

Core Concept: Ecosystem services

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If one were to build a healthy biosphere from scratch on another planet, what kinds of ecosystems and combinations of species would be necessary to support humans? This is the thought experiment that ecologist Gretchen Daily, a Bing professor at Stanford University, poses to illustrate the crucial role that the natural environment plays in supporting human society.

Efforts to spotlight the various ways human existence relies on our natural surroundings began in the 1980s, partly instigated by Daily's doctoral advisors at the time, ecologists Paul Ehrlich and Harold Mooney, both then professors at Stanford University (Mooney is now emeritus). Despite this reliance on nature, Ehrlich, Mooney, and others pointed out that humans degrade that natural life support through activities like deforestation, coral reef destruction, or freshwater contamination (1). Our fundamental relationship with nature, they argued, needed to shift. Such views would give rise to a call for valuing "ecosystem services" for the benefits they bring to society.

Efforts to assign economic value to these services would follow.

Nature's assets can provide life-sustaining benefits or ecosystem services, such as water purification, pest control, fisheries, and storm buffering. Daily notes that people place value on other essential assets, such as houses or cars, but nature also has a value that has been overlooked because it hasn't been defined or evaluated in the marketplace. Identifying ecosystem's services' worth offers economists, ecologists, and conservation biologists a common parlance to discuss and debate the value of the natural world (2).

The term "ecosystem services" also refers to aspects of humans' quality of life: whether spaces used for recreation or natural wonders have cultural and inspirational value. Recent research has suggested, for example, that a simple nature walk can improve cognitive thinking and emotional perspectives (3). An even less-tangible group of services involves preserving now what might possess a hidden value later, such as conserving a forest's biodiversity so that medicinal plants,

yet to be discovered, may one day provide pharmaceutical benefit.

Growing Recognition

Although many, dating back as far as Plato, have expounded on humanity's link to nature, the term "ecosystem services" first popped up in a popular book in 1981, and in the science literature in a 1983 paper by Ehrlich and Mooney (4, 5). It stuck.

Books on ecosystem services came out in the mid-1990s, including *Nature's Services*, edited by Daily (5). Since then, the rise in the term's use in journal literature has been exponential. In the 1980s, a Web of Science search for the terms "ecosystem services" and "ecosystem service" turned up only the 1983 paper by Ehrlich and Mooney (4). However, in 1995, papers noted either of these terms five times, in 2005 more than 100 times, and in 2014 more than 1,900 times.

The Millennium Ecosystem Assessment, initiated in 2001 after the United Nations Secretary General recognized the practical value of ecosystems, marked the first attempt ever to assess the condition of earth's natural wealth and its trends. Although the Millennium Ecosystem Assessment didn't monetize ecosystem benefits, it described the services that ecosystems like grasslands and forest provided, with respect to their health and importance to human well-being (e.g., human nutrition from coral reef fisheries). Their report from a decade ago found that more than 60% of two-dozen ecosystem services were deteriorating (6).

In hopes of translating the science into actual policy decisions, government leaders from United Nations countries formed the Intergovernmental Platform on Biodiversity and Ecosystem Services in 2012 to help preserve the planet's biodiversity and identify ecosystem services (7). It was the first time such terminology had been discussed and used in such a high-level policy setting, says Mooney. The Millennium Ecosystem Assessment and the Intergovernmental Platform on Biodiversity and Ecosystem Services, Mooney suggests, initiated the debates and discussion on how to value them in more than just monetary terms. "It stirred the pot and I think it's still swirling around," he adds.



As part of a mangrove reforestation project, volunteers plant trees in the mud in Samutsakorn, Thailand. Mangroves are known to provide ecosystem services, including flood and storm control. Image courtesy of Sura Nualpradid/Shutterstock.com.



The morning's harvest is collected at a Chinese harbor. Fisheries are among the most valued ecosystem services. Image courtesy of chungking/Shutterstock.com.

Careful Quantification

Public and private sectors have also embraced this concept, making strides to use ecosystem services as part of policy decisions in places like Costa Rica, which pioneered a nationwide payment system of initiatives to slow deforestation, as well as in China, South Africa, and even at the Vatican (8). China's government has gone so far as to establish zones across nearly one-half of the country to focus on conservation investments in regions that generate the most important ecosystem services (9, 10). China also aims to launch a new metric reporting gross ecosystem product alongside gross domestic product, to incentivize cities and provinces that improve gross ecosystem product (11).

As chief scientist at the Council for Scientific and Industrial Research in South Africa, Belinda Reyers relies on terminology ranging from "healthy landscapes" to "ecological infrastructure" to express human connection to the environment. Being sensitive to language is important, she says, because of the different values and interpretations across

South Africa; some words can trigger unintended perceptions in certain groups. For example, the word "nature" can conjure thoughts of a remote protected region, when in fact the service in question may be relevant to urban areas. As a result, work in

South Africa and other countries often attempts to help people understand what they value about their natural surroundings, such as a wetland, before beginning to quantify ecosystem services (12). Reyers cites one national policy with particularly exciting potential: the country's Ecological Infrastructure for Water Security investment. Now pending ministerial approval, it grew out of ecosystem services research.

Many still debate the degree of human focus on ecosystem services (13), particularly because people's valuation of them can shift. Ecologists, conservation biologists, and others, notes Daily, often disagree about whether and how to divide up the environment's complex systems into discrete services that lend themselves to modern accounting and policy-making. This, adds Daily, can confuse funders and other stakeholders who are otherwise keen on helping to support ecosystem services approaches (14–16). Meanwhile, some conservationists argue that nature has an intrinsic value that cannot and should not ever be monetized (17).

Reyers, for one, acknowledges that nature has a value in and of itself, but also notes that people have moved into most of the world's ecosystems. "It's impossible to think about nature," says Reyers, "without thinking about people."

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