the Anthropocene terrestrial biosphere

Erle C. Ellis, University of Maryland, Baltimore County

Human populations and their use of land have transformed most of the terrestrial biosphere into anthropogenic biomes (anthromes). Many anthropogenic transformations – including elimination of megafauna, land clearing, tillage, irrigation, and the introduction of domesticated and exotic plants and animals – date to prehistoric times and have been sustained for millennia in some regions. As a result, human reshaping of ecological pattern and process is global, profound, and, in most cases, virtually irreversible.

With rare exceptions, it is already too late to keep human influence away from Earth's biodiversity hotspots or anywhere else, and terrestrial ecosystem form and process have been permanently altered by the anthropogenic interactions of the past. Yet, despite widespread losses of native species and even greater increases in exotics caused by invasions,

domesticates, and other intentional introductions, contemporary levels of biodiversity still resemble native patterns in many regions. Even in ancient agricultural villages and urban regions, the majority of native plant species appear to be sustaining viable populations, though in the shadow of their more abundant exotic competitors. The concentration of human populations away from rural areas by urbanization may already be causing the recovery of native species in developed and developing regions.

Alas, global observing systems and models suitable for advancing scientific understanding of anthropogenic change processes at the local and regional scales remain at an early stage of development, and field studies of ecological pattern and process tend to be biased towards local understanding of the most developed regions of the Temperate zone. Effective global stewardship of the terrestrial biosphere in the Anthropocene will require fundamental advances in the use of integrated global frameworks for observing, modeling, and monitoring ecological processes and their changes within and across the novel ecosystems and anthropogenic landscape mosaics created and sustained by human systems.

Erle Ellis investigates the ecology of anthropogenic landscapes and their changes at local and global scales. His early work studied nitrogen cycling and sustainable agroecosystem management in China's ancient village ecosystems, and later measured long-term changes in carbon, nitrogen, and phosphorus storage and flux across China's village landscapes caused by the transition from traditional to industrially-based agricultural systems. At present, his research has three main foci: understanding the global ecology of anthropogenic landscapes (anthropogenic biomes); the development of global synthesis tools that link human and ecological change processes at landscape scales with their global causes and consequences (GLOBE); and developing inexpensive tools for measuring and managing ecological pattern, process, and change across anthropogenic landscapes (Ecosynth, Anthropogenic Ecotope Mapping). All of these come together in his central goal: informing sustainable stewardship of the biosphere in the Anthropocene. His teaching includes Introductory Environmental Science & Conservation (120), Landscape Ecology (305), Applied Landscape Ecology (405/605), Biogeochemical Cycles in the Global Environment (412/612), and Field Methods in Geography: Environmental Mapping (485/685).

Balancing the need for conservation of biodiversity and provision of services for human well-being

Michelle Marvier, Santa Clara University
Peter Kareiva, The Nature Conservancy

Conservation has earned a reputation of elevating animals above people and of working against the economic development that many people strongly desire. Some have claimed that conservation can remedy this situation by prioritizing protection of ecosystem services and thus aligning itself with, rather than against, people's interests. The problem, however, is that maximizing ecosystem services can be at odds with biodiversity protection.

As conservation promotes the utilitarianism of ecosystem services it needs to look unflinchingly at the consequences. First, many non-native species can deliver ecosystem services better than native species. For example, to protect people in landslide prone areas, it might be most effective to plant fast-growing nonnative tree species. Second the design of restoration efforts guided by ecosystem services will be different than the design of restoration projects guided by biodiversity recovery. This is evident in large scale efforts at oyster reef restoration in the Gulf of Mexico, where the deployment and design of oyster reefs to protect human communities differs from the deployment and design of reefs targeting biodiversity. Indeed, across large regions there seems to be zero correlation between species richness and ecosystem services, which can mean that prioritizing ecosystem services may imply reduced focus on biodiversity.

Biodiversity and species conservation have traditionally been guided by notions of historical baselines and natural conditions. In contrast, an ecosystem services approach is all about what can we do for people today and tomorrow, not nature before human impacts. Ecosystem services can broaden support for conservation, but it is important we do not over-promise what we can deliver – people might not care that logging bans have failed to recover spotted owl populations, but they are more likely to notice if we do not deliver on promises of abundant clean water and protection from floods.

Michelle Marvier is a professor in the Department of Environmental Studies and Sciences at Santa Clara University. She has published on topics ranging from salmon demography to conservation priority-setting and the use of meta-analysis in the assessment of environmental risk. She recently co-authored *Conservation Science: Balancing the Needs of People and Nature* with Peter Kareiva.

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Natural capital: Learning hard lessons and getting it right

Taylor H. Ricketts, University of Vermont

Ecosystem services represent an intuitively appealing argument for conservation, but they remain on the sidelines of natural resource policy. The science community is just beginning to provide governments, businesses, and others the information they need to incorporate ecosystem values into their decisions. Which areas provide most services? What are they worth? Which people benefit most from them? How do we manage lands and waters to support both biodiversity and people in a changing world?

The Natural Capital Project is one of several major efforts to answer these questions. "NatCap" is a partnership among universities and non-governmental organizations to map ecosystem services, estimate their economic value, and improve policies to reward their conservation. We have developed a modeling toolkit to map and value services, and we are using these tools in more than a dozen demonstration sites to support on-the-ground conservation efforts.

After briefly introducing NatCap, I will discuss the four most important lessons we have learned from all this work, regarding both the science of measuring ecosystem services and the art of applying that knowledge to real-world conservation. And I will argue for four things we still need to get right scientifically to ensure that our findings have impact on the long-term policies and daily decisions that shape our natural world.

Taylor Ricketts is Professor of Natural Resources & Environment and Director of the Gund Institute for Ecological Economics at the University of Vermont. His interests focus on the overarching question: How do we meet the needs of people and nature in an increasingly crowded, changing world? In his research and teaching, he integrates natural and social sciences to address both fundamental scientific issues and real-world conservation problems. Ricketts' recent work has focused on the economic benefits provided to people by forests, wetlands, reefs, and other natural areas. He is co-founder of the Natural Capital Project, a partnership among universities and non-governmental organizations (NGOs) to map and value these natural benefits. He also served as Convening Lead Author for the Millennium Ecosystem Assessment, a 5-year, UN-sponsored effort to assess global ecosystems and their contributions to human wellbeing. These and other collaborations are part of a continuing effort to link rigorous research with practical conservation and policy efforts worldwide. Before arriving at UVM in 2011, Ricketts led the World Wildlife Fund's Conservation Science Program for nine years, and he remains a Senior Fellow at WWF. He is the author of over 70 scientific publications, and his work has been featured in over 100 stories in more than 20 media outlets. He received his B.A. in Earth Sciences at Dartmouth College and his Ph.D. in Biological Sciences at Stanford University.

The spirit of conservation and the idolatry of management

Karim-Aly S. Kasam, Cornell University

Change demands systematic and critical interrogation of "scientifically held truths." This paper will contend that conservation targets devoid of epistemological and ontological pluralism will be vacant and ineffective. Our research suggests that multiple ways of knowing drawn from diverse sociocultural and ecological contexts contributes to conservation values which ultimately must inform effective management practices. Using interviews with second through sixth grades students in a high need rural school in upstate New York and photodocumentation by these children, we illustrate that connectivity to habitat is central to a sense of place and conservation values. These students, when describing science and engineering in their community, illustrate a non-linear connectivity with their environment. Their sense of being emerges from their engagement with their environment revealing an understanding of complex, diverse, and yet co-existing relationships to their habitat. This suggests that the starting point for management targets should be situated and valued in the context of ecological pluralism. If children get it, why don't we?

Karim-Aly Kassam is International Professor of Environmental and Indigenous Studies in the Department of Natural Resources and the American Indian Program at Cornell University. Since 2008, he has been Director of Graduate Studies of the American Indian Program. Prior to joining Cornell, Kassam was Associate Professor with the Faculty of Communication and Culture at the University of Calgary, Canada. In 2003, he was the first Canadian to receive the Organization of American States – Fulbright Ecology Fellowship. He developed and established the Theme School in Northern Planning and Development Studies in 1995 and until 2003 was its Director. From 1998 to 2001 he was the first Murray Fraser Professor of Community Economic Development at the University of Calgary. He is a Senior Research Fellow of the University of Central Asia,

Fellow of the Commonwealth Society at Cambridge University, Research Associate of the Arctic Institute of North America, and Faculty Fellow of the Cornell Center for Sustainable Future.

