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Ethnobotanical Research and Traditional Health Care in Developing Countries

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from

PLANTS, PEOPLE, AND CULTURE
The Science of Ethnobotany[1]

According to recent estimates by the World Health Organisation, more than 3.5 billion people in the developing world rely on plants as components of their primary health care. Just as many Europeans know of the use of *Aloe vera* [Aloaceae] to treat burns, many indigenous peoples know of some common plants that have medicinal uses. Ethnobotanical research should not be limited to discovering new pharmaceuticals for Westerners; it can also be of some benefit to peoples in developing countries.

An increasing number of nations, including China, Mexico, Nigeria, and Thailand, have decided to integrate traditional medicine into their primary health systems. In these systems, ethnobotanical research plays a crucial role in documenting the traditional health care practices of the country. Medicinal plant lore often recedes or completely vanishes in the wake of rapid Westernization. In some countries, careful ethnobotanical studies have become invaluable records of ancestral ways. In areas where the people are moving away from traditional lifestyles, particularly in rapidly growing urban populations, careful ethnobotanical documentation can provide the needed foundation for educational programs. Workers at Mahidol University in Bangkok, for example, have prepared a series of slide presentations and pamphlets to teach schoolchildren about traditional Thai uses of plants.

Ethnobotanical research can also help in the discovery of crude drugs. Only pure compounds with known structures and pharmacological activities are permissible as drugs in Western medicine, but in many developing countries the price of such pure substances puts them beyond the reach of all but the affluent. Careful clinical studies can document the safety and efficacy of crude extracts or tinctures of plants that can be dispensed at far less cost. Carefully designed clinical trials of crude botanical drugs have been conducted in Mexico and Thailand. The trials in Thailand have resulted in certification of a tincture of beach morning glory, *Ipomoea pescaprae* [Convolvulaceae], as an anti inflammatory treatment.

An area of ethnobotanical drug discovery that has yet to be developed is that of "gray pharmaceuticals"—drugs of proven safety and efficacy that are not marketable in the Western world. Decisions concerning marketability in the Western pharmaceutical industry are not driven solely by proof of safety and efficacy. To be marketable, a drug candidate must affect only one point on a biochemical pathway: compounds that affect multiple points

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[1] This chapter draws on material from: "Plants, People and Culture: The Science of Ethnobotany" by Balick and Cox c 1996 by Scientific American Library. Used with permission of W.H. Freeman and Company.

of the same pathway are unlikely to be marketed because only "magic bullets" (single-activity drugs) are viable in today's legal and economic environment. Drug candidates must also show superiority over competing drugs in the same market. Thus some plant-derived drugs that are not marketable as Western pharmaceuticals may still be acceptable in the country of their origin, particularly if they can be produced cheaply. The transfer of information (sometimes costing millions of dollars) concerning the safety and efficacy of such gray pharmaceuticals from Western firms to developing countries, should be encouraged, along with the appropriate patent rights and technologies to enable the developing countries to produce plant-based medicines.

Safeguarding indigenous intellectual property rights

Historically, the intellectual property rights of indigenous peoples have not been recognised. The use of information supplied by indigenous peoples in the discovery of commercially marketable pharmaceuticals raises the question of those people's intellectual property rights and the ownership of biodiversity.

We believe that indigenous peoples are entitled to the same intellectual property rights enjoyed by other investigators. Yet in many cultures, the preservation of important habitats is equally urgent. In Samoa, four village-owned and -managed reserves totalling 50,000 acres, beginning with the Falealupo Rain Forest Reserve (where the tree that produces prostratin was first collected), have been created with donated funds, and in Belize, the world's first extractive reserve for medicinal plants has been created on 6000 acres of tropical rain forest by the local government working with the association of traditional healers with significant international support. This effort seeks to demonstrate that conservation and the use of forests as sources of locally consumed medicines are compatible objectives. Elsewhere, as in India, medicinal plant reserves are being established to ensure a continued supply of plants for traditional health care practitioners and their patients.

Cash disbursement of royalty income most closely approaches the Western concept of equity, but this approach fails with peoples who have no monetary system. For many indigenous peoples, the right to live unmolested and undisturbed on their ancestral lands is the greatest value. Establishment of nature preserves that protect both biodiversity and indigenous cultures is of tremendous importance to indigenous peoples.

