SUSTAINABLE DEVELOPMENT

What is Biodiversity Worth? And to Whom?

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The term "biodiversity," the contraction of biological diversity, refers to the variability of life forms on earth. While a definition at this level of generality is frequently encountered in the biological literature, it is of little practical use. It provides no guidance as to what constitutes a little or a lot of biodiversity. Biodiversity loss is generally defined operationally as numbers of species. By this measure, we may be living in an era of precipitous decline.

The pattern of biodiversity evolution in the fossil record is one in which gradual increase is occasionally punctuated by steep falls. Many natural scientists believe that the earth is now in the midst of its sixth major extinction crisis. The five mass die-offs identified in earlier geological epochs have been linked to astronomical or geological cataclysms. The current episode differs from any of the earlier events in that the threat to so many species can be attributed, directly or indirectly, to the dominance of one: *homo sapiens*.

Is the decline in the number of species with which we share the earth a major threat to our own well-being or only a regrettable, but not momentous, byproduct of human development? The answer is not clear. It is devilishly difficult to determine what the biodiversity now at risk contributes to human welfare.

The prime suspect in biodiversity decline is the destruction of habitat on which imperiled organisms depend. These habitats tend to be disproportionately located in the poor nations of the developing tropics. If biodiversity is to be preserved, effective incentives must be brought to bear in poor countries. If a strong case could be made that biodiversity is important in the lives of the poor, the poor might be induced to protect it. The evidence for such a case is lacking, though. It is disingenuous of the rich to argue that the poor will most benefit from preserving biodiversity. Wealthier nations can most afford to be concerned about the long-term consequences of biodiversity loss. Effective conservation is going to require that those who can afford to conserve biodiversity make payments to those who most directly affect conservation.

Biodiversity and Habitats

Biodiversity is imperiled by a number of anthropogenic factors. Species have been hunted to extinction. Others fall prey not to humans themselves, but to exotic species introduced to new environments by humans. Chemical pollution threatens particularly sensitive species. The effects of climate change on biodiversity are not well understood, but might be devastating.

Most natural scientists agree, however, that the greatest human threat to biodiversity is another inadvertent by-product of expanding human activity. "Habitat conversion"—felling forests, clearing wetlands, fencing grasslands, etc.—is felt to be the largest single factor driving extinctions. We're destroying homes. It is, however, difficult to determine when extinctions are occurring. Biologists estimate that 90% or more of the world's species have not even been identified yet. We are, these biologists say, eliminating things we didn't even know were there. The bases for this inference are "biogeographic models" that relate numbers of species supported to the area of habitat available.

You may have heard statements such as, "If current trends continue, one third of all species will be gone by the end of the twenty-first century." Such statements are not based on careful counts of the number of extant species and the number of documented extinctions. They are, rather, projections formed by extrapolating current rates of habitat loss and fitting "species-area" relationships derived from biogeographic models.

One particular set of habitats draws special concern. It has been estimated that half of the world's existing terrestrial species can be found in only 6% of the earth's land area. This is the area covered by tropical rain forests. The number of species found on a hectare of land tends to increase as one moves from the higher, cooler, latitudes to the lower, warmer ones. There are numerous examples in the biological literature in which more species of trees, for example, can be found in a hectare of forest in the tropics than in the whole of some states in the United States, or more species of ants identified on a single tree in the tropics than are found in an entire temperate country. With tropical forests being felled at sometimes alarming rates, the potential threat to biodiversity is great.

The Costs of Biodiversity

The relationship between per capita income and latitude is almost the opposite of that between biodiversity and latitude. Countries that tend to be richest in biodiversity tend also to be poor by economic measures. High biodiversity is not sufficient to induce high economic achievement. It is premature to infer the converse, though. It would be imprudent simply to ignore biodiversity while pursuing economic development.

What should the custodians of the world's biodiversity do, then? Biodiversity per se is surely worth something. Most of the world's medicines, all of its agricultural crops, and a surprising number of its industrial products are of organic origin. Researchers should be willing to pay something for access to nature's repository of chemical blueprints, especially in an era in which biotechnology makes it ever easier to adapt those blueprints for broader use.

A number of other commercial ventures can be enhanced by the preservation of natural environments. Safaris in Africa, whether of the photographic or traditional kind, would hardly be as attractive if that continent's spectacular wildlife were eliminated. Costa Rica has become a very popular destination among tourists who seek a glimpse of undisturbed nature. Other areas have initiated "ecotourism" ventures.

