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Recommendations:
9th National Conference on Science, Policy, and the Environment:
Biodiversity in a Rapidly Changing World

Preliminary draft recommendations provided by breakout session participants - subject to review and editing
December 8, 2008

01. Breakout Session: Transforming the Role of Natural History Collections in Biodiversity Science

Natural history collections are a key part of the infrastructure for scientific research that documents biodiversity. With the availability of new technologies and the pressing research and societal questions facing us today, the natural science collections community is recognizing the importance of working collaboratively and implementing new technologies to inform our understanding of biodiversity. These new technologies provide a myriad of opportunities to improve access to collections and to transform not only the way that scientists document biodiversity, but also the role of museums in land management, conservation of biodiversity, and public policy. This breakout session will explore the opportunities and challenges that present themselves to collections, and how collections can assist biodiversity science and conservation.

- Task 1. In considering national infrastructure needs and economic stimulus, the Administration and Congress should consider the institutions and agencies charged with advancing knowledge of and protecting biodiversity (e.g., natural history museums, national parks) as infrastructure in need of increased support (e.g., providing support for creating databases of specimen collections).
- Task 2. The federal government should re-engage in existing international endeavors that impact biodiversity and the environment including ratification and implementation of the Convention on Biological Diversity, international efforts to combat global climate change, etc.
- Task 3. Science-based NGOs (e.g., AAAS, AIBS, NCSE) should convene a process to establish biological science standards for K-12 education with the goal of dramatically increasing science literacy in the US (our group would strongly argue for inclusion of evolutionary biology and biodiversity science in these standards).
- Task 4. U.S. should engage in a biodiversity "moonshot", modernizing collection and research infrastructures and educating an appropriate scientific (especially taxonomic) workforce to engage in an ambitious 50-year program to discover and describe the earth's species as a biodiversity baseline for environmental change and a legacy of knowledge of species diversity.
- Task 5. Federal agencies should recognize that biodiversity is a part of national security and biodiversity should be included in security decisions, practices, and studies.
- Task 6. Federal funding agencies and federal agencies should assure that collections are properly prepared, vouchered, catalogued, databased and made available openly online to the public.
- Task 7. The federal government should fund and support the Global Biodiversity Information Facility (GBIF) because it is the primary international conduit for information on biodiversity collections.
- Task 8. The Office of Science and Technology Policy (OSTP) and the President's Science Advisor should enact the recommendations in the 2008 report from the Interagency Working Group on Scientific Collections and the upcoming NSF survey of federally funded collections.

02. In a future distinctly different from the past, what metrics do we use for conservation?

Conservation goals have traditionally focused on restoring and maintaining genetic, species, and ecosystem diversity. In order to proactively prepare for climate change, however, we will need to develop new metrics with which to prioritize conservation areas and document success. We will need to find a balance between conserving ecosystem function and conserving biological diversity. When monitoring conservation success, two common approaches are ecological indicator species and adaptive management, but both approaches

will need to be adapted for climate change. As species in an ecological community respond individually to climate change, identifying appropriate species for indicators becomes more complicated. Adaptive management will become increasingly valuable as an approach, but it is unclear what data needs to be collected, how that information fits with the national ecosystem indicator species discussed above, and how we implement a standardized approach.

Our discussion consisted of the following main points:

(1) Biological diversity of an ecosystem is controlled by more than just climate, so saving important areas and ecosystems is a worthwhile goal even if the individual species that make up those areas and ecosystems is expected to change due to a changing climate.

(2) Conservation should consist of networks of resilient systems that are linked, so species can move. Learning to shepherd change will be the challenge.

(3) The management process should include collecting baseline data, prediction, action, monitoring, and analysis. In this way, we can learn as we manage. Without baseline data and predictions, we will not be able to increase our knowledge about the efficacy and impact of management action.

(4) Current indicators of ecosystem health may not be suitable as the climate changes. Indicators and standardized monitoring will need to be developed with climate change in mind.

(5) Interagency communication and cooperation in monitoring across large scales is needed. Standardized monitoring and data analysis across all natural resource agencies, as well as a central depository for monitoring data, will lead to a better understanding of broad scale trends, species status, ecological function, and regional anomalies.

(6) Some of the topics that need more research and better understanding include: (a) tipping points and thresholds of change (b) how systems recover from disturbance (c) baseline data on range and variation for many ecological variables, over broad spatial scales (d) developing better and more sophisticated measures of change in ecosystems (e) how to conserve floodplains.

(7) Some of the barriers to sound conservation of ecological resources include (a) lack of national leadership on the topic (b) lack of funding, related to a lack of interest or prioritization by decision makers (c) fragmented approach to conservation, rather than a national approach (d) measurement of conservation success with non-ecological variables, such as total acreage protected or miles of river restored.

(8) Managers and researchers do not often communicate;

(a) Many management decisions and actions are carried out without the involvement of scientists. Greater collaboration among scientists/researchers and managers is needed across natural resource agencies. Funding and research opportunities could be structured to encourage greater collaboration.

(b) Research is planned without the input of managers, and research results are often inaccessible to managers. Managers need to be involved in the planning of research, and research findings should have an outlet other than scientific publications – one that managers are have access to and are encouraged to utilize. The research will also need to be translated for managers to understand the implications to their field.

(c) A centralized database for analyzing management action and results would allow managers to provide data to researchers rather than analyzing the data themselves.

(9) Private landowners also need incentives to practice adaptive management, collect data, and collaborate with other landowners and agencies. Information on sound strategies for conserving biological diversity under climate change, and for increasing the resilience of ecosystems to climate change, will need to be shared with private landowners as well as federal and state agencies and NGOs. Programs such as the CRP could be expanded to manage for climate change, or new programs could be instituted.

Our recommendations included the following:

- Task 1. The President should establish a Climate Change Council composed of government and private organizations to identify conservation goals and priorities, develop new metrics, develop standardized monitoring frameworks at a number of spatial scales and provide oversight, and develop a national systems of environmental indicators, with climate change in mind.
- Task 2. The USGS National Climate Change and Wildlife Science Center should act as a central depository and clearinghouse for standardized monitoring data on ecological resources.
- Task 3. NSF should establish centers for collaborative science and management that are tasked with providing scientific expertise in adaptive management.
- Task 4. Natural resource agencies (federal and state) should restructure the funding system to reward collaboration between scientists and managers.
- Task 5. NSF and/or the new Climate Change Council (DOI) need to develop monitoring and analysis techniques to detect system thresholds, tipping points and act as an early warning system.
- Task 6. NSF should fund research focused on understanding ecosystem dynamics during recovery after disturbance.
- Task 7. The new Climate Change Council needs to develop a communication plan that energizes and educates the public about ecosystem services.
- Task 8. USGS National Climate Change and Wildlife Science Center should develop a knowledge network for managers that provides standardized adaptive management techniques and monitoring protocol, and allows them to upload monitoring data. The system would be structured in such a way that managers are strongly encouraged to upload their data.
- Task 9. In order to improve private land management, Congress should expand the CRP and other conservation programs on private land to address climate change issues.
- Task 10. All natural resource agencies need to adopt a common and scientifically rigorous definition of adaptive management that will allow them to collect data and increase knowledge in a compatible and effective manner.

03. Bridging the Divide: Putting Science in the Hands of Resource Managers

Science is the cornerstone of conservation but builders of conservation programs often have difficulty accessing science. This session identified ways to bridge the divide between researchers and those who design and implement biodiversity conservation programs. Access to data and scientific literature – thousands of papers in hundreds of journals across dozens of disciplines - has improved, but even unlimited access can't give resource managers the time to find, analyze, and

synthesize this body of knowledge. Knowledge gaps, uncertainty, and conflicting information are additional challenges. How can researchers get research to natural resource managers in a usable format? Can the research community develop a culture that expects researchers to work with natural resource managers to assure that science is incorporated regularly into natural resource management?

- Task 1. Natural resource management agencies (federal and state) should engage the academic and NGO sectors to develop independent advisory programs to review outcomes of management actions to refine future actions and make results available.
- Task 2. Natural resource management agencies (federal and state) should enable adaptive resource management and structured decision-making by providing resources for assessment at the inception and completion of each resource management project or decision; they should offer other incentives such as bonuses for managers who document their decision-making process, evaluate and document outcomes, and share results within the agency and with other agencies.
- Task 3. Federal agencies that fund intramural or extramural scientific research should require as a condition of funding that scientific results, methods, data, etc. be translated into usable information for the target audiences. They should engage impartial third parties to be bridges and assist dialogue between researchers, information managers, and field managers. Establish advisory panels that represent multiple disciplines to inform managers and decision-makers on appropriate uses of scientific information.
- Task 4. Federal agencies that fund scientific research - such as NSF, NIH, and USDA - should require development of a report on practical applications. If this report is not submitted, the researcher would not be eligible for future funding. Federal grant and contract terms should require that funding recipients create products such as project summaries, best practices, lessons learned, and publish handbooks and on line tools (e.g., to apply predictive models).
- Task 5. Natural resource management agencies (federal and state) should fund opportunities to train managers and researchers in new scientific disciplines (e.g., climate change and social science). This could be in the form of workshops, meetings, or webinars. Include examples of structured decision-making, and information on benefits and limitations of available scientific information.
- Task 6. The Natural Resources Division of the White House Office of Science and Technology Policy should convene a private-public team of experts to evaluate existing research programs that include federal and state agencies, public and private academic institutions, and non-governmental organizations in public-private collaborations (such as but not limited to the Cooperative Ecosystems Study Unit (CESUs), Cooperative Fish and Wildlife Research Units, and Joint Ventures), and build new collaborations based on the aspects of those models found to be successful. These collaborations should be formed around management issues or needs and bring together managers and scientists from all sectors to frame the research questions, prioritize and coordinate the research, do the research, apply the findings in a way that

generated statistically meaningful results. The team would then evaluate these findings and continue the process as needed.

