Translating Life's Diversity: Can Scientists and Policymakers Learn to Communicate Better?

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What causes biodiversity loss? The immediate causes are apparent: expansion of cattle ranching and agricultural activities; extensive adoption of agroindustrial models that radically simplify the rural landscape and rely on unsustainable use of energy and chemicals; overexploitation of biotic resources such as fisheries, old growth forests, bush meat, and ornamentals; introduction of invasive species; and recently, the first effects of climate change. All the above reduce the integrity, size, and connectivity of habitats; extirpate populations of species and degrade their genetic pool, eventually leading to extinction; threaten the functioning of ecosystems; and, generally speaking, destroy biodiversity.

Despite very real and extensive gaps in ecological science,[1] researchers know a lot about many of the above causes. The volume of literature on forest fragmentation is extensive and increasing; the demographic and mathematical tools necessary to understand the population dynamics of extinction are very sophisticated; the relationship between ecosystem complexity and ecosystem functioning (and thus ecosystem services), a cutting-edge topic of research, is beginning to be understood; and the overarching theme of biodiversity patterns at many scales is, at least, being studied. Databases of primary biodiversity data (observations of species) are growing very fast and becoming available through the Internet. The amount of remote sensing data we are obtaining - at unprecedented resolutions

- is staggering, far beyond our current capacity to process and understand the data.

Because natural scientists know about immediate causes of biodiversity loss, and more importantly, know how to study them, they tend to concentrate on them. The immediate causes of biodiversity destruction act on ecological processes amenable to the methods and theories of the natural scientist, enabling him or her to describe, measure, understand, and, ideally, predict. In short, natural science approaches the problem through the immediate causes. This creates a feeling among many scientists that if only we knew more about the ecology of populations, communities, and ecosystems, we could tell policymakers what to do to avoid their destruction or to promote their sustainable use.

However, the above feeling is based on an important fallacy, because there are deeper, fundamental sources of biodiversity destruction underlying the immediate causes: sources rooted in economics, culture, or social factors.[2] Examples of such root causes include population growth, the collapse of traditional institutions and subsequent loss of ownership rights, the paucity of markets for biodiversity goods and services, the uncritical adoption of developed-country technologies, the lack of coordination among government institutions, and various perverse incentives.

- *Explosive population growth.* The relationship between population density of a region and its environmental health is not a simple, linear one. However, the data on population growth are well known, and there is no doubt that when fragile, complex ecosystems such as tropical rainforests suffer population growth rates on the order of 4 to 10 percent - as some municipalities in Chiapas state in Mexico have experienced in the last decade[3] - almost any attempt to achieve sustainability will fail. The large proportions of numerically rare species, which almost by definition are sensitive to perturbations, characterize such highly diverse ecosystems.

- *Collapse of traditional institutions.* Many pre-industrial, traditional institutions controlled use of "commons" via nonprivate decisions, but many of these institutions have collapsed in the wake of development. Garrett Hardin's tragedy of the commons[4] is indeed real, but it should not be understood as equating communal ownership with free access to resources.[5] This was and still is far from true in aboriginal societies. Social systems that control access to common resources are well documented and may create powerful incentives for ecological sustainability. For example, the Unión Zapoteca-Chinanteca (UZACHI), an organization of communities in the mountains of northern Oaxaca, Mexico, maintains a tight communal control over their forests and water sources. They have adapted their old communal culture. Unfortunately, such community decision systems are among the most threatened by modernization and globalization.

- *Lack of ownership rights.* Often, after the collapse of traditional institutions, clear and widely accepted ownership rights over natural resources are undermined or vanish altogether. A situation of free access to biological resources then arises that favors overexploitation. In some of the forestry communities in Mexico's Yucatan Peninsula, for example, the activities of private timber dealers favoring one group in the community over others have weakened "community controls over access to resources," thus hindering the sustainable management of the forest and the productivity of the community enterprise.[6]

- *Lack of markets for biodiversity goods and services.* For most biodiversity goods and services, there are no markets in the global and national economies. This problem has been very well documented and it is one of the most powerful root causes of biodiversity loss.[7] Loss of biodiversity and ecosystem services are often related to increased erosion, higher vulnerability to natural disasters, depletion of aquifer levels, and very real economic damages, but because their markets are nonexistent, the economic incentives for sustainability are lacking.