Kassam's research focuses on the complex connectivity of human and environmental relations, addressing indigenous ways of knowing, food sovereignty, sustainable livelihoods, and climate change. This research is conducted in partnership with indigenous communities in the Alaskan, Canadian, and Russian Arctic and Sub-Arctic; the Pamir Mountains in Afghanistan and Tajikistan; and the rain forest in the south of India. By investigating the relationship between biological and cultural diversity, he seeks to expand the foundations of the notion of pluralism.

Symposium IV: Management Outside of Protected Areas: Approaching Alternative Choices

Integrating ecology and economics in the design of conservation strategies for a changing world

Paul R. Armsworth, University of Tennessee, Knoxville

To succeed, conservation strategies must be based on an understanding of the many and different ways that people interact with nature. I will offer some reflections on how ecology can be integrated with economics to achieve this.

(1) First, I will illustrate how integrating economic perspectives changes a classic organizing question in conservation planning: where and how should we invest available funding for conservation?

(2) Then, I will briefly examine the ability of economic valuation to help guide discussions of society's goals for conservation, before

(3) finally exploring how our perspective on conservation strategies changes when we acknowledge that conservation activity is itself a social construct.

Much writing in conservation planning focuses on where limited resources for conservation should be spent. Projecting future threats to biodiversity, where opportunities for conservation will arise and the costs of pursuing them requires economics. In discussing these ideas, I will pay particular attention to how conservation planning currently accounts for economic costs. I will also discuss the importance of evaluating how conservation investments are designed once priority locations for action have been identified, something that can be as important as the spatial prioritization questions that have preoccupied the literature. Most conservation planning exercises start from an assumption that a clear conservation objective (whether regarding biodiversity or ecosystem services) has already been agreed, despite this being one of the most difficult steps in the conservation planning process. Economics provides a variety of tools that can help. I will briefly review some and comment on their usefulness and limitations. Finally, the conservation movement itself is not static but evolves and changes. Conservation strategies should acknowledge broader, ongoing shifts in how people relate to nature because these undercurrents will ultimately determine the direction in which conservation is heading and our likelihood of success.

Paul Armsworth is an Assistant Professor of Ecology and Evolutionary Biology at the University of Tennessee, Knoxville (UTK) where he is affiliated with NSF's National Institute for Mathematical and Biological Synthesis. Prior to joining UTK in 2009, Armsworth was based at the University of Sheffield in the UK. A modeler by training, His research examines how ecology and economics can be integrated to inform more effective conservation and natural resource management strategies. This work spans theoretical and empirical techniques and examines both biodiversity conservation and the management of ecosystem services. In undertaking this work, his research group collaborates closely with partners from public agencies, nonprofits, and for profits as well as academics from a range of disciplines. Armsworth has authored 69 peer-reviewed publications and participated in relevant international (TEEB, MEA) and national (UK Business and Biodiversity Group) science panels.

Conserving working landscapes through collaborative partnerships

Gabriela D. Chavarria, U.S. Fish and Wildlife Service

We will discuss FWS work on community-based landscape conservation, integrating conservation across public and private lands, and the different aspects, from engaging the public on urban and rural lands to active restoration projects across the landscape. We will discuss the work of the America's Great Outdoors Initiative and the Landscape Conservation Cooperatives.

Gabriela Chavarria has served as Science Advisor to the Director for the U.S. Fish and Wildlife Service since July 2010. As Science Advisor, she serves as counsel to the

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Service Director and provides leadership on science policy and scientific applications in resource management. Born and raised in Mexico City, she has a Bachelor of Science degree in biology from the National University of Mexico, and a Masters and Ph.D. in Organismic and Evolutionary Biology from Harvard University. Her research focused on the systematics, behavior, and biogeography of Neotropical bumble bees. Before coming to the Service, Chavarria worked for the Natural Resources Defense Council, Defenders of Wildlife, National Wildlife Federation, and the National Fish and Wildlife Foundation.

The impact of introduced plants on food webs in managed ecosystems

Douglas W. Tallamy, University of Delaware
Karin Burghardt, Yale University

Managed landscapes in which introduced ornamental plants are favored over native plant communities now dominate the suburban/urban matrix in the United States. Many such ornamentals have escaped cultivation and have displaced native shrub species in "natural areas." Thus, the first trophic level is now commonly a novel mixture of plant species with no shared evolutionary history. We have used literature host records and controlled feeding trials, as well as common garden experiments, unmanipulated invasions of natural areas, and manipulated plantings in suburban neighborhoods to measure the impact of introduced plants on insect herbivores and the insectivores that eat them. We have found that native plants are recorded as host plants for up to 15-fold more species of *Lepidoptera* than are introduced plants. In common garden comparisons, native plants that were congeners of introduced species supported 50% more caterpillar species and abundance, whereas native plants that were not closely related to introduced plants supported 75% more caterpillars and caterpillar species. Specialists were five times less abundant on introduced plants and, to our surprise, generalist abundance and richness was reduced by over 50%. Moreover, invaded hedgerows supported 22 times fewer caterpillars and five times fewer caterpillar species than uninvaded hedgerows in Maryland, Pennsylvania, and Delaware. In view of the critical role that caterpillars play in supplying North American birds with essential carotenoids, lipids, and protein during reproduction, an understanding of how introduced plants reduce *Lepidoptera* availability should inform future restoration and stewardship practices in both urban and natural landscapes.

Douglas Tallamy is Professor and Chair of the Department of Entomology and Wildlife Ecology and director of the Center for Managed Ecosystems at the University of Delaware in Newark, Delaware, where he has authored 73 research articles and has taught Insect Taxonomy, Behavioral Ecology, and other courses for 31 years. He received his B.S. in Biology at Allegheny College, his M.S. in Entomology at Rutgers University, his Ph.D. in Entomology at the University of Maryland, and his Post Doctoral experience at the University of Iowa. His current research goal is to better understand the many ways insects interact with plants of different evolutionary origins and how such interactions determine the diversity and richness of animal communities.

Tweak, adapt, or transform: How to build a resilient future for agriculture

Lisa A. Schulte Moore, Iowa State University

Conservation of ecosystem services in agricultural regions worldwide is foundational to, but often perceived to be in competition with, other societal outcomes, including food and energy production and thriving rural communities. Perhaps nowhere is this clearer than the U.S. Corn Belt, which garners phenomenal agricultural productivity for human benefit while sacrificing topsoil, water quality, flood control, and native biodiversity. I will discuss the results of my social-ecological research on the strategic integration of perennial vegetation over landscapes and watersheds as a win-win solution for maintaining agricultural productivity, achieving substantial gains in environmental benefits, and expanding rural populations and vitality.

Lisa Schulte Moore is an associate professor of natural resource ecology and management at Iowa State University. Her research focuses on the causes, consequences, and design of landscape and land-use change, and spans from plot-scale ecological experiments to regional-scale social assessments. Focal ecosystems include forests of upper Midwest and agroecosystems of the U.S. Corn Belt. She teaches undergraduate and graduate courses in ecology, forestry, and wildlife biology.

The power of the crowd: Socially networked citizen science as an integrative tool for emergent conservation research and management

Janis L. Dickinson, Cornell University

Citizen science has become an increasingly important tool for large-scale ecological research, education, and outreach since the advent of the Internet. Today the Cornell Lab engages a large public to collect and enter data over the

web, and provides opportunities for participants to interact with data using graphing and mapping tools. Behind the scenes researchers are undergoing their own revolution, developing new techniques, including computational approaches and data mining, to describe patterns in large, complex data sets. These new approaches, and the dynamic maps they produce, allow participants and researchers alike to visualize changes in bird populations over seasons and years. Just viewing seasonal dynamics for the first time at vast ecological scales puts geographical ecology on the threshold of being able to develop new hypotheses and new understandings of how birds respond to environmental change, moving out of the descriptive realm towards asking new and important ecological questions.