Indigenous perspectives on conservation

Although small by Amazonian standards (approximately 5000 hectares), the Tafua forest on the island of Savaii, Western Samoa, is precious because of the unique diversity of its life forms. Over 25 percent of the forest plants are found nowhere else on earth.

For hundreds of years Savaii Island, like the rest of Samoa, was, in Somerset Maugham's words, "lovely, lost and half a world away." Increasing prices of rain forest timber in the early 1970s ended that isolation. An American timber firm built a large sawmill in Asau, Savaii. Lack of experience with both the forest and the culture of Samoa eventually caused the firm to jettison the project. The sawmill, however, remained in operation under various owners, and the rain forests of Savaii continued to disappear. Now

more than 80 percent of Savaii's forests are gone forever: only two large tracts of lowland rain forest remain, one of them the Tafua rain forest. Because of its proximity to the wharf, the Tafua forest offered the most lucrative logging opportunity in all of Samoa. The logging companies faced only one small problem: the paramount orator and chief, Ulu Taufa'asisina.

Samoans are gentle but determined people; but even by Samoan standards, Ulu was resolute. Although Tafua is a very poor village with no running water, electricity, or graded roads and few sources of cash from the loggers, not a single tree could be cut. The villagers begged Ulu to accept the logging companies' generous offers. How else could the village pay for a decent school for their children or a clinic for their sick and elderly? The loggers might even hire some of the villagers to work for them. Ulu's stance mystified the logging companies' representatives too. They were offering the village what would probably be its only chance for economic development.

The loggers failed to realise that no inducement could ever persuade Ulu Taufa'asisina to allow logging. When his father lay dying, Ulu had promised to honour his last wish: Ulu had pledged to protect the rain forest with his life.

Ulu Taufa'asisina has paid a price for conservation that few individuals in industrialised countries can comprehend: he has knowingly condemned his family, friends, and village to poverty rather than accept money from loggers. "Five times the logging companies have been here asking for our forest," Ulu explains.

> I was deeply depressed because they put a lot of pressure on all of us, persuading the people of my village to sell the forest for a few dollars. I resisted, because I love my land and the land more than the money.
>
> The land is our lives. The land is also our mother. The land is sacred. I believe that the land has provided the culture, the food, the water, and the other things essential for my people. I deeply respect the honour that has been given to me, as chief orator, to become a caretaker of our beloved land.
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> My forefathers had a dream. They had a dream that one day the land and the rain forest would be saved for eternity. They had a dream that the land and the sea would forever be well looked after, and not destroyed and distributed to other people. I share that dream. I believe that we can become masters of our destiny if we take care of our environment.

That destiny encompasses tooth-billed pigeons, flying foxes, and dolphins—and relentless economic hardship. But Ulu Taufa'asisina, like many other indigenous leaders, sees conservation in terms that transcend economic or political issues.

In the Western tradition, natural resources are property and therefore subject to either private or government ownership. Thus Western conservation has its roots in the pragmatic use of property; according to this viewpoint, no action should be taken that decreases the value of the resource for the long term.

Many indigenous cultures, in contrast, perceive the earth as existing not in the realm of the profane, but in the realm of the sacred, a world view that distinguishes them from

many Western traditions. Indigenous legends emphasise the need to protect the earth not because it is useful to humans, but because it is sacred. The perception of conservation as a religious duty, of course, also serves ecological and cultural purposes.

Though they start from very different assumptions, both Western conservationists and many indigenous peoples recognise the need to protect vanishing natural habitats. When Maori elders became concerned about the loss of native plants used in weaving, for example, they organised a *hui,* or a traditional conference, with the New Zealand Division of Scientific and Industrial Research (DSIR). They invited both scientists and traditional leaders to discuss conservation strategies. Such collaborations, although complicated by cultural differences, have provided strong support for three positions advocated by indigenous peoples: that all forest plants have a purpose and value; that the true economic (let alone cultural and spiritual) values of rain forests and native habitats have scarcely been considered and are vastly underestimated; and that entire cultures and ways of life will disappear if rain forests are destroyed. Recent ethnobotanical studies provide evidence that substantiates these indigenous views.