- *Uncritical adoption of developed-country technologies.* Many developed-country technologies adopted in developing countries are either outdated, proven to be unsustainable, or simply inadequate for different environmental and social conditions. For example, green revolution agricultural methods (genetically homogeneous, improved varieties that require investment in chemicals and machinery) may not be ideal in all situations: Local varieties and technologies adequate to low-income, subsistence agriculture may provide better answers in mountainous areas where indigenous populations are the majority.

- *Lack of coordination among government institutions.* In many countries, the efforts of different branches of the government result in environmental policies that, taken together, are uncoordinated and often contradictory. For example, for decades the Mexican government has subsidized and/or promoted large-scale deforestation of what some branches have defined as "wastelands." At the same time, environmental agencies, working with a relatively miniscule budget, have tried to stop deforestation. In another example, one branch of the government has been pushing very hard for the introduction of invasive alien grass species for cattle pastures, while another has attempted to pass legislation against introducing foreign species.

- *Perverse incentives.* Multiple perverse incentives promote and subsidize unsustainable fisheries, practices that substitute forests with simplified ecosystems, industrial agriculture, and other systems known to contribute to biodiversity loss. Often these incentives are the result of public policies, and the subsidies come from public funds.

The previous arguments illustrate an important hypothesis: Basic scientific knowledge, albeit significant in absolute amount and depth, is still fairly insufficient in relative terms. Most importantly, its focus is misdirected: It is concentrated on the questions that scientists define and regard as relevant rather than on the questions and processes that fundamentally determine biodiversity loss. For

example, an ecologist may see overexploitation of bighorn sheep in Baja California only in terms of minimum viable population analysis (a highly sophisticated branch of ecology), but it is also a matter involving the Minister of Environment, who must deal with an opposition governor; the campesino owners of the mountains where the bighorn sheep live, who are striving to get rid of intermediaries between wealthy foreign hunters and themselves; and the minor functionary - whose head is at risk if something goes wrong - who must decide how many permits to grant without causing an outcry from the environmental nongovernmental organizations (NGOs). And so on.

The question on how to convert scientific information about biodiversity into public policy can now be rephrased into two questions: How can data and information relevant for stakeholders in general and policymakers in particular be obtained? And how can that data and information be refocused into knowledge in formats and ways that do not betray the science but are accessible and interesting to the stakeholders? To provide one answer to those questions, it is helpful to examine some examples from Mexico.

Translator Institutions

In 1992, President Carlos Salinas de Gortari of Mexico issued a decree creating the National Commission on Biodiversity (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, or Conabio). The purpose of Conabio was to create a national inventory of biodiversity and to "advise governmental agencies, as well as social and private sectors on technical and applied research aspects regarding the use and conservation of biological resources."[8]

Conabio's annual budget has been on average US$3 million, plus about 30 percent extra in earmarked grants from a variety of national and international agencies. (Instituto Nacional de Biodiversidad (INBio) of Costa Rica, the Alexander von Humboldt Biological Resources Research Institute (the Humboldt Institute) of Colombia,

and the Environmental Resources Information Network (ERIN) in Australia have had budgets of the same order of magnitude, although the provenance is different. (A description of these organizations is found on Table 1, page 98.)

Conabio fulfills its mission with large biodiversity databases, software to enable queries on the data, analysis presented to various governmental branches, follow-up with policymakers, and occasionally, recommendations to further study an issue.

Conabio's first task has been to assemble large, primary biodiversity databases. "Primary biodiversity" refers to data almost without interpretation. In practice, this means registers of the presence of species, and Conabio now has millions of such records, with an average annual growth rate of 100,000 records. Conabio obtains the records for the database by funding Mexican taxonomists to revise specimens in museums and herbaria and then computerize the results. Another method relies on getting high-quality electronic pictures from specimens and their labels and then capturing the data in Mexico. In many cases, Conabio has established collaborative agreements with foreign institutions to perform the capturing jointly or to access directly the databases of the institution in question.