Citizen science's largest revolution is to come from socialization of the web and Web 2.0's focus on user-generated content. Fully socialized citizen science is likely to become a powerful tool for socio-ecological research, because it provides data on people's views and behaviors. Our newest project, YardMap, is a socially networked web application that allows people to learn about, map, discuss, and display their sustainable practices, especially those focused on habitat for birds. We have used research on social norms, sense of purpose, competitive altruism, and collective action to inform the design. The ecological focus is on creating corridors, reducing lawn size, creating bird habitat, growing food, reducing pesticide use, keeping cats indoors, maintaining yard bird lists, and monitoring nests. YardMap is designed to examine major drivers of occupancy, reproductive success, and relative abundance of birds in residential landscapes. The social focus is on change, resilience, and providing support for learning and practice communities interested in the potential impacts of crowdsourcing sustainable practices.

Janis Dickinson is Professor in the Department of Natural Resources and the Graduate Field of Neurobiology and Behavior at Cornell University and Arthur A. Allen Director of Citizen Science at the Cornell Laboratory of Ornithology. Her basic research in evolutionary behavioral ecology focuses on cooperation and conflict within social groups, especially those comprised of both kin and non-kin. Using a long-term population study of western bluebirds she has examined the fitness consequences and behavioral decisions involved in family-based winter territoriality, helping-at-the-nest, extra-pair mating, bi-parental care, and other cooperative behaviors.

After taking a position as Director of Citizen Science at the Cornell Laboratory of Ornithology in 2005, Dickinson extended her interest in cooperation from birds to humans. At the Cornell Lab, citizen science engages over 200,000 people in collecting data to help identify conservation threats to birds at broad geographic scales. In combining public engagement with ecological research it provides significant opportunities for tracking changes in bird distributions, abundance, and reproductive success across state and national boundaries. At the same time, it is a form of crowdsourcing and an important tool for public engagement with difficult environmental problems.

Pleistocene rewilding: Lessons for the future?

Harry W. Greene, Cornell University

An opinion piece in *Nature* (2005) and detailed exposition in *American Naturalist* (2006) advocated Pleistocene rewilding to partially restore a lost North American megafauna, with goals of diversifying ecological function and evolutionary potential. Responses from the public and scientists ranged from enthusiastic to highly critical, and among the latter several patterns emerged: (1) many critics had not actually read our papers and none responded fully to the questions we posed; (2) most criticisms accused us of elitism and/or imperialism, and most interestingly they often boiled down to fear of dangerous animals ("no lion in my backyard"); (3) many biologists are naïve regarding issues we raised (e.g., last live mammoth <4,000 ya, North American Peregrine reconstituted from seven subspecies); and (4) the intervening few years have included major challenges to traditional dogma in conservation biology and increasingly widespread recognition that all benchmarks are arbitrary and the future of biodiversity will flow ultimately from human values. To the extent that Aldo Leopold's view prevails, that we must save as many pieces as possible, Pleistocene rewilding remains relevant to 21st century conservation.

Harry Greene received a B.A. from Texas Wesleyan College, served 3 years as an army medic, earned a Ph.D. from the University of Tennessee, taught at UC Berkeley for two decades, and moved to Cornell in 1999. He has taught natural history of the vertebrates, non-majors intro bio, herpetology, desert ecology, and graduate field ecology, and received campus-wide teaching awards at Berkeley and Cornell as well as the Edward Osborne Naturalist Wilson Award. After decades of studying the ecology, evolution, and conservation of predators in many parts of the world, he recently became one himself, an experience that has profoundly influenced how he thinks about the meaning and fate of nature. His first book, *Snakes: The Evolution of Mystery in Nature*, won a PEN Literary Award and made *The New York Times'* 100 Most Notable Books, and his next one, *Tracks and Shadows: Field Biology as Art*, is nearing completion.

POSTER SESSIONS

Both sessions located in Commons Lobby
5:00 PM – 6:30 PM

Session I
Monday, February 27

1. Patrick Shirey
2. Ruscena Wiederholt
3. Heather Hulton
4. Anne Trainor
5. Miguel Villarreal
6. David Bunn
7. Bonnie Keeler
8. Nicole Michel
9. Leah Bremer
10. Elizabeth Law
11. Ashley Dayer
12. Hal Balbach
13. Christian Marks
14. Celia Smith

Session II
Tuesday, February 28

1. Paulette Blanchard
2. Karen Bagne
3. Sigrid Smith
4. Karen Allen
5. Suzanne Hagell
6. Monica Dorning
7. John Quinn
8. Paul Simonin
9. Lauren Hallett
10. Darragh Hare
11. Andrew Holdsworth
12. Laura Martin
13. Douglas Boucher
14. Susan Cook-Patton
15. Donna Brewer

Poster 1: Commercial internet trade of endangered plants cultivates opportunity for do-it-yourself assisted colonization

Patrick D. Shirey, Brianna N. Kunycky, Dominic T. Chaloner, Michael A. Brueseke, and Gary A. Lamberti

University of Notre Dame, Notre Dame, IN

Assisted colonization is a controversial conservation strategy that involves moving species to new environments to mitigate for habitat loss and climate change (Hunter 2007; McLachlan et al. 2007; Hoegh-Guldberg et al. 2008). While scientists debate the merits of assisted colonization, the language of the U.S. Endangered Species Act (ESA) allows individuals to transplant privately owned endangered plants, although interstate commercial trade is regulated.

While examining the movement of endangered species outside their historical range as examples of assisted colonization (Shirey and Lamberti 2010), we noticed that some endangered plants were being sold over the Internet without the required permit from the U.S. Fish and Wildlife Service (Shirey and Lamberti 2011). We investigated further, asking: If someone wants to move an endangered plant outside of its range, how easy is it to obtain individual plants? How many threatened and endangered plant species are being sold or at least advertised online in the U.S.? Of these, how many are sold in interstate commerce? Are sellers of these plants obtaining the proper permits?

From an Internet survey, 47 ESA-listed plants were available for purchase in interstate commerce, which requires a federal permit. Less than 10% of vendors of these plants had obtained permits, making most interstate offers illegal. Illegal trade undermines vendors who obtain permits, and conservation efforts of the Fish and Wildlife Service to ensure that commercial propagation aids the long-term survival of endangered species and supplements restoration efforts. To better integrate ecology and law into assisted colonization, we suggest that a framework for cooperation and management is needed to minimize unintended consequences. Future efforts to conserve plants through legislation, regulation, and management should consider the impact of commercial trade facilitated by the Internet, the growing interest in assisted colonization, and the potential of private efforts to recover endangered species.

Poster 2: What is the optimal management strategy for an endangered, high-elevation salamander faced with climate change?

Ruscena P. Wiederholt and Evan H. Campbell Grant

U.S. Geological Survey Patuxent Research Center, Laurel, MD

Amphibian populations are experiencing declines worldwide and up to one third of all amphibian species are estimated to be threatened. Climate change is hypothesized to be among one of the principal causes driving these declines as the behavioral, physiological, and ecological characteristics of amphibians make them especially vulnerable to this type of disturbance. The National Park Service is faced with the opportunity to develop management strategies for the effects of climate change on the Shenandoah salamander, *Plethodon shenandoah*, a federally endangered salamander species restricted to the Shenandoah National Park in the central Appalachian mountains. High elevation habitats are predicted to be greatly altered from climate change, and the limited range of this species poses an additional risk. Together with atmospheric scientists and managers from the National Park Service and the U.S. Fish and Wildlife Service, we developed strategies and overall project objectives for the management of this species. We used a Markov chain model to assess changes in Shenandoah salamander occupancy under anticipated future climate scenarios and assess its risk of extinction due to global climate change. We then incorporated these results into a decision analysis framework to determine the optimal management strategy, taking into account multiple and competing objectives. Our results indicated that the Shenandoah salamander population is likely declining, and that global warming poses an imminent risk of extinction within several decades. Several management strategies do however hold promise for improving population viability, while also meeting other project objectives. Overall, the model predictions obtained from this study will be used to develop an adaptive management plan for the Shenandoah salamander in conjunction with decision makers at Shenandoah National Park, and be used more broadly as a guide for mitigating the effects of climate change on high elevation communities.