Quantitative ethnobotany in South America

Forest-dwelling peoples often claim that most, and perhaps all, plants in their environment have a use. Ethnobotanist Brian Boom of The New York Botanical Garden used some pioneering plant census techniques to test that hypothesis. Working for an extended period in the Bolivian Amazon, Boom found that the Chácabo Indians knew of 360 species of vascular plants in the forest surrounding their village of Alto Ivón and that they had uses for 305 of them. They collected Brazil nuts (*Bertholletia excelsa* [Lecythidaceae]) for their own consumption and for sale, for instance, and used *Anthurium gracile* [Araceae] to cure appendicitis. Boom then surveyed a 1-hectare plot in the tropical forest and found that 82 percent of the tree species growing there had uses known to the Chácabo. When he measured the densities of plants in the plot, Boom found that the Chácabo used 95 percent of the individual trees for some purpose.

Similar studies were undertaken by William Balée among the Ka'apor and Tembé Indians in Venezuela. The percentage of tree species put to use by the Ka'apor was found to be 76.8 percent, by the Tembé 61.3 percent, and by the Panare 48.6 percent. Although these findings do not prove that every forest plant has a use, they do confirm the local people's claim that the forest plants have far more uses than Western investigators have realised. Balée and Boom have concluded that certain plant families are so important in these Neotropical areas that conserving them is essential if people are to continue to depend on the forest for their sustenance. Among these valuable plant families are the palm family [Arecaceae], the Brazil nut family [Lecythidaceae], a tropical relative of the rose family [Chrysobalanaceae], and a family that includes the hallucinogenic *capi* vine, Malpighiaceae. These studies were the first to use a quantitative approach to demonstrate the value of the forest to indigenous people and thus to promote conservation by making clear its utility.

Working in Tambopata, Peru, with mestizo people, Oliver Phillips and the late Alwyn Gentry of the Missouri Botanical Garden employed an even more detailed quantitative technique to inventory the plant families used for construction, in commerce,

for food, for technology, and for medicine. Their interviews with 29 field guides yielded a total of 1885 reported uses for the 605 tagged plants in their plots. When they compared data to determine whether the age of the person interviewed affected his or her knowledge of plant use, they found that the bulk of the information in some categories, such as medicinal plant lore, was held by older people. These are the people, Phillips and Gentry concluded, who should be the main focus of ethnobotanical studies and conservation efforts. Through their use of statistical tools, they substantiated the intuitive judgements of many other workers, who perceived that the long chain of oral ethnomedical tradition was coming unravelled in the current generation. Once investigators can identify the best sources of ethnobotanical information in a community or indigenous society, both local people and ethnoscientists can make more efficient efforts to conserve such information.

Forests are more than timber: ethnobotanical valuation studies

Historically rain forests have been cut down because the simplest and quickest way to convert them into cash is to harvest the timber, burn down all that remains, and plant and annual crop for a few seasons, until much of the soil's nutrients are leached out. Since most of the nutrients in the tropical rain forest are found in plant material rather than in the soil, large-scale removal of that living material (called biomass) prevents rain forests from growing back. By using the tools of economists to analyse the value of land under various uses, ethnobotanists have found that in some areas there are viable alternatives to clear-cutting.

Researchers studying the use of non-timber resources from forests in Brazil and Peru have concluded that non-wood forest products "yield higher net revenues per hectare than timber, but they can also be harvested with considerably less damage to the ecosystem. Without question, the sustainable exploitation of non-wood forest resources represent the most immediate and profitable method for integrating the use and conservation of Amazonian forests."

In a similar study, Balick and Mendelson valued the native medicinal plant species taken by the local people from a forest in Belize. From two separate 1-hectare plots of 30- and 50-year-old forest, respectively, total biomass of 308.6 and 1433.6 kilograms (dry weight) of plant material for medicines was collected. It was suggested that harvesting the medicinal plants, from a hectare of forest would yield the collector $564 and $3054 in the local markets, respectively, for the two plots, after the costs of harvesting, processing, and shipping were subtracted. For the 30-year rotation, a present value of $726 per hectare was calculated for the medicine, and for the 50-year rotation a present value of $3327 per hectare was calculated.

This study fostered a greater understanding of the value of the tropical forest to the local inhabitants and their economy. It ultimately led to the development of several industries based on the extraction of medicinal plants from the forest for processing into tinctures, extracts, and salves. Today local Belizean brands of traditional medicines—Agapi, Rainforest Remedies, Rainforest Rescue, Triple Moon—all help to generate employment for many local people.