- Task 7. Natural resource agencies (federal and state) should evaluate personal and organizational performance by acknowledging importance of the interactions between researchers and managers that lead to practical and effective management actions.

04. Breakout Session: Millennium Ecosystem Assessment – The Next Steps, A Second Assessment

This session will develop recommendations to guide follow up activities to the Millennium Ecosystem Assessment (MA), which from 2001 to 2005 assessed the consequences of ecosystem change for human well-being. The MA involved the work of more than 1,360 experts worldwide. Their findings provide a state-of-the-art scientific appraisal of the condition and trends in the world's ecosystems and the services they provide, as well as the scientific basis for action to conserve and use them sustainably. A recent conference recommended the creation of an IPCC-like body to do ongoing global and regional assessments of biodiversity. We will consider how such a body might be formed, how to maintain its scientific credibility and its effectiveness in communicating to decisionmakers.

- Task 1. There should be a second Millennium Ecosystem Assessment (MEA).
- Task 2. Recognizing that there are processes already going on internationally – it is important for the US to engage and provide leadership.
- Task 3. There should be a concerted effort to educate the new policy making community within the US on why the Millennium Ecosystem Assessment and subsequent efforts are critical for sustaining prosperity and security.
- Task 4. There should be high level interagency leadership/coordination and engagement of the private sector, universities and NGOs.
- Task 5. The focus of the MEA ought to migrate from "pure" diagnosis, to a mix of updating and identifying metrics for sustainable provision of services.
- Task 6. There should not be more one-off efforts – assessments should be institutionalized with respect to data, and with a secretariat.
- Task 7. The US should conduct its own analyses for its own resources and issues in addition to global analyses.

05. Assisting Wildlife Adaptation to Climate Change: Managing Across the Landscape

Session brought together government resource managers and researchers to discuss what is needed to assist wildlife adapt to the impacts of climate change. Studies have shown that addressing climate change will require active management if vulnerable species are to adapt and survive. Thus, managers must work more closely with researchers to identify management-relevant questions and informational and monitoring needs. Discussants explored opportunities and constraints to working in a more collaborative and active, truly adaptive management approach, across the larger spatial and longer temporal scales. Session also explored how agencies could refine their management approach under climate change and best work most effectively with the newly created National Climate Change and Wildlife Science Center within USGS.

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- Task 1. Congress should pass, and the President should **sign, cap-and-trade and related legislation** of greenhouse gas emission regulation that dedicates a portion of the revenue to provide new dedicated funding for the development, coordination, and implementation of a national climate adaptation strategy to maintain healthy natural ecosystems and assist species adaptation in the face of changing climate. These additional funds should be administered through federal land, ocean, and resource management agencies, of which, a portion are to fund grants to state and tribal fish and wildlife agencies and their non-governmental partner organizations.
- Task 2. Congress should pass legislation to **permanently establish and fully fund the National Climate Change and Wildlife Science Center** within the Department of Interior, U.S. Geological Survey.
- Task 3. The Office of Science and Technology Policy should convene an on-going interagency coordination effort to **conduct an interagency assessment of the current roles and responsibilities for climate change science** aimed at understanding and monitoring wildlife and natural habitat adaptation and response to climate change, identifying gaps and making recommendations to fill those gaps.
- Task 4. The Council on Environmental Quality should convene an on-going interagency effort to:
    - **coordinate agency wildlife and habitat planning at the landscape scale** to address impacts of climate change on native plants and animal resources, ecological functions, and ecosystem services;
    - **coordinate these federal efforts with state and tribal fish and wildlife agencies** and their non-governmental partner organizations to build and expand to the landscape scale, existing wildlife and habitat, and trust resource management plans;
    - **create a network of conservation lands to expand and connect the nation's existing conservation estate** by engaging major conservation landowners and other organizations involved in permanently protecting wildlife and natural habitat and create linkages between existing protected lands; and
    - **ensure all federal land and infrastructure planning and future forecasting of climate change effects include ecosystem service valuation in asset management systems** (e.g. the potential of natural ecosystem buffers to protect engineered infrastructure, etc.) that is part of an on-going and site-specific reassessment to detect spatial and temporal changes in processes due to climate change.
- Task 5. The Council on Environmental Quality should **assess and report on federal legislative and policy authorities that may pose barriers to the implementation of a more rapid, systems-based, and truly adaptive management approach** (i.e., managing in the face of uncertainty and making reasonable and justifiable 'course corrections' as new climate change information and impacts become apparent).
- Task 6. The incoming administration should **support a landscape scale Green Infrastructure Initiative** that incorporates process-based ecosystem protection and restoration into infrastructure planning and implementation, so as to maintain and enhance ecosystem services and fish and wildlife benefits. Such a national endeavor would provide resilient natural buffers against catastrophic effects of climate change, such as massive flooding, coastal storm surges, wildfires, and drought, while sustaining the nation's natural capital and biodiversity.
- Task 7. The Secretary of the Agriculture, serving as the lead agency and working jointly with the Secretaries of Interior and Commerce should to **assess and recommend how to create a national climate change adaptation extension service** capability through coordinating existing and new

education and extension programs to focus on natural systems and to reach beyond historic constituencies.

- Task 8. The Secretary of the Interior, serving as the lead agency and working jointly with the Secretaries of Commerce and Agriculture should institute an on-going process whereby both state and federal agencies work collaboratively to:
    - **identify and use existing tools for acquiring and sharing physical and biological monitoring data** regarding impacts, risks, and threats associated with climate change;
    - **facilitate the transfer of information** needed to enhance truly adaptive management responses to climate change, including reporting on results of management actions; and
    - **develop training to assist managers in using forecasting data and tools**, adaptive planning, and decision-making in the face of uncertainty.
- Task 9. The USGS National Climate Change and Wildlife Science Center should serve the following functions, although it is not limited to:
    - **promote and synthesize research** that forecasts possible national conservation landscapes of the future;
    - **focus on research priorities to address the information needs of biological managers** in response to climate change;
    - **guide the development of** a **national climate change and wildlife adaptation strategy** and inform the development of broader national strategies to facilitate adaptation of environmental systems and sustainable natural resources; and
    - **assist land and resource management agencies and conservation partners, to plan, manage, and expand the nation's conservation lands network** in the face of climate change to achieve appropriate level of connectivity, species representation and necessary redundancy, and long-term protection.
- Task 10. The USGS National Wildlife Health Center, working with other federal, state, tribal, and non-governmental partners should
    - **establish a system that will identify changes in the risk to wildlife populations of disease** emergence associated with climate change effects;
    - **assess the adequacy of current monitoring techniques** and systems in-place to detect emerging diseases in wildlife populations directly associated, or indirectly associated with the decline in environmental quality, due to climate change; and
    - **provide recommendations** to minimize these risks, improve early detection, and mitigate the impacts.

06. Invasive Species and Biodiversity: Challenges and Recommendations for a Changing World

The havoc wreaked by invasive species on native flora and fauna is second only to habitat destruction when accounting for the major threats to biodiversity worldwide. Combined with other stressors, invasive species can seal the fate of already vulnerable species, populations, or ecosystems. As the risk of species introductions continues to grow, it is incumbent on us to consider these issues. In this session, three discussants provided a brief overview on how the problem of bioinvasions is relevant to biodiversity research, policy, and management. The remainder of the session was devoted to a facilitated discussion among panelists and attendees about the major issues and challenges related to bioinvasions, and the best responses and options. The following list represents recommendations (not in priority order) offered by the group.

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- Recommendation 1. Congress should pass a resolution stating that it is a national goal to prevent the export, introduction and spread of invasive species (as defined in Executive Order 13112 signed in 1999 by President Clinton).

- Recommendation 2. Congress should establish and fund an interagency National Invasive Species Center to coordinate federal, state, and local efforts to prevent the export or import of invasive species and to control the spread of those already introduced, in both managed and natural ecosystems. Serving as a nationwide resource, the Center should share information on invasive species between agencies and organizations and online. Taking advantage of social marketing methods, the Center should also develop, implement, and promote education and outreach on invasive species.

- Recommendation 3. The Center should establish a national invasive species research program, including scientific and economic as well as relevant social and cultural research.

- Recommendation 4. Congress and the Administration, in collaboration with the Center and stakeholders, should develop for all intentional imports of organisms a comprehensive risk assessment process that adopts three different lists of organisms whose import is permitted, prohibited pending study, or prohibited, respectively. For these purposes, organisms should be classified to the species or even subspecies level rather than by more general categories.

