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Community Autonomy and the Maya ICBG Project in Chiapas, Mexico: How a Bioprospecting Project that Should Have Succeeded Failed

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The autonomy of indigenous and local communities is widely recognized by international, national, and local laws and customs. This autonomy includes the recognized rights of communities to grant permission to enter into agreements for access to their resources, including the commercial use of these resources based on fair and equitable benefit-sharing arrangements. Nongovernmental organizations (NGOs) and their allies have questioned the autonomy of local indigenous communities, which they claim have no rights to enter into agreements for bioprospecting projects. Efforts to limit the autonomy of local communities concerning commercial use of biological resources is tied to NGO opposition to any form of sustainable development which they believe contributes to globalization and exploitation of the developing countries of the South by the developed countries of the North. To achieve their goals, these groups have launched negative misinformation campaigns to discredit applied biodiversity research projects and the scientists who lead them. Although these NGOs have no legitimate authority to speak for local communities, their access to the press and the Internet provides them with a platform that allows them to be identified as the voice of the indigenous and local communities of the world. In this case study of the Maya ICBG project in Chiapas, Mexico, we describe how local community autonomy was taken from indigenous communities that had agreed to participate in an international development project on drug discovery, biodiversity conservation, and sustained economic development. A major lesson to be drawn from the Maya ICBG case is that local indigenous community autonomy, as envisioned in the 1992 Convention on Biodiversity, is more myth than reality in the access-to-biological-resources debate, especially in the politically charged climate of Mexico and Latin America.

Key words: community autonomy, sustainable economic development, natural resources, bioprospecting, Maya, Chiapas, Mexico

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What is the future of applied development programs that aim to promote the economic uses of biodiversity in regions of the world where indigenous and traditional communities are directly affected? An answer to the question is framed by one of two starkly different philosophical positions that characterize the access-to-genetic-resources debate today. The first holds that indigenous and local communities can raise their health and economic standards by participating in projects that promote the sustainable uses of the biological resources under their control. The second claims such projects, rather than providing local indigenous communities with opportunities for improving their marginalized status, are actually deliberate acts of economic colonialism.

In this paper we provide a description and analysis of how these two views were played out in the context of a major bioprospecting project in Chiapas, Mexico. We first outline the antecedents leading to one of the most important international environmental agreements of the 20th century, the Convention on Biological Diversity (CBD; UNEP 1993), and point out the major clauses of the convention relating to local and indigenous communities. We then describe an innovative applied research initiative of the National Institutes

of Health, the International Cooperative Biodiversity Groups (ICBG) Program, that was created with the belief that "drug discovery research with natural products [can] be conducted in such a way as to simultaneously promote human health, economic development, and conservation of biodiversity" (Rosenthal et al. 1999:6).

We follow this short discussion with a description of the major aims, methods, and initial results of a project supported by the ICBG Program, the Maya International Cooperative Biodiversity Group (Maya ICBG), one with multiple purposes and interlocking interdisciplinary components that would have benefited hundreds of Highland Maya communities in the southern state of Chiapas, Mexico (Berlin et al. 1999). We then close with a summary of the major arguments of the project's opponents that, in the end, were successful in bringing the Maya ICBG to a halt, and outline the potential benefits that were lost to participating Maya communities.

We frame our discussion of the controversy surrounding the project in terms of the CBD's stipulations regarding the rights of autonomous local and indigenous communities. We argue that opposition to the project was, in effect, opposition to local community autonomy over control of access to their biological resources. Although such autonomy as specified in the CBD is clear, opponents claim that it should be secondary to the views of an international community of stakeholders, primarily nongovernmental organizations (NGOs), opposed to globalization and what they consider the bankrupt neoliberalist policies of the developed countries of the North at the expense of the developing countries of the South.

Antecedents and Background

There are several sources that form the historical background for our discussion that relate to the environment, human rights, development policy, international regulations and laws, and the role of science and scientists in all of the above. Because of space considerations and our own expertise we focus this background discussion on the New World.

As is well known to readers of this journal, the history of human use of natural resources in the humid tropics has been exploitative—almost invariably one finds a scenario of harvest, extraction, and development until the resource is depleted, with no concern for the collateral effects on the environment. Indigenous populations residing in regions where particularly prized natural resources might be found were commonly forcibly removed and relocated or simply killed. It was not until the latter half of the 20th century that these practices of ecocide, ethnocide, and genocide, sometimes promoted as government policy, were effectively challenged (see for example Bodley 1990; Crosby 1986; Lewis 1969; Weiss 1988).

With the accumulation of ecological knowledge based on detailed field studies, the natural and biological resources of the neotropics took on new significance in the decades of the 1960s and 1970s. Environmentalists became more vocal and persuasive in their arguments for the conservation of biodiversity and a truly global ecology movement began to emerge. The earth's rain forest habitats, especially the Amazon rain forest, came to be characterized as the "lungs of the world." The complex relationship between and among species and the global impact of rapid local environmental change began to be more widely recognized, and efforts to develop comprehensive conservation programs began to have a serious impact on government and private development agencies such as the World Bank.

Almost simultaneously, social scientists and other intellectuals began calling attention to the plight of the aboriginal human populations residing in these regions of severe environmental change. The decade spanning the mid-1960s to the mid-1970s marked a major turning point in the struggle for cultural survival of native peoples of South and Central America. During this period, international attention became focused on the situation of the Indian as never before (as evidence see the 1971 Barbados Conference).[1] Support groups with stated goals of aiding indigenous populations by all means possible sprung up in this country and Europe as well as in a number of South American countries, and indigenous groups organized as political units and also as NGOs.[2]

A major argument put forth in the developing discussion was how much industrialized countries might benefit from the environmental knowledge and practices of indigenous peoples, given that these peoples had served as the stewards and conservators of their environmental resources for centuries. However, it was also clear that if traditional societies were to remain viable, they must have the economic resources to do so. From these ideas arose the concept of traditional ecological knowledge (TEK) and the extension of intellectual property laws to traditional intellectual property rights (IPR). It was not long until the proposal was put forth that traditional peoples must benefit economically from the use of their natural resources, a concept debated at the first meeting of the International Society of Ethnobiology (ISE) held in Belém, Brazil, in 1988. At that important meeting it was concluded that indigenous peoples merited economic compensation for their traditional knowledge and practices regarding biological resources. This was made explicit in Article 4 of the ISE's Declaration of Belém (ISE 1988).[3]

In brief, this was the social and intellectual climate that formed the context for the UN Summit on the Environment held in Rio de Janeiro in 1992, which resulted in the Convention on Biological Diversity (CBD). The CBD explicitly affirmed the rights of sovereign nation-states to absolute control over access to the biological resources within their national boundaries and to establish their own regulations for granting access to those resources (UNEP 1993). The international agreement was largely a response by the United Nations Environmental Program (UNEP) to the legitimate complaints of developing countries that had "historically...received next to nothing for their genetic resources, while much of the economic advantage of the colonial powers had been gained through free-access to [the world's] genetic resources"

(ten Kate and Laird 1999:4; see also Glowka 1998; Glowka, Burhenne-Guilmin, and Synge 1994).[4]

One of CBD's provisions of particular relevance to the present paper concerns the treatment of what it refers to as *indigenous and local communities*.[5] From the very outset, the framers of the convention were keenly aware of the role that indigenous and local communities had played, and continue to play, in the conservation of the earth's biodiversity. This is highlighted in Article 8(j) of the convention, which is aimed specifically at ensuring the rights of indigenous and local communities. This article stipulates that:

> Subject to [a signatory's] national legislation, [it will] respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices (CBD 1992d).

