



Twenty-first Century Ecosystems Managing the Living World Two Centuries After Darwin Summary of a Symposium (2011)

The publication of the 1988 National Academy of Sciences / Smithsonian Institution report *Biodiversity* helped reframe the concept of biological diversity as a “global resource, to be indexed, used, and above all, preserved,” and captured the attention of the public and policy makers. In subsequent decades, studies of biodiversity broadened further to encompass diversity at the genetic and ecosystem levels. Concepts of ecosystem services and natural capital emerged as a means of illuminating and capturing the value of biodiversity and ecosystems to human well-being, and fueled international approaches to the conservation of biological resources. By 2009, scientific and technological advances offered new opportunities for the synthesis and analysis of biological data. Yet the scientific community was increasingly aware of the limitations of current knowledge, including the rapidity with which biodiversity, and the services it provides to human societies, were being modified and eroded. One hundred and fifty years after Darwin offered a framework for comprehending the origin of diversity in the natural world, humankind is undertaking a vast, uncontrolled global experiment in the reorganization of natural systems, the full consequences of which will be played out over millennia.

“Instead of seeing the preservation of biodiversity as a heinous, expensive task without reward, view biodiversity correctly as the source of innovations for the coming century and the solutions to many of the problems facing humanity. Our lives depend on knowing about it and taking advantage of it.”

Michael Donoghue, February 11, 2009

The Symposium on Twenty-first Century Ecosystems, held in 2009 on the 200th anniversary of Darwin’s birth, was conceived by the U.S. National Committee for DIVERSITAS to highlight the ecological dimensions of critical challenges facing the world and our nation. This report focuses on the complexity and interrelatedness of these issues, drawing on eight overlapping themes that emerged from speakers’ presentations. The themes are linked by the idea of a systems-based approach to both research and decision making about twenty-first century ecosystems. Drawing on these concepts may help those scientists, nongovernmental organizations, and policy makers who are working to improve the future management of biodiversity and ecosystems, as well as the goods and services on which we all depend.

Theme 1: Learning What We Have. Successful management of biodiversity is founded on knowledge of the variety of life, the processes by which it is sustained, and the ways in which it functions within ecosystems. Speakers in several sessions highlighted significant deficiencies in human knowledge of biological diversity and the processes through which species interact, but they also described new technologies, approaches, information systems, and analytical tools. These give scientists the potential to realize a step-change in the ways that information about species and how they are changing is acquired, maintained, and used.

“Ecosystem services must be part of the national debate, and among those services is the power of nature to inspire awe and wonder.”

Larry Schweiger, February 12, 2009

Theme 2: Learning How Ecosystems Work and are Changing. Several speakers described challenges to ecosystems that are unprecedented in their magnitude, rate, and diversity, many resulting from human activity such as increased international trade. Changes occur at all scales—from global to highly local—and have implications for ecosystem degradation, rapid evolutionary changes, and the health of animals, people, and plants. With increased understanding of the functioning of ecosystems has come greater insight into the complexity of such systems and the difficulty of managing the consequences of human-induced changes.

Theme 3: Saving What We Can. Symposium speakers proposed an array of strategies for saving biodiversity and sustaining ecosystem functioning founded on the best possible understanding of what biodiversity exists, how organisms interact, and how these organisms and systems are changing. They emphasized the importance of public engagement, awareness, and support for successful conservation and management interventions.

Theme 4: Managing Ecosystem Services as Complex Adaptive Systems. In each session, speakers cited the trade-offs among ecosystem services, emphasizing the need to integrate the often fragmented approaches to research on and management of ecosystems for human benefit. They cited the need for cooperative strategies among disciplines and across jurisdictions, both public and private, designed to avoid unintended negative consequences where possible, but with ongoing adaptive capacities as knowledge and systems continue to evolve.

Theme 5: Increasing Capacity to Inform Policy Through Integrated Science. The ecosystem services framework has helped demonstrate links between ecosystem functioning and the economy and other aspects of human well-being. Speakers at the symposium explored the integration of economics and social science into natural science approaches to biodiversity and ecosystem management to support the development of effective public policy, with the purpose of providing comprehensible information to decision makers at all levels, both public and private. Such scientific input benefits from awareness of the strengths and limitations of research results and of the complexities of policy making.

“Policy makers, assessment groups, agencies, and commissions, among others, need to be better coordinated to take into account the interactions among the drivers of global change, and their separate and synergistic impacts.”
Stephen Schneider, February 12, 2009

Theme 6: Increasing Societal Capacity to Manage and Adapt to Environmental Change. Environmental changes, from climate change to introduced pests and pathogens, can threaten both ecosystem functioning and the services that human beings derive from ecosystems. Several speakers suggested that both scientific progress and public education will be necessary to develop and implement well-formulated strategies for mitigation and adaptation. Climate shifts and other environmental changes that are already ongoing—and likely to intensify, some speakers contended—demand attention at every scale, from global to local, in all parts of the world.

Theme 7: Strengthening International Institutions and U.S. Engagement and Leadership. Several speakers called for increased international cooperation to meet the scale and scope of threats to biodiversity and ecosystem services, mentioning specifically the opportunities offered by enhanced trade regulation and the nascent Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES). They emphasized the importance of U.S. leadership, given the nation’s economic and scientific resources.

Theme 8: Accounting for the Value of Nature. A number of speakers described the damage to ecosystems and biodiversity caused by economic incentives and social pressures that favor short-term exploitation rather than long-term sustainable management. Ecosystem services—some as fundamental as fresh water—can be damaged or destroyed because they are outside the market. Proposals were made in some presentations to expand the system of national accounts to include changes in non-marketed ecosystem services and the value of ecosystems, with the purpose of fostering policies to promote sustainable economic growth and assure availability of vital ecosystem services.

“Ecosystems are capital assets—part of national wealth, but loss of wealth associated with declining ecosystem services is not reflected in national accounts.”
Harold Mooney, February 11, 2009

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For More Information

Copies of *Twenty-first Century Ecosystems: Managing the Living World Two Centuries After Darwin – Summary of a Symposium* are available from The National Academies Press; call (800) 624-6242 or (202) 334-3313 (in the Washington metropolitan area), or visit the NAP website at www.nap.edu. To learn more, visit the U.S. National Committee for DIVERSITAS website at www.nationalacademies.org/usnc-diversitas, where video recordings of the lectures are also available.