Diverse natural ecosystems also provide innumerable goods and services to humanity. A forest or wetland may be home to animals that pollinate crops or prey on agricultural pests. Such areas also purify water, resist erosion, and moderate floods, among other attributes.

Diverse natural habitats could be the source of a multitude of economic values, then. Does this constitute a compelling argument that local people will preserve the natural habitats in which they live? Not necessarily, for two reasons.

First, we must distinguish between economic values and the institutions required to realize them. Think of the uses of biodiversity in the search for new and improved pharmaceutical, agricultural, and industrial products. Yes, biodiversity may be valuable for these purposes, but how would such values be translated into funds for conservation? Who owns the rights to biodiversity, and how can they transfer those rights?

The Convention on Biological Diversity was opened for signatures at the 1992 Rio Summit and was adopted by 183 parties. It assures nations of sovereign rights in "genetic resources" derived from their indigenous biodiversity. Some contracts for transfer of these rights have been developed, the most celebrated being that initiated before the Rio Summit, in 1991, between Merck, the world's largest pharmaceutical company, and Costa Rica's *Instituto Nacional de Biodiversi -*

dad (*INBio*). Yet a decade later, such arrangements remain controversial and, with relatively few exceptions, unreplicated.

It may be easier to control the right to enter and enjoy game reserves or "ecotourism" destinations than it is to control the use of genetic resources. Such ventures have generated their own controversies, however. Witness, for example, the Government of Zimbabwe's apparent indifference to the property rights of farmers who had established "game ranches" on their holdings. Concern also is frequently expressed over the distribution of benefits from ecotourism. More money may go to foreign airlines and hotel owners than to local people.

Institutional issues also are difficult when the subject is the "ecosystem services" provided by natural habitats. While such habitats shelter beneficial insects, purify water, moderate flooding, and so forth, they typically provide these services over areas larger than those controlled by the owner of the habitat itself. These services are examples of "public goods." Public goods are things that, when one person provides them, many benefit. Communities must develop effective institutions for allocating public goods. Absent such institutions, the communities may not fully capture their potential benefits. Generally speaking, the broader the communities over which ecosystem services are received, the more difficult it will be to craft institutions to allocate the public goods generated by ecosystems.

There is a second, more fundamental, problem in determining the biodiversity conservation incentives facing communities. It is very difficult to infer the real economic value of preserved natural habitats. Economic value is "value on the margin." The price someone will be willing to pay for something is not determined by its importance to that person in total. Rather, the economic value of something is determined by the incremental contribution it makes relative to the things that must be foregone to obtain it. It may well be that a community could not survive without some of the ecosystem services provided by the natural habitat surrounding it. It is certainly true that none of us would be alive today were it not for the many foods and medicines we derive from natural sources. But the economically relevant question is not "What's the total value of biodiversity?"; this value is incalculable. The relevant question is, "How do the benefits realized by maintaining natural habitats at their current levels compare with those that would be realized by converting a little more of them?"

If these benefits are not large, concerns about institutions for realizing the economic benefits of biodiversity would be obviated. We shouldn't jump to the conclusion that local communities are not managing their common resources well. Anthropologists and other social scientists have studied communities in which what may appear, on first inspection, to be "open access resources" available to unrestricted exploitation are, in fact, governed by complex and subtle rules. The economic theory of property rights holds that such rights come into existence when the benefits of their enforcement exceed the costs of their establishment. The most parsimonious reason for which local communities do not take what outsiders regard as "better" care of biodiversity may be that it's simply not worth it to them.

Determining exactly what is "worth it" to whom can be an extremely difficult exercise in the absence of economic data derived from markets. Some preliminary valuation exercises have suggested that at least some of the component values of biodiversity may not be worth much "on the margin." This is the conclusion of at least a couple of studies of the value of genetic resources in new product research. Even studies that identify large values in some places find negligible values in most. Economic value is inversely proportional to abundance. The same principle may apply

to ecotourism. Certain core attractions often draw tourists, but these attractions may have little if any reliance on maintaining large areas of natural habitat. Similarly, it is not clear to what extent larger natural habitats supply significantly more ecosystem services.

What would appear to be of value are the more diffuse, less well-defined benefits that waft their way into the consciousness of people in wealthy countries. Private philanthropists, conservation organizations, and the governments of wealthy nations have donated billions of dollars for international biodiversity conservation. At this juncture, it makes little sense to inquire more closely into the reasons for which such payments have been made. It will prove more constructive to ask how these donations can be applied most effectively.

