



Biodiversity Prospecting

Shopping the Wilds Is Not the Key to Conservation

by R. David Simpson

Preserving biodiversity may have little bearing on whether the next miracle drug is found. Better arguments should be stressed in developing conservation policies.

Some people say “biodiversity prospecting” offers a compelling reason to save as much as possible of the world’s immense variety of genes, species, and ecosystems. Sifting among genetic and biochemical resources for something of commercial value, as biodiversity prospectors do, could lead to the discovery of a wild plant or animal that contains the key for curing AIDS, cancer—or some other disease the world has yet to identify. The desire to capitalize on new and better products for industrial, agricultural, and especially pharmaceutical applications provides strong incentives for conserving nature, so the argument goes. What’s more, by acting on advances in biotechnology, researchers are better equipped than ever to investigate organisms at the genetic level, providing fresh financial reasons to conserve as many product leads as possible.

But several RFF studies show that losses in biological diversity may have little bearing on whether the next miracle drug is found. That’s because there are so many wild plants and animals that can be used by researchers engaged in biodiversity prospecting. With millions and millions of species, sources of useful products are either so common as to be redundant or so rare as to make discovery unlikely. Either way, the sheer numbers involved weaken the argument that biodiversity prospecting generates any appreciable economic value.

That is not to say natural leads are not important in the development of new products. Natural organisms have evolved a staggering variety of chemical com-

pounds to escape predators, capture prey, enhance reproductive success, and fight infection. Some of these chemical compounds have proved to be of great value when adapted for industrial, agricultural, and pharmaceutical uses. In the United States, for instance, nearly 25 percent of prescription medicines contain active ingredients derived from plants, while many other drugs are synthesized to replicate or improve naturally produced molecules. Today we treat leukemia with medicines derived from the rosy periwinkle of Madagascar, and the bark of the Pacific yew tree is the source of a promising treatment for ovarian cancer.

It is not surprising, then, that natural scientists, legal scholars, and even economists often cite nature’s contribution to new product research and development as one of the most important considerations in formulating biodiversity conservation policy. Given the passions that biodiversity and its protection arouse and the varied backgrounds of the people making proposals, however, it is also not surprising that many of the arguments are less than watertight.

Thinking clearly about the values that surround biodiversity is important, since destruction of a habitat is often irreversible. Over and above its potential as a source of new products, a plant or animal may be valuable for any number of commercial, ecological, esthetic, and ethical reasons. Given this fact, we should be cautious in making related policy decisions and choose to devote scarce funding to only the most

effective strategies. Placing too much emphasis on biodiversity prospecting may divert attention—and funds—from potentially more effective conservation strategies.

The Value of the “Marginal Species”

As a source of leads in new product research, natural organisms would be very difficult to replace. There is simply no substitute for biodiversity as a whole. Economically speaking, however, biodiversity is valuable to the extent that it makes sense to save a little bit more, and not to the extent of its admittedly astronomical value overall. That is because we typically are not concerned with actions that would wholly eradicate biodiversity, but rather with the costs and benefits of actions that would result in incremental reductions. In thinking about the role that biodiversity plays in new product development, therefore, it is important to consider the contribution of biodiversity on the margin.

In economics, the worth of something is its “marginal” value; in other words, the incremental benefit that a little bit more of the thing provides. In the case of biodiversity prospecting, the value of the “marginal” species is the contribution an additional species makes to the probability that researchers find what they are looking for. Put in another way, things are valuable to the extent that there are few substitutes for them. Within the immense set of living organisms, many species are likely to be adequate substitutes for one another as leads in the development of commercial products.

This may not be apparent, however. After all, aren't different species identified as such precisely because each is genetically unique, and therefore not a perfect substitute for any other? Biologically, yes; but let's consider the economic interpretation of this fact. Each species represents a research opportunity, and is a substitute for another in the sense that time and costs incurred in pursuing one research opportunity could be devoted to another. The question of economic interest is “how valuable is an additional research opportunity?” This, in turn, really boils down to the question “how much does having additional species to test increase the probability that a new product will be found?”

