WHITE PAPER

final report

Commissioned by the Biodiversity Support Program on behalf of
the Inter-American Commission on Biodiversity and Sustainable Development
In preparation for the Summit of the Americas on Sustainable Development,
Santa Cruz de la Sierra, Bolivia
December 6-8, 1996

The Successful Use of Economic Instruments
to Foster Sustainable Use of Biodiversity:
Six Case Studies from Latin America and the Caribbean*

Case Study 6: Bioprospecting

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published in *Biopolicy Journal*, volume 2, Paper 5 (PY97005), 1997
Online Journal. URL - http://www.bdt.org/bioline/py
archived with The British Library ISSN# 1363-2450

The author would like to thank the following individuals who read and commented on early drafts of this White Paper: Rafael Calderón, Mauricio Castro, Luis Corral, John A. Dixon, Rosa Ferrín, Julio Guzmán, Cristina Hernández, Mark Kenber, Ilana Locker, Nicolás Lucas, Peter May, Ricardo Meléndez, Jacob Olander, Meg Symington, Henry C. Vogel, and Sven Wunder. A special thanks goes out to the principals involved in the case studies: Ruth Arias, René Castro, Karla Ceciliano, Eunice Ester Echeverría, Wilson Loureiro, Eduardo Mansur, Maria Schultz, Medardo Tapia, and Tom van't Hof. Translations are always difficult and especially so when done as the author is writing the document. Consuelo Espinosa (into Spanish) and Camilo Gomides (into Portuguese) not only translated the text *just in time* but also with sufficient adroitness to spot errors in the original that had escaped English-speaking reviewers. The flaws that remain in the document are the sole responsibility of the author. Support has been provided by the Biodiversity Support Program, a consortium of World Wildlife Fund, The Nature Conservancy and The World Resources Institute, with funding by the United States Agency for International Development. The opinions expressed are those of the author and do not necessarily reflect the views of the U.S. Agency for International Development.

*Also available in Portuguese and Spanish

Executive Summary

The Samuelsonian equation for the optimal allocation of public goods is a theoretical construct for the conservation of biological diversity. The policy implication of the equation is straightforward: one aggregates all the simultaneous values generated from biological diversity and recommends conserving habitat until the cost of the last hectare conserved just equals the incremental aggregate value. Nevertheless, a fundamental theoretical problem exists in the methodology: preferences are unstable over human generations and any recommendation based on currently observed preferences may turn out to have underestimated the values resultant from the preferences of future generations. This shortcoming does not escape conservationists. To the extent it is routinely ignored, economic theory itself has fallen into disrepute. For example, the distinguished biologist Professor E.O. Wilson states flatly that contemporary economics is bankrupt.

The humble alternative to bankrupt economics recognizes the incommensurability of biological diversity and hopes only to internalize the externalities of protected habitats. The physical scope of these protected areas should be determined not by economic criteria but by safe minimum standards the precautionary principle. Six distinct categories of value can be simultaneously generated from conservation: existence, ecotourism, environmental services, sustainable agriculture, extractivism, and bioprospecting. Seldom will any one of the six be sufficient to justify the opportunity costs of the *seemingly* more profitable activities that would exterminate biological diversity. The challenge for conservation is to create a package of sustainable activities that in total can alleviate the economic and political pressures to relax or abandon safe minimum standards.

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Bioprospecting

Bioprospecting has received disproportionate attention in the popular press as a means to finance habitat preservation. Of the six values that can generate revenues in the short-run, bioprospecting occupies the last place. One predicts low returns for a fairly simple reason: many of the chemicals of interest to biotechnology firms do not exist in one country or even in one species but are diffused across both countries and species. This economic prediction has been confirmed by experience. A price war is emerging among supplying countries as each offers its biological diversity at lower and lower prices: royalties in some contracts have been reported as low as 0.2%.

Interestingly, the same economic argument that is made to defend monopoly patents over biotechnologies can be made to defend an oligopoly right over biological diversity. Royalties should be fixed at a rate similar to other forms of intellectual property, i.e., 15%, and revenues should be distributed among countries that could have provided the same chemical based upon their share of the habitat for the species bioprospected. A protocol to the Convention on Biological Diversity may be the appropriate mechanism to institutionalize a biological diversity cartel.

A pilot project in Ecuador attempts to create a similar cartel structure over indigenous knowledge used in ethnobioprospecting. Just as countries can compete in a price war for the provision of biological diversity in random screening bioprospecting, so too will traditional communities compete in a price war for the provision of useful knowledge in ethnobio-prospecting. The pilot project attempts to manage traditional knowledge in confidential databanks and then negotiate

access to the knowledge as a trade secret. Communities that deposit the same knowledge in the databank share in the benefits of any ethnobioprospecting contract.