Such databases, coupled with ad hoc software, can be used to answer questions about the presence of species in a given (arbitrarily defined) region or about the area of distribution, potential or actual, of a given species.[9] A large number of questions relevant for Mexico's federal government are related to the presence of species or their areas of distribution. For example, queries can be made to

- define species and areas of the country susceptible to contamination by transgenic species;
- define areas of the country that have a high likelihood of being invaded by an invasive species already present in a bordering country;
- define the tree species adequate to reforest a given region of the country;

- define the areas of the country that have the highest priority for biodiversity conservation;
- define the regions likely to be reached by vectors of diseases as temperature rises due to climate change;
- provide evidence of law breaking (for example, damage to endangered species) in the case of large-scale vegetation changes; or
- suggest sites where there is a high likelihood of finding intact populations of species protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Most of these queries can be answered through the use of suitable databases and appropriate information technology methods, together with consultations and fact-checking with networks of experts. Conabio acts as an intermediary between these experts and government, essentially taking on the role of translator between the two communities. Expert participation is a sine qua non for the correct interpretation of the databases, and maintaining a trustful, committed community of experts is part of Conabio's work.

Just as important as being able to draw data from extensive banks is that the results from these databases have to be phrased in terms that are relevant to the political, legislative, budgetary, or judicial processes. Informative, short executive summaries are always prepared, with relevant political, legislative, or budgetary points highlighted. As obvious as that may seem, Conabio was originally composed largely of natural scientists, and it took time to learn how to phrase the results in ways that could be understood by all parties. Now, Conabio biologists work in teams with lawyers, economists, and social scientists. This is one of the most difficult parts of the process, because it requires interdisciplinary work.

After an analysis has been submitted to policymakers, it is not possible to assume that it will take its proper course by itself, so to speak. There is a long period in which Conabio has to attend meetings,

Table 1. Selected institutions concerned with biodiversity

National-level institutions	Description/objectives
National Commission on Biodiversity (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, or Conabio) Established 1992 Based in Mexico City, Mexico Interministerial agency presided over by the President of Mexico and confirmed by 10 ministries http://www.conabio.gob.mx	Conabio is an interministerial commission mainly dedicated to conform and maintain updates to the National System of Biodiversity Information (SNIB), to support projects and studies focused on the knowledge and sustainable use of biodiversity, and to advise governmental institutions and other sectors. Conabio mainly focuses on the biodiversity informatics (data, information, and knowledge) needed to support the decisionmaking of users. Conabio is a boundary institution that links scientific research with policymaking.
National Institute of Ecology of Mexico (Instituto Nacional de Ecología, or INE) Established (with current objectives) 2001 Based in Mexico City, Mexico Part of Mexico's Secretariat of the Environment and Natural Resources (Secretaría de Medio Ambiente y Recursos Naturales, SEMARNAT) http://www.ine.gob.mx	INE is a governmental agency with objectives to generate scientific and technical information on environmental issues and to train human resources. The intent of these objectives is to inform society, support decisionmaking, encourage the protection of the environment, promote the sustainable use of natural resources, and support the Secretariat of the Environment and Natural Resources in reaching its goals. INE focuses on developing research on pollution, ecosystems conservation, and environmental policies and economics.
National Biodiversity Institute of Costa Rica (Instituto Nacional de Biodiversidad, or INBio) Established 1989 Based in Santo Domingo de Heredia, Costa Rica Nongovernmental, privately funded organization http://www.inbio.ac.cr/	INBio is a nongovernmental, nonprofit, public interest organization that works in close collaboration with different government institutions, universities, the private sector, and other public and private organizations within and outside Costa Rica. INBio was created to support efforts to gather knowledge on the country's biological diversity and promote its sustainable use. INBio's work focuses on the following areas of action: inventory and monitoring, conservation, communications and education, biodiversity informatics, and bioprospecting.
Alexander von Humboldt Biological Resources Research Institute of Colombia (Humboldt Institute) Established 1993 Based in Santafé de Bogotá, Colombia Civil nonprofit social corporation linked to the Ministry of Environment http://www.humboldt.org.co	The Humboldt Institute's objective is to promote, coordinate, and carry out research that contributes to the conservation and sustainable use of biodiversity in Colombia. It was created under Colombian law as one of the entities for the scientific and technical support of the Ministry of the Environment. It is a nonprofit organization, ruled by the norms of science and technology. It has various members, including the Ministry of the Environment, the Scientific Agency of Colombia, public and private universities, local government, and nongovernmental organizations. The Humboldt Institute focuses mainly on biodiversity inventories, conservation biology, use and valuation, policies and legislation, communication and information, and training.