Let's consider a couple of extreme cases. While species are genetically different, different species can produce the same chemical compound (caffeine, for

The Values of Biological Diversity

Recent research at RFF has focused on the value of biodiversity for use in the development of new commercial products. This is certainly not the only, and may not even be the most important, reason for preserving as much variety in genes, species, and ecosystems as possible. Taken together, the reasons might be classified in three categories:

- New agricultural, industrial, and pharmaceutical products, as discussed in the article.
- Harvested resources like lumber, fish, and game, but also things such as water and nutrient cycling, erosion protection, climate moderation, and the combination of these basic support services that makes it possible for society to function at all.
- Esthetic, ethical, and spiritual benefits.

Since the goods and services described in the second category are either sold themselves or support the production of other goods and services, they might be valued by investigating particular markets or looking at macroeconomic performance as a function of environmental conditions.

The final category of values is the most elusive and most controversial. The contingent valuation method—surveying people to ask them what biodiversity is worth to them—is perhaps the only way to elicit this information, but it is extremely controversial.

Considering these broader categories of values and ways in which they might be estimated is the subject of the book RFF Fellow R. David Simpson is now writing.

example, is found in both tea and coffee). Suppose, then, that it is relatively likely that several species produce the same chemical compound. How helpful will it be to maintain additional biodiversity for use in the search for new products? The answer is “not very,” as species are very likely to prove redundant when there are large numbers from which to choose for testing.

Now consider the opposite extreme. Suppose that it is very unlikely that two or more species among the millions in existence will prove to contain a chemical useful in the treatment of AIDS, cancer, or some other condition. But if it is very unlikely that two or more species among millions will prove redundant as sources of new product leads, it must mean that useful leads are so rare as to make it very unlikely that any species will contain the key for a cure.

Researchers at RFF have shown that, regardless of the probability that any one species chosen at random will yield a particular commercially valuable product, the value of the marginal species is negligible when there are large numbers of species available for testing. The value of the “marginal” species is equal to the expected payoff from testing it times the probability that all other species fail to provide the product that researchers seek. This figure is necessarily small when there are lots more species to choose from.

Pharmaceutical company willingness to pay to preserve a hectare of land in eighteen biodiversity “hotspots”

<i>Hot spot</i>	<i>Value in dollars per hectare</i>
Western Ecuador	\$2.29
Southwestern Sri Lanka	1.87
New Caledonia	1.38
Madagascar	.76
Western Ghats of India	.53
Philippines	.52
Atlantic Coast Brazil	.49
Uplands of western Amazonia	.29
Tanzania	.20
Cape Floristic Province of South Africa	.18
Peninsular Malaysia	.16
Southwestern Australia	.14
Ivory Coast	.13
Northern Borneo	.11
Eastern Himalayas	.11
Colombian Choco	.08
Central Chile	.08
California Floristic Province	.02

Sources:

R. David Simpson and Roger A. Sedjo, 1996, “Valuation of Biodiversity for Use in New Product Research in a Model of Sequential Search,” RFF Discussion Paper 96–27.

R. David Simpson, Roger A. Sedjo, and John W. Reid, 1996, “Valuing Biodiversity for Use in Pharmaceutical Research,” *Journal of Political Economy* 104, 163–185.

Norman Myers, 1990, “The Biodiversity Challenge: Expanded Hot-Spots Analysis,” *The Environmentalist* 10, 243–256.

Norman Myers, 1988, “Threatened Biotas: ‘Hot Spots’ in Tropical Forests,” *The Environmentalist* 8, 187–208.

Arriving at a numerical estimate of the value of a marginal species depends on how many species are available for testing, how many new products are being sought, the financial rewards earned from developing new products, and the relative value placed on future, as opposed to current, earnings. Even if these conditions are fairly favorable, however, the estimated economic value of biodiversity for use in new product research is modest.

Incentives for Habitat Conservation

The greatest threat to biodiversity probably comes from the conversion of natural habitats, particularly those in tropical rain forests, to agricultural or residential use. Such conversions take place because those undertaking them expect to gain some benefits. Making the economic case to preserve biodiversity means showing that the benefits to be had from preservation are as good or better than those to be had by converting the habitat for other purposes.

But such a case seems hard to make. RFF research shows that pharmaceutical researchers are not willing to pay much to preserve natural habitats even in some regions that are highly imperiled and rich in biodiversity.