Poster 3: Optimizing colonization patterns of a fragmented landscape to post-fire lands in Joshua Tree National Park

Heather Hulton, Kurt E. Anderson, and Cameron W. Barrows

University of California, Riverside, CA

The ecological consequences of habitat loss and fragmentation differ depending on the spatial configuration of the landscape and how this influences colonization rates. Joshua Tree National Park (JTNP) in southern California is experiencing habitat loss and fragmentation due to an increase in fire size and frequency, which is facilitated by the invasion of non-native grasses. Even 65 years after a burn, a site within JTNP has not approached its pre-burned vegetation character. One conservation strategy that JTNP managers are implementing is planting vegetation patches within the burned areas, but the most cost-effective planting configuration is unknown. We examined the influence of landscape structure on rodent colonization patterns as a way to assess how alternative planting schemes might influence resulting community dynamics and restoration success. Rodents are indicators of habitat quality due to their small home range, sensitivity to habitat changes, and their influence on ecosystem structure and dynamics via seed predation and dispersal. We sampled rodent community composition across a range of patch configurations by varying patch size, isolation levels, and surrounding matrix qualities. It was found that the habitat patch configurations that allow for a minimum of three colonization pathways was the most influential to rodent colonization, independent of patch size or distance from mainland (e.g., clustered

versus linear design). It was also found that remaining long-lived perennial species in a scattered, non-patch design within the disturbed matrix also increased rodent diversity. For future vegetation plantings, we strongly recommend that habitat patches are planted in a clustered design to maximize colonization pathways rather than in a linear corridor configuration. We also recommend that the surrounding disturbed matrix should be partially restored with a scattering of long-lived perennial or late succession species to maximize rodent diversity and colonization.

Poster 4: A framework for integrating climate adaptation and landscape conservation planning

Anne M. Trainor and Oswald J. Schmitz

Yale University, New Haven, CT

Global changes in climate are projected to drastically alter the spatial distribution, structure, and function of species, communities, and ecosystems. In order to allow biodiversity to adapt to a changing climate, conservation planners are assigned the difficult task of identifying important conservation targets. Our goal was to develop a strategic framework that highlights, through a critical evaluation process, how and when the different current approaches to geospatial habitat conservation planning may be applied and integrated to enhance decision-making to enhance the effectiveness of policy decisions related to wildlife (terrestrial and aquatic species) habitat conservation, climate change adaptation and compatible land use. The framework was created by a diverse panel comprised of 13 leaders from government agencies, academia, for-profit and non-profit groups. The panel provided a matrix with six major adaption objectives (e.g., protect current and future patterns of biodiversity and maintain ecological processes and connectivity) and three ecological levels (e.g., landscape, ecosystem, and species/populations) to encourage practitioners to employ various approaches to conservation with global changes. The Framework also provides insight into the types, formats, and sources of geospatially referenced wildlife, habitat, climate, and land-use data that are available to support decision-making. This presentation illustrates the Framework's value in anticipating changes in wildlife and landscapes over time; and to how the maps based on geospatial analyses can be used to support decisions. This Framework provides systematic and comprehensive guidance for practitioners to identify and conserve biodiversity, ecosystems, and landscapes vulnerable to global climate change.

Poster 5: Land use matters: Private and public land stewardship efforts moderate the effects of drought and resource consumption on watershed habitat loss

Miguel L. Villarreal[1], Laura M. Norman[1], Cynthia S.A. Wallace[1], and Kenneth G. Boykin[2]

1 - U.S. Geological Survey, Tucson, AZ
2 - New Mexico State University, Las Cruces, NM

In the arid southwestern United States, vegetation types that support high biodiversity are being impacted by variable and extreme climate patterns and intensive land use. Examination of watershed-scale habitat dynamics across a heterogeneous land use mosaic can illustrate the role of land management in mitigating the impacts of climate change on biodiversity. Using satellite imagery, land-ownership data, and long-term climate and vegetation monitoring data, we quantified changing spatial and temporal distributions of potential terrestrial vertebrates in a semi-arid watershed. Vegetation and land cover maps (1979, 1989, 1999, and 2009) were developed using combinations of satellite imagery and field data for application with SWReGAP species-habitat models. The resulting species-richness maps indicate that vegetation types with the highest mammal and avian richness, primarily desert grasslands (mammal) and riparian (avian) types, were most affected through time, yet change patterns were neither temporally directional nor spatially uniform over the landscape. While historical data from the study area describe 20th century shrub invasion of grasslands and late century growth of woody riparian plants, the land cover data show a 15% increase in grassland cover and 19% decline in riparian from 1979-2009. Cover change fluctuated over time with climate patterns; for example, the development and decline of riparian cover coincided with an El Niño wet period followed by extended drought. Impacted lands showed diverging patterns of resilience and sensitivity based on land-use management: urban and agricultural land uses contributed to the decline of riparian cover on private lands, while private and publicly managed grasslands and riparian habitat, where efforts in restoration and conservation were employed, demonstrate stability and increased potential for biodiversity. Habitat restoration and stewardship efforts in this study area appear to have minimized impacts from climate variability and drought, showing real potential to mitigate the effects of future climate change in arid lands.

Poster 6: A decision-tool for evaluating indicator species for conservation banks

David A. Bunn, Peter B. Moyle, and Christine K. Johnson

University of California, Davis, CA

California launched the first conservation bank program in the country in 1995 as a new mechanism to mitigate development impacts on threatened and endangered species. The U.S. Fish and Wildlife Service adopted a similar national conservation bank policy in 2003. The California and federal programs require monitoring to determine whether biological goals and objectives are being met, and to inform adaptive management. With limited monitoring resources, California conservation banks typically focus on surveying "covered species", which are species that provide the legal basis and primary conservation purpose of conservation banks. We investigated whether the covered vertebrate species serve as useful indicators for evaluating the impact of conservation measures on bank sites. Vertebrates were evaluated based on three primary criteria: (1) measurability of species' trends; (2) sensitivity to managed stressors; and (3) value as an indicator of ecosystem health. Our results show that, at the small scale of conservation banks, survey data of wide-ranging vertebrates are often

not adequate to assess population trends or the impact of changes in managed habitats. These results suggest that conservation bank programs and small reserves should pool resources to monitor vertebrates at the regional scale.

Poster 7: Rethinking water quality as an ecosystem service: A framework for integrated biophysical assessment and economic valuation

Bonnie L. Keeler[1] and Steve Polasky[2]

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2 - University of Minnesota, St. Paul, MN

Developing effective conservation targets under global change requires integrated approaches to assess the social, ecological, and environmental tradeoffs associated with future actions or decisions. Ecosystem service assessment and valuation addresses this need by highlighting the dependency of human well-being on natural systems and the economic value of the goods and services they provide. While the concept of ecosystem services is gaining momentum in the conservation community, there are still significant gaps in our understanding of how to link ecosystem processes with impacts on humans and integrate ecological and economic models for service assessment and valuation.

Here I present a novel framework for assessing and valuing the multiple ecosystem services impacted by changes in water quality. Degraded water quality is a global problem threatening human health and well-being through impacts on drinking water, recreation, aesthetic value, and commercial activity. Despite the broadly recognized importance of water quality, we lack a clear and consistent framework for evaluating how alternative land use or land management decisions impact the important services associated with changes in nutrients, sediment, or other pollutants in freshwater and coastal ecosystems. My research addresses this need by: (1) presenting a framework for linking actions to changes in water quality and impacts on people; (2) identifying key gaps in the ecological and economic literature that are barriers to the assessment and valuation of water quality as an ecosystem service; (3) proposing a step-by-step template for water quality valuation based on linked economic and biophysical models for individual services; and (4) providing clear guidance on how to integrate water quality assessment and valuation into decision-making. This framework paves the way for decision support tools that aid land managers in assessing tradeoffs among water quality and other ecosystem services and improve spatial planning to maximize the value of water quality for humans.