- Recommendation 5. Agencies should develop and propose a mechanism for recovering costs associated with conducting risk assessments of introductions of species from the private or public bodies seeking to introduce new species, and for insuring against the potential damage caused.

- Recommendation 6. Congress should establish an emergency fund for rapid response to newly introduced or newly spreading invasive species, a process for disbursement, and a tracking mechanism to assure accountability.

- Recommendation 7. The President should propose that Congress fund a public works program focused on invasive species removal and monitoring commensurate with the damage caused, and including employment and training, and involving service programs such as Volunteer America and other state and federal programs.

07. Population and Biodiversity

Rapid population growth has a dramatic impact on global biodiversity, leading to or accelerating habitat and species loss, changed land-use patterns, increased pollution, the advance of climate change, and other environmental impacts. The United States must explore methods of avoiding or mitigating the ecological and humanitarian harm of these impacts, including promotion of sustainable practices and slowing population growth by providing access to education and voluntary family planning services.

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- Task 1. Referencing UN population projections, the United States must recognize that many social, environmental, and security problems are rooted in rapid population growth due to both high fertility rates and in-migration, which often exceeds the local capacity of the environment to support the growing population. Areas of high biodiversity have some of the fastest population growth rates.

- Task 2. Failure to address the ecological impact of a rapidly enlarging worldwide human population will lead to accelerated environmental degradation, loss of biodiversity, competition for water resources, and agricultural failure, as well as having social, economic, security and humanitarian implications.

- Task 3. The link between populations and biodiversity is mediated through individual and collective consumption behaviors. In addition to addressing unmet need for family planning, particularly in the developing world, it is essential that policies and programs also focus on improving efficiency and sustainability in production and reducing unsustainable per capita consumption in the developed world.

- Task 4. The US must make a significant public commitment to and financial investment in international family planning, by contributing its fair share of the cost of meeting current unmet need for family planning supplies and services (approximately $1 billion in FY 2009, based on GDP), and restoring funding to the United Nations Population Fund.

- Task 5. USAID should increase support for innovative programs that address Population, Health, and Environment (PHE) issues through integrated approaches to delivering services that meet health and family planning needs, promote sustainable livelihoods, and conserve biodiversity.

- Task 6. The U.S. Government should fund more research on coupled human-natural systems, including links between population dynamics and biodiversity, and should assume a leadership position in evaluating and addressing the effects of population growth on biodiversity.

- Task 7. Integrated programs that address PHE issues should use established best practices, such as girls' education, micro-credit, and other interventions designed to promote sustainable development and alleviate poverty.

08. Biomass, Biofuels, & Biodiversity

Biofuels can reduce dependence on fossil fuels and net emissions of carbon dioxide to the atmosphere. Biofuels production is expanding rapidly in the United States and elsewhere, but potential impacts on biodiversity have not been fully explored. These impacts are associated with changes in land use from food crops to feedstock production and from natural systems to agricultural systems. As production expands, it is critical to identify means to maintain and enhance biodiversity in agricultural landscapes and to preserve biodiversity in relatively pristine systems. This session will build on recent discussions sponsored by organizations including the Ecological Society of America, the Pinchot Institute for Conservation, and the National Research Council to focus on biodiversity and mechanisms to incorporate knowledge about biodiversity conservation into biofuels policy.

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- Task 1. The U.S. federal government should tie the allocation for biomass R&D and assistance programs to defined sustainability standards. OR The U.S. should require allocation of federal dollars for biomass R&D and assistance to those projects and programs that explicitly contain a component addressing long-term issues of social, economic, and ecological sustainability.
- Task 2. The federal government should increase funding via a joint DOE, USDA, and NSF program of basic research on soil food webs, with particular emphasis on microbial and mesoflora/mesofauna biodiversity and biogeochemical cycles that underpin ecosystem services affected by and affecting biomass-to-biofuel production systems.
- Task 3. The federal government should increase funding for research on biofuels derived from algae and other non-agricultural sources.
- Task 4. The USDA, EPA, and NSF should encourage a collaborative research project among farmers, universities, federal agencies, NGOs, and the biofuel industry to develop useful methods of Integrated Pest Management (IPM) specifically aimed to reduce the use of pesticides to control insects, weeds, and pathogens in biomass production.
- Task 5. The USDA and DOE should lead an inventory of all candidate lands for biomass production and evaluate their suitability based on impacts on biodiversity and ecosystem services.
- Task 6. The EPA should develop an integrated assessment protocol, including the assessment of biodiversity, ecosystem services, and socio-economic factors based on a transparent and standardized approach, which will enable assessing environmental consequences from the development of bioenergy systems.
- Task 7. The development of biofuel policy should be based on sound science, with participation open to all stakeholders. The success and effects of the implementation of these programs should be clearly communicated to the general public.
- Task 8. Congress should enact a federal renewable portfolio standard of 25% from renewable energy by 2025, subject to an analysis of potential for achieving this goal through sustainable community-scale facilities using federal interagency expertise such as the EPA, DOE, USDA, and Department of Interior.
- Task 9. Researchers and state and federal regulators should include net energy return for consumptive use of water and impacts of increased feedstock production on local, state, and regional watersheds as standard components of biofuel life cycle assessments.
- Task 10. The federal government should provide funding for research assessing the biodiversity and ecosystem value of alternative biofuel feedstocks at multiple spatial scales.

10. State and Local Government Actions to Conserve Biodiversity

As human population and development pressures intensify and expand in large geographic areas, landscapes are increasingly fragmented by developed land uses, and resident biodiversity is increasingly compromised. The differences are ones of geographic scale, type of development pressures, the affected resources and biological communities, and the nature of effective government actions that can be taken to preserve landscapes and biodiversity. Discussants will present perspectives from different levels of U.S. government ranging from local land use authority and control, State Wildlife Action Plans and state conservation efforts, and federal programs aimed a protecting endangered species and biodiversity. The objective of this session will be to determine which government actions are most effective in conserving biodiversity at points along the urban-rural continuum and where sufficient government action is lacking.

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- Task 1. Governments, universities, and NGOs should work to gather and synthesize biodiversity information and deliver it in accessible, relevant forms to inform the public and local policymakers.
- Task 2. While implementing State Wildlife Action Plans, states should seek to work closely with local governments to share data (e.g. at-risk species lists; maps of priority conservation areas) so they can incorporate conservation actions into local land-use planning processes.
- Task 3. Plan (via identification of appropriate case studies and models) and conduct Green Infrastructure studies at the state and local level. Refer to this http://www.greeninfrastructure.net/ for a comprehensive review of the Green Infrastructure assessment and planning approaches. Include a citizen assessment tool to allow citizens to actively participate in examining Green Infrastructure in their community.
- Task 4. Stakeholders should identify existing incentives and create new incentives for local governments and landowners to encourage biodiversity protection.
- Task 5. Each state, in coordination with stakeholders, should develop communication tools to foster environmental literacy and teach the public about biodiversity at the community, local, and state levels. Target and develop stakeholder specific messages for ranchers, farmers, landowners, new homeowners, and students, among other groups.
- Task 6. During the pre-planning stage of grey infrastructure development projects, government agencies at all levels (local, state, Federal) should develop early coordination with resource agencies, using procedures appropriate to the sensitive nature of biodiversity information. Resources such as web-accessible screening tools developed by Natural Heritage Programs can facilitate this.
- Task 7. School systems should develop habitats for outdoor learning at every school. Congress should pass the No Child Left Inside Act to facilitate this and related initiatives
- Task 8. The Federal government should increase the amount of State Wildlife Action Plan grant funding and the Federal component of the match should be increased from 50% to 75%; this program has enabled recent biodiversity conservation successes in many states. This objective would be enabled by the passage of the Teaming with Wildlife Act. Allow State Wildlife Grant funds to be used for projects targeting at-risk plants and their habitats, in addition to animals.
- Task 9. Include funds for ecosystem restoration in FEMA disaster assistance grants to state and local governments.
- Task 10. The United States should ratify the Convention on Biological Diversity. State and local governments should embrace the tenants of the convention.

11. Building and Sustaining Conservation Partnerships

This session will explore how conservation partnerships can most effectively engage individuals and organizations in protecting and restoring biodiversity. Amplifying conservation action through partnerships– citizens, public and private entities, and government agencies – increases the likelihood of success, program sustainability, and ecosystem resilience. We will explore the conditions under which this can and has happened. Participants will craft a case statement on the direct benefits of these types of partnerships and their ability to most effectively leverage public conservation dollars to meet the most pressing, and often complex, biodiversity conservation priorities

- Task 1. The Congress and Executive Branch will create additional incentives such as stewardship contracts to engage the private sector in partnerships to restore, conserve, or sustain biodiversity.