RFF researchers arrived at the estimated prices shown in the table on this page first by using a formula often employed by biologists to predict how species extinctions are related to habitat loss to estimate the effect of a “marginal hectare” in preserving species. That is, we considered the effect of such a plot of land in supporting and sustaining endangered species. Taking the estimated effect of an extra hectare of land, we then multiplied it by our estimate of the value of the marginal species to be sustained. This procedure yielded an estimate of only a couple of dollars per hectare for the preservation of even some of the hottest of global biodiversity “hot spots.”

Even in some relatively biodiverse regions of the globe these figures might amount to only pennies per hectare. Values on the scale shown in the table might have some small impact on biodiversity preservation incentives in some of the more isolated parts of the regions indicated. Many of these habitats are, however, imperiled by metropolitan expansion; the incentives provided by biodiversity prospecting are negligible in proportion to the pressures for land conversion in these areas.

Estimates of Value and Conservation Strategies

Estimates of value on the margin are important for devising workable conservation strategies. In particular, they raise some serious doubts concerning the efficacy of two popular strategies intended to encourage the conservation of biodiversity.

One of these strategies involves expanding biodiversity prospecting activities with the idea that conservation will follow. The fact that a resource may have a relatively low value on the margin does not imply that the activity in which it is used is not worthwhile: water tends to be relatively cheap, but it is essential to businesses that use it in producing important products and services. By the same token, however, investment in businesses that use water does not necessarily have much effect on the value assigned to this plentiful resource.

Similarly, increasing investment in biodiversity prospecting activities may have some socially desirable effects—the number of new products discovered may, for example, increase—but it is unlikely to increase the value assigned to the marginal species by much. It may be a little too simplistic simply to say that “you can’t get something from nothing,” but attempts to increase the value added in biodiversity prospecting operations is unlikely to have any appreciable effect on conservation incentives. Biodiversity will remain plentiful with respect to the needs of new product research.

A second focus of conservation efforts has been on

the establishment of property rights in biological diversity. The argument here is that when people own a resource with commercial value, they take effective measures to conserve it. Increasing incentives for preservation will be irrelevant, however, if the values generated by protection do not outweigh the costs of forgoing alternative uses of the land. The RFF estimates of value suggest that incentives for conservation would still be negligible even if property rights were perfectly well defined and the owners of a hectare of land were entitled to all benefits arising from the biodiversity prospecting conducted on it.

Prospecting and Preservation

The point of recent RFF research on biodiversity prospecting is *not* that diversity in nature is without value. In fact, the point is almost the opposite. Biodiversity may be important for any number of commercial, ecological, esthetic, ethical, or even spiritual reasons. However, when it comes to commercial prospecting among natural sources for new products, the value of biodiversity is not as high as some conservationists might suppose. Since that is likely to remain the case, it is important that other, more workable, incentives for conservation be developed. 🏠

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For an in-depth look at RFF research in this area, see the author's several latest discussion papers, which are available at <http://www.rff.org>. To order hard copies of any of these papers, see instructions on page 22.

- In 96-14, “Investments in Biodiversity Prospecting and Incentives for Conservation,” the author and RFF Senior Fellow Roger A. Sedjo argue that added investments in biodiversity prospecting are unlikely to increase incentives for conservation by much. If a living organism's existence makes a difference in finding a new product, researchers will already have an incentive to invest in it. If the organism's

existence doesn't make a difference, additional investments are unlikely to transform it into something consequential.

- In RFF 96-27, “Valuation of Biodiversity for Use in New Product Research in a Model of Sequential Search,” Simpson and Sedjo describe development of a mathematical model of biodiversity prospecting applied to new product research in the pharmaceutical industry, and a statistical model of optimal search intensity with simultaneous samples. Their results indicate that the sheer numbers involved weaken the argument that biodiversity prospecting generates much economic value.

- In 96-33, “The Social Value of Using Biodiversity in New Pharmaceutical Product Research,” Simpson and 1996 summer intern Amy B. Craft of Stanford University developed a model of competition using pharmaceutical industry data from twenty-three countries. The researchers found that the magnitude of losses from even a catastrophic decline in biodiversity would be negligible when compared with the production of the world economy.
- See also R. David Simpson, Roger A. Sedjo, and John W. Reid, “Valuing Biodiversity for Use in Pharmaceutical Research,” *Journal of Political Economy* 104 (February 1996), 163–185.