Table 1, continued

National-level institutions	Description/objectives
Environmental Resources Information Network (ERIN) Established 1989 Part of the Australian Government Department of the Environment and Heritage, based in Canberra, Australia http://www.deh.gov.au/erin/	ERIN aims to improve environmental outcomes by developing and managing a comprehensive, accurate, and accessible information base for environmental decisions. Information covers environmental themes ranging from endangered species to drought and pollution. ERIN is a unit specializing in online data and information management and spatial data integration and analysis.
International-level institutions	**Description/objectives**
Convention on Biological Diversity (CBD) Formed 1992 Secretariat based in Montreal, Canada http://www.biodiv.org	At the 1992 Earth Summit in Rio de Janeiro, world leaders agreed on a comprehensive strategy for sustainable development, to meet human needs while ensuring that we leave a healthy and viable world for future generations. One of the key agreements adopted at Rio was the Convention on Biological Diversity. This pact among the vast majority of the world's governments sets out commitments for maintaining the world's ecological underpinnings as we go about the business of economic development. The convention establishes three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources.
Clearing-House Mechanism http://www.biodiv.org/chm/	The convention established the Clearing-House Mechanism to ensure that all governments have access to the information and technologies they need for their work on biodiversity. The Clearing-House Mechanism is based on the philosophy that broad participation and easy access must be a top priority. Its database can therefore be tapped through traditional and electronic means of communication. Special efforts are made to ensure the participation of indigenous communities, whose unique knowledge and expertise are so important.
Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) http://www.biodiv.org/convention/sbstta.asp	The SBSTTA is an open-ended intergovernmental scientific advisory body and a subsidiary body of the Conference of the Parties (the governing body of CBD). It reports regularly to the conference on all aspects of its work. SBSTTA functions include providing assessments on the status of biological diversity, assessments of the types of measures taken in accordance with the convention's provisions, and responses to questions asked by the convention.
Global Environment Facility (GEF) Established 1991 Secretariat based in Washington, DC http://www.gefweb.org	GEF is an independent financial organization that helps developing countries fund projects and programs that protect the global environment. GEF grants support projects related to biodiversity, climate change, international waters, land degradation, the ozone layer, and persistent organic pollutants. GEF projects are managed by GEF implementing agencies: the United Nations Environment Programme, the United Nations Development Programme, and the World Bank.
SOURCE: J. Soberón M., 2004.	

resubmit the analysis, and, generally speaking, follow up the recommendations until they become "public policy" (guidance for decision-making, legislation, or budget). Sometimes the follow-up period may take several years.

When there is not enough data in the databases or in the existing literature or expertise, Conabio has to make the argument that the decisions should be postponed and must either obtain external funds or allocate money from its core budget to commission the required studies. A field study in Mexico typically costs between US$50,000 and $100,000. Conabio cannot afford to commission many such studies per year; however, primary biodiversity databases and information technology can only answer certain categories of questions and only at certain scales or resolutions. Such specific studies must be commissioned when very specific, localized answers are needed or the answer requires knowledge of the dynamics of some system.

Several of the points described above characterize so-called "boundary organizations"[10] that translate and communicate between the world of the policymakers and the world of science. Efficiency in this communication can be characterized by how salient and relevant the information is to stakeholders, how credible it is in the sense of being based on adequate science, and how legitimate it is in the sense that its production respects the different points of view and values of relevant stakeholders.[11] Because these boundary organizations are characterized by several criteria, not all of which apply to Conabio, for the purpose of the present work it may be preferable to label it just as a "translator institution."

Conabio is not the only technical agency of the environmental branch of the Mexican government. The National Institute of Ecology (Instituto Nacional de Ecología, or INE), in its current form as a technical advisor to the government, was created in June 2001. INE has expertise in environmental economics, pollution, and ecological ordination of the territory. INE and Conabio tend to work together and often present reports jointly. INE also has a high awareness of the importance of responding to stakeholders' demands rather than to academically defined scientific questions, and, there-

fore, it can also be regarded as a translator between the government and the scientists and researchers in universities.

To summarize, the experience of Conabio - and perhaps that of INE as well - shows that one way of solving the problem of how to make scientific data, information, and knowledge relevant for stakeholders is to create institutions that translate between science and the stakeholders. Such institutions obtain, create, or contract for the required data, organize and analyze it to turn it into information, check with experts as needed, and translate the information into knowledge and formats that are relevant to the users. Finally, they follow up the results until they become public policy.