Additional studies to establish the net present value of the tropical forest of the Neotropics have confirmed the relatively high value (often several thousands of dollars) of the products that can be harvested on a hectare in areas where land is now priced in the hundreds of dollars or less. Critics of this method of establishing the value of forests point out that the land must be near to a market or to a distribution channel in order for the economic benefit to be realised. They state that there is probably a finite market for the commodities produced under these management schemes. Both points have their validity, but nevertheless, it is clear that in areas that have been intensively studied the harvesting of non-timber forest products has increased the income levels of local people and has stimulated the development of new industries with a local value-added component that increases returns to the region or country of origin. Such studies also tend to confirm indigenous beliefs that tropical forests, if properly managed, have far more value than as mere sources of lumber and wood pulp. Given the proven profitability of sustainable exploitation of non-timber forest products, why has so little been done to promote the marketing, processing, and development of these valuable resources? We believe that the problem lies not in the actual value of these resources, but in the failure of public policy to recognise it.

"Green" industries now promote the sale of rain forest products, such as the buttons fashioned from palm seeds that adorn garments made from Paris to Hong Kong, ice creams flavoured with exotic nuts and fruits, and rare tropical essences in perfumes, shampoos, and body creams. We can wash with soap made from tropical oils and nectars, eat cereals based on grains that once sustained the Aztecs, and drive to work on tyres manufactured from wild rubber harvested in the Amazon Basin. Like other suggested solutions to the dilemmas posed by deforestation and economic development, green marketing is hardly a panacea. The continued use of these products depends on the reliability of their supply, markets, and distribution. Key to maintaining supply is the issue of sustainable resource production.

Goods from the woods: sustainable production

Of greatest concern in the development of products based on tropical forest species (usually known as non-timber forest products, or NTFPs) is our ability to ensure sustainability. But nowadays, the concept of sustainability is used in a rather cavalier fashion. In truth, we know very little about the sustainability of any production, especially of the products from tropical ecosystems. Charles Peters of The New York Botanical Garden has undertaken many detailed studies of tropical forest trees in efforts to determine the level of sustainable production or harvest of each species. According to Peters, "a sustainable system for exploiting non-timber forest resources is one in which fruits, nuts, latexes, and other products can be harvested indefinitely from a limited area of forest with negligible impact on the structure and dynamics of the plant populations being exploited." A plant such as *Brosimum alicastrum* [Moraceae], a tree found in Central and South America that is exploited for its protein-rich fruits, needs to produce over 1.5 million seeds to ensure that *one* tree will live long enough to reproduce. If most of the fruits produced by this species were to be harvested rather than left to grow in the forest, the population would become extinct within one generation.

Too little is known about the levels of sustainable harvest of many of the internationally important NTFPs, including the Brazil nut. Some 200,000 people harvest the Brazil nut from the 20 million hectares of Amazonian forest where it grows; annually they produce around 42,000 metric tons for the commercial trade, valued at approximately $35 million, or 1.5 percent of the total international nut trade. The harvest of this nut is one of the largest sources of cash income for many of these people, and reduction in government subsidies for other NTFPs such as rubber, which grows in the same areas, has led people to harvest increased quantities of Brazil nuts. What, then, will happen 50 or 100 years from now, when most of the seeds produced by once-great populations of Brazil nut trees have been removed from the forest and sold? Quite simply, the mature, seed-producing trees that are the backbone of the population will die and not be replaced, and the resource base on which these industries are built will disappear.

What, then, are the options for the continued use of NTFPs as a tool for economic development and conservation of biodiversity in the future? Charles Peters suggests six steps for exploiting NTFPs in a sustainable fashion. First, the species to be exploited should be carefully selected, after such factors as the ease of harvesting and resilience of natural populations to disturbance are considered. A tree valued for its roots will be harder to harvest than one valued for its fruits, and the harvest of a species that produces fruits in massive quantities at one time of year will be easier to manage than the harvest of a species that produces fruits sporadically throughout the year. Once the species has been decided upon, a forest inventory should be undertaken to learn where the resource is found in greatest abundance and the number of productive plants per hectare. Investigators should then estimate the quantity of the resource produced by the species in its various habitats and by trees in all size classifications, to determine which trees in which habitat it is best to harvest.

When these three steps have been taken, the harvesting of the resource can begin, but the careful measurement should continue. The status of the population should be monitored for signs that the forest is being overharvested. People should examine the status of adult trees periodically to determine whether the flowers are being pollinated, whether large numbers of fruits are being consumed by predators, and so on. If problems arise, the harvest should be adjusted to keep its level below the rate that would threaten sustainability.