General Recommendations for the Successful Use of Economic Instruments to Foster the Sustainable Use of Biodiversity

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- Without a cartel among suppliers, a price war will emerge and bioprospecting will not generate significant revenues. The justification for such an oligopoly is identical to the neoliberal justification for monopoly patents. Governments should endorse a Special Protocol to the Convention on Biological Diversity which institutionalizes a cartel over biological diversity for random screening bioprospecting. Traditional communities should do likewise for knowledge over biological diversity and negotiate access to such knowledge as trade secrets in material transfer agreements.

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VI. Bioprospecting (Case 6): The Impossibility of a Successful Case Without a Cartel

Bioprospecting is often perceived as the salvation to biological diversity. Not only is there little evidence that the royalties from bioprospecting can significantly contribute toward the financing of habitats (Aylward, 1993) but the absence of a multilateral accord to fix the royalty rate guarantees that the royalties will be meager (Vogel, 1995). Nevertheless, many commentators in both the popular and academic presses have seized upon isolated anecdotes of billion dollar drugs (e.g., taxol) or biotechnologies (e.g., polymerase chain reaction, PCR) as examples of the potential economic value that may exist. Models are sought as to how to capture some of this value and dedicate it to the habitat from which the biological samples were taken. Usually, the model found is that of Instituto Nacional de Biodiversidad (INBio) of Costa Rica (Reid *et al*., 1993). Without doubt, INBio is the most comprehensive model of bioprospecting in the world and is deserving of the favorable press. However, seldom mentioned in the press coverage is the fact that most of the biological diversity of Costa Rica is not endemic to Costa Rica but diffused from Chiapas in southern Mexico to Beni in northern Bolivia. Also ignored is the fact that bioprospectors are not interested in species *per se* but secondary compounds which are not necessarily unique to the species (e.g., the active compound in taxol is paclitaxel which has been found in both *Taxus brevifolia* of the Pacific Northwest of the US and *Taxus baccata* of Europe). Because secondary compounds are diffused across international boundaries and taxa, a bioprospecting institution such as INBio is granting access not just to the biological diversity of the home country, in this case, Costa Rica but also to the biological diversity of the entire region, Mexico, Guatemala,...Peru, and Bolivia. These two facts—diffusion of species and diffusion of secondary compounds—are key to understanding why INBio or any other successful institution cannot be viewed as a model to replicate in the quest to internalize the value of biological diversity for bioprospecting.[1]

Economic theory is powerful in its simplicity. From basic principles, one can explain and predict. One knows that the price of any good in a competitive market will equal its marginal cost. In the case of bioprospecting, there are many countries which can supply the same secondary com-

[1] There are also other reasons why INBio is not an appropriate model to replicate. See, Feinsilver and Chapela (1996).

There is a flower that grows in Ecuador

President George Bush vacillated over whether or not to sign the CBD at The Earth Summit, Rio'92. He decided against signing based on communications from industry leaders such as Kirk Raab, then CEO of Genentech. Raab defended his lobbying of Bush with these remarks: "I don't believe mixing in industrial property rights is the least bit appropriate. If you dig up a little piece of dirt in Naples...or pick a flower in Ecuador, I don't think there is necessarily a requirement that the country of origin has some predetermined economic rights."

Sally Lehrman, "Genentech Stance on Biodiversity Riles Staff" *Nature*, 9 July 1992, p. 97.

pounds. Given competition among potential suppliers, the economist expects the price to be driven down to the marginal cost of supplying botanical samples—a nominal fee. This simple implication is confirmed by experience. The transnational giant Monsanto, Inc. has negotiated bioprospecting contracts with the International Cooperative Biodiversity Groups (ICBG) for access to samples with royalties as low as 0.2% on net sales (RAFI, 1994, p. 7). Even INBio, probably the most advanced bioprospecting institution in the world, is believed to be receiving royalties of only 2%.[2]