Poster 8: Walking the line between the "empty forest" and "ecological meltdown": Managing to prevent the tropical biodiversity crisis in an era of mesoherbivore decline and release

Nicole L. Michel and Thomas W. Sherry

Tulane University, New Orleans, LA

Loss and fragmentation of highly diverse tropical rainforests is widely considered to be precipitating a tropical biodiversity crisis. Most conservationists argue for setting aside large blocks of land in protected areas, with biological corridors to allow dispersal, annual or climate-induced migration, and gene flow between reserves. However, in an age when carnivores, herbivores, and insectivores – and their ecosystem services – are being lost due to synergistic interactions of fragmentation, climate change, poaching, and other drivers, merely setting aside land is insufficient. Overhunting has eradicated populations of large and mid-sized vertebrate seed predators and dispersers (hereafter mesoherbivores) in many tropical forests, resulting in an "Empty Forest." Elsewhere – and often overlooked – overprotection and declines in apex predators have allowed dramatic increases in mesoherbivore populations, resulting in "Ecological Meltdown" (e.g., the Lago Guri Islands in Venezuela, and hyperabundant collared peccaries at La Selva Biological Station, Costa Rica). Both processes have dramatic cascading consequences for understory and, ultimately, canopy tree biodiversity, and also impact forest vegetation structure, e.g., the loss of liana tangles – critical foraging habitat for understory insectivorous birds – at La Selva. In order for conservation to succeed, it is imperative that reserves of sufficient size and/or connectivity not only be set aside, but these reserves must also contain sustainable populations of both apex predators (whether extant or reintroduced) and mesoherbivores, i.e., balanced populations to which the natural vegetation and other organisms are adapted. Furthermore, adequate protection needs to be instituted and continued monitoring of predator and herbivore populations, as well as monitoring and management to retain crucial components of vegetation structure (e.g., liana tangles), is crucial in order to prevent destructive trophic cascades and the subsequent loss of tropical biodiversity.

Poster 9: Tradeoffs in biodiversity and ecosystem services under land-use changes promoted by compensation for ecosystem services (CES) programs targeting highland Andean grasslands (páramos) in Ecuador

Leah Bremer[1,2], Kathleen A. Farley[1], Carol P. Harden[3], and James Hartsig[3]

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2 - University of California, Santa Barbara, CA
3 - University of Tennessee, Knoxville, TN

Despite considerable debate surrounding the efficacy of joint conservation and development initiatives to simultaneously meet a range of biophysical and socio-economic goals, ecosystem services programs are increasingly advocated as a way to enhance one or more ecosystem service while also improving livelihoods of local landowners. In Ecuador, Andean highland grasslands (páramos) have become the focus of compensation for ecosystem services (CES) initiatives intended to protect or enhance hydrological services, carbon sequestration, and biodiversity. As with other ecosystem services programs around the world, however, these initiatives are racing ahead of the science with little understanding of how promoted land uses actually affect biodiversity, carbon storage, and other valued ecosystem services. Accordingly, in some cases, well-intentioned policies may not be achieving desired or assumed program goals. Here we present research examining how afforestation and burn exclusion (two land use practices incentivized by CES programs targeting

páramo grasslands in Ecuador) affect carbon storage, soil hydrology, and plant diversity in a study site where a chronosequence of páramo burn histories are found adjacent to several pine plantations. Our results challenge the idea that páramo grasslands can be managed to simultaneously maximize plant diversity, carbon storage, and water quantity. Rather, our results suggest tradeoffs in hydrology and plant diversity with land uses that increase overall carbon storage (afforestation and burn exclusion). This research highlights the importance and complexity of clearly defining restoration and conservation objectives and the difficulty of "bundling" ecosystem services, particularly in systems like the páramo that have a long history of human management.

Poster 10: Defining synergies and tradeoffs between ecosystem services for integrative land use planning in degraded peatland regions of Central Kalimantan, Indonesia

Elizabeth A. Law[1], Erik Meijaard[2], Matthew Struebig[3], Thilak Mallawaarachchi[4], and Kerrie A. Wilson[1]

1 - University of Queensland, St Lucia, Australia
2 - People and Nature Consulting International, Jakarta, Indonesia
3 - University of Kent, Canterbury, United Kingdom
4 - Queensland, St Lucia, Australia

Following recent agreements at international fora, developing nations have heightened expectations for carbon-based opportunities to raise living standards for the poor and safeguard global biodiversity. An added challenge is to mitigate land degradation in regions that are rich in biodiversity but high in rural poverty. The question then is: can we achieve the often conflicting objectives of carbon emission reduction and sequestration, biodiversity management, as well as ensuring sustainable social and economic development, and what would make those dreams closer to reality? This paper focuses on a REDD+ high priority region in Kalimantan, Indonesia. We discuss the challenges in defining spatial distributions of multiple ecosystem services for use in systematic land use and conservation planning at regional to local scales, highlighting the importance of data, definition, and double counting. We then outline the characteristics of areas and land use management within our study area that facilitate achievement of multiple objectives, and highlight regions and management that may challenge this approach. Finally, we show how this data can be used to determine tradeoffs and synergies for integrative land use management that explicitly and transparently recognises and plans for biodiversity conservation.

Poster 11: Beyond ecologically sound conservation targets: Bridging the implementation gap through a focus on how to conserve

Ashley Dayer[1,2], Shorna Allred[1], Rich Stedman[1], and Ken Rosenberg[2]

1 - Cornell University, Ithaca, NY
2 - Cornell Lab of Ornithology, Ithaca, NY

The field of conservation has been described as facing an "implementation crisis." Ecological science knowledge and conservation prioritization is relatively well established, but the ability to apply this information effectively to practical conservation issues is often lacking (Knight, Cowling, and B. M. Campbell, 2006). This implementation crisis will likely become even more pronounced in a period of rapid global change unless our conservation targets are designed in a manner to ensure their successful implementation. We must expand our thinking beyond what to conserve to embrace ideas about how to conserve as well. Applying lessons offered from the implementation crisis literature, we offer suggestions about how to develop more effective conservation targets, as indicated by their implementation on the ground. First, integrating social sciences is critical as conservation occurs in increasingly human-dominated landscapes. Second, conservation practitioners, particularly those who work with people through education and communications positions, must be engaged in the conservation strategy design. Third, scientists (ecological and social) must be prepared to engage in the implementation process. Fourth, evaluation should be multi-phasic: during formation, application, and completion of interventions. We offer a case study demonstrating the utility of such a process for conservation target development and implementation in New York State to address declines of early successional forest habitat birds. Evaluation of conservation interventions with landowners, as well as scientists and practitioners' experiences, suggest that such an approach that integrates these principles for conservation targets focused on how to conserve can lead to successful implementation.

Poster 12: Climate change in the economic environment: The challenge of managing public lands

Harold E. Balbach

U.S. Army Engineer Research and Development Center (ERDC), Champaign, IL

Along with recognized and anticipated changes in climate and biological systems, it is becoming clear that the historic economic environment is undergoing significant disruption. Public lands are increasing in both the number of sites and land area. This presents us with a series of mixed messages. While the land area is increasing, personnel and funds to manage these lands are running out. Ecologically, this may have severe consequences for the future of natural areas. As we understand clearly, doing nothing causes changes. One cannot do nothing and be assured that the land and its living components are secure forever. Maintenance of ecological integrity is dependent on having personnel and funding to manage the properties toward the ends required. If natural areas are at risk from funding shortages, lands used for organized recreation are under an even greater threat. Bureau of Land Management (BLM) properties and National Forests near population growth centers face doubled demand for access by mid-century. This implies that there will be personnel to manage the facilities and maintain the recreation areas. Who will provide these funds? Congressional appropriations are already inadequate to operate many existing

properties. For locations where specific recreational activities are supported, implementing or increasing user fees is one opportunity. But what about natural areas? Which sector of the public could or should pay for maintaining them? One role model which has been proposed is that of promoting local and regional partnerships, where citizens serve as unpaid support to the site. But even this requires paid personnel at some level to organize and manage the volunteers. The BLM has been active in this effort, and the Department of Defense is engaging local and regional partnerships to promote region-wide management of at-risk species rather than concentrating only on populations within installation boundaries. Is this our future?

Poster 13: Selecting floodplain conservation targets for the Connecticut River at the whole watershed scale

Christian O. Marks

The Nature Conservancy, Northampton, MA

The 660 km long Connecticut River is New England's longest river. Despite a long history of human activity, the Connecticut River remains one of the most ecologically important in the region. The Nature Conservancy identified floodplains as a primary conservation target for its Connecticut River Program because floodplain forests are arguably the rarest forest type in New England, yet have great habitat value and contribute disproportionally to ecosystem services. To increase effectiveness of limited conservation resources requires concentrating the conservation actions of multiple partners on focal areas. Here, I present the framework, the methodology used and the results from a multi-year whole-watershed scale study that identified priority floodplain areas for conservation on the Connecticut River and its tributaries. Specifically, the floodplain prioritization emphasized creation of a network of focal areas that will be resilient to global change both anticipated and unanticipated as well as encompassing a full representation of floodplain forest biodiversity.