When necessary, people may replant areas that do not seem to be regenerating, clean out competitive species, or open up the forest canopies to allow more light to reach the young trees and thus speed up their regrowth. The precise measurements that Peters recommends are expensive and time-consuming, and very few species have been studied from this perspective. However, plant populations may be threatened if harvests are determined by the demands of the marketplace rather than the needs of the ecosystem. As Peters notes, "nature does not offer a free lunch." In our enthusiasm to support conservation of the natural world by focusing on its usefulness to economies, we are perhaps inadvertently dooming elements of it to extinction. Only when ecologically sound management plans based on scientific studies are developed for resource extraction will the use of those resources be able to contribute to the conservation of biological diversity.

Conservation areas and indigenous peoples

Early nature preserves were established in the tropics during colonial times primarily to serve the needs of big-game hunters or to protect watershed and timber resources. The colonial administrations created most exciting rain forest reserves by simply declaring government land to be a national park or by purchasing land from private owners, the same strategies followed to create national parks in North America and Europe.

The Mexican government owned more than 99 percent of the 528,000 hectares of rain forest, wetlands, and coral reefs that are now included in the Sian Ka'an biosphere Reserve on the Yucatan Peninsula, whereas the 100,000-hectare Guanacaste National Park in Costa Rica, an area of dry lowland tropical forest, was purchased largely from private landowners for $9 million contributed by a variety of conservation organisations, trusts, foundations, private donors, and government agencies.

The Monteverde Cloud Forest Reserve in Costa Rica, on the other hand, was created partially through a "debt-for-nature" swap—conservation organisations purchased part of the country's international debt and accepted conservation of rain forest acreage as payment. While these strategies have been effective in preserving land, they have been primarily focused on meeting national needs rather than the concerns of local peoples.

These traditional strategies create reserves that are essentially free from human disturbance. New strategies differ in that they emphasise the possibility of using the resource while protecting it from degradation. In the late 1980s, Brazil created a category of forest reserve known as the "extractive reserve," an area where local people can extract products on a small scale while still preserving a largely intact ecosystem. This form of biological reserve is closely associated with a social movement, begun in the state of Acre, which attempts to improve economic standards among Brazil's traditional peoples. The first reserves were established for the extraction of rubber and Brazil nuts. Most of the rubber produced in the Amazon Basin is gathered in a way that does not destroy the trees, so the people who gather it are strongly opposed to any destruction of the rain forest. When ranchers who wished to clear the forest assassinated Chico Mendes, the movement's most visible leader and organiser of the local rubber tappers' union, there was such an outcry that the government eventually responded by creating the first major extractive reserves, which now total some 10 percent of the entire state of Acre. Over the last few years, however, the value of both wild-harvested rubber and Brazil nuts has fallen. Ethnobotanists and taxonomists such as Douglas Daly of the New York Botanical Garden are working with local inhabitants of the reserves to identify other species that can be produced for regional and international commerce and provide income opportunities for the people who protect these areas of tropical forest. Individuals in north temperate countries are also helping to create extractive reserves. Such organisations as Conservation International and Cultural Survival have organised the marketing of forest products from reserves.

Maintaining an extractive reserve is not without its problems. The forest ecosystem may be damaged if economically important products are overharvested. An extractive reserve differs from a parcel of land that is simply public property in that a social structure is a key element of the reserve. Ideally, guidelines can be developed and rules and regulations enforced. While such rules do not exist or are strongly enforced elsewhere, it

appears that most reserves are respected by the local people, particularly if they are established with an understanding of local culture and needs.

Sometimes the ecosystem of a forest reserve can be altered by protecting economically important species (or even augmenting them by strategic replanting) while other species—those whose value is not clear—are not protected with the same tenacity. Thus, some critics have argued, extractive reserves are able to protect only a portion of the biodiversity they contain. The lesson is that there is no one formula for protecting wildlands, especially in remote regions of the tropics. But in the global effort to assemble a jigsaw puzzle of conservation areas, ethnobotanical research can play an important role by helping to preserve and disseminate traditional knowledge. When this knowledge is applied, economic returns can accrue to those who make their living in the rain forest while still protecting it.

