

Ecosystem-Service Science and the Way Forward for Conservation

Conservation biology began life as a crisis discipline, its central tenet to understand and help reverse losses of biodiversity and habitat. Those losses continue unabated, implying that, as a discipline, we are failing in our central charge. A growing number of conservation biologists are therefore looking for a new way forward, and we believe that an increased focus on ecosystem services provides it. Yet the conservation community remains deeply, and sometimes very publicly (McCauley 2006), divided over how much emphasis ecosystem-service approaches should receive relative to those based solely on moral suasion. Put bluntly, will we achieve greater conservation success by protecting nature for its own sake or for our own sake?

This dichotomy highlights extremes of a continuum that was prominent a century ago. Nature for nature's sake, often blended with aesthetic appeals, can be traced most notably to the preservationist John Muir. Conservation through utilization can be traced to another icon, forester Gifford Pinchot. These complementary strands, each valid, powerful, and deeply rooted in the conservation movement, clashed long ago, especially in the United States. But just as Muir's writings acknowledge a role for utilitarianism and Pinchot's a keen awareness of the intrinsic value of nature, pluralism between the two schools of thought is the norm in conservation practice. For example, in a survey of current projects underway in major conservation nongovernmental organizations, it is proving difficult to distinguish those focused on biodiversity for its own sake and those focused on ecosystem services and human well-being. Most projects mix the two approaches, drawing on the diverse ways in which people perceive and interact with nature to motivate action.

We see an expanded role for ecosystem-service approaches in conservation not because these approaches are more valid in some way, but because they have not yet come close to reaching their conservation potential and because people from all walks of life can contribute to the realization of that potential. Despite past successes, the rate of biodiversity loss has not slackened, making it urgent that we broaden and strengthen the foundation for conservation. Nature for nature's sake resonates only with the already converted. Business interests, farmers,

and the billion humans living in rural poverty remain unwilling or unable to move. We need these people as partners in conservation, and ecosystem-service approaches provide a means of motivating and enabling them. If human dependence on nature becomes widely recognized, society will demand greater environmental stewardship. The resulting investments in conservation promise to outweigh select instances in which the two approaches conflict. Arguing for a greater focus on ecosystem services is not "selling out" biodiversity (McCauley 2006)—quite the opposite.

By emphasizing the many ways nature sustains and enriches people's everyday lives, ecosystem-service programs turn traditional conservation approaches, which are based on separating people from nature, on their heads. Conservation efforts premised on protecting a small number of places or species from people are necessary but far from sufficient. Conservation efforts must be interwoven throughout entire land and seascapes and must place greater emphasis on preserving population numbers and diversity if they are to sustain biodiversity. Arguments for ecosystem-service approaches drive us toward this vision of conservation.

Already, ecosystem-service advocates are finding allies and enjoying traction in places where ethical arguments for biodiversity conservation are given short shrift. For example, ecosystem-service ideas embed concerns about the environment and biodiversity in the heart of broader policy debates concerning global poverty reduction (Sachs & Reid 2006). In much of the world, conserving nature out of moral obligation is a luxury most simply cannot afford. Nevertheless, human well-being is intimately linked to the immediate environment and natural capital is a vital part of the economic base. In the face of a sea of poverty, demonstrating the ignored links between nature and elements of well-being—safe drinking water, food, fuel, flood control, and aesthetic and cultural benefits that contribute to dignity and satisfaction—is the key to making conservation relevant and, if we are lucky, possible.

As a community conservation biologists must refocus research efforts to deliver the science to support ecosystem-service conservation. The Millennium

Ecosystem Assessment (MEA 2005) provided the definitive summary of what we know about global trends in the state of ecosystems and ecosystem services. The headline figures are compelling, but the MEA did not deliver the tools necessary to make ecosystem-service conservation operational. Business-as-usual ecological studies will not provide the kind of science we need either. Ecosystem-service arguments are not just the latest way to frame introduction and discussion sections of journal articles. Instead, we need to plan our research programs from the desired endpoint and work backwards from there. What decisions regarding ecosystem services is our science intended to inform? What opportunities are available to change the provision and consumption of those services? Then, we can ask what evidence will be required to support those decisions over what scales, and with what degree of accuracy, before finally moving towards a research design to deliver on what is needed?

The question of what degree of precision is needed to support conservation actions is an important one. Ecologists tend to look to the finest of scales in pursuit of mechanistic explanations for phenomena. Before we know it, and despite grand ambitions, we find ourselves measuring the turning angle or feeding rate of a single species. To meet the challenges of ecosystem-service conservation, we need to focus on techniques for large-scale problem solving in the face of irreducible uncertainty, instead of indulging in all-too-frequent reductionism.

Ecologists also need to make marked efforts to embed human beings within their conceptualization of ecosystems. Despite repeated calls to move in this direction, most studies in ecology and conservation biology still treat people as an exogenous source of impacts on their study systems, something that is to be managed and, where possible, avoided. Instead, we need to recognize that human populations are an integral part of ecosystems and must be included in studies just like other key species. The prevailing view of *Homo sapiens* as somehow detached and insulated from ecosystem processes is outdated and dangerous.

The MEA's vision of ecosystem-service science is holistic, integrative, and cross-disciplinary. The breadth of this vision is important but risks paralyzing action; significant contributions are well within the reach of small projects. For example, recent studies demonstrate the links between crop pollination and wild bee pollinators and thereby highlight the economic value of natural habitats (Kremen et al. 2004; Ricketts et al. 2004; Morandin & Winston 2006). Although these studies involved intensive field work, their scale was tractable and their designs relatively straightforward. What mattered was that the studies directly addressed the ecosystem-service question of interest.

The conservation community is working toward the shared goal of ensuring that biodiversity in all its forms is maintained for the long term. We suggest that our chances of success will be vastly improved if ecosystem-service science succeeds in restoring and reemphasizing the fundamental links between nature and human well-being.

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