In Costa Rica, INBio has acted as such a translator institution, and in Colombia, the Humboldt Institute is perhaps another example. INBio is an NGO with very strong links to the Costa Rican government and has advised it on many issues related to bioprospecting and biodiversity information. Currently, one of the largest databases of primary biodiversity data in the world is maintained and increased by INBio. The Humboldt Institute is the main biodiversity institution in Colombia. It has a mandate of performing scientific research on biotic resources. It has a legal link to the environmental authorities of Colombia and provides advice on these issues. In other countries, some departments in universities or the larger, more experienced international NGOs perform this role.

Caveats and Provisos

In an ideal world, stakeholders and scientists would be able to communicate among themselves without intermediaries. Values and language would be shared and each party would understand the needs and capacities of the other. However, in at least some developing countries this is not true, and translator institutions must fill in the communication gap.

There are a number of risks created by the existence of such organizations. First, by acting as an intermediary, the translator institu-

tion may acquire power over policy that may not have been intended when its role was implemented. Such institutions know the experts and may hire them. On the other side, they have direct access to the policymakers. This situation creates the opportunity for a translator to play one party against the other to advance an internal, rather than a publicly defined, agenda. It is easy, for example, to exaggerate the capacities or avoid mentioning the technical hurdles of remote sensing data. A translator institution may be able to obtain support (not necessarily financial) by claiming to be able to do things that may be impossible or only feasible in the long term. One way to avoid this risk is to have overseer boards composed by members of all stakeholder sectors.[12] The Humboldt Institute and INBio have such boards, but INE does not have one and Conabio has only a small, government-dominated board.

Also, by managing grants, a translator may create a clientele, opening the door for corrupt behavior. The way to minimize this risk is by being aggressively transparent. Budgets, acts of boards, reports of the expenses, and project financing and results should be on the Internet and generally open to public inspection. Projects should be supported by open competition. External reviews should always be used. By very recent law, Mexican public institutions must now comply with all those measures.

In addition, many translator institutions are composed mainly of natural scientists. There is a big risk that overrepresentation of one group in an organization can create a bias that strongly affects the objectivity of reporting, undermining the legitimacy of the results. Biologists and ecologists tend toward a Weltanschauung that engenders opposition to almost any action that disturbs natural environments. Remaining objective and dispassionate may be very difficult. However, long-term credibility of the institution critically depends on public perception that it is neutral, bound by available data and knowledge, and partisan only to rigorous thinking and the law.

Finally, there is a risk that some translator institutions may overemphasize the value of responding to the demands of stakeholders. Such institutions should speak the language of the policy-

makers and understand their values and culture, particularly because they often have to answer questions posed by those stakeholders. However, there is a very big risk of becoming focused only on stakeholder-posed questions, which can divert a translator institution's attention away from much-needed strategic and long-term thinking. For example, Conabio chose to base the National Biodiversity Information System on primary data, a choice that was not demanded by any stakeholder; in fact, many opposed it. The decision was made in response to analyses of pioneer experiences in Australia, the United States, Costa Rica, and India. If Conabio had responded only to the demands of policymakers, it is very unlikely that Mexico would have a biodiversity information system at all. Institutions such as Conabio or INE have a responsibility to be forward thinking, to push the envelope, and to look outside the box. Such an innovative stance can only be financed from the core budget: Almost all grants come earmarked to some defined product. Conabio has been extremely lucky to have had an extended period of core budgets come from Mexico's federal budget, allowing the organization to develop its databases. The funding will carry Conabio through the next phase of bioinformatics development. It is doubtful, however, that many developing-country institutions will be as fortunate.

The Convention on Biological Diversity

Lessons learned from the experience of and risks involved with Conabio and other national-level translator institutions can also be applied to similar, international-level institutions, particularly in the case of the Convention on Biological Diversity (CBD) and its Clearing-House Mechanism (see Table 1). Eleven years after its adoption by parties, CBD has yet to deal satisfactorily with some of its substantive tasks. Global biodiversity loss remains unchecked. Wild forests and fisheries maintain downward trends. Against this, CBD has not been able to mobilize significant resources or extensive local activities. Its Clearing-House Mechanism, despite its technical brilliance and smooth operation, is essentially a depository of national reports and

internal documents (decisions, reports, guidelines, and so on). CBD's scientific advisory board, the Subsidiary Body for Scientific, Technical and Technological Advice (SBSTTA) has lost legitimacy by becoming politicized. Anecdotal evidence seems to indicate that an increasing number of delegates to the Conference of the Parties and associated meetings feel that too much money and time is being put into CBD to get such ineffectual results.[13] Of course, as the interim financial mechanism for the CBD system, the Global Environment Facility (GEF) has disbursed hundreds of millions of dollars for biodiversity projects. However, an argument can be made that GEF's operation is actually hindered by the extremely loose, unfocused, and often contradictory "guidance" that emerges from CBD.

