Ecosystems as conservation targets

One of the wonderful things about biodiversity is that it can be measured at multiple levels of organization—from genes to biomes. On what level of organization, then, should programs to conserve biodiversity be focused? An appealing answer is 'at all levels', but a multi-level approach could easily become fragmented. I suggest the best conservation strategy lies in a synthesis organized around the central concept of ecology: the ecosystem. The beauty of the ecosystem concept is that it unites the abiotic and biotic worlds and includes processes as well as entities.

What some see as a weakness of the ecosystem concept—that it is arbitrary and open-bounded in space—is actually a strength. There is a wide spectrum of conservation problems, and different problems are best approached at different scales. Whether we are interested in maintaining a vernal pool, a free-flowing river, or the tropical rainforest, the ecosystem is a practical target. A simple definition of an ecosystem—a reach with an associated assemblage of interacting organisms—is liberal enough to encompass plant associations, major vegetation types, and habitats defined by biological, physical or geographical parameters (e.g. coral reefs, limestone caves, deep-sea thermal vents or the Arctic Coastal Plain). To be useful to conservationists, defined ecosystems must be discrete enough to be mapped. They must also be describable by adjectives denoting quality, such as, undamaged, old-growth or ungrazed.

Some of the possible objections to focusing on ecosystems in a conservation strategy can be addressed as follows:

Ecosystems and communities are not real. Most ecologists today subscribe to the individualistic notion, articulated by Henry Gleason early this century, that plant associations and other communities are not natural units, but artificial constructs. As summarized by Robert Whittaker, 'most communities intergrade continuously along environmental gradients, rather than forming distinct, clearly separated zones'. Yet, ecologists have shown themselves to be quite capable of making cover maps of virtually any landscape on Earth. As long as we realize that every classification or map is an abstraction invented for convenience, they can be tremendously useful.

The strategy of conserving ecosystems is untested. It is true that most emphasis in conservation biology has been on the population and genetic levels, and that some laws and policies (for example, the US Endangered Species Act) have encouraged a species-by-species approach. But representation of all ecosystems in protected areas is one of the oldest and best-accepted goals of conservation. The approach has been called a 'coarse filter' and is based on the reasonable assumption that the vast majority of species does not need individual attention but can be saved by protecting examples of the full suite of natural communities. The coarse filter may be especially useful for protecting organisms that are poorly known and difficult to survey, such as soil microfauna, bacteria and fungi.

If you think protecting species is hard, just wait until we try to protect whole ecosystems. In fact, there is widespread agreement that conservation at the ecosystem level will be more efficient and cost-effective than a species-by-species approach. Ecosystem conservation has the additional advantage of being potentially proactive, by protecting habitats and assemblages before any single species declines to endangerment. If many species associated with an ecosystem are already imperiled, habitat restoration based on their collective needs will be more efficient than single-species recovery. Because direct habitat alteration remains the leading proximate threat to biodiversity worldwide, habitat protection and restoration offer the greatest hope for species and ecosystems. Furthermore, the persistence of any group of species requires the continued operation of natural processes within a range of variability experienced during their evolution. Thus, an ecosystem approach, which explicitly considers disturbance, succession, nutrient cycling, hydrology, species interactions, and other processes, should sustain conditions necessary for persistence of most species.

Ecosystem conservation ignores the needs of individual, sensitive species. The traditional 'museum piece' approach to ecosystem representation, where tiny examples of natural communities are set aside in preserves, will not do much to protect the most sensitive species and will be ill-suited to a changing environment (e.g. with global warming). However, an expanded coarse filter that seeks to maintain entire environmental gradients and habitat mosaics at a landscape scale offers greater potential. Still, many species will require individual attention, at least for a while; these include stenoenemic and patchily distributed species, which are not predictably associated with any ecosystem type, and large vertebrates with demanding area requirements. The needs (including genetic viability) of area-demanding species will often set the spatial scale for ecosystem conservation. However, ecological processes such as disturbance and hydrological regimes should also help to define scale and boundaries.

Ecosystem conservation has little public appeal. Pandas are more charismatic than bamboo forests. Thus, flagship species will still come in handy for fundraising and education. But there are signs that the public cares about ecosystems. For example, people want to save the rainforest, not just monkeys and parrots. Our report on endangered ecosystems in the USA prompted a front-page story in the New York Times. Conservationists simply need to educate the public to the beauty, value and imperiled status of ecosystems of all kinds.

The most urgent argument for ecosystem conservation is that ecosystems are endangered. The biodiversity crisis involves more than extinction of species; entire habitats and assemblages are being lost on a grand scale. Examples include destruction or serious degradation of 76% of the Caledonian forest of Scotland, 96% or more of the raised bogs of Britain and the Netherlands, over 75% of the mangrove forests of India, Pakistan and Thailand, over 90% of the natural vegetation of Madagascar, and 88% or more of the dry forests of western Central America, the Atlantic coastal forests of Brazil, and, in the USA, longleaf pine forests of the southeastern coastal plain and native grasslands and savannas across the country.

The future of the natural world is too tenuous to argue species versus ecosystems. Biodiversity is threatened at all levels, virtually everywhere. A pluralistic conservation strategy centered on ecosystems may be our best hope to turn the tide.

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References
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