Ecosystem Function of Biodiversity

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Regarding ideal levels of species richness, the data are few and unclear

It has become a tenet of conservationists that biodiversity is crucial to the earth's "life-support system": as we lose species, we also alter the integrity of processes that maintain soil fertility and water quality, provide natural checks on pest outbreaks, convert carbon dioxide into plant tissue, and support the complex food webs upon which we and other creatures depend. Until recently, however, ecologists have made few attempts to find out just how changes in the number of species or even the diversity of ecosystems across a landscape might affect these processes.

Earlier this year, 50 ecologists from around the world gathered at Asilomar on California's Monterey Peninsula to try to do just that. The goal of the workshop, sponsored by the Scientific Committee on Problems of the Environment (SCOPE), was to pull together what is known about the impact of biodiversity on ecosystem functions and identify major gaps in our knowledge. The gaps were evident right outside the meeting rooms. One side of the problem—the relentless human pressure on biodiversity—was easy to spot. Crowds of sunbathers encroached on the territory of harbor seals, and signs warned beachcombers away from trampled dunes where tiny, endangered wallflowers clung to life in protective cages. But how the loss of seals or wallflowers or any other species might alter ecosystem processes—especially those crucial to human life—turns out to be much harder to predict.

Participants in the SCOPE project spent two years before the workshop assessing published observations and experimental studies from 15 major biomes, ranging from arctic and alpine systems to tropical forests, lagoons and mangrove swamps to coral reefs. Not unexpectedly, they found that for most ecosystem functions, especially below-ground processes such as decomposition and nutrient cycling, not enough is known yet to predict how sensitive they are to loss of diversity. However, for one important process, net primary productivity, the weight of evidence seems to show that above a threshold number of species, increases in species diversity do not improve function. Thus, it appears most natural ecosystems can afford to lose some species without faltering in their production of plant material.

But ecologists remain a long way from being able to predict how many and which species might be expendable for any function of a given ecosystem. And Stanford ecologist and SCOPE program leader Harold A. Mooney notes that even species that might now appear expendable may in the long run help ecosystems endure stresses such as drought, disease, or global climate change.

The very notion of a project that asks "What good is biodiversity?" has roused the ire of some ecologists. Workshop participants reminded one another periodically that separate from function, there are economic, moral, and aesthetic reasons to save species. Indeed, function is as much an anthropocentric concept as aesthetics, some noted, because creatures often fill multiple roles in different settings and their only biological function is to persist. As Christian Korner of the University of Basel in Switzerland noted: "Species don't exist to produce but to project their genomes in time and space."

With all those caveats, a key reason for pursuing the touchy subject of function is that diversity is rapidly falling victim to land clearing for agriculture and development, invasions of exotic species, pollution, and human-caused changes in atmosphere and climate. Governments have only limited resources, and they must have some guidelines about what is most important to save. "We're asking a technical question, but you can't divorce that from the bigger societal issues," says Mooney. "If we lose biodiversity, what else are we losing? No one has tried to answer that before."

The SCOPE workshop is part of two larger international efforts to assess the status of global diversity. One is a Global Biodiversity Assessment being conducted by the United Nations Environment Program; the other is the *Diversitas* project, sponsored jointly by UNESCO's Man and the Biosphere program, SCOPE, and the International Union of Biological Sciences.

In addition, the SCOPE team's work has already set the directions for a major new research initiative launched in August by the International Geosphere-Biosphere Program called Global Change and Ecological Complexity. That program, led by ecologist Osvaldo E. Sala of the University of Buenos Aires, is to evaluate the accelerating pressures on biodiversity likely to be caused by atmospheric and climate changes and predict the consequences for Earth's life-support system.

by Yvonne Baskin