The International Cooperative Biodiversity Groups (ICBG) Program

In 1993 the CBD came into force[6] after being adopted in June, 1992, at the United Nations Conference on Environment and Development at Rio de Janeiro, and in that same year the Fogarty International Center of the National Institutes of Health, in partnership with the U.S. Agency for International Development (USAID), announced its first request for proposals as part of its innovative International Cooperative Biodiversity Groups Program. The program was revolutionary. It proposed that "the discovery and development of pharmaceutical and other useful agents from natural products can, under appropriate circumstances, promote sustained economic growth in developing countries while conserving the biological resources from which these products are derived" (NIH 1993).

When NIH made its first call for proposals, a group of us at the University of Georgia (UGA) submitted a project in collaboration with colleagues at El Colegio de la Frontera Sur (ECOSUR) in San Cristóbal de Las Casas, Chiapas, Mexico, and the Mexican Institute of Social Security (IMSS).[7] NIH made five awards in its first round of five-year grants and our proposal ranked sixth. We were informed that one major weakness of our research plan was our lack of a private-industry partner responsible for conducting broad-scale, high-volume pharmacological analysis.

A second round of grants was announced in 1997 and we again submitted a proposal in collaboration with ecologist colleagues at ECOSUR, adding MolecularNature Ltd (MNL),[8] a small natural products discovery company in Wales, as our private industry partner. This time, we were successful and work on the Maya International Cooperative Biodiversity Group (Maya ICBG) project began in late 1998.

Goals of the Maya ICBG Project

Our multifaceted project focused on three primary goals: drug discovery, medical ethnobiology and biodiversity conservation, and sustained harvest and economic development. These general objectives were to be met by the following specific aims:

1. discover, isolate, and preclinically evaluate bioactive agents from *pharmacologically important* species of **vascular plants** (this and other terms in bold face are defined in the glossary) found in the state of Chiapas, Mexico, one of the richest and most endangered biodiversity regions on earth;

2. discover, isolate, and evaluate bioactive species of immediate health significance and potential economic value to the local Maya populations, including targeting species that could be produced and promoted for increased local use, species with commercial production potential as **phytomedicinals** in national and international markets, species that could serve as crop protection associates in cultivated fields, and species of potential veterinary medicinal value in livestock production. A major component of this goal was a comprehensive comparative description of the Highland Maya materia medica (preparation methods and treatment processes employed in traditional medicine);

3. initiate ecologically sophisticated biodiversity surveys aimed at comprehensive coverage of the vascular flora of the Highlands of Chiapas, on a municipality-by-municipality basis, thereby significantly enriching the holdings of local herbaria and producing an innovative *Ethnoflora of the Highlands of Chiapas* (to have included as much comparative ethnobotanical as well as botanical information as possible) to be published in Spanish and the two major Maya languages of the Highlands, Tzeltal and Tzotzil; and

4. strengthen existing academic exchanges between UGA and ECOSUR for both Mexican and American students to complete advanced graduate degrees in ecology, systematic botany, entomology, horticulture, conservation biology, evolutionary biology, ecological anthropology, medical anthropology, biochemistry, and ethnopharmacology. In parallel with this academic preparation, the Maya ICBG aimed to develop extensive training and capacity-building programs for Maya collaborators in community development, linguistics and native language literacy, field botany, herbarium and laboratory techniques, and community development.

To achieve these goals, our project aimed to implement fully the major objectives of the Convention on Biodiversity.

The Maya ICBG's Associate Programs

The project incorporated three cohesive associate programs (APs) that were mutually synergistic. Their interconnectedness can be best described by outlining briefly the research agendas of each.

Associate Program 1: Drug Discovery and Pharmaceutical Development

Researchers in Associate Program (AP) 1 would develop an advanced laboratory for carrying out preliminary screening of extracts of vascular plants at ECOSUR, our host institution.[9] Plant extracts were to have been produced from a prioritized set of species selected by researchers in AP 2, Medical Ethnobiology and Botanical Inventory, on the basis of their medicinal importance as inferred from informant consensus concerning use and general availability. The hypothesis on which this operational selection procedure for initial screening was based assumes that: "The greater the degree of consensus [among native collaborators] regarding the use of a plant based therapy, the greater the likelihood that the remedy in question [will be] physiologically active or effective" (Trotter and Logan 1986:93). Further, we argued that the species that comprised an herbally based ethnomedical system must be *commonly known*, *widely available*, and *easily accessible* if such a system is to continue to function effectively. It follows, therefore, that those common and well-known species used in the treatment of the regularly occurring illnesses will have been selected on the basis of their pharmacological effects and are likely to show high levels of bioactivity and should form the first set of species to be evaluated pharmacologically.

Infrastructure Development and Technology Transfer

Preliminary to initiation of natural products research, infrastructure enhancement of ECOSUR's laboratories was necessary. This critical step was based on the view that an infrastructure necessary to support modern natural products research must be developed in the host country. The Maya ICBG concurred fully with Asebey and Chapela's assessment that we must:

> invert the current model for natural products drug discovery...[that] take raw materials from the developing world and ship them to the developed world where the necessary technology and capital to exploit these resources exist (the "resource extraction" model). Conversely, [we should] take the capital and state-of-the-art technology to countries rich in biological diversity (Asebey 1996:57; see also Chapela 1996; Feinsilver and Chapela 1996).

We had taken initial steps to implement this model. With financial support from NIH and the University of Georgia Research Foundation (UGARF), and in consultation with scientists at UGA and MNL, our collaborators at ECOSUR began upgrading their laboratory facilities. We planned to make the new laboratory capable of carrying out all preliminary natural products evaluations except extensive **fractionations**, a step requiring **high performance liquid chromatography (HPLC)** capabilities that were to be added in the third year of the grant period. High interest compounds (prioritized on bioassay results from ECOSUR, UGA, and MNL) would be purified *on site*. When functioning at full capacity, ECOSUR would have had the capability to process, fractionate, and bioassay extracts of the vascular flora that would have been equivalent to the capacities of a modern natural products research laboratory.

A laboratory at ECOSUR was renovated for use as a tissue culture facility that would have been maintained by two additional technicians, one a Tzotzil-speaking collaborator with elementary laboratory experience. Species for tissue culture propagation included **bromeliads** as well as medicinal species showing high potential as phytomedicinals. As part of AP 1's technology know-how transfer goals, we also envisaged a strong training program aimed at training local collaborators, both indigenous and not, in modern laboratory techniques. They would become familiar with all basic laboratory methods.[10] These various forms of technology transfer and training would thus have provided a strong foundation for the expansion of scientific investigation at ECOSUR that would contribute to the long-term development of our host institution's research goals.

Finally, AP 1's bioassay laboratory results on species that showed promise for the development or promotion of phytomedicines of local importance would have been provided to APs 2 and 3, even if these species were shown to exhibit molecular structures that are well known and would not have been candidates for patentable pharmaceuticals. Returning practical information on the bioactivity of species significant in contributing to local health needs represented one of the Maya ICBG's most important short- and mid-term benefits for local Maya communities.