Poster 14: Teaching about global change using digital library resources

Celia Smith

Ecological Society of America, Washington, DC

Initially established as Ecoed.net in 2002, ESA's EcoEd Digital Library (EcoEdDL) is a forum for scientists and educators to locate and contribute peer reviewed resources for 21st century undergraduate ecology education. With the support of a National Science Foundation (NSF) grant, ESA has developed the academic and technical framework for EcoEdDL in collaboration with BiosciEdNet (BEN). BEN is sponsored by the American Association for the Advancement of Science (AAAS), and is a pathway of the NSF-funded National Science Digital Library (NSDL).

EcoEdDL houses classroom, lab, and field activities; datasets and simulations; figures, tables and graphs; teaching strategies and course syllabi; and photographs, illustrations and other visual resources. Partnership with the Cornell Lab of Ornithology Science Pipes project will also allow EcoEdDL to provide complex data visualizations for educators to use in their classes. ESA publications housed in EcoEdDL include the *Issues in Ecology* series, *Teaching Issues and Experiments in Ecology (TIEE)*, and the Education Section's *Ecology 101* Articles. Peer review protocols are currently being developed for additional resource types.

Currently, a Special Collection of teaching resources related to conservation targets under global change is being developed in parallel with the 2012 Emerging Issues Conference, and conference attendees are encouraged to contribute their own teaching materials. This collection joins another special collection on *Drought, Water and Ecosystem Services*, a product of ESA's 2009 Millennium Conference.

EcoEdDL is built on a Collection Workflow Integration Systems (CWIS) platform, which was specifically created to help build collections of Science, Technology, Engineering, and Math (STEM) resources and connect them to NSDL. Current site features include resource ratings and comments, personalized resource recommendations and alerts, and a discussion forum. Through its varied resources, and through the use of web 2.0 communications and interactive online tools, EcoEdDL strives to foster a community of ecology education resource users and contributors.

Poster Session II – February 28

Poster 1: Climate change politics in Oklahoma: The new Indian wars

Paulette L. Blanchard

Haskell Indian Nations University, Lawrence, KS

This research examines climate change in Oklahoma from a Native American perspective. Scientists are providing an abundance of valuable evidence that Mother Earth is experiencing changes. Yet, a number of political leaders in Oklahoma continue to dispute and negate this evidence. Many Indigenous communities and individuals are reporting changes in weather patterns, seasons, plants, and animals. In light of these changes and the lack of support from state and federal governments, tribal communities across Oklahoma need to evaluate the past, present, and future conditions of the places where they live. This poster shows the ways in which research by Indigenous students and scholars could contribute to creating policies specific to the tribes and their lands to adapt to and/or mitigate the effects of projected climate changes. I am currently collaborating with scientific communities in Oklahoma to establish an inter-tribal meeting on climate variability and change. This meeting is an opportunity for tribes in Oklahoma to learn of the science of weather variances and projected climate change. There will be opportunity to not only learn but to exchange location specific information with scientists on the effects experienced in relation to current issues related to weather extremes. The information gathered has the potential to be considered for use in the United States Global Research Program National Climate Assessment to be submitted to Congress and the President in 2013.

Poster 2: A new tool for setting priorities and identifying management targets for terrestrial vertebrate species

Karen E. Bagne, Megan M. Friggens, and Deborah M. Finch

Rocky Mountain Research Station, Albuquerque, NM

The magnitude and speed of climate change presents a major challenge for management and conservation of biodiversity. Management actions based on past or current conditions will likely be inadequate, but there is little to guide proactive solutions. A number of assessment tools have been made available in the past few years, but many require detailed information or special skills such as GIS applications. We created an assessment tool based on fundamental ecological principles that is both flexible to the addition of new information and simple to use. This tool, SAVS (System for Assessing Vulnerability of Species), assesses vulnerability by scoring individual terrestrial vertebrate species on 22 criteria predictive of change to survival or reproduction related to climate change. The criteria are divided into four factors of response: habitat, physiology, phenology, and interactions. Scores reflect vulnerability (i.e., reduced survival or reproduction), resilience (i.e., increased survival or reproduction), or a neutral response and are based on projected climate change, as summarized from available sources, and on species attributes known from natural history records, published research, or expert knowledge. As with any prediction of the future, final outcomes are unknown and a method is provided to help quantify score uncertainty. Outputs of the tool are an overall score and scores on the four factors as well as associated uncertainty scores. Scores can be used to rank species vulnerability on a common scale and to set priorities, identify specific areas of vulnerability for a single species, or highlight target elements for effective management.

Poster 3: Mapping cumulative stress to prioritize restoration and conservation opportunities in the Great Lakes region

Sigrid D.P. Smith[1], David Allan[1], Peter B. McIntyre[2], Ben Halpern[3], Greg Boyer[4], Andy Buchsbaum[5], Allen Burton[1], Linda Campbell[6], W. Lindsay Chadderton[7], Jan J. H. Ciborowski[8], Patrick J. Doran[7], [13], Tim Eder[9], Dana Infante[10], Lucinda B. Johnson[11], David Lodge[12], Jen Read[13], Ed Rutherford[14], Scott Sowa[7], Alan D. Steinman[15], Christine Joseph[1], and Adrienne Marino[1]

1 - University of Michigan, Ann Arbor, MI
2 - University of Wisconsin, Madison, WI
3 - National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara, CA
4 - State University of New York, Syracuse, NY
5 - National Wildlife Federation, Ann Arbor, MI
6 - Saint Mary's University, Halifax, NS
7 - The Nature Conservancy, Lansing, MI
8 - University of Windsor, Windsor, ON, Canada
9 - Great Lakes Commission, Ann Arbor, MI
10 - Michigan State University, Lansing, MI
11 - University of Minnesota, Lake City, MN
12 - University of Notre Dame, Notre Dame, IN
13 - Michigan Sea Grant, Ann Arbor, MI
14 - NOAA Great Lakes Environmental Research Laboratory, Ann Arbor, MI
15 - Grand Valley State University, Muskegon, MI

Ecosystems are subject to a variety of stressors, and assessing their impacts is challenging when these stressors have different spatial distributions and their impacts vary across habitats. This is particularly true in the Great Lakes, where a multitude of direct human activities and emergent effects (from climate change to land-based pollution to exotic species) have dramatically affected the Lakes. The ability to map the intensity of individual stressors, weight individual stressors by ecosystem impact, and build an integrated cumulative stress map would greatly enhance conservation and management planning. In the Great Lakes Environmental Assessment and Mapping Project, we are assembling GIS layers of nearly 40 stressors, determining their relative importance in

each habitat from a detailed survey of Great Lakes experts, and synthesizing these data into one cumulative stress map. We are further building on the cumulative impact approach used in recent global threat analyses for oceans and rivers by juxtaposing this snapshot of current condition to maps of human values, such as economic benefits of the Lakes and current recreation and conservation areas. The intensity and relative importance of stressors varies greatly across the Great Lakes basin. The most stressed areas occur predominantly in nearshore areas, but Lake Ontario also has high stress scores offshore. Comparing this map to recreation and conservation areas, some areas considered highly protected also exhibit surprisingly high stress scores. By synthesizing this information into a single map of cumulative threat levels across the basin, we will provide a new, science-based tool to guide spatial planning and conservation efforts. This will be augmented with sensitivity analyses to assess which stressors contribute most to cumulative stress in given areas. The comparisons with human values proceeding concurrently will help to communicate this information with the public and explore the coupling of social and ecological systems.

Poster 4: Valuations of the landscape by proximity to protected areas

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Costa Rica is often lauded for its expansive park system, where an estimated quarter of the country's land is in protected areas. The last 20 years of development in Costa Rica has been wedded to such conservation, under the rubric of nature tourism. However, the lack of a controlled development framework has led to a rampant proliferation of tourism ventures and residential areas that are potentially threatening to both the ecological sustainability of parks, and the economic sustainability of nature tourism. While many studies have examined the sustainability of nature based tourism, few have considered the manner in which landowners on the periphery of the tourism industry are driving land-use change. My research focuses on how land-use decisions are influenced by both tourism and conservation activities, and how these decisions in turn shape the composition of the landscape. I completed formal interviews among independent landowners within the Corredor Biológico Pájaro Campana (CBPC), a biological corridor radiating from the protected areas in Monte Verde, Costa Rica, to the Pacific Coast, in order to evaluate whether perceived values and uses of landholdings vary with proximity to park borders. I combine this data with ethnographic fieldwork that examines the economic and perceived ecological impacts of land-use change, in an attempt to explain how development patterns relate to conservation goals. This research will lead to the design and implementation of a stated preference experiment to be administered among landowners in the region of study, in an effort to quantify the opportunity cost of reforestation, and how this cost is spatially distributed across the CBPC. The results of this study will provide conservation planners with information regarding the economic and cultural motivations behind land-use decisions, a key factor determining the efficacy of Payments for Environmental Services and environmental education programs.