- Task 2. The Administration and State governments will link all State and Federal agency missions to biodiversity and ecosystem services.
- Task 3. The Secretary of the Interior will require agencies to create co-equal economic and environmental goals (as in past principles and standards).
- Task 4. Congress will support interdisciplinary research and implementation projects on the scale of the National Institutes of Health.
- Task 5. The Executive Branch will clearly identify the risks associated with not protecting biodiversity and reducing ecosystem services.
- Task 6. The Executive Branch and State agencies will encourage partnerships, and build them into legislation, where appropriate.
    - Transform organizations to acknowledge the importance of partnerships.
    - Create incentives for agencies to promote partnerships.
- Task 7. Agencies will promote conservation partnerships using best management practices that have been demonstrated through the North American Waterfowl Management Plan and the National Fish Habitat Action Plan.
- Task 8. Agencies will work with the Ad Council to develop and implement a national public awareness campaign that promotes building and sustaining conservation partnerships.
- Task 9. The National Institutes of Health will link human health with biodiversity.
- Task 10. The Office of Management and Budget will simplify fund transfers and reduce bureaucracy through the establishment of a National Biodiversity Conservation Fund.
- Task 11. The National Science Foundation will support social science research on the dynamics of partnerships.

12. **Zoos, Aquariums, and Botanical Gardens: Can living institutions do more to achieve biodiversity conservation?**

Living Institutions serve as endangered species "arks" for propagation and scientific research. They are educational centers providing science and environmental programs to students and teachers. They provide recreation and inspiration to millions of visitors. Increasingly, they are i*n situ* conservation organizations, providing staff and resources to high-priority conservation sites and constituencies worldwide. They can be mentors to institutions and professionals around the globe, as well as advocates for political and social action. Few living institutions can engage in all these activities and no consensus exists on how limited resources should be deployed. This session will consider which activities are the highest priorities in terms of biodiversity conservation and will seek to produce priorities for how living institutions can maximize their individual and collective impacts.

- Task 1. The President should significantly increase funding for informal science institutions and support living institutions as centers of excellence in protecting America's wildlife and natural resource heritage.
- Task 2. Zoos, Aquariums and Botanical Gardens in the U.S. need to develop their own capacity for conservation at the following levels and mentor international partners to increase capacity in these areas:
    - Training staff
    - Infrastructure for conservation
    - Creating mechanisms to sustain a conservation agenda

- Task 3. Living Institutions have a unique role to play in urban ecology and urban education. They are places where green education and environmental protection come together. They need to find more ways to promote citizen science on their grounds and in their communities.
- Task 4. Zoos, Botanical Gardens, and Aquariums should develop a common set of messages and actions they can stand behind in term of conservation and sustainability, and collaborate in consistent messaging to the public about what matters.
- Task 5. Government agencies and foundations should fund efforts to understand the attitudes, motivations and behavior of visitors to living institutions. Research on social learning and environmental psychology should be a priority
- Task 6. Living Institutions should play a larger role in developing public understanding of global climate change. They should speak out on environmental protection and not shy away from advocacy.
- Task 7. Congress should support the No Child Left Inside Act (NCLI) and ensure every child has an opportunity to have real science experiences outside of the classroom.
- Task 8. In a time of limited travel budgets, local, state and federal agencies and universities should view America's living institutions as powerful venues for education, research and training.
- Task 9. Living Institutions should seek ways to educate and influence policymakers about their unique role in terms of science education and biodiversity conservation.

13. The Climate is Changing: What Will Happen and What can a Natural Resource Manager Do?

Climate change will affect ecosystems at all scales of biological organization and across all regions of the world. An understanding of the types of impacts and the ecological and human responses to these potential impacts is crucial for the conservation of ecosystem functions and services. The breakout session focuses on the results of three assessment reports that pertain to ecosystems and were completed through the US Climate Change Science Program (CCSP). The goals of the session are to (1) discuss implications of climate change for biodiversity and ecological systems, (2) discuss implementation of adaptation strategies in these systems with agencies and NGOs and (3) use results from the discussion to inform the science strategy of the Ecosystems Interagency Working Group of the CCSP.

- Task 1. There should be a more coordinated monitoring system across federal agencies that is targeted to identify climate change effects across ecosystem types and across spatial scales.
- Task 2. The research community should identify what happens to ecosystems before, during and after reaching thresholds and how to measure a threshold and conversely, ecosystem resilience to change.
- Task 3. The research community should develop interdisciplinary studies that look at interactions between ecosystem function, biodiversity and climate change, which includes field experiments that test and evaluate adaptation approaches, reporting both positive and negative results, and that help resolve metrics of success.
- Task 4. As a management community, change the way we think about managing ecosystems and better understand how to manage for change and define adaptation goals.
- Task 5. Public agencies at all levels need to convey climate change information to land managers through existing communication methods and at scales that are appropriate and usable.
- Task 6. Federal agencies should coordinate better within and across agencies and other partners by making coordination and consideration of climate change a part of the mandate and include adaptation to climate changes in both personnel and agency performance measures.

- Task 7. Agencies and the research communities should develop generalizable tools for resource managers, including guidance on adaptive management approaches, incorporating tools from other fields.
- Task 8. Agency funding structures should reconcile both short-term priorities and long-term monitoring.
- Task 9. Identifying priority actions with the goal of understanding what existing stressors are the most pressing to resolve and maximizing ecosystem resilience to changes at both a regional and local scale.

14. Ecosystem Restoration – What Does Ecosystem Restoration Mean in a Rapidly Changing World?

In a world of disintegrating ecosystems and declining biodiversity, ecosystem restoration is an important option for some critical areas. Yet climate change, human needs for water and natural resources create new environmental challenges, which mean that ecosystem restoration is as best a partial process. The session will explore the record of ecosystem restoration in the United States and globally, identify the role of restoration in maintaining and restoring biodiversity and make recommendations on ways in which large scale ecosystem restoration can enhance biodiversity in a dynamic human/ecological environment. Presentations will include the physical ecosystem context , the human context (G. Milan), the policy context (D. Botkin), the institutional context (Lee Talbot) and a project focused vision for large scale restoration (J. Gritzner) as well as a business perspective (Earl Dodd).

- Task 1. The workshop conveners will explore the possibility of contracting an individual who could undertake a detailed analysis of restoration projects globally and assess their major successes and shortcomings.
- Task 2. NCEAS, NRC, or NSF could be a vehicle for creation of a database system of restoration projects, and a database of restoration projects.
- Task 3. The workshop conveners will work with NCSE to write a proposal to NCEAS to convene a group of experts to develop a comprehensive list of what is known and what is unknown from restoration experiences, identify gaps, and prioritize research and implementation.
- Task 4. IUCN should identify “hotspots” for restoration ecology including urban systems. Note: The Society for Ecological Restoration International (SERI) will be an important organization that the group will work with in forwarding these four recommendations.
- Task 5. NSF, EPA, NOAA, and education organizations should focus on restoration, starting from kindergarten to increase children’s exposure to nature.
- Task 6. U.S. and international agencies should address existing policies that have poor scientific backing or are being implemented poorly (e.g. wetland mitigation).
- Task 7. An interagency working group (USGS, NOAA, BLM etc.) should be convened to explore the creation of an effective monitoring and evaluation system that allows truly effective adaptive management in ecosystem restoration and other projects. Decicated quasi-independent, long-term funding should be part of each restoration activity.

15. Scaling Biodiversity: Setting Local Conservation Goals in an Era of Rapid Global Change

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Climate change, economic and social influences on land use, and energy policies are global forces that can have powerful effects on biological systems and habitats at local scales, where conservation action typically is focused. The challenge to conservationists, managers, and policy-makers is to develop goals and plans for fostering local biodiversity that incorporate the cascading effects of global processes. This breakout session will consider this challenge from the perspectives of both the conservation objectives and the global forces. Presentations will focus on scaling climate model projections, evaluating land-use change, and the roles of nongovernmental organizations and government agencies in conservation planning and management.

- Task 1. The Challenge: to match the scales of decisions and management to the scales of the relevant biological processes.
- Task 2. The Secretary of the Interior should develop an interagency, open access biodiversity data center to organize and standardize data and metadata in relation to the spatial scale of the data, identify information gaps, and facilitate transferability of data among organizations.
- Task 3. Federal agencies should collaborate to enhance the value and capacity of remote sensing to enhance land-use decisions that incorporate biodiversity inventories and information
- Task 4. Strengthen and expand existing organizations (such as the NRCS and land grant extension and outreach services) to provide environmental information to local governments and private landowners and help them use it to conduct land-use planning that incorporates biodiversity values.
- Task 5. The USFWS should attach a requirement to State Wildlife Action Plans for periodic reporting of biodiversity status at multiple scales.
- Task 6. The Departments of Interior and Agriculture should create a joint task force to develop comprehensive and standardized protocols to monitor and inventory the nation's biodiversity at multiple scales and collaborate with NOAA and other relevant entities to link the results to models projecting climate change at multiple scales.

16. Endangered Species and Conservation – Reliant Species

It has been called the end of nature, the end of the wild, and domestication of nature. Our relationship with Nature has changed. The traditional assumption that, once we identified an endangered species, we would identify the threats to its existence, develop and implement management actions that would mitigate or eliminate the threats, the species would increase in numbers and distribution reach predetermined recovery goals and be de-listed. The species no longer needs species specific management interventions. Eighty percent of species on the United States Endangered Species fail to meet that assumption. They require species specific management intervention for the foreseeable future. Participants will discuss the implications of conservation reliant species for policies, laws, and conservation practices for endangered species.