Cost-Effective Conservation

International conservation policy has gone through several phases. In the first, areas of more-or-less "natural" habitat were simply designated as parks. Regrettably, among the more-or-less "natural" elements of some such habitats were indigenous peoples. In some newly declared parks, the inhabitants were evicted, sometimes violently. In others, they were just ignored. Parks from which inhabitants were evicted were criticized as unjust. Those in which inhabitants were ignored often came to be criticized as "paper parks" with little real conservation function.

It would be irresponsible to simply ignore the plight of poor people dispossessed by protected areas. Even if one were to do so, though, it has become obvious that protected areas cannot be effective without some "buy-in" from the local people affected by them. Absent their cooperation, intrusion, poaching, and habitat conversion occur. Once this was realized, a new approach to conservation was developed.

The term "integrated conservation and development project" has been applied to a wide range of conservation undertakings, but in its broadest sense it simply means an effort in which biodiversity is conserved while taking measures to improve the lot of local people. There has, however, been tremendous controversy regarding the best way in which to achieve these two not-necessarily-consistent objectives. A great many projects have been implemented around the world in which local communities are provided with subsidies with which to undertake ecotourism, bioprospecting, or other purportedly "sustainable" ventures. These subsidies have been widely criticized for being ineffective. Worse yet, they can be counterproductive if the activities they promote are not carefully planned to be ecologically benign. As a result of frustration with such "indirect" approaches, there has been a greater interest in recent years in more "direct" incentives. These involve direct payments to local communities in exchange for their preservation of habitats.

It is regrettable that the history played out as it did, as some have portrayed direct incentives as a return to the discredited "fences and guards" approach and all the social inequities it embodied. This is not accurate. Some advocates of direct incentives do feel that protected areas can best be managed by encouraging their current human inhabitants to relocate. There can be little serious disagreement in this day and age, however, that relocation can only be justified if it is voluntary, and done in exchange for fair compensation.

There is much to recommend payments made directly for conservation. The economic rationale can be stated as simply: "You get what you pay for." What the international community cares about in encouraging biodiversity conservation is biodiversity conservation. International conservation donors have little if any intrinsic interest in encouraging tourism or pharmaceutical re-

search per se. These donors will realize more success if they pay for what they want to get. While international donors may also care about improving local living standards, separate measures tailored specifically to meet this end are likely to be more effective.

Tough Problems

Preserving imperiled habitats in the developing world will not be easy. Wide-scale conservation will prove to be very expensive. Acquiring the habitat needed to preserve the world's imperiled biodiversity could require expenditures of one trillion dollars or more. This is a lot of money! Confronted with this price tag, many conservation advocates hope to leverage limited expenditures into a radical transformation of economic possibilities. The hope is often expressed that pilot projects will demonstrate the potential of ecotourism, or bioprospecting, or other benign uses of natural habitats. Then it is hoped that, with no further expenditures on the part of donors, such ventures will be emulated elsewhere.

Despite the initiation of many such pilot projects, these ventures are, by and large, not arising in sufficient numbers to solve the problem. One wonders if appealing to such "demonstrations" in motivating a "transformation" is not a counsel of despair. It seems analogous to betting the last of the grocery money at the racetrack. Is the situation really so desperate?

In one respect, it is not. Nothing in what has been said above should be construed to suggest that there are not at least some opportunities to conduct profitable ecotourism, bioprospecting, and other ecologically benign ventures. The argument is not that such ventures are not possible. It is, rather, that conservation donors are typically not well situated to evaluate them. For this reason, the donors would be ill advised to subsidize them. Rather than pay for such ventures, conservation donors should arrange to be paid by them. If there are entrepreneurs who feel they can profit by conducting "eco-friendly" activities in protected areas, some of the costs of habitat acquisition can be offset by auctioning off the rights to conduct such activities in protected areas. If no entrepreneurs can be found to pay for such rights, conservation donors should conclude that they are not good investments.

The greatest challenge to reversing biodiversity loss is creating effective channels to get payments from the wealthy to the poor. This brings us face-to-face with one of the great conundrums of economics: are the poor poor because their institutions don't work, or do their institutions not work because they're poor? Putting this question in our context, is channeling money to the poor really going to induce them to preserve biodiversity, or will it simply be siphoned off by entrenched corruption? There does seem reason to hope that setting up transparent mechanisms for transferring conservation funding and holding local people accountable for performance will succeed.

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