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Conserving Biological Diversity

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Introduction

Life first appeared on Earth about 3.8 billion years ago and over time covered the land and sea with microbes, plants and animals. The count of known species now stands at about 1.8 million, and no one would be surprised if over 10 times more exist, still undiscovered. Most humans come from a small group that slipped out of Africa less than 100,000 years ago and spread around the globe, less than one-tenth of a second on a time-scale measured at 1 hour since life first appeared. Despite mankind's very recent presence, we have eliminated species and pushed many more out of the places they lived. This began with mammoths and other prehistoric animals, but the pace of extinction and displacement has accelerated since permanent settlements were established and machines were invented to improve our lives. E.O. Wilson has estimated that 3 species are lost per hour. Exact numbers are elusive—starting with not knowing how many species there really are to begin with—but the big picture of loss is unmistakable.

Convention on Biological Diversity

Many national governments have recognized the value of nature and taken steps to conserve it through protected areas and laws that regulate exploitation. A range of international agreements have also been adopted. The most comprehensive in scope of these is the Convention on Biological Diversity ("CBD"), which entered into force on 29 December 1993, and now has 193 parties. The CBD's preamble notes "the intrinsic value of biological diversity and of the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its components." It notes "the importance of biological diversity for evolution and for maintaining life sustaining systems of the biosphere." And it affirms "that that the conservation of biological diversity is a common concern of humankind."

The CBD's effectiveness has been questioned, but representatives stepped forward at the most recent meeting of the Conference of the Parties (COP 10) in Nagoya, Japan, held in October 2010. The parties acknowledged failure to significantly reduce loss of global biodiversity between 2002 and 2010, as the first strategic plan of the CBD prescribed, and they adopted a new strategic plan for 2011–2020 ("Plan").

The Plan's vision is "a world of *'Living in harmony with nature' where 'By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people.'*" The Plan's mission is to "take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services . . ." The Plan has 20 "Aichi Targets", named after the Prefecture whose capital is Nagoya, many with references to accomplishments by 2020. Target

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11, for example, states: "By 2020, at least 17 per cent of terrestrial and inland water areas, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved . . ." However, the Plan offers no specific measures to determine whether an area has been "conserved" or not, nor does it commit parties to achieving the targets. The sentiment for action in the Plan is good, but could any informed observer believe the timelines: that global loss of biodiversity will be halted in 9 years, or that mankind collectively will be "living in harmony with nature" 39 years from now?

One important, concrete, and realistic step forward would be to give the people who manage areas of land and water better guidance on how to conserve biological diversity on their properties. More than guidance is needed, of course. Developing nations, where degradation of the natural world is most rapid, are faced with stark, short-term economic choices on resource use, high population growth, and limited educational and governance capability. These realities are fundamental obstacles to conservation that only economic and social advancement can remove, combined with finding nearer-term opportunities for people to conserve biodiversity and make a living at the same time. Yet these obstacles call out for guidance too, because the difficulty of taking actions needed for conservation will depend on what kinds of actions conservation requires.

Land and water managers need an owner's manual for conservation. Many, whether government, business, or personal owners, have limited background in science, law, or policy and also have responsibilities other than conservation—like making a profit. Unless they know just what to do for conservation, it won't be done, and yet it is primarily their actions that will determine the future of Earth's biological diversity. But what does "biological diversity" actually mean?

The term "biological diversity" first appeared in 1968 in a book by Raymond F. Dasmann, *A Different Kind of Country*, in reference to the richness of living nature that conservationists should protect. It resurfaced in the 1980's in books, articles and conferences on conservation, and was presented as an alternative to "wildlife management," whose concepts and practices were seen as over-emphasizing species of fish and other animals that are caught or shot, and as giving too little attention to plants and invertebrate animals and to multi-species ecology. The term biological diversity is defined in the CBD to mean:

> "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."

The key word in this definition is "variability," which all the other words qualify. The basic concept of this definition was first articulated for "species diversity" and defined through information theory. Its variables are the number of species and the relative abundance of the different species. Species diversity is higher in an area if more species are present. It is also higher if the species present have similar relative abundances, rather than one or a few species dominating in numbers while the others are rare. The CBD definition also includes variability within species and variability of ecosystems. Intraspecific variability is a recognized plus in conservation—for example, the in-breeding and very limited genetic variation in cheetahs is harmful to their conservation. It is also beneficial to have more kinds of ecosystems, such as bogs, mountain meadows, coastal dunes, coral reefs. Overall, we benefit from having more species, more ecosystems types, more genetic variation within species, and a more distributed representation of all these things rather than having them clumped in a few places.

But variability isn't everything. In misguided efforts to increase species diversity, the CBD definition of biological diversity could be read to promote the introduction of non-native species into an area (although the CBD has separate language inveighing against invasives). The definition could be read to give lower priority to high-latitude ecosystems that have fewer species than the tropics, even though high-latitudes might have species of great ecological and economic significance, such as krill in the Southern Ocean. Not much debate has emerged, however, along these lines because biological diversity has been treated more as a general reference to wild living nature than as something that can be reduced to a formula. Nonetheless, the first objective of the CBD is conservation of biological diversity, and objectives require measures of success. So what might those conservation measures be?