Conclusions:

- Few endangered species are likely to recover to a point at which they can flourish without some form of continuing protection or active management intervention;
- Rather than keeping such species on the T&E list indefinitely, an objective of the ESA should be to secure commitments – from states, NGOs, or others – to provide the protection or active management needed by such species; those commitments could then provide the basis for ESA delisting, while keeping on the T&E list those species for which continued ESA protection is essential.

- There needs to be reasonable certainty that there will be adequate funding for commitments to provide ongoing protection or active management of delisted species.

Recommendations:

- FWS/NMFS should incorporate the above conclusions into its policies, handbooks, etc., to guide its future implementation of the ESA
- States, NGOs and others with the capacity to undertake ongoing protection or active management responsibilities should offer to enter into formal commitments to do so
- Funders (both public and private) should increase funding available to enable states, NGOs and others to take on such commitments.

17. Mapping Conservation Landscapes Across Continents: The Future of Protected Areas in a Changing World

This session's focus is to advance the design and implementation of continental-scale wildland networks as a biodiversity adaptation strategy to climate change. Much uncertainty exists regarding the pace, scale, and extent of changes in climate, ecological interactions, and land use, yet conservation science and practice must operate and evolve with this uncertainty. Potential alternative configurations and land management options for interconnected conservation landscapes should be based on the best available data, tools, and analyses. This session will provide an overview of approaches to large landscape conservation in a changing climate. We will discuss the application of climate model outputs and species distribution modeling techniques to understanding species response to climate change, and we'll present current integrative, interactive mapping efforts that can support continental-scale conservation planning.

- Task 1. The Administration should work in a coordinated fashion to expand the reserve network to build resistance and resilience, protect ecosystem services, and manage the national working landscape matrix to be permeable to wildlife.
- Task 2. The National Climate Change and Wildlife Science Center (NCCWSC) should coordinate an effort to identify, evaluate, prioritize, and facilitate the ability to mine, and digitize historic species distribution data.
- Task 3. The NCCWSC should develop a maximally interoperable protocol for future data collection for monitoring biodiversity response to climate change.
- Task 4. The NCCWSC should develop a database for valuation of ecosystem services to help select priority sites for fine-scale conservation planning
- Task 5. The biodiversity research community should identify regions of existing climate refugia and of high evolutionary potential to evaluate their potential role in wildland network design.
- Task 6. The NCCWSC should facilitate the integration of climate model outputs with ecological forecasting to help reduce uncertainty in modeling biodiversity responses to climate change.
- Task 7. The biodiversity research community requires strategic enhancement of computational capacity in core facilities to support the outcome of Task 6.
- Task 8. NCCWSC should support efforts to create science-based visualizations, at multiple scales, from local to global, of climate change impacts to garner public support for policy change.

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18. Agricultural Landscapes and Natural Diversity

Currently about 37% of the globally available land is agricultural. With a growing human population and the need for fiber and fuel there will be tremendous pressure to increase agricultural activities, some estimate by as much as a billion hectares by the year 2050. Thus, a significant portion of the world's current and future biodiversity is tied to farming, land management and land managers. This breakout session will explore biodiversity management and conservation in agricultural ecosystems, and especially the goods and services provided by biodiversity within and among farms, the necessity of balancing the needs for biodiversity with the requirement for the economic production of crops, and which sort of policies might be most effective in preserving biodiversity within agricultural landscapes.

- Task 1.USDA should charge cooperative extension to develop a major focus on conserving and sustaining life, encompassing and integrating food quality and quantity, rural communities, water and ecosystem sustainability and related issues.
- Task 2. USDA (along with the Forest Service and Department of Energy) should develop a research implementation program to build partnerships (NGO, government agencies, commodity groups, business) that increase the adoption of practices that increase biodiversity and ecosystem services in agricultural landscapes.
- Task 3. USDA should develop practices and policies that enhance the value of ecosystem services and benefits across the value chain (including packaging, processing and transport).
- Task 4. Congress should integrate commodity conservation, nutrition and energy titles in the Farm Bill to support farmers in the provision of ecosystem services.
- Task 5. The President should redirect and invest more resources to support research on how diversification at all levels (genes to landscapes) will enhance the biodiversity and ecosystem services supported by working lands.
- Task 6. NSF, USDA, EPA, DOI should fund research on how to:
    - Evaluate and value the multiple services provided by "working lands,"
    - Optimize the multiple services provided by "working lands" so communities can assess the tradeoffs and potential ecosystem services provided by working lands.

21. Integrating Cultural Diversity and Biological Diversity

Societies have deeply embedded cultural traditions that have positive and negative consequences on biodiversity. For example, tropical ecosystems, where most of the world's remaining biodiversity is found, is also home to indigenous societies with cultural knowledge of the sustainable use of local species for medicines, food, fodder and fiber. Such biocultural knowledge contributes to global conservation policy such as the UN Biodiversity Convention. Better awareness of the impact of cultural practices on biological resources can contribute to better informed policies and projects for biodiversity conservation and its sustainable use.
This session will explore how collaboration between the social and environmental sciences in crafting policy and projects can capture the complex biological and cultural factors that facilitate success in biodiversity initiatives. Discussants, who are leaders in policies and projects for biocultural conservation and sustainable use, will lead this session's participants in developing such recommendations for interest groups and policy makers.

- Task 1. The Department of Treasury, USAID, and World Bank should increase access to funding and capacity building for indigenous peoples globally for their environmental and conservation activities.

- Task 2. USAID should develop an indigenous policy at least as strong as that of the World Bank and OAS and should implement biocultural diversity impact assessments beyond social impact assessments and environmental assessments.
- Task 3. NSF, NEH and other appropriate agencies and international partners should greatly expand the endangered languages program to develop a global assessment of the state of world languages and cultural diversity similar to the Millennium Ecosystem Assessment. Currently, the precise number of languages and cultures worldwide is unknown, as are their health and rates of decline.
- Task 4. Congress should fund cross-sectoral programs and positions in the following agencies Department of Interior (NPS, FWS, BIA etc.), State Department (USAID, etc.),Peace Corps, USDA (Forest Service, etc.) to institutionalize biocultural diversity approaches and improve environmental governance.
- Task 5. The Department of State should adopt and work to realize the UN Declaration on Rights of Indigenous Peoples.
- Task 6. USAID, Dept. of Interior, USDA, and Smithsonian Institution should hire more anthropologists and social scientists (and interdisciplinary scholars) to identify key social processes driving adaptation to loss of biodiversity, as well as to increase research on the interrelationship between biological diversity and cultural diversity.
- Task 7. The Department of Education working with other agencies, including at the state level, should develop a program on biocultural diversity that will be incorporated into core curricula at all levels.
- Task 8. The White House should create a blue ribbon panel of Native Americans to bring innovation through their traditional knowledge to bear on the current national and global environmental and climate crisis.
- Task 9. The Peace Corps should develop in-country core training in biocultural diversity conservation for all volunteers and staff. Their environmental programs should integrate local cultural aspects in their implementation.
- Task 10. A cross-governmental task force on biocultureal diversity, including NGO and international partners, should be created to inventory federal programs and develop a research and action plan.

22. The Future of Biodiversity in Africa

Biodiversity remains the fundamental basis of Africa's development, and underpins the well-being of current and future generations. However, climate change, population growth and globalization of trade pose serious threats. Opportunities must be seized building on successful conservation approaches and new innovation.
This breakout session will discuss how to mainstream biodiversity into development agendas, promote good conservation practices, and strengthen the role of social institutions in conservation. It will give feedback on a Vision Statement on "The Future of Biodiversity in Africa" developed by African conservation leaders in September 2008, and will draw upon experts and NCSE participants to brainstorm on turning this into action. Participants will make recommendations to guide the new US Administration and other partners on the future of biodiversity in Africa.

- Task 1. The US Administration should give Africa the priority it deserves in a global development and conservation context.
- Task 2. The US Administration should raise the prominence of development assistance to cabinet level and integrate conservation with development assistance.

- Task 3. US government policies should expand assistance for capacity building of Africans and African institutions in biodiversity conservation and natural resource management, including academic exchanges with US universities for students and scholars.
- Task 4. US government policies should promote the linkages between biodiversity, economic development and sustainable livelihoods in Africa.
- Task 5. The US Administration should retake a leadership position in the negotiation of international treaties and agreements relating to the wise use of natural resources and to implement internationally agreed aid effectiveness principles.
- Task 6. The US government should demonstrate adaptability in streamlining development assistance in a rapidly changing global environment (globalization, governance approaches).
- Task 7. The development assistance portfolio should align with African ownership and leadership.
- Task 8. US communities should harness faith-based institutions to strengthen their role in African biodiversity conservation.