Associate Program 2: Medical Ethnobiology and Biodiversity Inventory

AP 2 consisted of two major components, one focusing on medical ethnobiology and the other on biodiversity inventory.[11] The medical ethnobiology section was to have been responsible for in-depth comparative documentation and analysis of ethnomedical formulary in participating communities in each of the Tzeltal- and Tzotzil-speaking municipalities of the Chiapas Highlands. The aim of the biodiversity inventory section was to conduct a broad general survey of the vascular plants of the study area, leading ultimately to a comprehensive ethnoflora of the Chiapas Highlands. The project was able to achieve some preliminary results in each of these areas before it was terminated.

Technology Transfer and Training

The first step for both sections of AP 2 required training of native speakers of the local language(s) in the field methods (see Berlin and Berlin n.d.a). We conducted workshops that prepared local collaborators in anthropological and ethnobiological data-collecting techniques including: linguistic transcription; ethnobiological interviewing skills and native language questionnaire production; botanical, ethnobotanical,

and ethnoecological data collection and recording methods; herbarium curation procedures and processing priorities; basic computer literacy, including word processing and database management; and basic biological laboratory techniques, regulations, and precautions. These trained collaborators were then prepared to become full-fledged field assistants in data collection and processing (for training photos see *http://www.arches.uga.edu/~obberlin/maya_icbg/*).

Implementation of Research on Medical Ethnobiology

The initial focus of the medical ethnobiology section was to be on the most important medicinal plant species commonly used in the treatment of the most significant health conditions, as determined from earlier research on Maya health and healing (Berlin and Berlin 1994; Berlin and Berlin 1996; Berlin and Jara Astorga 1993). Documentation of Maya **ethnoformulary** focused on precise extract preparation according to traditional procedures, with attention to informant variation that might prove relevant for future bioassay assessment.

A major goal of AP 2 was the production of extracts used in the treatment of health conditions in each of the 12 most significant therapeutic areas recognized in Maya ethnomedicine:

1. gastrointestinal diseases, including general diarrhea, bloody and mucoid diarrhea, abdominal pain, epigastric pain, and intestinal parasites;
2. respiratory conditions such as coughs, croup, and tuberculosis;
3. inflammations of the nose, ears, and throat;
4. dermatological infections such as skin eruptions, boils, carbuncles, ulcers, topical "cancers" that do not heal normally, and skin dispigmentation;
5. wounds resulting from accidental injuries and violent acts;
6. pain and inflammation due to broken bones, sprains, bruises, and painful joints;
7. fevers, chills and fevers, and fevers thought to be malaria;
8. serious infections of the mouth, gums, and tongue, including teeth abscesses;
9. eye infections;
10. mental disorders such as dizziness, disorientation, conditions often accompanied by convulsions, seizures, and extreme agitation;
11. fertility regulation (contraception, abortion), general obstetrics, and gynecology (pregnancy, childbirth, hemorrhaging due to childbirth, menstrual problems); and
12. urinary disorders such as anuria, polyuria, and infections.

Our initial results revealed Maya herbal remedies to be complex, often involving a number of species that undergo several forms of preparation and administration.[12] Medicinal preparations were to be documented in a series of steps to ensure systematic identification of all required procedures. Following the verbal description, collaborators were to be videotaped as they worked through the actual preparation.[13]

Finally, as part of our outreach activities related to Maya health, AP 2 produced a bilingual Tzeltal-Spanish basic health manual that includes most of the major medicinal species and their methods of preparation and administration relevant to their associated health conditions (see Berlin et al. 2000). Other health manuals were being produced which would have been distributed in each municipality, all written in the appropriate dialect of each Maya language.

Implementation of the Ethnobotanical Survey

The second major aim of AP 2 was to mount a broad general botanical survey of the vascular plants of the study area, leading ultimately to a comprehensive ethnoflora of the Highlands. The plan was to carry out this survey in each of the 28 municipalities of the Chiapas Central Plateau and Northern Highlands, an area representing approximately 16,000 square kilometers. Initial surveys were begun in four of these targeted municipalities prior to the termination of the project.[14] By the end of October 1999, more than 7,000 herbarium collections (in sets of seven) had been made and deposited in the ECOSUR herbarium, where they are currently housed.

Our collecting procedures would have allowed for recollecting many of the same species from distinct geographic and ecological zones of Highland Chiapas. This would have led to an understanding of species distribution and species variation that is commonly lacking in even the most complete regional floras. Furthermore, samples of the same plant species that showed interesting bioactivity or chemical profiles could be recollected from sites representing highly diverse microhabitats. Collection at varying times of the year would have allowed us to investigate geographical, ecological, and seasonal effects on phytochemical composition, particularly important in bioassay evaluations. When collections of the same species showed significantly different levels of bioactivity, the particular ecological conditions of the species in its distinctive microhabitat could have been reexamined in detail, allowing for hypotheses to be tested on a range of factors that might account for this variation. Our ability to collect and recollect pharmacologically interesting species representing the full range of the species' regional biogeographical and ecological diversity was a major strength of AP 2's collecting program.

Associate Program 3: Sustained Harvest and Economic Development

A major subproject of AP 3 focused on the most commonly known medicinal plants as part of an outreach program aimed

at the promotion and maintenance of traditional Highland Maya medicine.[15] Building on previous research over the last 10 years, we identified a core group of around 100 medicinal plant species that we have come to refer to as the Highland Maya *cuadro básico* (basic medical kit). The majority of these plants are used to treat specific illnesses rather than act as broad panaceas. There is variation in the cuadro básico across municipalities, but the factors that account for this variation are presently unknown.

The Highland Maya are perhaps unique in Mesoamerica in that they have not traditionally cultivated medicinal plant gardens. All medicinal species are collected in the wild, save for a small number of introduced exotics from Europe (e.g., rue, *Ruta graveolens*, and rosemary, *Rosmarinus officinalis*). The Tzeltal and Tzotzil characteristically employ fresh plant material in the production of herbal remedies and do not customarily use dried specimens. Medicinal plants that have been dried are thought to lose their healing power. As a consequence, the most commonly used medicinal plants are collected as needed along trails and in secondary growth forests where they are found as ruderal species.

However, at the explicit request of several local Maya communities, the Maya ICBG worked extensively to develop community medicinal plant gardens for experimental cultivation of the most commonly used species. The initial phase of the project involved identification of appropriate species for inclusion in the gardens and recruitment of local collaborators to maintain them. By the end of the summer of 2000, eight cooperative ethnobotanical community gardens had been established as part of the Maya ICBG's effort at promotion and maintenance of traditional knowledge of medicinal plants (for garden photos see *http://www.arches.uga.edu/~obberlin/maya_icbg/*). Composite species inventories of three of the fully established gardens included 324 species in 103 botanical families. While the majority of species are medicinal, other useful plants were also included. These gardens became one of the project's most important community development activities. One of these gardens, in the Oxchuc community of Pak'bil Na, has now expanded to cover more than a hectare and has obtained funding from the state of Chiapas.

Prior to the termination of the project, members of AP 3 had made considerable headway in exploring the potential benefits of some of the cuadro básico medicinal species as agents for pest control in local Maya horticultural gardens.[16] Their goal was to develop a viable substitute for the chemical pesticides currently widely used in the Highland Maya area, especially cabbageworm infestation (larvae of *Leptophobia aripa eloidia*) that has become a major problem in the area. The initial experimental results of this work identified a number of species in the control of this insect pest. Another group had developed a new medium for rapid propagation of *Tillansia eizii*, an endangered endemic bromeliad that is harvested annually in great quantities by pilgrims from all over Mexico for use in religious ceremonies.

