Biodiversity: A Scientific Dilemma

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Introduction

The movement to conserve worldwide biodiversity is a rare example of scientific activism. Dismayed by field observations confirming mankind’s destructive impact on other species, a core group of conservation biologists galvanized their discipline and vented their frustration in advocacy. Created, defined and shaped by biologists, the biodiversity conservation movement has swept into the political arena with potent force. Despite this activist success, the scientific community behind the movement has retained its credibility as objective, even as it has struggled with the dangers of expressing values in the public sphere. The current challenge to the movement, however, may require scientists to step farther into activism, testing their credibility yet again.

How did scientists create “biodiversity?”

As is often the case with important concepts that find their way into mainstream dialogue, “biodiversity” is hard to define. The term has been defined so many ways by so many people (including even the conservation biologists who invented the word) that critics easily assail the concept as a meaningless basis for policy and action. Careful consideration of the myriad published definitions of “biodiversity,” however, reveals that differences among the scientific definitions converge to a common call for action. Here, a simple definition put forth by the Office of Technological Assessment will suffice: “variety and variability among living organisms and the ecological complexes in which they occur.” (OTA 1997) This broad description can encompass many scientific sub-definitions of “biodiversity,” including the diversity of genetics, species, populations, communities, ecosystems, landscapes and regions.
As mentioned above, “biodiversity” was born in the discipline of conservation biology, a field formed in the 1980s by biologists concerned with the relation between nature and our ideas of nature. (Takacs 1996) This emergent scientific discipline focused much of its attention on the worldwide loss of species diversity due to human action. Conservation biologists coined the term “biodiversity” to catalyze public interest. In 1986, the National Academy of Sciences and Smithsonian Institute hosted a National Forum on Biodiversity, organized by Walter G. Rosen and strongly supported by Edward O. Wilson, both conservation biologists. In a departure from the NAS tradition of avoiding potentially political issues, the forum sounded a warning from scientists and other advocates that species extinction was rapid and problematic. (Takacs 1996)

This call to action successfully brought biodiversity into the public and political consciousness, spurring additional conferences and conventions. In 1992, the United Nations Conference on Environment and Development in Rio de Janeiro (the “Earth Summit”) launched the Convention on Biological Diversity, which was signed by 157 countries and the European Community. The agreement entered into force in 1993, and the First Conference of the Parties was held in Nassau, Bahamas in late 1994. Also in 1994, UNESCO culminated a three-year cooperative scientific program on biodiversity (DIVERSITAS) with an international forum in Paris. (See di Castri and Younes, 1996.) More recently, the Organisation for Economic Co-Operation and Development hosted an international conference in Cairns, Australia in 1996 to explore “Incentive Measures for the Conservation and the Sustainable Use of Biological Diversity” on behalf of OECD member nations. (See OECD 1997.)

What do scientists tell us about biodiversity?
In this decade-long whirlwind of scientific and political debate regarding biodiversity, conservation biologists have been effective in communicating the primary issues perceived by the scientific community. Biodiversity is described as the property that makes nature’s resilience possible, allowing organisms to harness stress in the evolutionary process. The planet has survived five major extinction spasms in the last 600 million years, each time returning to higher levels of biodiversity within 5 to 10 million years. (Wilson 1994) As Wilson colorfully describes it, “the greatest powers of the physical environment slam into the resilient forces of life, and nothing much happens.”(Wilson 1992a) This is possible only because biodiversity provides enough genetic and species variety to ensure that some forms of life will survive any catastrophe, thereby serving as the foundation for post-catastrophe evolution and genetic development. This biodiversity-borne resilience, in turn, protects the human habitat and maintains planetary conditions necessary for human survival.

In addition to providing ecosystem services, biodiversity stores a wealth of genetic information with potential commodity value. Wilson counsels us that the DNA of diverse species should be considered “part of humanity’s greatest heritage” because the value of biodiversity to human safety and progress is immeasurably great. (Wilson 1992b)

Scientists say this wealth is in jeopardy, however, if the current crisis of biodiversity loss is not addressed. Homo sapiens evolved during a time of unprecedented levels of biological diversity on the planet. Throughout the human tenure, biodiversity has steadily decreased as a result of human activities, falling to crisis levels in the last half-century. 1.5% of all species alive at the turn of the century are now extinct, and the overall percentage of species ranked as “imperiled” or “rare” is 22.2%. (Eisner et al. 1995) Habitat destruction is the primary agent of destruction, creating a level of biodiversity loss similar to that which accompanied the dinosaurs’ extinction 66 million years ago. (Wilson 1992b) The exact current rate of extinction is unknown because we have yet to catalog an estimated 90% of the
world’s species, but biologists are certain that the loss of tropical rainforest has the biggest impact on biodiversity, since 50% of the world’s species are believed to live in the rainforests. (Wilson 1992b) Significant loss also occurs on coral reefs, which are severely impacted by warming of ocean waters due to global pollution and its warming effects.