23. Conservation Biodiversity in a Rapidly Changing Arctic

Climate change and industrial development are challenging the integrity of Arctic ecosystems in unprecedented ways, with potentially drastic effects on Arctic biodiversity. Changes in high-latitude habitats such as shrub and treeline advance, permafrost degradation, and sea ice loss are driving changes in distribution and abundance of arctic-adapted species. These changes are also leading to invasions by species formerly restricted to lower latitudes. At the same time, the human population of the Arctic is growing, and there is rapidly increasing interest in Arctic resource extraction and tourism. Baseline data on plant and animal distribution and abundance is lacking or incomplete for much of the Arctic, making detection of changes difficult. In this session, we discussed threats to Arctic biodiversity, evaluated current biodiversity conservation efforts, identified data gaps, and proposed additional needs and opportunities for Arctic biodiversity conservation.

- Task 1. Congress should direct The National Academy of Sciences to facilitate an expanded and quantitative integrated assessment of cumulative effects of climate change and energy development on terrestrial and marine biodiversity throughout Arctic Alaska.
- Task 2. The Departments of Interior and Commerce should design and implement a comprehensive inventory and monitoring infrastructure for fish, wildlife, and their habitats in the terrestrial and marine systems of Arctic Alaska.
- Task 3. Congress should direct the U.S. Geological Survey and the U.S. Fish and Wildlife Service to investigate causes of persistent declines in resident and migratory Arctic wildlife species, initially focusing on bird species that have been designated as Birds of Conservation Concern by the U.S. Fish and Wildlife Service..
- Task 4. The National Science Foundation and the National Oceanic and Atmospheric Administration should support a multi-university effort to develop a marine bio-geographic database for fauna and flora associated with sea-ice and benthic communities, with emphasis on regional studies.
- Task 5. The National Oceanic and Atmospheric Administration should establish a scientific basis for regulating emerging Arctic fisheries, including documenting life histories for arctic fishes, and investigating stock status and trends.
- Task 6. The Departments of State and Interior should provide full support for existing Arctic Council activities, in particular the Arctic Monitoring and Assessment Program and Conservation of Arctic Flora

and Fauna (including Arctic Biodiversity Assessment and Circumpolar Biodiversity Monitoring Program)

- Task 7. The National Science Foundation should fund scholarships for studies that incorporate traditional ecological knowledge in the design of scientific investigations of Arctic change.
- Task 8. The Department of the Interior should elevate the recognition of Arctic ecosystem services among the legislative bodies and the general public public through research and outreach, and academic institutions should incorporate the concepts of ecosystem services and environmental economics into academic curricula.

24. Water for Biodiversity and Human Needs

Freshwater habitats are changing more rapidly than any other component of the biosphere. Many of these changes pose enormous threats to both biodiversity and human wellbeing, with the main causes of freshwater species extinction—depletion and degradation of surface waters—also causing an inordinate amount of human misery. Upon examination, the actions to provide safe drinking water to poor people in the US and elsewhere often can contribute to freshwater biodiversity conservation, and *vice versa*. This session explored how freshwater conservation and development efforts can complement one another.

- Task 1. Development organizations should employ strategies that recognize the importance of healthy freshwater ecosystems to human wellbeing; conversely, conservation organizations should guide their efforts in recognition that functioning human societies with access to adequate resources are essential to the long-term success of freshwater biodiversity conservation.
- Task 2. Funding organizations (e.g., The World Bank, United Nations Development Programme, and national development agencies such as the US Agency for International Development and the United Kingdom Department for International Development) should require that development projects have input from the environmental community, and that conservation projects have input from the development community, possibly in the form of impact analyses. Organizations that make grants for human health and development, such as the US National Institutes of Health, should include biodiversity specialists or conservationists on review panels.
- Task 3. Both development and conservation organizations should take steps to ensure that water-related issues in both areas of activity are introduced more broadly to society, through education and other forms of communication, to convey both the urgency and severity of water problems and the need to engage these problems before situations become more dire than they already are.
- Task 4. Actions designed to promote energy production should develop strategies to reduce impacts on water supply; these strategies should be based on science-based protocols developed in research settings and implemented by companies and agencies engaged in energy development, such as the US Department of Energy, the US Department of Agriculture, the US Department of the Interior, and similar agencies in other countries.
- Task 5. Appropriate government agencies (e.g., the US Department of Agriculture, the US Geological Survey, the US Forest Service, and similar agencies in other countries) should take definitive steps to collect basic data on surface and (especially) subsurface water quality, quantity, and biodiversity.
- Task 6. The US government and other governments and funding organizations should require government agencies and scientific and conservation organizations to develop information systems designed for rapid dissemination of data on freshwater ecosystem characteristics and conditions, to

support improved conservation and development decisions (as well as the design and implementation of integrated conservation-development strategies).

- Task 7. Development projects, and the organizations that fund such projects, should consider the importance of maintaining sustainable freshwater ecosystem services and take substantive steps to develop project designs that maintain these services.
- Task 8. Development and conservation projects, and the organizations that fund such projects, should formally recognize the connection between human health and functioning freshwater ecosystems, noting the role that monitoring such ecosystems can play in predicting impacts on people as well as the human health benefits gained through ecosystem restoration; additional research should be focused on exploring further the relationship between human health and the health of freshwater ecosystems.
- Task 9. The US government and the governments of other nations should take steps to identify the most serious and imminent fresh water issues, affecting both people and other species, and mitigate them by providing adequate funding to agencies that can address these issues effectively and efficiently (such as continued financial support of the Senator Paul Simon Water for the Poor Act in the US).

25. Coral Reefs

Coral reef biodiversity is extremely rich, providing a broad suite of services to humankind. Unfortunately, these very precious ecosystems are rapidly declining. The objectives of this session are to: 1) Explore what is known about coral reef biodiversity and the observed rapid decline of these biological treasures due to a suite of stressors. 2) Based on the consensus of the scientific community, summarize what is presently known on the main threats to their biodiversity. 3) Examine the value of current protective measures, and 4) Explore innovative ways needed to ensure the future biodiversity and survival of coral reefs. Discussions during the session will be limited to topics associated to ecosystems associated with light dependent corals (0-100m).

- Task 1. The Administration should implement the recommendations on biodiversity from the Pew Ocean Commission and the U.S. Ocean Commission.
- Task 2. By 2014, the Administration should protect 20% of coral reefs and their biodiversity in marine reserves both nationally and internationally, working with NGOs, the World Bank, GEF, UNEP, and IUCN.
- Task 3. Agencies and NGOs should increase outreach to Congress, stakeholders, academia and the public to raise awareness on issues of coral reef biodiversity.
- Task 4. Taxonomic and species assessments should be recognized as essential tools for understanding and protecting coral reef biodiversity: academic institutions should increase training and employment opportunities for taxonomists; and agencies should increase funding for taxonomic research.
- Task 5. Managers and agencies should determine the socio-cultural, economic and biological value of ecosystem services provided by coral reef biodiversity.
- Task 6. Congress, agencies and academia should include coral reef biodiversity issues in climate change funding mechanisms and research.
- Task 7. Agencies should create a virtual communication portal to facilitate the collaboration and leverage capabilities of the coral reef biodiversity community (NGOs, stakeholders, managers, academia), for example www.gulfbase.org .

- Task 8. NOAA should reorganize Fishery Management Councils or establish Regional Ecosystem Management Councils to conserve coral reef biodiversity.
- Task 9. Agencies, recognizing the importance of biodiversity in coral reefs, should fund research to establish the appropriate indicator species to detect changes in baseline ecosystem health.

26. Applying Marine Biodiversity Towards Better Ecosystem Management

Earth's ecosystems provide essential processes and services that support human survival and well-being. Thus, an ecosystem approach to management (EAM), encompassing consideration of direct and indirect effects on and interactions among both biotic and abiotic ecosystem components, is now the preferred means of implementing marine resource management. Because biodiversity may play crucial roles in the maintenance of ecosystem functions and services, conservation of natural biodiversity is a central part of EAM. Understanding biodiversity's role within an ecosystem is critical when addressing demands of various stakeholders, managers, and policy-makers. It is critical that policy makers and managers better recognize the extent to which biodiversity not only relates to ecosystem function, but is essential to sustaining human life. To a degree, the future of marine biodiversity research relies on the ability of successful programs and committed scientists to relate their findings, strategies and challenges to managers, decision-makers, and the public. This session explored how to better apply our current knowledge of marine biodiversity to ultimately guide future endeavors and ensure improved marine policies and management within the United States and resulted in the following recommendations for action.

Task 1. The Administration and Congress should establish conservation of natural biodiversity as a national priority and undertake specific actions to implement that policy. Such actions should include, but not be limited to, endorsing and implementing the Valencia Declaration, establishment of a U.S. system of fully protected marine reserves, and support for international biodiversity efforts, which include evidence-based approaches from all major marine ecosystems and programs, such as the international Census of Marine Life.

Task 2. Congress, the Administration, and state governments should require use of the best available scientific information relating to energy, land use, and other projects; such information should encompass consideration of the impacts on marine biodiversity over the long term via a continuing focus on key biodiversity indicators.

Task 3. Congress, federal, state and tribal agencies, NGOs, and private business should develop, fund and complete an effective ocean observing system that includes, as an integral component, measures of marine biodiversity at all appropriate organizational scales.

Task 4. The ocean science community, with involvement from resource managers, should develop, test, and implement marine biodiversity decision support tools for enabling EAM.