What went wrong? CBD was received by many with the highest expectations, and its three objectives of conservation, sustainable use, and equitable sharing of benefits, if taken as a general philosophy, make a great deal of sense.[14] It is likely that there are several reasons for the problems CBD is facing, but three are outlined below.

First, CBD has mainly focused on addressing the immediate causes of biodiversity loss but is almost totally isolated from the main root causes. In national governments throughout the world, environmental ministries or departments normally have low political clout and, if in conflict with agriculture or trade departments, will often be defeated. Such environmental agencies normally do not have control of demographic policy nor of the structure of economic incentives and disincentives that promote environmental degradation.

Second, CBD is a "toothless convention," binding only in a very weak sense. Most articles begin with debilitating phrases such as "as appropriate," "according with national legislation," or even, "if appropriate." CBD lacks appendices, priorities, targets, and indicators. Except for the Biosafety Protocol, which is binding (but largely irrelevant to biodiversity loss), most output of CBD is in the forms of decisions (more than 100) and voluntary guidelines or principles (for example, the Ecosystem Approach, the Invasive Species Guidelines, the Bonn Principles, and the Addis Ababa Operational Guidelines), and most of these documents have little impact in the

real life of stakeholders.[15] These decisions and guidelines were not a result of stakeholder demands: The delegates to the Conference of the Parties tend to be bureaucrats who are often isolated from the demands of individuals or groups who exploit or make a living from the components of biodiversity, such as foresters, park managers, fish and wildlife inspectors, indigenous or peasant groups, ranchers, fishers, or companies. Also, the output of CBD often does not have true follow-up. In many developing countries, at least, such decisions or guidelines do not affect the budgets and only recently have they affected legislation, mainly around the subjects of access and benefit sharing (the issue of bioprospecting for genetic resources and how to do it legally, paying all stakeholders a fair share) and biosafety (the issue of liberation of genetically modified organisms and the associated risks to biodiversity). Unfortunately, although these are topics that are important to many politicians, they are low in a priority list of causal factors of biodiversity loss.

Third, the Clearing-House Mechanism (the Clearing-House), which created large expectations, has become a technically well-implemented but largely irrelevant depository of bureaucratic documents. Despite efforts by CBD Secretariat personnel, the Clearing-House does not provide access to scientific primary data or constitute a network or a community of experts, and it is not applied to solving specific problems in the countries. Each meeting of the Conference of the Parties adds new responsibilities to the Clearing-House (for example, a plan to control invasive species, an initiative on global taxonomy, and a strategy for plant conservation), but, generally speaking, the parties do not work on the data they are responsible for under the Clearing-House Mechanism nor do they allocate budgets to make them really useful. SBSTTA, which was supposed to provide sound scientific advice to the Conference of the Parties, has become increasingly bogged down in political discussions. It has had considerable difficulty engaging the wider scientific community because it has not performed well as a translator institution. Also, it has been largely isolated from the stakeholders at the field end of the spectrum, namely, peasants, farmers, ranchers, foresters, fishers, park managers, and the like.