Academic disciplines, like such as conservation biology and landscape ecology, have emerged to address this issue in combination with long-standing research for industries such as fisheries and forestry. The former look mostly at determining what features are best for the ecology of places and the latter typically address what extraction is sustainable. A wealth of information is available on both fronts. Much less has been done to effectively translate work on ecological priorities and sustainability of extraction into practical, relatively simple, guidelines that land and water managers need to conserve their property's biological diversity. "Best practices" have been developed for many industries, such as principles and criteria of the Forest Stewardship Council and an array of best practices for different fisheries put out by the Food and Agriculture Organization. These are tailored to the uses and places for which they were developed and can be an important component of conservation planning. However, best practices describe a process with do's and don'ts rather than a measurable vision of what features of biological diversity in a managed area should look like if they are to be considered conserved. A vision is needed. Two different models warrant consideration. One references the "original" features of an area before any disturbance by man, and the other references the features exhibited when the area is used for *sustainable* provision of goods and services for people. Together, the original condition and sustainable uses can provide the vision and framework needed.

Biological diversity has been diminished at the hand of humankind through habitat fragmentation and reduction, direct over-exploitation, pollution and introduced invasive species. A location's original condition before this happened is a reference point. Unless an area is undisturbed now, that originial condition must be estimated by using historical information or by reference to related but less disturbed areas believed to have similar, original features. Once the original features are characterized for an area, it can be resurveyed periodically and progress in conserving biological diversity measured as change in the similarity between the original features and the current features.

The original condition isn't biased by interest in extraction, and it is the condition that usually reflects a long course of evolution and complex ecological relationship tested through time with only the very recent involvement of the human species. The original condition also often has the high variability in species and ecosystems that the CBD defines as biological diversity. An exceptional adjustment to this management of the original condition may be warranted for climate change, because it is on-going and cannot be locally reversed. For example, if a wetland will be permanently submerged through sea level rise and a now dry higher elevation area will become wetland, then this should be accounted for in managing a property overall to approximate its "original" condition.

But conserving biological diversity also must embrace *sustainable* provision of goods and services for people. Use of biological diversity is an objective of the CBD and many other legal regimes, just as is conservation, and if use were prohibited it would still continue to happen and conservation would suffer from the policy. Biological diversity has provided valuable goods and service for people throughout human existence. These "ecosystem services" are now prominent in many policies and programs for development, and failure to embrace sustainable use of these resources for current human livelihoods would not only diminish standards of living but would undermine political support for long-term resource conservation.

Not every place should be modified by human use. We should strive to keep wild a significant share of those diminishing, genuinely pristine areas of biological diversity on Earth, and the growing number of wilderness parks and sanctuaries on land and sea are contributing to that. But most areas are significantly modified, and can be managed in a way that moves them towards their original condition and also allows resource use. Core objectives in this case include sustainable harvest of target species, such as trees and fish, protection of endangered or threatened species, maintaining balanced amounts of old-growth forest or big fish, preserving unfragmented habitat and corridors for movement, and preventing or managing pollution. The kinds of uses make a difference. Very strict scrutiny and constraints are needed for commercial harvest of trees or fish and any conversion of natural lands for agriculture or settlements, whereas traditional indigenous uses may be intrinsically beneficial to conservation by bringing watchful eyes into an ecosystem.

Policy Recommendations

With the discussion above in mind, the following principles are offered for managers with responsibility for conserving the biological diversity of geographic areas of land or water:

1. **Develop a comprehensive plan for conserving the biological diversity of the area.** The plan should include goals, objectives, implementing actions, and measures. It should include a system for assuring compliance with plan requirements, and should provide for regular internal and external reviews of compliance and, less frequently, of the plan itself.

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2. **Make implementing the conservation plan a significant element in performance reviews of employees whose work affects conservation.** This will vary with position. A government director of a national forest might be appraised with respect to the forest as a whole, including monitoring and enforcement of applicable laws. The work of a company manager logging in that forest might be reviewed by his corporate supervisors for implementation and compliance with conservation requirements developed and endorsed by the government director. A logger working in that forest might be reviewed by the company manager for compliance with specific instructions, incorporating conservation, on what and how to cut. People care about keeping jobs and earning as much as they can.

3. **Make sure available information demonstrates that actions will be consistent with conservation objectives before the actions are taken.** The burden of proof in natural resource use has often determined whether conservation or over-exploitation occurs. Fishery regulation has been based historically on quotas that regulators are required to develop and substantiate. Number are proposed by them, fishing interests express opposition, and, after the dust of debate settles, over-exploitation happens. Yet the fishing in some geographically designated areas, such as national wildlife refuges in the United States, is presumed closed unless users or managers can demonstrate that the catch will be compatible with conservation, and the fishing allowed in these refuges typically does not deplete the populations that are fished. Existing laws for a given area may not shift burden of proof to users, but private land-owners can voluntarily accept that shift, and laws can be changed.