Island biogeography theory and modeling, confirmed by numerous field studies, predicts that a 90% loss of habitat area results in an eventual 50% loss of species. In the tropical rainforests, current levels of deforestation thus translate into .5% species loss per year. (Raven and Wilson 1992) Because of its sheer magnitude, this staggering loss cannot be permanently offset by the propagation of species in zoological parks and botanical gardens. Once habitat destruction has begun to take its heavy toll in an area, three additional factors contribute to the continued loss of biodiversity: pollution, overharvesting and the introduction of exotic species. Worldwide extinction rates are hundreds or thousands of times higher than before the coming of man, and species loss over the next few decades could easily amount to 20% or more. (Wilson 1995, 1992a, 1992b)

To those who charge that extinction is part of the natural evolutionary process, conservation biologists point to the fossil record, showing the current rate to be an anomaly. Most species have a lifetime of between 1 and 10 million years before natural extinction or complete evolution into a new species occurs. Human activity has cut these normal lifetimes significantly, causing the current high extinction rates. Biologists are particularly worried by the rapid extinction of plant species, an unexplainable phenomenon that did not accompany the major animal extinction cycles of the past. (Biodiversity Teleconference 1986)

**Why should non-scientists care about biodiversity loss?**
Scientists have been savvy enough in their presentation of the biodiversity crisis to go beyond the scientific description outlined above. The invisible extinction of one or thousands of species is an important scientific event, but does little to ignite the public passion. Focusing especially on commodity value, scientists have been convincing in their anthropocentric defense of nature’s diversity, only occasionally calling on morality and ethics as the proper basis for our interaction with other species.

The most widely used argument is that humanity has gained direct economic benefits from biodiversity and should not jeopardize its potential for gaining many more. Development of new foods, discovery and synthesis of new medicines, and production of new industrial technologies all benefit from the “genetic library” maintained by natural ecosystems. A second argument is that diverse species are the key working parts to the proper functioning of natural ecosystems, which provide invaluable services to humanity. Ecosystem services include maintenance of the gaseous composition of the atmosphere, regulation of climate, generation and maintenance of soils, and control of crop pests, among others. Finally, some scientists make an appeal to the morality of Earth’s dominant species, claiming that people have an “absolute moral responsibility to protect what are our only known living companions in the universe.” (Ehrlich and Wilson 1991)

What do scientists want us to do?

Conservation biologists believe that the biodiversity crisis poses an enormous challenge to both science and society. If Wilson is correct in saying that every species extinction diminishes humanity (Wilson 1989), then a massive scientific, social and economic effort must be organized to address the current crisis. Scientists must expand their understanding of biodiversity so that society has a better grasp of the natural environment’s true value. This new understanding will allow scientists to map a wildland preservation
policy, focusing on “hotspots” of high biodiversity. In addition, society must find ways to address poverty through sustainable development in developing, tropical countries to alleviate the economic pressures that cause diversity destruction. (Wilson 1992a) Finally, scientists are advocating for societal population control to limit the source of biodiversity loss.

Most biologists agree that a complete survey of the world’s fauna and flora is the first step toward advancing our understanding of biodiversity’s importance. Tropical and non-tropical countries alike must expand their taxonomic inventories and reference libraries to map the world’s species and identify hotspots for priority in conservation. (Wilson 1989) Conservation biologists Raven and Wilson have proposed a 50-year plan that would first concentrate on those groups that are relatively well known now (flowering plants, vertebrates, butterflies, etc.) to reveal the existence of hot spots. The identification of those parts of the world believed to contain the largest numbers of endangered species could be applied directly to the problems of economic development, land use, science and conservation. While this preliminary effort is underway, adequate training should be provided to assemble a scientist corps to undertake the complete survey: a worldwide identification and biogeography of all species. (Raven and Wilson 1992)