Conclusion

To sum up, CBD's scientific bodies, SBSTTA - created for the "provision of scientific, technical and technological advice" to the Conference of the Parties,[16] - and the Clearing-House Mechanism - created to "promote and facilitate technical and scientific cooperation"[17] and for "enhancing networking between existing national, regional, subregional and international centers of relevant expertise"[18] - appear so far to have only partially achieved those aims. How can these institutions be improved? The experience of Conabio as well as other translator institutions suggest several areas for improvement. It can be hypothesized that questions addressed by SBSTTA or documents distributed by the Clearing-House tend to be defined mainly by a narrow group of government officers and a few NGOs. Therefore, their products often lack legitimacy and saliency to other stakeholders. Parties to CBD must find ways to engage much wider communities of stakeholders. Of course, many countries do consult their citizens, and many are required to do so by law. However, this is not by any stretch of the imagination universal, and it may be quite interesting to find out precisely to what extent different sectors of stakeholders regard decisions by the Conference of the Parties as relevant and legitimate. A recent study by IUCN-The World Conservation Union showed a remarkable lack of correlation between working programs of the Conference of the Parties and priorities of countries in Mesoamerica.[19] A number of scientists have questioned whether many SBSTTA decisions are based on good data or sound theory. Finally, the products of CBD tend to be presented in the formalized language of diplomacy. The translation role of a true "boundary organization" must be improved to pique the interest of all stakeholders - and not just the attendees of the meetings of the Conference of the Parties. This is precisely one of the roles that INBio, Conabio, the Humboldt Institute, and other organizations have been performing in their own countries. On issues that have a high technical or scientific content (for example, global taxonomy, plant protection, and invasive species), perhaps it will be necessary for some parties to CBD to create or identify their own translator institutions, capable of translating, communicating, and following up on such issues.

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Notes

[1] It is likely that less than 10 percent of the total number of species on the planet is known to science. Of the nearly 1.5 million species that have been described, we have some knowledge of population ecology, physiology, and/or genetics of an order of 1-10 percent.

[2] P. Stedman-Edwards, Root Causes of Biodiversity Loss: An Analytical Approach (Washington, DC: World Wildlife Fund, 1998).

[3] Consejo Estatal de Población, Estado de Chiapas (State Population Council of Chiapas), data provided June 2004.

[4] G. Hardin, "The Tragedy of the Commons," Science, 13 December 1968, 1243-48.

[5] E. Ostrom, J. Burger, C. Field, R. Norgaard, and D. Policansky, "Revisiting the Commons: Local Lessons, Global Challenges" Science, 9 April 1999, 278-82.

[6] L. Merino, El manejo forestal comunitario en México y sus perspectivas de sustentabilidad (Management of Forest Communities in Mexico and their Perspectives on Sustainability) (Mexico City: National Autonomous University of Mexico and World Resources Institute, 1997).

[7] G. Daily, Nature´s Services: Societal Dependence on Natural Ecosystems (Washington, DC: Island Press, 1997).

[8] Mexican National Commission on Biodiversity, Creation Agreement Document, http://www.conabio.gob.mx/institucion/conabio_ingles/doctos/acuerdohtml#ART4 (accessed 20 June 2004).

[9] J. Soberón and A. T. Peterson, "Biodiversity Informatics: Managing and Applying Primary Biodiversity Data," Philosophical Transactions: Biological Sciences B 359, no. 1444 (2004): 689-98.

[10] D. W. Cash et al., "Knowledge Systems for Sustainable Development," Proceedings of the National Academy of Sciences 100, no. 14 (2003): 8086-91.

[11] Ibid.

[12] Ibid.

[13] A very recent study begins to describe some of the problems as well as methodological issues to evaluate the work of the Convention on Biological Diversity (CBD). See G. Le Prestre, ed., Governing Global Biodiversity: The Evolution and Implementation of the CBD (Aldershot, UK: Ashgate Publishing Company, 2002).

[14] The very strange narrowing of the third objective to only "sharing of the benefits arising from the use of *genetic* resources" (emphasis added) leaves out ecosystem services as well as hunting, fishing, and other extractive-and all nonextractive-uses that already have markets of billions of dollars. CBD, Convention Text, "Article 1," http://www.biodiv.org/ convention/articles.asp (accessed 20 June 2004).

[15] For a complete listing of decisions and guidelines of CBD, see http://www.biodiv.org.

[16] CBD, note 14 above, "Article 25."

[17] CBD, Decisions from the Meetings of the Conference of the Parties, "Decision I/3," http://wwwbiodiv.org/decisions/default.aspx?m=COP-01&id=7063&lg=0 (accessed 20 June 2004).

[18] CBD, Decisions from the Meetings of the Conference of the Parties, "Decision II/3," http://www .biodiv.org/decisions/default.aspx?m=COP-02&id=7076&lg=0 (accessed 20 June 2004).

[19] Comisión Centroamericana de Ambiente y Desarrollo (CCAD) (Central American Commission for Environment and Development), G. Hernandez, ed., Biodiversity in Mesoamerica: Report 2002 (CCAD, 2002).