Conflicts between indigenous peoples and nature preserves

Because indigenous peoples have seldom been involved in the planning process, conflicts have often arisen between them and Western-educated preserve managers. Conflict has been particularly acute over the management of Amboseli National Park in Kenya, which is overgrazed and thus capable of supporting far smaller animal populations than in the past. "The decline of Amboseli has little to do with the large number of tourists that used to visit it or with the increase in elephant population—excuses often used by the authorities, for which there is ample evidence to refute," writes David Lovett Smith, a former warden of Amboseli.

> The demise has been brought about, in my opinion, by inept management and a total lack of communication with the local people. . . .For it was the Masai people who themselves who looked after wildlife until governments and wildlife authorities took over its management, and, from the 1970s on, proceeded to mismanage it so badly.

Implicit in the authorities' explanation of Amboseli's degradation is the view that the Masai and their herds are inimical to efforts to conserve the ecosystem, rather than potential parts of the solution. But changing such a view requires reconsideration of some of the fundamental tenets of Western land ownership and management.

Consider the differences between Western and indigenous notions of property ownership among the Turkana, a pastoral African people living in the Rift Valley of north-western Kenya, about 20 kilometres north-west of Amboseli National Park. Like many indigenous peoples, the Turkana do not believe in private ownership of natural resources. Instead, the *Acacia* [Mimosaceae] trees that their goats feed on are administered as a communal trust. Villager elders ration feeding privileges, chasing away offending goats with sticks. In Western view, such communal trusts are inherently unstable. According to most Western theorists, such resources will inevitably be degraded, and the result will be what bioethicist Garrett Hardin has termed "the tragedy of the commons".

To forestall what they saw as the "inevitable" collapse of the Turkana grazing system, a team commissioned by the United Nations divided up the Turkana grazing areas into

plots, which were then deeded to private individuals. The village elders' sticks were no longer required. Soon, however, all of the *Acacia* trees were all denuded. George Monbiot argues that while the indigenous system of communal ownership of the *Acacia* trees might not have been sustainable in a Western society, it worked for the Turkana.

A new and very important branch of ethnobotany might be termed "ethno-conservation biology"—the incorporation of indigenous conservation models into wildlands management. Attempts are now being made to document indigenous conservation strategies throughout the world.

An ethno-biomedical forest reserve in Belize

Belize is a small nation with a population of around 200,000. Vast tracts of forest still cover a significant portion of the country. A recent environmental profile of Belize estimated that more than 93 percent of the country could be classified as forest land, although this estimate was optimistic, for it excluded only urban areas and large-scale farming operations. In 1988 the Belize Ethnobotany Project was initiated to inventory, understand, and conserve as much ethnobotanical data as possible in a country that is undergoing rapid change, accompanied by loss of natural habitat and the erosion of existing cultures. The project is a collaborative effort between The New York Botanical Garden's Institute of Economic Botany, and the Ix Chel Tropical Research foundation in the Cayo District with the Belize Centre for Environmental Studies, the Belize Zoo and Tropical Education Centre, the Belize College of Agriculture, and a host of other government and non-governmental organisations in Belize. This multitiered effort has linked the mutual interests and activities of local healers, farmers, students, ethnobotanists, and pharmaceutical researchers to the conservation of their main source of materials and ideas: the area's forests. These forests serve as both a classroom and a source of raw materials for local health practitioners. An ongoing inventory of species and their uses focuses in the collection, documentation, and study of traditional medicines. Collection efforts in small villages and isolated forest regions have been linked to the Developmental Therapeutics Program of the National Cancer Institute in the United States, supplying it with more than 2000 bulk samples for testing in its cancer- and AIDS-screening programme.

Supplementing the more familiar role of ethnobotany as a documentary science, the project seeks to renew interest in cultural knowledge and its transmission, particularly in the area of medical practices. It has focused on work with groups of elderly healers, most of whom have no apprentices and whose accumulated knowledge is in danger of being lost. The long-term interdisciplinary nature of the project has allowed in-depth work with traditional healers in efforts to understand disease concepts, healing traditions, and the uses of plants. This type of knowledge recovery has been described as "salvage ethnobotany".

The project helped local organisations convene four national traditional healers' meetings. The open forum provided by these meetings enabled healers from different cultural groups and geographic regions of Belize for the first time to exchange information about the medical uses of local and exotic plants. They discussed the importance of traditional healing, the central role of the healer as community health care provider, and the increasing difficulty of locating certain useful species.