Task 5. Scientists and managers should ensure that marine biodiversity programs incorporate the following elements: (1) development of new technologies for research and for education; (2) enhanced understanding of diversity, distribution, abundance and connectivity (including monitoring), patterns and processes; and (3) solutions to environmental and societal problems.

Task 6. Education institutions at all levels should promote and employ multi-disciplinary approaches to education that incorporate an understanding of biodiversity and other ecological concepts with communication skills to enhance public ocean literacy.

Task 7. Government, industry, and academia should support a science-industry interface to develop best practices for industries tied to major threats of marine biodiversity.

Task 8. The Federal government, working with industry and the states, should set up a system of marine biodiversity risk bonds that industry, with investments above a certain threshold, would be required to put up as insurance against unanticipated environmental impacts resulting from investment over the life of new projects.

Task 9. The ocean science and education communities should foster the development of effective and consistent curricula, education and outreach programs that articulate the societal benefits of biodiversity exploration and conservation.

27. The Global Loss of Amphibians

This session will focus on current scientific and conservation work to counter the recent worldwide tide of extinctions and population declines of amphibians, the prime example among vertebrate animals of the loss of biological diversity globally.
Aspects to be considered are ongoing worldwide threats and the adequacy of responses under the Amphibian Conservation Action Plan; the nature and epidemiology of a principal cause of losses -- a pathogenic chytrid fungus; direct and synergistic effects of agrichemicals: consequences for ecosystems; climate change effects; and the state of emergency responses for critically threatened species.

- Task 1. The U. S. Congress should enact a conservation act for amphibians, similar to the Great Ape Conservation Act, in order to provide dedicated funding for conservation and research efforts to address the global crisis of declining amphibian populations and species extinctions. The Department of the Interior in general, and its USFWS and USGS specifically, should be directed by such an act to implement and support appropriate conservation and research actions nationally and internationally. Other federal agencies, such as U. S. Forest Service, USAID, NIEHS, NOAA, and EPA, should be directed to cooperate and collaborate in these efforts, in effect making the USGS National Amphibian Research and Monitoring Initiative a multiagency endeavor.

- Task 2. The U. S. Congress should dedicate specific funds within the NSF and NIH programs to support basic research on amphibian ecology and evolution pertinent to the conservation of this class of vertebrate animals.

- Task 3. The U. S. Congress should provide funding for increased support and expanded capacity of the USGS Wildlife Diagnostic Lab to act as a National Center to monitor and measure amphibian diseases, deformities, and the effects of contaminants on them. This work should be done in conjunction with the

development of a national network of amphibian specialist positions in relevant state and federal agencies (i.e., create Green Jobs to monitor and promote the health of amphibians).

- Task 4. The EPA should require that at least one native amphibian species be included in testing of all chemicals that may be applied to the environment (e.g., pesticides, heavy metals, industrial wastes), in order to determine lethal and sublethal effects.

- Task 5. The U. S. government should support national and international policies and programs that monitor and regulate the spread of exotic and farmed species of amphibians and also diseases and contaminants that affect amphibians. As part of this effort, the USDA should cooperate with the Office International des Epizooties.

- Task 6. NIEHS should dedicate funds to support research on amphibians as sensitive indicators of environmental health.

- Task 7. The U. S. Congress should redefine wetlands to be more inclusive of all such habitats used by amphibians, so as to better guide the EPA, Army Corps of Engineers, other agencies, and the private sector to develop proactive programs to protect national water quality and all flora and fauna inhabiting and using wetlands.

28. Microbial Diversity

Microbial diversity encompasses the spectrum of variability among all types of microorganisms (bacteria, fungi, viruses and many more) in the natural world and as altered by human intervention. Microorganisms are essential for the earth to function. They play many roles both on land and in water, including being the first to colonize and ameliorate effects of naturally occurring and man-made disturbed environments. Because microorganisms are small, they are least known, and this gap in knowledge is particularly apparent for bacteria and other procaryotic organisms. Current evidence suggests there exist perhaps 300,000 to 1 million species of procaryotes on earth yet only 3,100 bacteria are described. There are relatively poor connections between those who study microbial diversity and those who study other aspects of biodiversity, and microorganisms are often ignored in biodiversity research and conservation plans. This session will consider research needs for microbial diversity and also how to better engage microbial science into broader discussions of biodiversity research and conservation.

- Task 1. Numerous partners, including professional societies, science writers, biology teachers and thought leaders should elevate education towards microbial literacy in college graduates and the general public, and do so using all modern and emerging media outlets.
- Task 2. Federal agencies (NSF, NIH, NOAA, EPA, USDA) should invest in microbial diversity and habitat studies - especially of extant environments that are the focus of climate change studies and other classes of environmental perturbation.
- Task 3. NIH and NSF should invest in studies of microbial evolution and co-evolution, including microorganisms as drivers of evolution in hosts.
- Task 4. APHIS, NIH, NSF and the Department of the Interior should invest in studies of the microbiomes of endangered species.
- Task 5. The Department of Defense, the Department of Energy, NSF, and EPA should invest in development of technologies to harness the vast diversity of microbial physiology (e.g. carbon and sulfur scrubbers, bioelectricity, advanced fermentations, therapeutics and recycling).

- Task 6. The FDA, NIH and pharmaceutical companies should invest in the characterization of the microbial pharmacopea and other microbial prospecting targets inherent in the Earth's biodiversity.

29. Biodiversity Conservation: Employing Markets and Payments for Ecosystem Services.

This session will (1) describe lessons learned from current programs that are implementing markets and payments for ecosystem services (PES) to achieve biodiversity conservation; (2) identify constraints and strengths of current approaches; and (3) discuss and propose a set of recommendations that would provide increased applicability and credibility for ecosystem service markets and payments for biodiversity conservation. The session will also address two questions: (1) can payments and markets for ecosystem services such nutrient recycling, carbon sequestration, etc. result in biodiversity conservation, and (2) can such market mechanisms as mitigation banking and trading for habitats and particular species result in attaining biodiversity conservation goals. The session will also address recommendations to measure and value the contribution of increased ecosystem services for conserving biodiversity.

- Task 1. The new USDA Office of Ecosystem Services and Markets should take the lead in providing primary research and outreach in order to generate increased demand, both regulatory and voluntary, for viable markets and payments for ecosystem services on private lands.
- Task 2. Through various Federal agencies and a new economic stimulus plan, the Congress and the Administration should promote the investment in green infrastructure (floodplain restoration, etc.) to offset the negative environmental impacts of gray infrastructure.
- Task 3. The new USDA Office of Ecosystem Services and Markets, in collaboration with the National Science Foundation, should investigate the creation of markets for multiple ecosystem values/services, specifically evaluating the potential for at bundling ecosystem services in a single market that maintains the ecological integrity of the services provided.
- Task 4. Federal and state agencies, in collaboration with the private for-and-non-profit sectors should improved marketing and communications to policy-makers, buyers and sellers, and to the general public as to the potential benefits associated with ecosystem service markets. This communication needs to be user friendly.
- Task 5. The USDA Office of Ecosystem Services and Markets should guarantee broad stakeholder involvement in the federal Ecosystem Markets Standards Board, and provide transparency in the Board's operations and decision-making processes..
- Task 6. Federal agencies should collaborate with the private sector to develop metrics and/or indicators that define ecosystem services as commodities and which are are cost-effective, administratively feasible, and credible.
- Task 7. The USDA Office of Ecosystem Services and Markets should take the lead in developing a strategic research program to support ecosystem service market development with a strong adaptive management component.
- Task 8. A permanent Federal agency task force should be established to map, quantify, and monetize services across US ecosystems, including terrestrial, aquatic, and marine. This information would service as a baseline for future ecosystem service market development.

30. Conservation Law and Policy Priorities for a New Administration and a New Congress

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This breakout session will draft recommendations on the use of existing laws and new legislation to help protect and responsibly use biodiversity. We will cover several major statutes and treaties, including the Endangered Species Act, the National Environmental Protection Act, the National Forest Management Act, the Marine Mammal Protection Act, and the Convention on Biological Diversity and its protocols. We will lead off by briefly reviewing the status of existing laws, and what may need to change to meet challenges to biodiversity in the present political and scientific context. Invited discussants will seed the discussion with their own ideas for change. Then we expect a lively open discussion, leading to concrete suggestions for the new Congress and Administration, as well as federal agencies responsible for administering the laws.