Prior Informed Consent, Local Indigenous Communities, and Access to Biological Resources

None of the goals and activities described above would have been possible without the prior informed consent (PIC) of the Maya communities (Glowka, Burhenne-Guilmin, and Synge 1994).[17] On the basis of these guidelines for ethical bioprospecting research, the Maya ICBG project initiated the informed consent process among Maya communities in Highland Chiapas, beginning with those with whom contacts already existed due to our earlier work (Berlin 1999; Berlin and Berlin 1994, 1998; Berlin et al. 1990; Meckes et al. 1995). We aimed to present accurate information about the project's activities "in a manner and language comprehensible to the provider [of the biological resource]" (COP 1999).

Based in large part on the suggestions of our Maya research assistants, we developed presentations about the project in the form of a theatrical performance. Our *teatro* included a narrator who described, in Tzeltal, Tzotzil, or Tojolabal, a series of mimed skits performed by project members. The skit included an introduction about our overall goals and each component of the project's activities: demonstrations of our ethnobotanical collecting procedures, work on Maya medical anthropology and ethnophamacology, establishment of ethnobotanical community gardens, agroecological use of medicinal plant species in traditional agriculture, laboratory procedures, benefit sharing, and our plans to produce illustrated bilingual materials on herbal medicine.

Initially, community leaders were invited to the theater presentation at ECOSUR where they also toured the laboratories, herbarium, and experimental gardens. At the end of these daylong activities, they were provided written bilingual (Spanish and appropriate Maya language) summaries of the project's goals, activities, and proposed benefit-sharing program.

These representatives discussed the day's events with their respective communities and decided whether to invite us to give a presentation to a general community assembly (*asamblea comunitaria*), the traditional decision-making group for indigenous communities in Highland Chiapas. Communities that agreed to collaborate with the Maya ICBG, as a result of open consultation and voting in the community assemblies, were then asked to indicate their approval by signing a letter of agreement. There was a good deal of variation among communities in who signed the agreement for participation, ranging from elected community representatives (sometimes including individuals who were not elected leaders, but who wished their names to be recorded) to the heads of households of each family in the community. In all instances, the project followed individual community's traditional norms and practices. Of the 47 that were approached in the short three-month period that we worked to achieve prior informed consent (PIC), 46 signed agreements to collaborate with the project (for PIC photos see *http://www.arches.uga.edu/~obberlin/maya_icbg/*).

Benefits Sharing

A major component of the Maya ICBG dealt with developing equitable economic benefits-sharing arrangements with collaborating Maya communities. From the outset, all members of the proposed ICBG indicated their firm commitment to assuring that just financial compensation be made for any natural products that might be commercially produced as a result of the proposed research. Our original proposal to NIH included a specific plan to guarantee just compensation,

> Our framework ensures the intellectual property rights and equitable return of any economic benefits to participating Highland Chiapas Maya communities through wages for collaboration in the research and by dispersal from a trust fund in the event of the development of pharmaceutical products. This includes promoting natural products whose structures are already well known but whose production will benefit from our research and is related to development programs that are sustainable and promise short to mid-term economic or health benefits to local communities. Our framework for benefit sharing is evolving. We do not assume that this process will be straightforward nor without its difficulties. We are confident, however, of success in developing the legal guarantees required for adequate recognition of intellectual property and benefit sharing of Maya traditional knowledge (Berlin 1998:10).

Determining the best and least controversial way to distribute any future benefits sharing was one of the most difficult aspects of our intellectual property arrangements. Our initial and tentative solution, one that was never implemented due to the maelstrom of protest that eventually engulfed the project, was to envisage the establishment of a legally registered nonprofit organization, known as an Asociación Civil in Mexico. The nonprofit association was to be named Protection of Maya Intellectual Property Rights (hereafter PROMAYA) and would be comprised of individuals selected by the communities with whom the project had established collaborative agreements. A trust fund would be established through PROMAYA to receive and disburse any **milestone payments** or royalties accruing from testing or sale of drugs resulting from research of the Maya ICBG. All parties had agreed to give 100 percent of all milestone payments to the Maya trust fund. Any royalties from pharmaceutical development would be divided in four equal shares (ECOSUR, UGA, MNL, and PROMAYA). We hoped that funds administered by PROMAYA would be used to develop home and market-oriented community herbal gardens, community cooperatives, establishment of scholarships to be awarded to qualified Maya students, or other significant activities that might lead to the improvement of the social and cultural well-being of Maya communities in the region.

The establishment of a nonprofit organization comprised of individual local and indigenous communities was based on the premise that each community could rightfully enter into contractual relationships with third parties regarding access to biological resources, in accordance with the stipulations of the CBD. As we were to discover with the initial attacks on the project, this assumption was not held to be true by our detractors. On the contrary, NGOs who opposed the project argued that local communities were not capable of representing themselves in agreements for bioprospecting projects.

Opposition to the Maya ICBG Project

Shortly after the project began in 1999, a small local healers' NGO began to oppose it. The NGO was known as the Organización de Médicos Indígenas del Estado de Chiapas (OMIECH, Organization of Indigenous Doctors of the State of Chiapas). The healers group later became known as the Consejo de Medicos y Parteras Tradicionales de Chiapas (COMPITCH, Council of Traditional Doctors and Midwives of Chiapas), and most of their campaign against us was under that name. COMPITCH argued that the permissions we had obtained from collaborating Maya communities were invalid. They also claimed that we had understated the project's economic potential for the purpose of exploiting local knowledge for commercial purposes. We had, in fact, deemphasized monetary benefits under the advice of our Maya collaborators and to avoid raising unrealistic expectations, one of the most often cited problems of bioprospecting projects.

We had earlier contacted this group and invited it to participate in a preproject conference designed to examine biotechnology projects in Mexico and to make recommendations for new national legislation, informed it of the pending project, and invited its participation. COMPITCH chose not to cooperate. It did, however, quickly establish a relationship with the Rural Advancement Foundation International (RAFI; now the Action Group on Erosion, Technology, and Concentration, or the ETC group), a Canadian NGO led by Patrick Mooney. Mooney had earlier made a name for himself with his successful attack on Monsanto Corporation's efforts to develop a "terminator gene" that would have required farmers to obtain new seeds from the company each planting season. Mooney apparently considered the ICBG projects to be just as dangerous. With a posting on the RAFI Web site in December 1999, Mooney mounted a relentless and sophisticated Internet campaign against the project, labeling it *biopiracy*, a term he claims to have coined (see ETC group 1999).

RAFI was opposed to the International Cooperative Biodiversity Groups from the very outset of the program (see Brown 2003; ETC group 1994a, 1994b; Greene 2004; Rosenthal n.d.). In its early opposition to one ICBG Program project carried out in Peru, led by Walter and Memory Lewis of Washington University in St. Louis, RAFI aligned itself with the Aguaruna-Huambisa Council, a loose coalition of communities that had first agreed to work with the Peru ICBG but later called for its termination.

> When RAFI intervened in negotiations, it assumed that the Aguaruna-Huambisa Council was the true representative of the Aguaruna people...however, the Aguaruna are not yet a polity in the sense that they have, or ever have had in the past, a centralized political structure that defends

> their collective rights and resources. By casting its lot with the Council, RAFI inadvertently [*sic*] mimicked the actions of colonial powers who assumed that native people were...organized as tribes and under the direction of chiefs (Brown 2003:113).

