Biodiversity Science Evolves

The planet's biodiversity is increasingly threatened by human activities. We have heard this before, and the global mantra to stop the damage has forged numerous international panels and agreements over the past 15 years. Yet despite these efforts to ensure biodiversity conservation, we have witnessed extensive population extinctions and massive deforestation and fragmentation of natural habitats, and we may even see the geographic contraction of major ecosystems, such as the tropical rainforest in its northernmost distribution in the Americas. Our quantification of species extinction is poor, yet we do know that the number of threatened species, including the most charismatic animals, is considerable. For example, 25% of all the mammals on the planet are endangered. Obviously, there continue to be problems with enforcing conservation in the face of social and economic growth in industrialized and developing countries.

This week, DIVERSITAS, the international program on biodiversity science, is holding its first open science conference in Oaxaca, Mexico, to discuss why the challenge of biodiversity conservation—arguably one of the biggest challenges facing modern society—remains so formidable, and how the international scientific community can be moved into action to address this problem. The timing of this conference is appropriate: It follows the Millennium Ecosystem Assessment, released in May 2005, which provides a comprehensive analysis of past and future trends in the state of ecosystems and discusses what information is necessary to inform policy decisions on conservation.

Increasingly robust databases on species distribution and analytical tools such as remote-sensing and climate change models have allowed us to make substantial progress toward understanding biodiversity distribution and rates of change. Likewise, we have begun to explore synergies between the drivers of biodiversity change, and there is a greater understanding of the relationships between biodiversity and ecosystem functioning. However, although compelling, these findings and knowledge are still being interpreted in isolation from one another, and this has perhaps been one of the major problems in achieving the goals of protecting biodiversity. The biodiversity scientific community is fragmented among types of ecosystems (terrestrial, freshwater, and marine); types of organisms (such as vertebrates, invertebrates, plants, and microbes); and, perhaps most critically, among disciplines (taxonomy, molecular biology, ecology, and socioeconomic sciences). Consequently, biodiversity science has been undervalued by the policy sectors.

As an important move toward integration, the DIVERSITAS conference, "Integrating Biodiversity Science for Human Well-Being," is providing a venue for researchers and students from different disciplines, as well as policy-makers, to assess the current strengths and weaknesses of biodiversity science and its main future challenges. The scientific challenges are enormous. We need many new technologies: molecular and bioinformatic tools to examine Earth's biodiversity; a coordinated observation system and standardized methods to monitor biodiversity; integrated analyses and models of social, ecological, and evolutionary processes to predict future biodiversity changes; and large-scale experimental facilities and new models to understand and predict the multiple effects of biodiversity changes on ecosystem services and human societies. At the same time, new approaches are needed to optimize the multiple uses of biodiversity in ways that consider tradeoffs and conflicts between conservation and development options and that incorporate the ethical dimensions of biodiversity conservation. Conservation in human-dominated landscapes as well as protected areas (only 10 to 11% of the land surface) will require that it become a socially and economically attractive activity that takes into consideration local inhabitants and landowners. This will require new economic approaches to ensure that rural inhabitants are compensated when they opt to conserve their land. The Costa Rican experience of sustained programs of payment to farmers as compensation for setting aside forest for biodiversity conservation and ecosystem services is a promising example.

For biodiversity science to progress so that it produces socially relevant knowledge—in the sense that it can help society to better understand and capitalize on the value of biodiversity—it must evolve. There is an urgent need to integrate biological and social disciplines in order to generate reliable recommendations for society and to incorporate biodiversity conservation and use into mainstream policy worldwide. We need unity in diversity.

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