Poster 5: The challenges of climate change adaptation for wildlife managers in Wisconsin

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While identifying strategies for conservation under climate change is a topic of increased discussion, we must also ensure that these strategies can be realistically implemented. For example, the utility of conservation targets lies in their ability to effectively guide management. The Wisconsin Initiative on Climate Change Impacts (WICCI; www.wicci.wisc.edu) is an example of the type of collaborative, interagency momentum that has been used to address climate change adaptation at the state level. The next step is to translate the resulting research and best available information into management on the ground. The WICCI Wildlife Working Group, with representatives from seven agencies, used current knowledge of past and future climate and species' ecology in their first phase (2007-2011) to screen 463 terrestrial species for sensitivity and develop detailed conceptual models for 3 species of interest. This group then defined a set of target species based on sensitivity to climate change and social and economic importance. The objectives of the second phase are to: (1) develop and quantify additional conceptual models; (2) identify common research priorities in collaboration with a wider array of wildlife professionals; (3) design needs and place-based outreach for natural resource managers; and (4) assess information transfer between research and management. Our ultimate goal is to create infrastructure within Wisconsin that can support an adaptive management program in light of climate change. This includes not only successful information exchange, but ongoing monitoring of changes in management practice through program evaluation. We report on the process and challenges of developing targets and on the use of outreach to integrate science and management to address adaptation strategies.

Poster 6: Simulating land change scenarios to explore urbanization-conservation conflicts at the edge of metropolis

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Increases in population and per-capita land consumption continue to drive land-use changes that directly threaten the persistence of biodiversity and natural ecosystems. Conflicts frequently arise between demands for development and

the conservation of natural resources. Simulation models of land-use/land-cover change provide powerful analytical tools to address challenging policy issues associated with environmental pressures such as rapid urbanization. We applied the Future Urban-Regional Environment Simulation (FUTURES) model to examine outcomes of conservation planning scenarios for urban and rural growth in the North Carolina Piedmont through the year 2030. FUTURES is a generalized framework for simulating the spatial structure of per-capita land use changes and settlement patterns by taking into account multiple influential factors from environmental, socioeconomic, and infrastructural dimensions. We utilized the model to understand how future development resulting from various land use planning trajectories will conflict with regional conservation priorities and influence the composition of the landscape. Scenarios that included conservation planning were based upon guidelines from the North Carolina Wildlife Resources Commission's (NCWRC) "green growth toolbox," which outlines specific conservation targets and provides suggestions for regional development that limit environmental impacts.

Results of multiple FUTURES simulations indicated that if current trends continue, conflicts between development and the protection of natural resources are inevitable. Analysis of conservation planning scenarios revealed that trade-offs will exist between conservation of priority resources and preservation of landscape connectivity. For example, scenarios that preserved conservation targets near urban areas resulted in increased fragmentation of forests and farmlands in rural areas. Implementation of these land change scenarios provided an important avenue for the exploration of potential landscape level impacts of future development on ecological communities and conservation priorities. These visualizations of alternative future landscape patterns are currently being used by the NCWRC to engage community stakeholders and guide effective preservation of the region's remaining natural resources.

Poster 7: Conservation targets in managed ecosystems: Consideration of tradeoffs and scale

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The tradeoff between biomass production and biodiversity conservation confounds the challenge of setting conservation targets in landscapes dominated by crop production. Proposed solutions fall along a spectrum between two conservation philosophies: land sparing where conservation and production targets are reached on separate lands and wildlife-friendly farming where biodiversity conservation targets are integrated with agronomic production goals. Yet, despite rigorous discussion, applied conservation targets based on this tradeoff remain vague, often limited to "increased species richness." In light of anticipated future increased biomass production, ecologically-based conservation targets are needed to pragmatically mediate between crop production and conservation objectives and move past simple aggregate measures of diversity. Furthermore, these targets must consider multiple scales, but be scale and context specific.

Our past and current interdisciplinary efforts in the Great Plains looking at the tradeoffs between crop production and bird conservation at local, landscape, and regional scales provide unique insight into the complexity of tradeoffs necessary when setting conservation targets. For example, while organic farming increases local species richness and economic profit, the diversity of practices associated with this management system limits our ability to make predictions for individual species, thus confounding the identification of suitable targets for individual growers. In addition, current collaboration with faculty in agronomy and agricultural economics brings to light tradeoffs at regional, macroeconomic scales. Lastly, given the varied rate of change between global agroecosystems, our recent comparison of avian conservation efforts between regions provides insight but highlights the challenge of suitable cross-system conservation targets.

To better address the need for conservation targets in agroecosystems, in this poster we will integrate the knowledge gained from the above projects and perspectives and discuss important tradeoffs at each scale when considering conservation targets.

Poster 8: Multifaceted governance and conservation targets as key to subsistence fisheries management

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In the Wakatobi Marine National Park, Sulawesi, Indonesia, multiple governance strategies and goals were used in concert to reduce overfishing while maintaining livelihoods for people. Southeast Sulawesi lies at the center of the Coral Triangle, the world's most biodiverse marine system, so has been the target of numerous conservation initiatives, and management options here are comparable to those in subsistence fisheries worldwide. Research was conducted as part of a development program aimed at stabilizing biodiversity loss and enhancing system resilience, with humans treated as the primary predator and ecosystem engineer. Our objectives were to: (1) determine the efficacy of conducting the project using reef-based metrics of success vs. human-based metrics, and (2) test the efficacy of specific governance techniques at reducing biodiversity loss and maintaining human livelihoods. Data from 1996 through 2011 were used, with 2006 through 2011 the primary study and management - manipulation years. Severe overfishing was documented with catch per unit effort (CPUE) metrics in 2010 at less than half their 2005 levels, and reef surveys verifying reductions in fish population sizes and mean individual lengths. Management conducted with only reef-based metrics, or only human-based metrics, was found unsuccessful if the goal was stabilized biodiversity loss and enhanced resilience on the system level. System-level metrics were therefore necessary, and we focused, in concert, on metrics of CPUE, fish abundance on reefs,

household income, and household protein intake. Similarly, a suite of governance techniques was necessary, so community organizations, regulations, alternative livelihood strategies, and market-based access to fishing rights were created and implemented. We conclude that successful ecologically-based fisheries conservation targets will include a diversity of metrics that encompass and analyze humans as dominant predators and ecosystem engineers.

Poster 9: Are novel and historic ecosystems functionally equivalent? A test in California grasslands

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Novel ecosystems, characterized by new, non-historic species configurations or new abiotic settings, are on the rise due to increased biotic (invasion and extinction) and abiotic change (particularly land use and climate change). Although novel ecosystems by definition differ from historic ecosystems in their composition, functional similarities of past and present species may mitigate the effects these changes have on ecosystem functions and services. Considering ecosystem change along an axis of ecosystem function may be a useful way to determine management goals for novel ecosystems, and integrates well with existing goals such as ecosystem service provisioning. For this framework to be applied, it is necessary to consider the range of functions a novel system may provide, from regulatory through to cultural services. We tested this framework experimentally in California grasslands, which have been shaped through rapid, often irreversible, species invasions. Historically dominated by perennial grasses, invasion by annual Mediterranean grasses have transformed California grasslands into annual systems that have still had value as rangelands. More recently, a second wave of noxious invasive grasses, such as *Taeniatherum caput-medusae* (Medusahead), have begun to invade these systems, reducing their grazing potential. Although the forage value for each system is well assessed, less attention has been directed to regulatory functions. In 2008 we established eight replicate plots each of native perennial grasses, non-native annual grasses, and Medusahead under five grazing treatments. In 2010 we measured a suite of ecosystem functions, including decomposition rates, soil moisture, potential soil respiration, and inorganic and resin nitrogen. We found that ecosystem functions were equivalent across systems, and all systems showed similar sensitivities to grazing for these functions. This suggests that, although species composition can cause dramatic divergence in economic functions such as cattle forage provision, for a variety of regulatory services novel and historic systems may be functionally equivalent.