RAFI took the same position in its opposition to the Maya ICBG project, claiming that COMPITCH, an exclusive guild of healers with its own established for-profit business of medicinal plants, somehow spoke for the local indigenous communities of the Highlands.

> The bottom line is that 11 credible, legitimate local indigenous peoples' organizations [comprising COMPITCH] are demanding that the [Maya ICBG] project be stopped. If not local people, then who should be setting the process, timetable, and deciding when it is proper to object? Are 11 organizations under the COMPITCH not significant enough [to stop the project]? (Mooney 1999).

In addition to RAFI, San Francisco-based NGO Global Exchange joined in the campaign against the project. This group questioned the validity of our consent agreements, charging that the communities with whom we had chosen to work were politically affiliated with the then-dominant governing political party in Mexico, the PRI (Partido Revolucionario Institucional) and, by implication, opposed to the goals of the Zapatista Rebellion. Global Exchange later sponsored a biopiracy speaking tour in opposition to the project at nine U.S. colleges and universities.[18]

In the face of this opposition, the Maya ICBG was invited by the new governor of Chiapas to prepare a model program for obtaining PIC and to suspend other research activities of its three associate programs. We received permission from NIH to restructure the project completely and to focus exclusively on PIC during its remaining three years. In the new project, we would convene workshops and summer-long environmental policy training programs organized for indigenous Maya promoters on the legal and ethical issues associated with biodiversity law, working to develop training modules in the local Maya languages of the region. The programs were to be led by prominent biodiversity experts in Mexico.[19] The government presented the revised proposal to our opponents who rejected it outright.

At this same time, the dispute was joined by Mexican intellectuals and other national and international NGOs with shared values (see Barreda 2003; Nadal 2000). With skillful use of the Internet's antiglobalization electronic list serves and rapid access to the print media, in particular *La Jornada*, a national Mexican newspaper, a fast-moving negative publicity campaign successfully portrayed the Maya ICBG project as another example of the continued exploitation of the South by the North, theft of traditional knowledge, and usurpation of indigenous rights. The negative publicity that continued to besiege the project finally led ECOSUR, our host institution, to withdraw—and the Maya ICBG project came to an end in October 2001 (Berlin and Berlin n.d.b).

Arguments Used Against the Project that Diminish Community Autonomy

A number of conflicting and contradictory arguments were raised against the Maya ICBG project. One set of criticisms claimed that local communities were ultimately exploited pawns in a prospecting plan aimed to enrich money-hungry pharmaceutical firms whose work was being carried out by mercenary biopirates. More serious arguments openly questioned the autonomy of local communities' control of their own biological resources. These arguments are the most pernicious and need to be discussed in some detail.

Biological Resources and Knowledge of those Resources that Extend Beyond Community Boundaries

It is commonly the case that the same biological resources and shared knowledge of those resources extend beyond the boundaries of any specific community. Opponents to the project argued that an individual community couldn't formulate valid agreements for research and development of natural resources within its territory and its knowledge about those resources, because to do so would violate the rights of other communities where the same species might be found. In such cases, permission to conduct research on the commercial use of such knowledge and resources must be granted by *all* relevant communities having shared knowledge and resources. As stated by Rafael Alarcón, a non-Indian adviser to OMIECH and COMPITCH:

> Medicinal plants are not the sole property of Chiapas, they belong to all of Mexico. Furthermore, there are plants in Chiapas that exist in Guatemala. If we [Mexicans] come to an agreement that plants found here can be carried away, patented and sold, this could be the cause of an international controversy with Guatemala because plants that are found in Chiapas are also found in Guatemala (XERA Radio 2000).

Patrick Mooney's organization further elaborates a version of this argument when it states that "Bioprospectors must assume, in the *absence of definitive evidence to the contrary*, that the same or similar plants and preparations are used by different communities in the same country and very possibly, by communities in other countries. Agreement must be reached with each community before bioprospectors can consider that they have permission to proceed" (ETC group 2000, emphasis added).

The shared knowledge/shared resources argument against the project was widely accepted. It hardly seems necessary to point out again that one of the primary purposes of the 1992 treaty on biodiversity was to establish the fundamental right of sovereign nations to control over their own natural resources. "States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources

pursuant to their own environmental policies" (CBD 1992e). No international agreement requires one country to seek permission for access to a species within its own borders because that species is also distributed within the boundaries of the second country.

Our own earlier research in 14 Tzeltal- and Tzotzil-speaking municipalities of Highland Chiapas provides conclusive evidence that the most important species with similar medicinal uses are widely known weedy species that occur in several communities of the same municipality, across municipal boundaries, throughout Mexico and other areas of Latin America (Berlin and Berlin n.d.a, 2004). Furthermore, their uses as medicinal plants (e.g., *Chenopodium ambroisioides* against intestinal parasites and *Cissampelos pareira* against diarrhea and gastrointestinal conditions) are shared throughout Mexico, Mesoamerica, and other regions of Latin America (see Cáceres, Samayoa, and Logemann 1990 for Guatemalan plants used to treat gastrointestinal conditions and Morton 1981 for a comprehensive inventory of medical species found in Middle America and the Caribbean), including plants that derive from Europe and are still utilized by indigenous people.[20]

If different communities prepare these common species in similar ways, it does not follow that agreements must be obtained from *all communities* where these same resources might potentially be found, even if such a requirement were practical and feasible to meet. Knowledge that extends across many local communities, throughout a region or country, or across national boundaries must necessarily be deemed to be knowledge in the *public domain* rather than *specialized, private knowledge* subject to considerations of confidentiality. Public domain knowledge has been defined as the "set of all knowledge that (a) is publicly available, and (b) is not subject to patents, copyright, or other forms of intellectual property protection" (Maurer 2002:5). "Public domain information is publicly accessible information, the use of which does not infringe any legal right, or any obligation of confidentiality. It thus refers to the realm of all works or objects of related rights, which can be exploited by everybody without any authorization" (Matsuura 2004:1).

Of course, even before widely distributed medicinal species, which have been used over centuries and are in the public domain, are collected, it is nonetheless ethically and legally essential to acquire the permission of individual local communities on whose lands these species are found before they can be collected. One of the major goals of the project was to develop sustainable economic uses of these common resources that would benefit those local communities directly.

Rights of Local Indigenous Communities versus Larger Political Organizations and Indian Nations

A second argument used to discredit local communities' autonomy held that decisions concerning access to biological resources should be vested not at the community level but in larger sociopolitical units referred to in Mexico as *pueblos indios* (Indian peoples, Indian nations). Ronald Nigh (2002:473), a local supporter of this position, has claimed that the 46 indigenous local communities with whom the project had signed agreements were "fictions imposed from outside," simply "administrative conveniences that may or may not bear any relationship to local residential patterns or social organization" (ironically, this is most characteristic of the structure of the new Zapatista communities and municipalities). These groupings, he said, could not function as "legal decision making bodies." Instead of indigenous local communities, he argues that one should move to empower "regional social and political formations of *indigenous peoples*" that "transcends the restricted 'geographically bounded' and imposed 'community'" (Nigh 2002:473, emphasis added; see also Sánchez 1999:67).