In 1992 the Belize Association of Traditional Healers was formed and Rosita Arvigo of the Ix Chel Tropical Research Foundation was elected its president. Yet without plants, their work is impossible. As one of the healers, Hortense Robinson, said, "we can't do our work without the plants—it's like a mechanic without his tools. Just knowing what the name of the plant was won't help—you can't use the name to heal you." As part of the effort to conserve species that are important to the work of traditional healers, a 2400-hectare parcel of lowland tropical forest was given forestry reserve status in June 1993 at the suggestion of a government minister, Daniel Silva, who noted that Belize has a rich tradition of conservation reserves. It has reserves for jaguars, for monkeys, for butterflies, so why not for medicinal plants? The reserve was intended to provide a source of medicinal plants as well as a place to teach apprentices. Funds for surveying and demarcating the reserve were provided by the Healing Forest Conservancy and the Rex Foundation. The forest, in the Yalbak region of Belize, contains a wide diversity of fauna as well as many useful medicinal plant species. As originally conceived, this "ethno-biomedical forest reserve" would serve as a site to promote ethnobotanical and ecological research in efforts to define harvesting regimes for sustainable extraction. Toward this end, a team of scientists is carrying out ecological inventories as well as experiments designed to learn at what rates bark and roots will regenerate after harvest. Unfortunately, within a year after the reserve was established, the local government changed, and controversy arose over which group of local healers would be responsible for its operation. Various plans have been submitted to the Forestry Department and scientific experiments continue, but development of the educational and social component of the reserve's program is currently on hold. Despite the best of intention, not all conservation efforts are immediately successful.

As habitat destruction and overharvesting are depleting the supply of medicinal plants in the forests of Belize, Rosita Arvigo and Gregory Shropshire of the Ix Chel Tropical Research Foundation have started a program to develop horticultural nurseries in collaboration with Hugh O'Brien of the Belize College of Agriculture. As part of the program, the subject of medicinal plants was introduced into the college curriculum. The major goal of the joint project is to learn to propagate many of the commercially valuable plants currently harvested from the wild. The species differ wildly in their morphology and biology—some are easily reproduced weedy herbs while others are long-lived trees—so the task is complex. Local and regional businesses that depend on native plants will ultimately benefit from techniques being developed in the nurseries. The project also rescues plants threatened by development. A team from Ix Chel and the Belize College of Agriculture collects seedlings of rare or slow-growing trees from areas soon to be cleared for housing and transplants them to a "tree orphanage." Eventually they will settle the young trees in more secure areas, such as forest reserves and privately owned farmlands.

The future of ethnobotanical conservation

Many challenges face ethnobotanists in future years, particularly the rapid loss of biodiversity and the concomitant loss of indigenous knowledge systems. UCLA anthropologist Johannes Wilbert tells us that many years ago the Warao of Venezuela were highly amused when he carefully documented their traditional dances. Why, they wondered, had this man come so far to study something everyone knew how to do? When

their grandchildren attempted the same dances three decades later, they turned to Wilbert to find out if they were doing them correctly.

Some contemporary critics fear that outsiders' studies of traditional knowledge is not without risk. Published reports of the use of a medicinal plant might create a demand for the resource, with riches flowing to all parties involved except the original owners of the knowledge. Others fear that if only the most sensational information is written down, the more mundane information—about food plants, for instance—may be lost. Clearly, one priority for the future is to involve indigenous colleagues in ethnobotanical research as coinvestigators and to train a new generation of people from a variety of cultures to initiate studies among their own people.

Increasingly, the local people involved in ethnobotanical research, especially the healers, are being credited as co-authors of scientific papers and receiving patent rights to discoveries that result from the information they have provided. In ethnobotanical research , anything less than equal treatment should be viewed as unacceptable.

Is there, then, a place for indigenous cultures in the twenty-first century? While we have no wish to deny modern technology to indigenous peoples, we also have no desire to see them plunged needlessly into the problems of modernity. In this, as in so many issues, we rely on indigenous wisdom. We believe that indigenous peoples, if given the proper information and granted status as equal partners, are capable of plotting their own future. And while that future will probably include satellite ground stations, kidney dialysis machines, and personal computers, we are determined that the information flow should not be one-way, from Western nations to indigenous peoples. One of the most important lessons that we have learned as ethnobotanists is that the richness of indigenous plant uses, and the dignity of indigenous knowledge systems, will not only continue to be part of the cultures in which they developed but will also increasingly grace our own.