

New ecological knowledge and practices for society and sustainability

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As attributes of the Earth's ecosystems shift in the face of human impact and sustainability of ecosystem services becomes less certain, one important tool at the disposal of the scientific community and other groups is a blueprint for understanding, evaluating, and communicating the value of ecological services. The blueprint presented here is based on (1) an examination of the ecological and societal trade-offs accompanying any given action, (2) revised methods of communication, and (3) coordination of actions at many different scales. The Mexican National Commission for the Knowledge and Use of Biodiversity (CONABIO) is a good example of a demand-driven "bridging institution" between academia, government, and civil society, and it works to collect and convert scientific information into information for policy, management, and conservation. Intergovernmental organizations like the United Nations Educational, Scientific and Cultural Organization (UNESCO) are well placed to facilitate such coordination at the international level, through their work with member states. Through collaboration with the constituencies of such organizations as the Ecological Society of America, the blueprint described below has the potential to become an important tool for assessing and managing threats to ecosystem services that are essential to life.

Dado que las características de los ecosistemas de la Tierra cambian debido al impacto humano y la sustentabilidad de los servicios ecosistémicos se vuelve más incierta, una herramienta importante a la disposición de la comunidad científica y de otros grupos es un plan para entender, evaluar y comunicar el valor de los servicios ecológicos. El plan que presentamos aquí se basa en (1) una examinación de los compromisos ecológicos y socio-económicos ligadas a cualquier acción, (2) métodos de comunicación actualizados y (3) coordinación de acciones a muchas escalas diferentes. La Comisión Nacional para el Conocimiento y Uso de la Diversidad (CONABIO) de México es un buen ejemplo de una "institución puente" entre los sectores académicos, gubernamentales y la sociedad civil, dirigida por la demanda y que busca coleccionar y convertir la información científica en información útil para desarrollar políticas para el manejo y la conservación. Organizaciones intergubernamentales, como la Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura (UNESCO), están bien posicionadas para facilitar esta coordinación a un nivel internacional a través de la labor de los estados que la componen. Gracias a la colaboración con miembros de organizaciones como la Ecological Society of America, el plan que se describe más abajo tiene el potencial de convertirse en una herramienta importante para evaluar y manejar las amenazas a los servicios ecosistémicos que son esenciales para la vida.

Front Ecol Environ 2007; 5(4): W5–W7

The Earth is undergoing an intense period of ecological change due to human activity. The industrial revolution and increasingly intensified exploitation of the Earth's resources have thrown into question the future of resource availability and the ecosystem services on which human

well-being depends. These changes have important implications for the ecological sciences, as well as for society, and the term "new ecological world order" has been used to describe the pervasiveness of human impacts (Hobbs *et al.* 2006). These ecological changes are apparent at local to global scales and include alteration of species assemblages and biological extinction (populations and species), reduced resilience to disturbance, ecological processes moving beyond historic ranges of variability, ecosystems crossing thresholds into different states, and disruption of major biogeochemical cycles (MA 2005).

The rapidity and magnitude of environmental changes have facilitated a shift in ecological thinking. There is now widespread recognition of human agency in environmental transformation. Many ecologists are initiating studies into how ecosystems can continue to supply necessary goods

Workshop: New ecological knowledge and practices for society and sustainability

Organized by: S Arico and N Ishwaran

Ecology in an era of globalization
Ecological Society of America International Conference
Merida, Mexico; 8–12 Jan 2006
<http://abstracts.co.allenpress.com/pweb/esai2006/schedule/>