Is a 2% royalty or even a mere 0.2% royalty necessarily bad? Ever since Adam Smith, the public has come to appreciate the beneficial role of competition. Through the removal of market barriers, more firms can enter an industry and each will impose discipline on its own internal operation, passing on savings to consumers through lower prices. Competition enhances both efficiency and equity. However, in the case of bioprospecting, such competition is bad, both inefficient and inequitable. The explanation is somewhat abstract and draws from the economics of information. In modern economies, a certain class of goods exists which are extremely costly to create but nevertheless extremely cheap to reproduce. Almost all goods that experience this cost structure, viz., extremely high fixed costs coupled with extremely low marginal costs, are based in information (e.g., software, publications, symbols). Once the producer of the information good releases that good to the public, he or she has almost no control over its consumption (non-exclusion). Given the inadequacy of the usual exclusionary mechanisms (e.g., fences, locks and keys) for information goods, the granting of a monopoly through intellectual property rights (IPR) is the only instrument that permits creators to recoup the fixed costs of their creation. Under IPR protection, any competition through illicit copying is considered piracy and is both inequitable and inefficient. In a world of pirates, there are fewer creations and the economy is deprived of information goods (e.g., software, etc.).

Surprisingly***, the rationale for IPR has an exact analog in the realm of biology***. Although biological diversity is not an intellectual good, it is very much an information good—indeed, it is not uncommon to see the phrase "genetic information" in the scientific literature. ***As an information good, biological diversity shares a similar cost structure: extremely high opportunity costs in the maintenance of habitats but extremely low costs of accessing components of those habitats*** (see Vogel, 1994). Hence, competition will drive the price of biological samples down to their marginal costs and deprive countries from recouping the opportunity costs of conservation.

If one accepts *monopoly* patents, copyrights, trademarks as legitimate instruments to enable the emergence of a market for information goods, then one should accept *oligopoly* rights over genetic resources to enable the emergence of a market for habitats. Countries which supply biological samples should fix a royalty rate and distribute economic rents and countries which

[2] Royalty rates are usually not disclosed and are viewed as confidential information. Nondisclosure makes evaluation of bioprospecting contracts impossible.

Privatize Profits, Socialize Costs
The Motto of the US Biotechnology Industry?

"Meanwhile businesses based upon copying and 'counterfeiting' intellectual property are thriving in some countries, notably India, Brazil, Argentina, Egypt and Turkey. Their influence has sometimes made it difficult for those countries to reform their laws. In the publishing, fashion, film-making and music sectors, this has led to substantial lost revenue. In the pharmaceutical industry, this sometimes leads to human, as well as economic costs"— Edmund Pratt, Jr. former CEO of Pfizer, Inc. paid announcement in *The Economist*, 27 May 1995, p. 24.

Through some simple word substitutions, advocates of a cartel over biological diversity and associated knowledge can make exactly the same argument as to why companies, like Pratt's Pfizer, should pay an oligopoly price:

Meanwhile businesses based upon extracting and synthesizing natural information are thriving in some countries, notably the US. Their influence has made it difficult for that country to ratify the CBD. In tourism, advertising, and plant breeding, this has led to substantial lost revenue. In the pharmaceutical industry, this sometimes leads to human, as well as economic costs.

demand biological samples should respect the cartel. Unfortunately, spokespersons of the biotechnology industry refuse to recognize such logic and wish to continue either the *de jure* free access of the old "common heritage of mankind" doctrine (see Box) or a *de facto* free access disguised in bilateral accords (e.g., the Monsanto-ICBG deal of a 0.2% royalty). The position even becomes hypocritical as Northern biotechnology companies complain bitterly about intellectual piracy in the South (see Box).

The Convention on Biological Diversity (CBD) attempts to correct the inefficiencies and inequities of free access by recognizing the sovereignty of a country over its genetic resources. In various articles of the CBD, signateur countries are compelled to share the benefits of biotechnologies that utilize genetic resources with the country of origin. Unfortunately, the drafters of the CBD failed to perceive that sovereignty would result in a price war that would deny all countries any economic rent. To make matters worse, the CBD refers to benefits of bilateral accords without specifying the worth of those benefits or even how to measure them. Such ambiguity is unthink-able for an economist. Indeed, as Ronald Coase, the 1991 Nobel Memorial Laureate in Economics, has quipped, economics is the most advanced social science, not because of any theoretical sophistication, but simply because it has a convenient measuring rod: money (see Posner, 1993, p. 208). When the Parties to the CBD embrace "benefit-sharing" in things like "technology transfer", they toss out the profession's powerful tool. The economist suspects that

the money value of the technologies transferred under bilateral accords will also be extremely low: a dumping of outdated technologies at inflated appraised values, thereby cheating not only the suppliers in the South but also the governments in the North of corporate taxes (e.g., the appraised value will be subtracted from revenues in determining taxable profits).