What are these "regional social and political formations" to which Nigh refers? Whatever they are, they are not those groupings officially recognized in Chiapas (and Mexico) as indigenous peoples as determined by their linguistic affiliation (Tzeltal, Tzotzil, Chol, Zoque, Tojolabal, Mam, Kachiquel, Lacandón, and Mochó). One's ethnic identity in the Highlands of Chiapas lies not with one's native language group. First and foremost, it is defined by the person's *community membership* within a particular municipality. Municipalities may be comprised almost exclusively of one or the other major languages or, as is more commonly the case in modern Chiapas, a combination of both.

This general lack of correspondence with native language and primary ethnic identify is typical of other areas of Mexico and many parts of Latin America. Few, if any of the so-called pueblos indígenas of Mexico, as defined by a common language, have organized themselves into sociopolitical organizations with their own forms of self-government, elected officials, or procedures for the legitimate forms of representation of the local communities that comprise them. As stated by Neil Harvey, a political scientist at New Mexico State University and one of the primary supporters of the formation of politically recognized, autonomous Indian peoples—"Right now, in Mexico, you cannot get PIC from a pueblo indígena because the definition of what constitutes a pueblo indígena remains undecided" (Neil Harvey, personal communication, July 15, 2002). No such organizations exist or are likely to exist in Chiapas in the foreseeable future; although some would argue that the "autonomous municipalities" that have emerged as a result of the Zapatista Rebellion may represent one immediate model.[21]

The bioethicists Fran Brunger and Charles Weijer (n.d.) have adopted an alternative view of community autonomy and access to biological resources—one espoused by many of the NGOs but in contradiction to Weijer's prior publications on the topic (Weijer and Emanuel 2000). In a recent analysis of the Maya ICBG project, they argue that local indigenous communities are not qualified to make decisions concerning access to their biological resources. They state that "understanding which communities are at risk and who are the

appropriate community members to consult, [must be] framed by the broadest context of risk in relation to identity, from the perspective of *those most able to speak with authority* about the potential risks and benefits and about what groups of people would most likely be affected" (Brunger and Weijer n.d., emphasis added). These authorities are those persons who, "based on what [is] known to date about pharmacogenomic [*sic*] research among indigenous communities, recognize that [bioprospecting] will likely have global political implications for all Indigenous peoples as well as implications for local indigenous [communities]" (ibid.).

In the case of the Maya ICBG project, Brunger and Weijer (n.d.) state,

> the experts to be consulted at the first level of negotiation [s]hould have included groups representing Indigenous Peoples.... The community whose interests were "at stake" was not only "the Chiapas Maya," comprised of individual...communities. In this case, there was an entirely different set of stakeholders, whose community boundaries—that is, the shared sense of solidarity—only tangentially overlapped with the [local indigenous communities of Chiapas] (see also Gudeman 2001; Ratner and Rivera Gutiérrez 2004).

This would presumably include RAFI, Global Exchange, and other NGOs that have taken it on themselves to represent the indigenous peoples of the world.

The Paradox of Local and Indigenous Community Autonomy and Broadly Representative Indigenous Governance

What are the practical implications of Highland Maya communities' lack of a single, representative political structure? Joshua Rosenthal (n.d.:20), director of the International Cooperative Biodiversity Groups Program at NIH, suggests that the lack of an "established, credible and broadly representative governance system of the [local Maya] communities involved" was key to the demise of the Maya ICBG. He argues that, in the highly charged political climate surrounding access to biological resources involving native peoples, "individual indigenous and local communities are powerless to act on their own behalf on matters of access to biological resources involving bioprospecting" (ibid.).

Rosenthal (n.d.:20, emphasis added) concludes "if [individual] indigenous communities are to find the space to negotiate on their own behalf with outsiders, rather than through national governments, universities, or external NGOs, they will need the authority that *western organizational and accountability systems provide*," an authority he refers to as "Western-style governance as an enabling condition." This position has significant implications for applied anthropology programs involving the uses of biodiversity "because it suggests concerted movement away from the traditional model of individually oriented ethnobotany studies for bioprospecting involving indigenous communities, and towards one that is structured around institutional relationships" (ibid.:3).

While we may support the spirit of Rosenthal's proposal, we find it unrealistic and highly prejudicial to those thousands of local communities who are not part of a representative centralized political structure. Political entities such as the Kuna Nation of Panama, the Shuar Federation of Ecuador, and the several organizations of Aguaruna and Huambisa communities of Peru, are rare exceptions in Latin America. The overwhelming number of local and indigenous communities of the world are not now, nor will they become in the future, members of comprehensive and democratically representative indigenous organizations with governance—Western-style or not—that provide them the powers of so-called Indigenous Nations. If these small local communities are to have voices, requiring them to become members of larger political groupings is not a viable proposal, nor, for that matter, is it any of our business.

Implications

Rosenthal et al. (1999:6) ask: "Can drug discovery research with natural products be conducted in such a way as to simultaneously promote human health, economic development, and conservation of biodiversity?" Looking at the success of the 11 multidisciplinary projects sponsored by the International Cooperative Biodiversity Groups Program that Rosenthal administers, the answer is "yes"—given certain social conditions. All but one of these groups have been funded for at least a full five-year cycle, several for two cycles, and a handful are now beginning their third period of support.

Only two of these projects, however, directly involved the participation of local indigenous communities. Each came under intense attacks from local, national, and international NGOs from the beginning of their work. One, the Peru-ICBG, survived only because it was able to establish strong cooperative linkages with local indigenous communities grouped into four, well-organized indigenous federations which, in turn, were represented by yet another umbrella organization that provided them with institutional stability (see Greene 2004; Rosenthal n.d.). No such organizational structure was present in the case of the communities involved in the Maya ICBG and, lacking this organizational structure, local, national, and international NGOs opposed to biodiversity prospecting were able to develop a successful misinformation campaign that led to its downfall.

A major lesson to be drawn from the Maya ICBG case is that local indigenous community autonomy, as envisioned in the CBD, is more myth than reality in the access of biological resources debate, especially in the politically charged climate of Mexico and Latin America. Most local communities are not members of representative, democratically organized political federations, organizations, or "Indian nations." Lacking more general representation, these groups are especially vulnerable to the interventionist tactics of national and international NGOs and their allies, indigenous or not, who have assumed the role of representing them on the world stage. Finally, their ready access to the press and the Internet provides external organizations with a platform that allows them to be identified as the voices of the Indian peoples of

the world. International opinion readily accepts claims of biopiracy and builds on stereotypical images of indigenous Davids pitted against Goliath-like pharmaceutical "gene giants" whose aims are to further exploit the poor populations of the developing world.

As always, the local indigenous communities are the real losers. And how much they have lost!

1. Had the project been allowed to continue Maya ICBG scientists would have carried out natural-products bioassays on the major medicinal plant species of the Maya ethnopharmacopoeia, employing the most modern procedures and methods available in natural products science.

2. We would have been able to discover, isolate, and evaluate bioactive agents from all species of immediate health significance and economic value to the local Maya populations; design sustainable production systems; and develop capacity for sustainable management and use of these resources, including phytomedicines that could be cultivated as dooryard garden supplements, species with commercial production potential and native species that could serve as crop protection associates in Maya corn fields.

3. Highland Maya ethnomedical formulae shown to be both safe and efficacious would have been promoted throughout the region as part of local community garden projects. The medicinal plant gardens could have marked the beginnings of small indigenous cooperatives capable of producing phytomedicinal products for the growing national and international herbal remedies market.