Scientist-advocates also believe that the serious need for major efforts in science to address the biodiversity problem is accompanied by a serious need to help people understand the many benefits biodiversity confers. A complete taxonomic inventory will allow conservation biologists to demonstrate biodiversity’s role in ecosystem function, establishing its practical potential. (Lovejoy 1999) As Wilson puts it, scientists have the important duty of “creating” biological wealth: finding potential commodity value for species and ecosystems in order to buy time for continued study. (Wilson 1992a)
Once this wealth is scientifically established, scientists believe a massive restoration and preservation system should unfold to protect it. Legal regulation and economic incentives should be used to save the biodiversity that remains and create favorable conditions for its recovery. Wilson has found support among his colleagues for his call for an increase of wildland reserves from 3% of the planet to 10% of its land preserved in a “habitable and undisturbed condition.” (Wilson 1994) In addition, ecosystems must be restored and even created to bolster biodiversity. Both species and habitats should be protected, and priority should be given to protection of hotspots and umbrella species with the largest ranges. (Eisner et al. 1995)

In advocating an extensive global preservation network, conservation biologists willingly trespass in the realm of development planning, an intensely political arena. This willingness to become political actors is based on a belief that conservation must be coupled with economic development, especially in countries where poverty and high populations threaten the planet’s last wildlands and biodiversity reserves. “Merely setting aside reserves, without regard for the needs of the local population, is but a short-term solution to the biodiversity crisis.” (Wilson 1989) Scientists believe they must participate in the development of new agricultural methods for the poor to prevent their desperate destruction of wildlands, while also addressing biodiversity loss in developed countries at the same time. Some have advocated for a movement to make human-dominated regions more hospitable to other organisms by substituting alternative economic activities, such as game ranching for cattle ranching, or native landscaping for lush gardens in desert cities. (Ehrlich and Wilson 1991)

In calling for new social and economic systems, conservation biologists do not pretend that these changes will be easily achieved. While recognizing that preservation of biodiversity and its sustainable exploitation go hand in hand, Ehrlich and Wilson admit that
“the social, political, economic and scientific barriers to achieving this goal are so formidable that nothing less than the kind of commitments so recently invested in the Cold War could possibly suffice to accomplish it. And we are 45 years late in starting.” (Ehrlich and Wilson 1991)

In the closing panel of the National Forum on Biodiversity in 1986, both Ehrlich and Wilson were among the participants of a teleconference broadcast to colleges and universities around the country. In response to a caller’s simple question about what the average person can do to help solve the biodiversity problem, Ehrlich did not hesitate in answering that the first step is to contact your legislators and become an advocate. The single most important issue to raise with your legislative representatives, he said, is the need for a national population policy. (Biodiversity Teleconference, 1986) “The indispensable strategy for saving our fellow living creatures and ourselves in the long run is, as the evidence compellingly shows, to reduce the scale of human activities.” (Ehrlich and Wilson 1991)

This means controlling population as the source of biodiversity loss.

**Do scientists have the right to be advocates?**

Identifying population control and legislative advocacy as the most important responses to the biodiversity crisis puts scientists like Ehrlich and fellow panelists Wilson, Raven and Lovejoy in a distinctly non-scientific position. As David Takacs points out in his survey of conservation biologists’ thinking and participation in the biodiversity movement, biologists who become spokesmen for biodiversity seemingly endanger their credibility as being objective. (Takacs 1996) The public is quick to question the motivation of scientists who leave dispassionate objectivity behind, “lowering” themselves to the status of citizens with an agenda. In the case of biodiversity, this agenda would seem all the more questionable because the scientists themselves control many of its resources. (Burkey 1998)
And yet, the movement to protect biodiversity has been led from its outset by biologists who have “made the jump” into the policy debate with relative success.

These conservation biologists are not immune to criticisms of their scientific credibility, but they have done much to pioneer a new form of science that makes room for interpretation, if not activism. Wilson is a passionate defender of scientific objectivity (see Wilson 1998a), but he admits a major flaw in the scientific disciplines: scientists are judged on their accomplishments and discoveries, not on process or interpretation. The scientist who “interprets” becomes a “scholar” of humanities instead of a “scientist.” The regrettable outcome of this shortcoming, he explains, is that many “accomplished scientists are narrow, foolish people, and … many wise scholars in the field are considered weak scientists.” (Wilson 1998b) Conservation biology has left this dichotomy behind, raising a chorus of scientific voices to influence the direction of social and economic policy. Even the term “biodiversity” was coined to manipulate public opinion and policy. (Takacs 1996)

**Are scientists advocating for biodiversity conservation in useful ways?**

Conservation biologists have not emerged from their transformation unscathed, but they have been largely successful in retaining their stature as objective scientists while simultaneously effecting real policy changes through activism. Biodiversity has entered into mainstream dialogue, nearly becoming a household word. The prominence afforded the concept at the 1992 Earth Summit is a testament to the success of biologists’ efforts to raise awareness. The question now is whether the biodiversity conservation movement will survive two distinct challenges brought about by scientists’ own advocacy.