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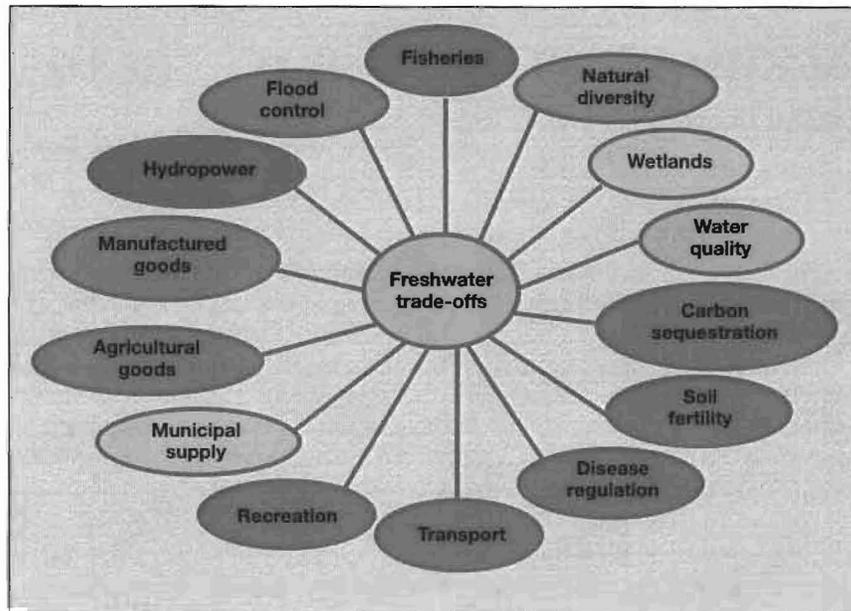


Figure 1. Human uses of freshwater resources should be compared to trade-offs in the essential ecosystem services they provide.

and services, how to make local human needs compatible with biodiversity conservation (particularly in the developing world, where most of the Earth's biodiversity is found), how to maintain and restore biodiversity in human-dominated landscapes, and how to quantify and communicate the value of ecological services to decision makers at all levels. These were the themes of a workshop organized by the United Nations Educational, Scientific, and Cultural Organization (UNESCO), as part of the Ecological Society of America's (ESA) Merida conference.

A main outcome of the workshop was the development of a blueprint for scientists and organizations to understand, evaluate, and communicate the value of ecological services. The blueprint approach goes beyond simple recognition of the importance of natural resources and ecological processes to human and societal well-being. Instead, it is based on three suggested elements: (1) an examination of the trade-offs accompanying any given action, (2) revised methods of communication, and (3) coordination of actions at many different scales. The blueprint requires explicit interdisciplinary collaboration from the outset, including collaborations with social scientists, engineers, local communities, the private sector, and government bodies that design and implement policies. Ultimately, the approach aims to evaluate how ecological resources change with human-caused alteration and to quantify the impact of environmental degradation on human welfare, while placing firm emphasis on effective communication of this knowledge to government and private organizations and local populations. Finally, the blueprint highlights the need for collaboration among stakeholders to protect, restore, and monitor ecological resources and the services they provide.

The first element of the blueprint – describing environmental change in terms of trade-offs – is an innovative and effective way of explaining the impacts of human activities on natural resources and the services they provide. During the workshop, this was applied to freshwater ecosystems by comparing societal benefits that come from manipulating these systems to the inadvertent negative ecological impacts of such manipulation and, ultimately, the consequences to society. The benefits of having a reliable freshwater supply, for example, are countered by the costs of losing floodplain fertility and species migration corridors, as well as the movement of essential nutrients downstream and into estuaries (Figure 1). Trade-offs are also

evident in tropical forest management, where the production benefits of conversion to cattle grasslands can be weighed against the costs of losing carbon sequestration, climatic regulation, water purification, erosion control, nontimber forest products, and traditional knowledge and culture. Quantifying the trade-offs and impacts of any given scenario could be useful in comparing the value of maintaining natural services as compared to the value of services for societal use only. More of these small- to regional-scale quantitative comparisons are needed in applying the science of ecology to the practice of sustainability. Examining trade-offs in this way provides a new perspective on societal choices regarding ecosystems and the services they provide.

The second element in addressing contemporary ecological challenges is the importance of finding new ways to communicate across disciplines and with policy makers and local populations. This means envisioning the audience from the outset, in order to keep data as relevant as possible. It also signifies a need to find new ways to communicate scenarios to local communities and to explain the long-term benefits of modifying attitudes and behaviors to align with the sound utilization of natural resources. For example, the evidence-based approach used by natural scientists when providing information on biodiversity loss and ecological services still seems too “soft” and abstract to policy makers and non-scientists; it would likely be of great benefit to devise an appropriate model for assessing the qualitative as well as quantitative values of these goods and services. Packaging ecological information in different ways is one method used to make it more accessible and useful to non-scientists. This would facilitate the translation of new information into policy, while making it more meaningful to the daily lives of the general population.