4. Arrangements for fair and equitable benefit sharing were in place, should there have been economic gains arising "from the commercial...utilization of genetic resources" (CBD 1992c), following to the letter the spirit of the CBD. Milestone payments would have returned money to fund cooperatives and small businesses, educate promising young Maya, build community infrastructure, or whatever else the communities decided were their goals.

5. The comprehensive botanical surveys of the vascular flora of Highland Chiapas would have significantly enriched the holdings of local herbaria and developed the most complete regional floristic database for southern Mexico. It would have been unique in that accompanying data would be presented not only in Spanish but also in Tzeltal and Tzotzil, providing encyclopedic documentation of the richness of Maya ethnobotanical knowledge.

6. The large variety of botanical and ethnobotanical information compiled would have significance for identifying areas of particular importance for biological conservation and resource utilization. Fragile and endangered species could have been identified and targeted for conservation programs.

7. All of this information would have been made available in a form relevant to local Maya communities, government policy makers, and nongovernmental organizations working toward the conservation of cultural and biological diversity in southern Mexico.

Our detractors will claim that these contributions are minor, that they could not have been guaranteed, that our contractual agreements would not, in the long term, have been honored. The "globophobes," however, offer no positive alternatives to changing the intense marginalization that local and indigenous communities continue to suffer under the social and economic conditions that Chiapas faces today. So long as their nihilistic views go unchallenged, we must conclude that when it comes to promoting the economic uses of biodiversity by local indigenous communities of Mexico, and perhaps all of Latin America, the future of applied anthropology is bleak indeed.

Notes

[1]The 1971 Barbados Conference was crucial to the increased concerns of the international community on the nature of indigenous peoples' problems. The conference brought together an international group of distinguished anthropologists and other social scientists as part of a program organized with the support of the World Council of Churches. The results of their deliberations appeared in 1972 as *The Situation of the Indian in South America: Contributions to the Study of Inter-Ethnic Conflict in the Non-Andean Regions of South America*, the first regional survey of current social and environmental conditions of native peoples in each of the Amazonian South American republics. Significantly, the group produced the "Declaration of Barbados for the Liberation of the Indians," aimed at developing a set of guidelines for future action by anthropologists, missionaries, and governments in their dealings with tribal peoples of this region of the world.

[2]David and Pia Maybury-Lewis founded the nongovernmental human rights organization Cultural Survival in 1972 (see Lutz 2004 for a concise history of the organization). Partially as a result of efforts of groups such as Cultural Survival, a number of indigenous populations organized federations themselves, which allowed them to develop legitimate political organizations within their respective countries as well as to achieve international recognition as NGOs. The World Council of Indigenous People was founded in 1975.

[3]The relevant section of the declaration is Article 4: "HENCEFORTH: procedures be developed to compensate native peoples for the utilization of their knowledge and their biological resources" (ISE 1988). Although not explicitly stated, the compensation envisaged was meant to be monetary.

[4]The convention is formed around three major objectives: "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, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding" (CBD 1992a). Significantly, while the CBD affirmed the rights of sovereign states to control access to the biological resources within their national boundaries, the overriding goal of the treaty was not to close off access but to regulate it. The agreement clearly states that parties to the convention should provide access to genetic resources on the condition that this access, when granted, "shall be on mutually agreed terms [and] shall be subject to prior informed consent of the Contracting party [the recognized owner of the resources]" (CBD 1992b). Furthermore, arrangements for fair and equitable benefit sharing should be developed should there be economic gains arising "from the commercial...utilization of genetic resources" (CBD 1992c).

[5]The compound phrase—"indigenous and local communities"—is used in all United Nations official documents relating to the CBD and it implementation. The phrase occurs 72 times in the CBD handbook (CBD n.d.); 11 times in Conference of the Parties III(1) (COP; n.d.a); 14 times in COP IV(9) (n.d.b); and 38 times in COP V(16) (n.d.c), all of which specifically refer to article 8(j) and related provisions. Unfortunately,

neither the CBD nor these subsequent documents explicitly define what is meant by "indigenous and local communities." However, numerous working definitions do exist, and that proposed in 2000 by the International Union for the Conservation of Nature (IUCN) is one for which there can be little debate: "By 'local community' we mean a socially and geographically defined group of people, not necessarily homogenous, living close to the natural resources, with customary rights of use, distinctive knowledge and skills and direct dependency on natural resources as individuals or as groups of individuals. They have a close and unique relationship to the[se] natural resources as a community" (IUCN 2000).

[6]To date, 188 countries are parties to the CBD, excluding the United States. Although President Clinton signed the treaty in 1993 and asked the U.S. Senate to ratify it, the convention is still awaiting ratification and is unlikely to be approved any time soon.

[7]The historical precedents of our research plan built on a history of more than 40 years of fieldwork among the Maya of Highland Chiapas, but more specifically on medical ethnobiological research undertaken since 1987 by E. A. Berlin and B. Berlin and colleagues from a variety of disciplines. Researchers at El Colegio de la Frontera Sur (ECOSUR, formerly the Centro de Investigaciones Ecológicas del Sureste, CIES) had been working on issues relating to biodiversity conservation and agroecology for a quarter of a century. Our colleagues at IMSS included Xavier Lozoya, Mariana Meckes, Maríaluisa Villarreal, and Jaime Tortoriello. Lozoya had established the first major medicinal plants research program in Mexico, the Instituto Mexicano para el Estudio de Plantas Medicinales (IMEPLAM) in the early 1970s and was the country's leading ethnopharmacologist.

[8]MNL is a small pharmaceutical firm with expertise on the phytochemistry of well-known European medicinal plants, particularly the identification of novel trace compounds. This fledgling company shared the goal of development of herbal medicines for local production and sale. This was—and remains—a major interest of many of the Maya with whom we established collaborative ties and hoped to develop further with the Maya ICBG project.

[9]The two coleaders of AP 1 were David Puett, head of the Department of Biochemistry and Molecular Biology at UGA, and Robert Nash, research director, Molecular Nature, Ltd. Senior investigators Thomas Murray, head of the Department of Physiology and Pharmacology, UGA School of Veterinary Medicine, and Raghubir Sharma, Fred C. Davison Professor of Toxicology in the same department, joined them. MNL scientists included phytochemists Neil Robinson, Felicity Currie, Zahid Latif, and the late Maria Inês Chicarelli-Robinson, natural products chemist and managing director at MNL.

[10]These procedures included aseptic techniques, cell viability counts, and cell culturing and maintenance. Native technicians would also learn to use common laboratory equipment including balances, pH meters, micropipettors, an autoclave and a distiller, Soxhlet glassware, rotary evaporators, recirculating chillers, lyophilizers, and nitrogen blowdown. They would have learned to pack and use low-pressure chromatography columns and principles of separation. The technicians would be able to identify and isolate bands corresponding to bioactive compounds and to prepare, handle, and process TLC plates and solvents. Technicians were to be trained in methods of accurate recording and presentation of data, to maintain laboratory notebooks, and to transfer the data into database, word processing, and statistical programs. Researchers working in the tissue culture laboratory were to evaluate a variety of plant hormones and phytochemicals to determine rapid growth conditions. Again standard laboratory procedures were to be taught and our collaborators would be responsible for evaluating data and synthesizing experiments.