What would be an efficient and equitable royalty rate for bioprospecting? One cannot look toward the market for an answer inasmuch as the market reflects the outcome of a price war among suppliers of biological samples. Theoretically, the rate would depend on the degree of substitutability of natural secondary compounds as a whole with other activities that could yield the same function (e.g., gene therapy or rational molecular design). However, one would need the cartel in place before one could observe industry willingness to pay for secondary compounds vs. gene therapy or rational molecular design. The problem of an efficient and equitable royalty rate

even becomes circular as one would probably also have to suggest what would be the more favorable rate before suppliers would join the cartel. In *Genes for Sale*, Vogel (1994) suggests a royalty on net sales of 15% based upon what is commonly observed in other forms of intellectual property where there is monopoly control. This 15% could conceivably have the following two-tier structure: the institution that provides the sample would enjoy between 1-3% as payment for the value added to the genetic resources and countries which protect the same genetic resources would share the economic rent of 12-14%.

Although some 160+ countries have ratified the CBD, the world leader in biotechnology, the US, has not ratified as of the date of this publication (December, 1996). Undoubtedly, suggestions of a cartel and a royalty of 15% will harden the opposition of the US toward the CBD. The non-ratification status of the US has serious ramifications inasmuch as any US firm is free of legal obligations to the "fair and equitable sharing of benefits arising out of the utilization of genetic resources" as set forth in Article 1 of the CBD. The US even gains a comparative advantage in bioprospecting simply because it has not ratified. For example, a US firm could enjoy free access to much of the biological diversity of the South by simply bioprospecting within US jurisdiction. Consider the extent of biological diversity that falls under US jurisdiction but yet is part of larger ecosystems that fall under the jurisdiction of CBD ratified countries: Hawaii, Guam, and Samoa (the South Pacific Island nations), Alaska (Canada and Russia), the Continental US (Canada, Mexico, and Caribbean nations), Puerto Rico and the Panama Canal (Latin American nations), *ex situ* genebanks, botanical and zoological gardens, and possibly even US embassy grounds (the some 160+ countries that have ratified the CBD as of December 1996).[3]

Ironically, the non-ratification of the CBD also deprives the US government from "benefit-sharing" over the resources provided by its federal park lands. For example, the aforementioned PCR technology derives from *Thermus aquaticus* (*Taq*), a thermophilic bacteria taken from Yellowstone National Park. Cetus Inc., sold the patent rights over PCR to Hoffman-LaRoche for USD 300 million and eventually the technology could generate USD 1 billion per year in revenues (Chester, 1996, p. 23). In contrast, Yellowstone National Park gets nothing. Had the discovery of *Taq* occurred under the CBD and a cartel charging a 15% royalty, the US Department of the Interior would have received up to USD 150 million per year (assuming that *Taq* is endemic to Yellowstone National Park).

The drafters of the CBD failed to foresee the consequences of competition among suppliers of the same secondary compounds or the ramifications of the non-ratification status of the US. Both problems can be remedied via a Special Protocol to the CBD. Such a protocol should incorporate the following points:

1. The amendment of national laws on intellectual property rights to require Certificates of Origin (see Tobin, in press) on products that utilize biological diversity.
2. Scientific analysis to determine the taxon at which the biochemical is found and a clearing house mechanism to determine the range of the habitat for those taxa in order to identify the commoners.
3. The establishment of a fund to receive a royalty of 15% on net sales of biotechnologies that use biological diversity and the distribution of the money collected to cartel members according to the representation of individuals in the taxon in which the biochemical is found.
4. A tracking of holders of intellectual property that use biological diversity and a verification as to whether the economic rent has been paid.

[3] The embassy grounds of CBD ratified countries would be covered by the CBD.

5. A filtration of the first and fourth points to permit a clouding of title on biotechnology exports from non-ratified CBD countries to ratified CBD countries whenever the economic rent has not been paid to the fund.

The Special Protocol would force industrial end users in non-ratified countries to voluntarily pay the royalty or risk losing the export market through challenges to ownership of the exported biotechnology.

A subset of bioprospecting is ethnobioprospecting and it too can be cartelized. Traditional knowledge facilitates the identification of lead compounds and can benefit communities whenever the knowledge has not yet fallen into the public domain. Because cultural erosion is happening much faster than biological erosion, incentives should be given to the biotechnology industry to conduct ethnobioprospecting before random screening bioprospecting. One possible incentive would be to keep the royalty rate at 15% with half of that sum going to intermediaries that have isolated the compound (7.5%), a quarter going to the member communities of a trade secret cartel (3.25%), and the remaining quarter to the member countries of the biological diversity cartel (3.25%).