The third element of the blueprint is the coordination of interventions on different scales. There are currently many local, national, and global initiatives to promote the role of ecological sciences in society, but linking them in the context of a coherent framework for cooperation is quite difficult. These initiatives are often significantly hampered by institutional inertia, and it may therefore be more beneficial to maximize depth of cooperation among relevant existing initiatives instead of creating new ones. Promoting collaborations among different initiatives is not easy and considerable debate continues over its implementation.

A good example of this third element is the coordinating role of intergovernmental institutions, such as UNESCO. UNESCO's mandate is to respond to the needs of its member states (191 as of January 2006) by synthesizing scientific information relevant to global problems, providing a forum for designing and coordinating new regional and global scientific programs, and building the scientific and technical capacities of member governments. Intergovernmental organizations can help to coordinate meetings and communication forums where groups facing similar challenges can exchange and synthesize knowledge, create knowledge and project networks, and encourage capacity-building and the dissemination of specific examples.

Recent work based on this blueprint approach highlights the need to strengthen ecology-related collaborations at all levels, including from the standpoint of formulating research agendas, one obvious addition to which is a deeper understanding of the structure and function of previously undescribed ecosystems. It is uncertain whether conventional ecological theories remain relevant as novel conditions are produced, since these phenomena generally lack historical analogues. Our knowledge about thresholds and the frailty of the resources and ecosystem services on which humans depend is limited, as is information about realistic mechanisms for preventing, reducing, and reversing harmful ecological trends. The agenda should also include further study of the impacts of human migration on biodiversity, the need to revise existing methodologies for incorporating local people and socioeconomic factors into ecological studies, and the distinct roles of agencies and individual ecologists in biodiversity research. These shifts in ecological thinking and research agendas could produce knowledge that is both more relevant and more easily disseminated for the benefit of society. This could help us to meet targets related to issues such as ecosystem services, climate change, and biodiversity loss.

A good example of this kind of approach was introduced at the workshop. The Mexican National Commission for the Knowledge and Use of Biodiversity (CONABIO) was created in 1992, in response to the realization that Mexico is among the five countries in the world with the highest biodiversity. CONABIO acts as a demand-driven "bridging institution" between academia, government, and civil society in Mexico, and works to collect and convert scientific information into informa-

tion for policy, management, and conservation. It also provides data and interpretations directed toward specific sectors of society, including agriculture, health, energy, economy, and tourism, and collaborates with similar organizations around the world. In its daily operations, CONABIO represents a concrete application of the proposed blueprint, in that it collects the scientific information necessary to decide on trade-offs, communicates this information to concerned organizations and stakeholders, and coordinates action across different sectors of society. CONABIO's experience could be very useful to other countries interested in exploring this type of approach.

The aim of this workshop was to discuss how UNESCO, ESA, and their partners could collaborate to address contemporary understanding of environmental and social problems caused by the global impacts of human activities. One outcome was the blueprint described above. Another was recognition of the importance of individual action, and the benefits that individual ecologists and ecological societies can gain from collaborations with international organizations. For instance, UNESCO is well placed to act as an interface between the scientific community and governments, but it requires the support of individual scientists, who stand to benefit from the collaboration in turn. Suggested future steps included conducting a more in-depth workshop on the incorporation of ecological sciences into policy making and implementation. UNESCO also plans to develop an outreach-motivated article on the ecological blueprint, to be published in Spanish, English, and French and distributed to its member states and field offices.

New challenges and questions arising from anthropogenic changes to the Earth are not limited to the ecological sciences, nor is the utility of the blueprint approach limited to that sector. Policy makers, the private sector, local populations, and the scientific community can all learn from the individual elements and from the blueprint approach as a whole. By examining environmental trade-offs, developing new and more successful ways to communicate across sector boundaries, and coordinating among local populations, we can achieve better conservation of the ecosystem services that are key to human well-being, for the benefit of man as well as nature.

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