Having elevated their scientific concerns to social and economic forums to gain a wider audience, biologists are now losing control of the movement. The First Conference of the Parties to the Convention on Biological Diversity, held in 1994, was an important
opportunity for scientists to influence policy. After having spent nearly a decade advocating for global attention to biodiversity issues, biologists expected that the First Conference would allow them to help shape an international action plan. Instead, politicians controlled the debate, polarizing it with North-South disagreements and excluding most scientific content. (McNeely 1999) In examining what went wrong, it becomes obvious that scientists very nearly made a deal with the devil in advocating to bring biodiversity to the forefront of public policy. Public policy decisions are characteristically made largely on the basis of emotion, rather than hard facts, and even scientific facts can be dangerous in the hands of non-scientist policy makers. Biodiversity has migrated to a realm where it faces four formidable non-scientific issues:

1. Current practices that deplete biodiversity are often quite popular, given that the desire for consumption (fueled by advertising) is far more powerful than the conservation-minded advice of scientists.
2. No easily identified opponent is available to catalyze the organization of conservation forces.
3. Biodiversity loss is not immediately observable to those whose consumption creates the most significant impact.
4. The modern public has little appetite for complex arguments. (McNeely 1999)

Neither scientific reasoning nor the limited policy activism that conservation biologists are comfortable with can overcome these obstacles.

A second challenge to biodiversity conservation arises directly from conservation biologists’ strongest activist message: that biodiversity is quantifiably valuable to human beings. Scientists have made repeated appeals that the public recognize three distinct values for biodiversity: direct utilitarian values, indirect utilitarian values, and spiritual or ethical values. Of these value claims, the first two (the most scientific) seem inherently flawed and potentially destructive to the movement. Direct utilitarian values, such as the medicinal or industrial values of as-of-yet-undiscovered genetic information, represent a double-edged sword. Judging natural resources by their usefulness to humans leaves room for
determinations that certain species are dispensable. (Noss and Cooperrider 1994) This attitude, of course, represents the root of the biodiversity crisis; therefore, “assigning value to diversity … merely legitimize[s] the process that is wiping it out.” (Ehrenfeld 1986) Indirect utilitarian values, such as the value of ecosystem service provision, are nearly impossible to quantify, given our limited understanding of ecosystem function. In fact, apparent redundancies within an ecosystem could very well lead to determinations of non-value for some species. The truth is that it is not possible to figure out the exact economic value of any piece of biological diversity or even the value of biodiversity as a whole, particularly because some species do not seem to have any conventional value at all. (Ehrenfeld 1986)

So scientists are left with the value claim with which they are least comfortable: spiritual or ethical value. This, of course, is not quantifiable although it is admittedly powerful. That natural objects and processes should be valued in and for themselves is probably the least biased and most secure argument for conservation (Noss and Cooperrider 1994), but perhaps this limb extends farther than scientists can climb without sacrificing all credibility. As Ehrenfeld eloquently states, “[I]f conservation is to succeed, the public must come to understand the inherent wrongness of the destruction of biological diversity.”(1986) But who will teach this lesson?

**If scientists can’t solve the problem, who can?**

The biodiversity movement’s current challenges create a decided fork in the road of scientific participation. At this point, conservation biology could leave the political “movement” behind and concentrate on the technical work to be done, such as inventoring, mapping and theorizing about ecosystem function. This could keep them busy for the next 50 years, at least. Alternately, activists like Wilson, Raven, Ehrlich and others could abandon their scientific posts to accept the challenge of teaching global morality and
advocating for moral changes to political decision-making. McNeely sees a middle road in which scientists could “build on science to demonstrate the real benefits of conserving biodiversity to farmers, ranchers, and foresters, balance the attention given to loss of biodiversity with concern for sustainable use of harvestable species, and build a broader constituency among business, the public and the academics.” (McNeely 1999) Perhaps he is describing another transformation of the scientific disciplines that would preserve objectivity and credibility while tuning attention more finely to the realities of political power. Conservation biology has made one such transformation in the last 15 years. Is it up for another?
References Cited

Wilson, Edward O. (1998a) “Back to the Enlightenment: we must know, we will know.” Free Inquiry. 18(4):21-23.