[11]The coleaders of AP 2 were the authors, who have been conducting medical ethnobiological research among the Highland Maya for decades. Other senior researchers in AP 2 included Mario González-Espinosa, a plant ecologist and program coordinator of ECOSUR's San Cristóbal Campus; Michael Heinrich, professor of ethnopharmacology, Department of Phytotherapeutics, School of Pharmacy, University of London; David Giannasi, professor of botany at UGA; Susana Ochoa, botanist, senior researcher, ECOSUR-Villahermosa Campus; and the late David Halperin, former head of Social Medicine at ECOSUR's San Cristóbal Campus.

[12]These procedures might involve boiling, steeping, grinding into powder, braising over low heat, breaking, squeezing, searing, expressing as drops, rubbing, chopping, preparing into sticky pastes, mashing, kneading, and mixing by hand. Many forms of preparation of herbal teas involved some type of primitive distillation and condensation. Forms of administration were also elaborate, including plastering, drinking, gargling, washing, medicinal baths and shampoos, wiping, burning, wrapping, packing, holding between the teeth, and inhaling and washing with essential oils in a closed place (such as a traditional sweat bath, especially important in childbirth).

[13]Our plans were to next submit each of these formulae to preliminary testing for bioactivity in ECOSUR's new natural products laboratory. We would have carried out simultaneous comparison of natural products formulae with standardized extracts of individual species, a procedure yielding two significant benefits: 1) ethnomedical formula demonstrating increased levels of specific bioactivity, relative to the activity of its individual constituents, would be candidates for further research as a commercial phytomedicinal; and 2) the procedure would produce a test sample for analysis of synergistic ingredients and provides a positive control for detecting therapeutic activity, maximizing our hit rate and increasing the probability of short- and long-term benefits to local Maya communities.

[14]The study area represented one of the most biologically diverse regions of Mexico, second only to parts of Oaxaca, due to its varied typography, geology, climate, and soils. In a recent classification of world biodiversity, Chiapas holds a rank of 9 (on a 10-point scale) with more than 4,000-5,000 species of vascular plants /10,000 km^2 (Barthlott, Lauer, and Placke 1996; also see *http://www.botanik.uni-bonn.de/biodiv/globbiod.gif* for an excellent map of the world's most diverse regions).

[15]The two coleaders of AP 3 were José Carlos Fernández Ugalde, an economist and then director of ECOSUR's Laboratory of Geographic Information Systems and Analysis, and Luis García Barrios, an agroecologist and head of ECOSUR's Program on Agricultural Systems of Production. Other senior investigators included Hazel Wetzstein and James Affolter, both professors in the Department of Horticulture at UGA, and Jan Wolf, a population plant ecologist in charge of a bromeliad conservation project and currently professor of Tropical Forest Canopy Research at the University of Amsterdam.

[16]Led by Luis García Barrios, with graduate research assistants Maritza Ramírez Gerardo and Romeo Trujillo Vásquez; Tzotzil and Tzeltal translators Juana Hernández and Luis Antonio Ramírez; and field assistants Pedro Girón Hernández and Cristóbal Sántiz Gómez. Advisers on the project were Helda Morales (integrated pest management and peasant knowledge of crop-associated insects), Leopoldo Cruz López (insect chemical ecology), Adriana Castro Ramírez (ethnobiology and peasant knowledge of crop-associated insects), and Cesar Rodríguez Hernández of the Colegio de Posgraduados SAGAR (botanical pesticides).

[17]See Philippine Executive Order 257 for one of the most comprehensive guides to implementing the PIC process in the context of access to biological resources (Ramos 1995).

[18]Mexican NGOs joined RAFI and Global Exchange in their opposition to the project. The Centro de Investigaciones Económicas y Políticas

de Acción Comunitaria (CIEPAC, Economic and Political Community Action Research Center), a radical local NGO in Chiapas, was the source of particularly vicious and distorted attacks, including a supposed master's thesis that falsely claimed that Brent Berlin was reviled among the Maya as *pukuj*, "the devil," (Castro Soto 2000) and that "Berlin has stolen plants and genetic materials [from Chiapas] for many years, [where] hundreds of [plant specimens] now adorn the laboratories of the University of Georgia and large pharmaceutical firms [from whom] he has received thousands of dollars for his services" (Castro Soto 2004).

[19]One of these experts was Jorge Larson-Guerra, a well-known Mexican environmental policy analyst who has been working for many years on issues relating to regulations of access to genetic resources in Mexico as part of the long-term goals of the Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO, *http://www.conabio.gob.mx/*).

[20]In addition to these widely distributed native species, numerous medicinal plants with commonly shared medical uses were introduced from Europe, presumably with the arrival of the Spanish, and most continue to be frequently used both in European and Latin American folk medicine. The more important plants include manzanilla (*Matricaria chamomilla*), rue (*Ruta graveolens*), several species of mint (*Mentha spp.*), garlic (*Alium sativum*), common plantain (*Plantago mayor*), basil (*Ocimum offinalis*), oregano (*Origanum vulgaris*), valeriana (*Valeriana officinales*), ginger (*Zingiber officinale*), anis (*Pimpinella anisum*), lemon grass (*Cymbopogon citrate*), and a variety of species of citrus (*Citrus spp.*).

[21]Mariana Mora (1998) notes:

Within the[se] newly created municipal structures, the communities name their authorities, community teachers, local health promoters, indigenous parliaments, and elaborate their own laws based on social, economic, political and gender equality among the inhabitants of diverse ethnic communities. In the autonomous municipality 17 de Noviembre, located in the region of Altamirano, educational promoters from the region's 75 communities meet regularly through workshops and meetings in order to create the municipality's new educational system. Those responsible for carrying out this monumental task, firmly rooted in Tzeltal history, attempt to write the municipality's own educational materials, create a bilingual teaching system, train local teachers, and eventually provide non-governmental schools for the region's 20,000 inhabitants. The educational promoters are accountable to the rebel municipality's Education Commission, a body of community representatives democratically chosen to carry out the tasks related to education, and must periodically inform the autonomous parliament of the work's progress.

If the Mexican government ultimately ratifies the San Andrés accords, the development of these new autonomous municipalities could develop, although on a much smaller scale, into something comparable the Kuna Nation of Panama, the Shuar Federation of Ecuador, or the Aguaruna-Huambisa Confederation of Peru. We would applaud such a development. However, it is highly unlikely that more than a small number of the 8,000 or more Highland Maya communities would be incorporated into these new groupings.

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Glossary

bromeliads: An American family of epiphytic tropical plants typically found high on branches of trunks of trees in the tropics. Pineapples are members of the family, as is Spanish Moss.

ethnoformulary: A set of medicinal formulae, their properties, preparation, and use that form part of a traditional ethnomedical system.

fractionation: Break down into individual constituents or chemical compounds.

HPLC: High Performance Liquid Chromatography, a method of pharmacological analysis based on separation, identification, purification, and quantification of various compounds in a sample, such as a plant infusion.

milestone payments: During the evaluation process, compounds may be contracted out to third-party researchers or companies for testing. These are "blind" compounds. The third party is not privy to any identifying information. Third parties pay for rights to analysis. If they find a promising lead, they negotiate payment for rights for further research. Each of these payments is called a milestone payment. This process is repeated, and yields monetary benefits at each step as testing progresses.

phytomedicinals: Plant-based herbal medicines.

vascular plants: Plants whose nourishment is carried through a system of vessels in a manner similar to the circulation of blood in the human body.