4. **Don't mix guidance for conservation with guidance promoting use or benefit-sharing.** The objectives of the CBD are, ". . . the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources . . ." The CBD parties will continue to pursue all three objectives, but they should not be intertwined with guidance for conservation, which is by itself difficult to define and achieve. If all three objectives are mixed into a single measure, the likely consequence will be confusion on what is needed for conservation.

5. **In respect to any funding for Reducing Emissions from Deforestation and Forest Degradation (REDD), make conservation of biological diversity a condition for funding, but do not use it to determine the *amount* of funding.** The Cancun Agreements adopted at the 16th Conference of the Parties to the Framework Convention on Climate Change (FCCC) endorsed and expanded the policy of Reducing Emissions from Defor-

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estation and Forest Degradation (REDD). This included recognizing the role of conservation and sustainable forest management and the "co-benefit" of biodiversity. The Cancun Agreements also set out details for the Green Climate Fund and, in principle, will be the financial mechanism through which developed nations will contribute to developing nations for climate actions on mitigation and adaptation, including those concerning forests. The FCCC parties have agreed to a goal of mobilizing $100 billion per year for this purpose by 2020, and hope that significant additional funding will be available to conserve forests and their biodiversity. However, the primary purpose of REDD is to reduce carbon emissions, and the mainstream discussion on funding levels and offset credits that may be earned through forest investment is tied to the level of reduction in carbon emissions. Furthermore, carbon is an atomic element that can be measured without the problem of subjectivity in definition that is inherent in measuring biological diversity. In the interest of clarity and effective process, conservation of biological diversity should be a condition for REDD funding, but the funding amount is better determined by the amount of greenhouse gas mitigation.

6. **Map features defining the area's current and original biological diversity.** The current features can be determined with a survey. The original features—those present before human disturbance—cannot be exactly determined if the area has been disturbed, but may be estimated using historical information for the area or through reference to other pristine or less disturbed areas believed to have similar, original features. The features mapped should at a minimum include: (a) kind, abundance, and distribution of indicator species and ecosystem types; (b) age structure of harvested species such as trees or fish, (c) endangered or threatened species if present, (d) invasive species; (e) habitat coverage showing any fragmentation; (f) corridors that impede or facilitate movement or spread; (g) sources and levels of any harmful pollutants. The original features might require adjustment in setting management objectives to address future climate change. The data assembled for mapping should be geospatially referenced and entered into a GIS application that can both prepare visual maps of variables and support diverse analyses of the data. Contractors should be engaged if in-house expertise is not adequate. The intensity of detail and choice of methods for surveys will vary with scale, from satellite or aerial imaging combined with ground-truthing for large areas, to ground-based work alone for small areas. The specifics will also vary with the area's use. For example: An area managed as wilderness would look closely for effects of invasive species, climate change and illegal activities; A logged forest or fishing ground would include detailed information related to harvest. Initial surveys will typically be more detailed than subsequent surveys to monitor change.

7. **Periodically re-map the area and estimate the similarity between current and original features to assess progress in conserving biological diversity.** Progress in conservation by this measure will show an increase in similarity over time. A policy of "no-net-loss" would require that the similarity not decrease. Various statistical tools can be used for this now, but finding agreed models and, especially, user-friendly applications for this task should be a priority for funding agencies, institutions and experts concerned with conserving biological diversity. This is a situation where concepts abound and where focus and simplification is needed. The programs offered might be subtle and internally complex, but they should be easy for managers to use and read, and they should have as much endorsement as possible by authorities, including the CBD.

8. **Manage the area to approximate the original features mapped, implement best practices that make sense, and don't allow unsustainable uses.** The map of original features is essentially a blueprint for the area's modification and management. The specific actions will vary widely between areas, but are techniques and practices for these are well-developed and familiar to a range of experts. Existing and proposed uses with the potential to significantly impede achievement of original features should be closely reviewed, such as logging and fishing, and allowed only if they are determined to be consistent with conservation of biological diversity. These uses should be sustainable for the species and ecosystems impacted, not detrimental to the survival of any associated endangered or threatened species, and consistent with other values such as maintaining some fully protected areas, keeping a share of old-growth forest or big fish, avoiding habitat fragmentation and loss of corridors, and preventing harmful pollution. This review will necessarily require some subjectivity and subtlety and independent technical expertise should be engaged and respected.

Conserving biological diversity is a stated priority not just in the CBD but in the domestic laws of most nations and in the priorities of international, regional, and national development agencies. Furthermore, many conservation projects have been undertaken in connection with economic development initiatives such as roads, dams, and agricultural expansion, sometimes required by development agencies as conditions for loans or grants. But the actual contributions of these projects to conserving biological diversity, and to mitigating environmental impacts associated with construction and land-use change, will be uncertain unless measures such as the principles above are woven into projects by the agencies that oversee and fund them. Having measures doesn't guarantee success, but lack of measures begs for failure. The principles offered above for conserving biological diversity can certainly be refined, augmented and improved. But if followed, they offer a prescription for the task ahead. We need that.

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