Although there can be no successful case study of bioprospecting without cartelization, efforts exist to move in the direction of a cartel. A project entitled "The Transformation of Traditional Knowledge into Trade Secrets" is currently underway in Ecuador. The project attempts to achieve a cartelization of traditional knowledge within Ecuador and then expand the organizational structure to neighboring countries. The project is a collaborative effort by the InterAmerican Development Bank-Consejo Nacional de Desarrollo Program on Environmental Capacity Building, CARE-Ecuador, and the NGO EcoCiencia. The project began in late 1995 and will enter a pilot phase in the regions of the Coast, Sierra, and Amazon in early 1997. The project sets out to catalog traditional knowledge in customized databases written in FOXPRO 2.53. Each participating community will have its own file in the database and will not be able to access files of any other community. The database is maintained at regional centers (NGOs or universities) and is safeguarded through a hierarchy of access restrictions. Because traditional knowledge is usually not unique to any one community, the manager of the database filters the deposited knowledge across communities to determine which communities are commoners to the same knowledge. He or she then filters this knowledge against what is already in the public domain through the on-line botanical database known as NAPRALERT from the University of Illinois-Chicago. That knowledge which is not yet public can be negotiated as a trade secret in a Material Transfer Agreement (MTA) with either industrial end-users or intermediaries. The benefits from the MTAs are to be paid in money and split between the government and all communities that deposited the same knowledge in the database. The share of the communities is then used to finance public projects previously identified by each community. Recognizing that traditional knowledge is not unique to one country, the project attempts to refine a set of standards from the pilot phase so that other countries may adopt them and help forge an international cartel.

A 200 page book entitled *From Traditional Knowledge to Trade Secrets* (Vogel [ed.], in press) is available in both English and Spanish through EcoCiencia. The book is authored by five contributors spanning the professions of botany, economics, informa-tion science, law, and microbiology and lays out the theory behind the cartel and step-by-step instructions to transform traditional knowledge into trade secrets. Software and technical specifications for setting up the database are also included.

For more information regarding the transformation of traditional knowledge into trade secrets, please contact:

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Conclusion and Recommendations

As evidenced in the opening quote to this White Paper, there is much hostility between economists and conservationists regarding the allocation of habitats and the subsequent fate of biological diversity. The inclination of the economist is to put a dollar value on biological diversity, admit that the estimates are crude, and then boldly plug the estimates into a cost-benefit analysis of the project under deliberation. Despite the rigor of any such analysis, the resulting net gain or loss will be a meaningless number. The conservation biologist David Ehrenfeld (1988, p. 214, 216) explains both the illegitimacy of the approach and its inherent danger: "[I]t is not possible to figure out the true economic value of any piece of biological diversity, let alone the value of diversity in the aggregate. We do not know enough about any gene, species, or ecosystem to be able to calculate its ecological and economic worth in the larger scheme of things...I cannot help thinking that when we finish assigning values to biological diversity, we will find that we don't have very much biological diversity left."

Conservationists are not alone in the rejection of the indiscriminate application of cost-benefit analysis. No less of a theorist than E.J. Mishan (1972, p. 20), pointed out the limits of cost-benefit analysis and the duty of practitioners:

"If the unmeasurable effect is completely beyond his [the economist's] range of reasonable guesses, so that a decision cannot be reached by the economist on the basis of the measurable data and by reasonable guesswork, he serves the public better by confessing the truth: that, with the existing techniques and information, he is unable to discharge his task."

What then is the economist's task? This White Paper attempts an answer: First it is to emphasize the impossibility of the application of cost-benefit analysis to projects that jeopardize the existence of species. Second, it is to emphasize that the decision to protect biological diversity is not only an ethical decision but also an economic one: in the absence of information, the prudent decision is to adopt the precautionary principle in the form of safe minimum standards. Lastly, it is the economist's task to provide instruments that can internalize the external benefits of biological diversity and make people pay when they benefit. People should pay, not because habitats must compete with timber, cattle, and dams, but because there is tremendous political pressure by the vested interests behind timber, cattle, and dams to encroach on protected habitats. The generation of revenues from the sustainable use of biological diversity can create

countervailing pressures against the exterminators. This has been the humble alternative to bankrupt economics.

This White Paper has reviewed six categories of economic value that can be derived from the sustainable use of biological diversity: Existence, Ecotourism, Environmental Services, Sustainable Agriculture, Extractivism, and Bioprospecting. Although each case can be considered a success, and a few, remarkable successes, all can still profit from the application of contemporary economic theory. The challenge for sustainable development is to improve upon these, the best cases and replicate them whenever possible.

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