Poster 10: Beyond ecology: Conservation targets in their wider context

Darragh Hare

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Ecologically-based conservation targets will only work if they are acceptable to society in general. It is of crucial importance, therefore, that conference participants think about the processes we might use to enable consensus and political acceptance, and the challenges that we can expect to encounter as we do so.

How can we agree what conservation targets should be designed to achieve? How can we frame the questions they are to answer? How do we go about delivering them? How do we evaluate them? Answering these questions will require us to challenge orthodoxies, re-examining the boundaries we have erected between the ecological and the social, between nature and culture, and between theory, policy, and practice.

While it is clear that ecology must play a central role in developing conservation targets, it cannot do so alone. Conservation targets must make sense across a range of disciplinary logics, being cognizant of and responsive to the nuances of the various arenas in which they will have to operate. This can only be achieved by means of a deliberative, iterative process involving representations from the biophysical sciences, the social sciences, and the humanities, fully incorporating the expertise of policymakers, practitioners, professional groups, and the public.

What currently passes for interdisciplinarity is often little more than a single-disciplinary approach with cursory nods to other areas of expertise. We must move beyond this unsatisfactory model towards a practice of shared inquiry that is more refined, pluralistic, and robust.

This poster will propose a new approach to interdisciplinary collaboration. It will be informed by my international experience of working within and across a variety of academic disciplines and professional arenas. It will draw upon lessons learned while directing projects that bring together academics, policymakers, professionals, and practitioners, thereby offering an important additional dimension to the conference proceedings.

Poster 11: Conservation targets in practice: Lessons learned at a state natural resource management agency

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Developing ecologically-based conservation targets is critically important in the face of global change. However, achieving those targets in the face of economic, demographic, and other societal changes is a major challenge. It will require integrating science, values, politics, and economics; it will require setting management goals that are achievable in the context of federal and state budgets, political will, and public support. The work of a state natural resource agency provides a real-world example of setting and pursuing conservation targets that are desirable, achievable, and sustainable. For the last 15 years the Minnesota Department of Natural Resources has been building approaches for setting and acheiving conservation targets. This experience began with an environmental indicators initiative in the mid-nineties and has matured to include the development of a department-wide information system for integrated tracking and reporting of conservation funds and

outcomes. Lessons learned include the following. The best indicators and targets are based in sound science, clearly defined objectives, and a collaborative, adaptive process. Although ecologically-based targets are an essential reference point, ultimately we need science-policy targets that are consistent with stakeholder values, political will, and funds. Long-term targets should be supported by performance management systems that connect them to budgets and use indicators and incremental targets to measure performance and report results. It is difficult to set targets for resource results we do not have complete control of. Never underestimate natural resistance to change; leading change to focus on results and not just process requires committed leadership support and action throughout all levels of an organization.

Poster 12: Mapping where ecologists work

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The disciplines of ecology and conservation biology have been criticized for their emphasis on temperate zones, biodiversity hotspots, and unpopulated areas. While based on firsthand knowledge of these disciplines, few of these critiques have been backed by quantitative assessment. In a review of more than 2,500 articles published in ten leading ecology journals, we find that ecologists' field site selections are subject to a number of geographical biases. For example, while only 12.9% of land is under some form of protection, more than 63% of field sites were situated in protected areas. Temperate deciduous woodlands were studied four times as frequently as expected by their global extent. And even within densely settled or agricultural regions, ecologists tended to study "natural" fragments: few explicitly study ecological processes in the surrounding matrix.

Such geographical biases in the ecological literature limit the scalability of ecological theory and may hinder conservation efforts in the 75% of the world where humans live and work. Pervasive climate and land use changes make essential a better understanding of ecological processes in anthropogenic landscapes. It is critical that we reflect upon how dominant paradigms – such as the ideas that "pristine ecosystems do not include humans" or "non-native species have unqualified negative effects on native species" – constrain our scientific theories and practices. This necessity connects the present project to my future dissertation work, in which I will consider the possibility that the introduction of non-native species may at times increase evolutionary potential within native communities.

Poster 13: Ending tropical deforestation by 2020: A feasible target with enormous climate and biodiversity benefits

Douglas H. Boucher

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Human societies have been clearing forests, predominantly for agriculture, for thousands of years, and during the late twentieth century almost all of this deforestation has been in the tropics. Over the past several years there has been an appreciable decrease in tropical deforestation, after several decades of it remaining essentially constant despite major conservation efforts. The annual assessments of the Global Carbon Budget indicate that emissions from land use change have dropped from over 5 GtC annually to about 3.25 GtC annually, strongly contrasting with the trend in fossil fuel emissions.

The majority of this decrease is due to success over the past 6 years in reducing deforestation in the Amazon basin, especially in Brazil where it has dropped by more than two-thirds from the average of 1996-2005. Moratoria on deforestation by the soy and cattle industries, prompted by pressure from civil society and supported by establishment of large protected areas and indigenous reserves, have played an important role in this decrease, as has the Norway-Brazil REDD+ agreement that provides a financial reward for decreases in deforestation. Other countries are moving forward with similar efforts.

This success makes the reducing of emissions from tropical deforestation to zero in this decade a feasible target. It is the logical outcome of the broad trend described by geographers as the "forest transition", analogous to the demographic transition, which has already resulted in subtropical, temperate, and boreal land use emissions moving from net deforestation to net reforestation. The target, and progress toward it, would best be measured by "net anthropogenic emissions from land use change in tropical forest regions", rather than by area deforested or by gross tropical forest emissions. Achieving this goal would have great benefits in both climate and biodiversity terms.

Poster 14: When diversity is not enough: Using species characteristics to predict biodiversity-ecosystem function relationships

Susan Cook-Patton and Anurag A. Agrawal

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Our biotic landscape is changing dramatically as rates of species extinctions and introductions accelerate. As a result of these two processes, the number of species present in a community and the characteristics that they possess are being substantially altered. We know from experimental manipulations of species number that diverse communities usually have higher ecosystem functioning than species-poor communities. However, the variation around this biodiversity-ecosystem functioning relationship is large, suggesting that the characteristics of the species in those communities may also be important. For my dissertation, I have conducted mesocosm experiments to ask which species characteristics explain the most amount of variation around biodiversity-ecosystem functioning relationships. These characteristics include the phylogenetic relationships among species, the origin of species (i.e., whether they are native or non-native), and the functional traits they possess. The data I have gathered so far suggest that non-native species interact synergistically with other non-native species and contribute substantially to ecosystem functioning. However, native species growing amongst non-natives show diminished performance.

Understanding what species characteristics contribute to strong and positive biodiversity-ecosystem functioning could help us optimize ecosystem services in human-dominated systems. If phylogenetic diversity is the best predictor, then we might want to plant agricultural grasslands, biofuel fields, green roofs, roadsides, or urban landscapes with species that are distantly related. If native diversity is a better predictor, then we want to strongly encourage the use of native species over the use of non-natives. The results of this work thus have broad implications for the construction and management of coupled human-natural systems.

Poster 15: Structured decision making: A toolbox for assessing inherent tradeoffs, risks, and benefits to achieve conservation objectives

Donna C. Brewer and Michelle A. Haynes

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The goal of many conservation plans is to utilize science-based, practical decision tools to achieve on the ground conservation. Structured decision making is a general term for carefully organized analysis of problems in order to reach decisions that are focused clearly on achieving fundamental objectives. Based in decision theory and risk analysis, structured decision making encompasses a wide range of methods which center on several core steps which include a clear understanding of the decision context and fundamental objectives, and development and evaluation of alternatives and their consequences relative to the objectives. The step-wise process places emphasis on the identification of objectives, and uses those objectives to drive the remainder of the analysis. A substantial literature is growing where structured decision making and adaptive resource management, which is focused on iterative or recurrent decisions that explicitly deal with uncertainty, are being used to assist conservation practitioners and managers understand, frame, analyze, communicate, and implement decisions which are focused on clear objectives. Scientists from the U.S. Geological Survey have collaborated with conservation practitioners at the U.S. Fish and Wildlife Service's National Conservation Training Center to develop a curriculum of training courses and workshops which provide fully developed examples of how these tools can promote improved conservation.

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