- Task 1. The President should issue an Executive Order directing agencies to conserve biological diversity, with particular emphasis on public lands and water and including incentives for private land conservation. This process should include several steps including agency reviews of existing authorities and practices, recommendations to [and from CEQ/OSTP] OMB and CEQ and responses, followed by revisions to the extent authorized and requests to Congress for additional authority and alterations in appropriations.
- Task 2. Each agency should review its authorities, regulations, initiatives, waivers, spending, and related international agreements and report to the President, CEQ, and domestic advisory bodies on changes required to conserve biodiversity.
- Task 3. Review and extend biodiversity legislation *(e.g.* restore National Forest Management Act requirements to maintain viable wildlife populations and extend them to BLM public lands).
- Task 4. Ratify of several of the more universal conservation treaties including the Convention on Biological Diversity, UNCLOS (Law of the Sea), the Convention on Migratory Species and/or agreements under the CMS. Work with all stakeholders to develop additional legislation or funding, as needed to achieve biodiversity goals compatible with these treaties.
- Task 5. Congress should appropriate more funding and ensure capacity building for biodiversity assessment, monitoring, and conservation and reduce spending for those things that reduce biodiversity.
- Task 6. Establish biological and economic baselines, e.g. green GDP, trends and targets with the assistance with a new Bureau of Sustainable Consumption and the Bureau of Economic Affairs under the Department of Commerce.
- Task 7. Renew and expand support for environmental, science and math education w/in the Dept of Education, the National Science Foundation, and other agencies, academies, and venues.
- Task 8. OMB, Office of Government Ethics, and agency heads should adopt new regulations to protect the integrity of scientific data in the decision-making process and increase accessibility to data and transparency of decision-making (e.g. E.U. Directive on "accountable expertise.).
- Task 9. In making decisions affecting economic growth, factor in the full impact on biodiversity and long-term costs and benefits of alternative courses.
- Task 10. Incorporate participatory governance and precautionary principles and the UN Principles on Responsible Investment across federal agencies.

31. Putting Biodiversity Back on the US Political Agenda

Twenty years after national biodiversity legislation was first introduced in the US Congress, political support for protecting life's diversity remains minimal. There is considerable interest in protecting elements of biodiversity – charismatic and endangered species, agriculturally important genotypes, and spectacular and attractive ecosystem

types. Despite scientific understanding of the interconnectedness of life, the challenges of even thinking about conserving the totality of genes, species, ecosystems and evolutionary and ecological processes and phenomena is daunting. Ironically, rapid global climatic disruption, now the greatest threat to biodiversity, has pushed biodiversity even further off the public and political agenda. Meanwhile, biodiversity continues to decline at an alarming, but generally unrecognized rate. This session will explore strategies for putting biodiversity back on the US political radar screen.

- Task 1. Initiate a campaign focused on specific policies with constituent building (including scientific community and specific goals, objectives and plans). The campaign should be a massive coordinated effort, involve international conservation, be lead by the President and the new administration, a broad-based coalition, be based on roadmaps in issue areas with new partners (labor, local government, health, faith based organizations), and feature messages that are easily understandable and include specific goals, objectives and plans.
- Task 2. Conservation groups should develop messaging linking biodiversity to other environmental and social issues. Issues to be linked include (but are not limited to): security, sustainable development, ecosystem services, ecosystem based management, energy security, health and climate change. This will aid in reducing the conception that biodiversity is peripheral and a luxury.
- Task 3. Conservation groups should produce a report on biodiversity and how losses of biodiversity affect humans, carried out by a reputable organization (such as the National Academy of Sciences). Information should be easily accessible, understandable and aid in determining policy decisions.
- Task 4. The new Administration should pursue including: US ratification of the Law of the Sea Treaty and the Convention on Biodiversity, ensuring that biodiversity is a part of the climate change and wildlife adaptation, and incorporating international conservation into plans for development assistance.

32. Ramping up the public connection: Strategies and tactics for mobilizing public will for biodiversity conservation

This session will build on the diverse communications capacities of participants to identify near-term opportunities and actions to apply the best practices of social change communications to biodiversity awareness and conservation actions. Resource people will be on hand to lead discussions on particular topics of interest to the participants, and we will also allow time for group discussion across topics. We will emphasize approaches that will produce "big shifts" rather than incremental steps.

- Task 1. Participants in this conference should organize a new Life on Earth Coalition to define policy solutions and serve as a base for a new National Communications Campaign on caring.
- Task 2. The Administration should set up a council of environmental policy makers (like the economic council) that would explore leading indicator indices (social and environmental and health), employ systems-level thinking to address the complex and inter-related environmental problems we face and to overcome our current siloed approach. The council would recognize and communicate about upstream and downstream environmental and health effects of decisions in transportation, energy, water, food, land use and city planning.
- Task 3. Environmental communities should utilize social media (people-to-people online networks) to engage media consumers and train new media/journalists in necessary science.

- Task 4. The Department of Education (and other education partners) should promote and support K – 12 education by creating standards of learning that include biodiversity knowledge and practices and provide state funding to study local biodiversity education (in the classrooms).
- Task 5. Health care providers should provide incentives/credits for biodiversity experiences in families (especially for low income and disadvantaged kids).
- Task 6. There should be a Department of the Ocean, which should develop a new marine/aquatic biodiversity education program to raise the profile and action on marine biodiversity.
- Task 7. The Administration, especially the Department of Defense should acknowledge that the importance of biodiversity in other countries is important for preventing conflict and help establish an international green-keeping force to prevent the emergence of conflicts. The DOD should make it an explicit part of their mission to preserve national security by protecting international biodiversity.
- Task 8. The philanthropic community should support a new nationwide study of biodiversity attitudes, behavior, values, and concerns including the links between biodiversity and climate.
- Task 9. The National Endowment for Humanities and cultural institutions should collect and disseminate stories of life (connections that are related to biodiversity).
- Task 10. The federal government should put more resources into public lands addressing the run down campsites, lack of security, and high admission prices to parks to foster access to and establishing relationships with biodiversity on public lands.

33. Biodiversity in Education: Training the Next Generation of Scientists and Achieving Literacy for Decision-makers and the Public

A knowledge and understanding of biodiversity is the foundation for addressing the challenges facing the scientific community in developing the science tools to conserve biodiversity in the face of unprecedented threats such as climate change. It is also a necessity for effective policy-making that must be made rapidly if we are to sustain biodiversity. The barriers to biodiversity education need to be addressed and a blueprint for the most efficient mechanisms and effective messages to educate the various audiences needs development. We will focus on short-term and long-term goals for biodiversity education that meets the needs of resource managers and policy makers, the workforce in public and private research, and a biodiversity literate public who can make informed personal and political decisions.

- Task 1. Education policymakers and schools of education should promote outdoor education, active learning, community engagement, inquiry based, and experiential learning in grades K-12 (both for students and for teacher training). Allow greater flexibility in learning standards to encourage integration.
- Task 2. At the university level, continue experiential learning, support career planning, connect college students with agencies and employers, and encourage the involvement of historically underrepresented students to promote pursuing science as a career.
- Task 3. Universities and scientific societies should encourage new partnerships between education and practicing experts in various disciplines in order to answer questions relating to biodiversity.
- Task 4. Develop a biodiversity network for academia, science, industry and the public.
- Support environmental study abroad programs at different levels.
- Task 5. Conservation organizations and agencies should market biodiversity awareness to the public as a concern in daily life.

- Task 6. Increase appreciation and support for citizen scientist programs and in-country activities geared towards biodiversity and conservation initiatives.
- Task 7. Support capacity building locally and globally for biodiversity protection.
- Task 8. Encourage value based decision making regarding the benefits and the moral/cultural values of biodiversity in academia and the public
- Task 9. Globally, the U.S. should take and active role in the 2010 International Year of Biodiversity Conservation.

34. Building an Adaptive Ark: Conservation Leadership in a Rapidly Changing World

Biodiversity conservation in the 21st century brings unprecedented challenges that require new leadership and new forms of leadership at many levels. There is a great need for leaders who can integrate across science, policy, and management fields—and do so in manner that is adaptive to rapidly changing social and ecological conditions. This breakout session will develop a set of recommendations for improving leadership capacity for biodiversity conservation, drawing on the experience of panel members and participants. Recommendations will be sent to several audiences including the new US administration, executive leaders and human resource departments in key agencies and NGOs, university administrators, and boards of professional conservation and environmental societies.

- Task 1: The Obama Administration should promote leadership development as an essential component of its environment, energy, and economy agenda. Improved, broad-based leadership capacity will be essential to addressing these long-term, interrelated challenges. Several approaches are key:
    - Call on individuals from all walks of life to mobilize around the environmental issues they care deeply about.
    - Give citizens new opportunities to interact with government and policy making through the Internet and leadership training.
    - Provide a primer on leadership and offer resources on leadership development on Whitehouse.gov.
    - By mid 2009, convene an energy, environment, and economy summit bringing together business, academia, non-profit and government organizations. The summit should set an agenda for the long-term transformation and revitalization of these sectors, while catalyzing a new era of environmental leadership and capacity building.
    - Develop a new, a cross-agency environmental leadership program that builds leadership capacity and new collaborations among agencies.
    - Develop and present a unified vision of ***sustainability*** as an organizing theme for government, education, energy use, and environmental leadership. The federal government should reward sustainable practices and innovations through new policy incentives, leadership awards, and communication campaigns.

- Task 2. The US must reestablish itself as a legitimate global environmental partner by taking the lead in capacity building and leadership development throughout the world, through cultural exchange and skills sharing. Congress should increase funding to international exchange programs, in order to increase US global responsibility and build international collaboration and understanding.

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Recommendations:
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- Task 3. A partnership of NGOs, government, university, and businesses representatives—convened by a group such as the National Council for Science and the Environment—should conduct an assessment of existing environmental leadership development opportunities and create a comprehensive website describing them.