Trees for Life Journal
a forum on beneficial trees and plants

Open access, freely available online

Research Articles

Rapid Ethnobotanical Survey of the Maya Mountains Range in Southern Belize, Central America: A Pilot Study

Todd Pesek[1, 2, *], Marvin Cal[2], Victor Cal[3], Nick Fini[2], Chris Minty[4], Peter Dunham[5], Pablo Sanchez[6], Luis Poveda[6], John Arnason[7]

1 Cleveland State University, Department of Health Sciences, Cleveland, Ohio, USA, **2** Naturaleza, Cleveland, Ohio, USA, **3** Belize Indigenous Training Institute, Belize, C.A. **4** Royal Botanic Gardens Edinburgh, Scotland, UK, **5** Cleveland State University, Department of Anthropology, Cleveland State University, Cleveland, Ohio, **6** Herbario Juvenal Valerio Rodriguez, Universidad Nacional, Heredia, Costa Rica, C.A., **7** University of Ottawa, Department of Biology, Ottawa, Canada, *Author to whom correspondence should be directed

Indigenous peoples worldwide have a cosmocentric view of life and have long lived closely with nature. This relationship with their environment spawned reverence and understanding of our natural world. As a result, indigenous traditional healers and their age-old cultural healing knowledge hold countless benefits for our health and wellness (1). This knowledge, along with our rainforests and planetary ecological integrity, is disappearing. Evidence can be seen in language. Language is fundamental to culture. Of the 15,000 languages spoken 70 years ago, only 6000 are spoken today (2,3,4). This is an unfortunate trend, because language embodies knowledge and wisdom as well as cultural heritage and identities (4,5,6). This knowledge and wisdom includes healing traditions which have long helped indigenous communities maintain personal health and wellness. These traditions can help these communities and others maintain a healthier way of life today.

Statistics clearly show that our planetary biodiversity is being lost (7,8) and our rainforests are being destroyed at a staggering rate (9). According to the United Nations Food and Agriculture Organization (FAO), we lost between 9 million and 12 million ha per year from 1990 to 2000. The FAO estimates that approximately 0.8 percent of that which is left is destroyed annually and that, at present, total rainforest losses annually range from 5 million ha to over 20 million ha (9). Jeffrey McNeely, chief scientist for IUCN, argued at the recent Biodiversity and Health conference (10) that the preservation of indigenous cultures and the tropical forests they live in are inseparable and can only be achieved together. Unfortunately, indigenous communities are often biodiversity rich but economically and politically disadvantaged. A recent analysis of human development and poverty in Latin America shows that although poverty rates overall have been declining in Latin America, the poverty rate in indigenous communities has remained the same (11). Therefore, it is vitally important to find ways to minimize, and hopefully stop, the destruction of the rainforests and to support culturally ethical, ecologically sustainable economic development of the areas which house the enormous amounts of species diversity essential to the health of people and our planet. It has been argued that economic development and loss of forest species used in traditional healing are not inextricably linked, and that perhaps good governance can allow countries to preserve their cultural and natural resources (5). To more effectively accomplish this preservation of culture, natural resources and biodiversity, it is clear that sustainable livelihoods must be available for local peoples from the living rainforests. In the recent past this has been attempted by linking biodiversity prospecting for drug discovery with profit-sharing agreements with indigenous people. Some of these arrangements, however well intentioned and negotiated, have run into complex difficulties, including politics, cross-cultural exchange discrepancies and views that traditional knowledge was being sacrificed for international

Contact: Todd Pesek
Email: t.pesek@csuohio.edu
Received: February 21, 2006
Accepted: April 21, 2006
Published: July 25, 2006

The electronic version of this article is the complete one and can be found online at: http://www.tfljournal.org/article.php/20060523162101723

Trees for Life Journal 2006, 1:10

PEER REVIEWED

commercial interests (12,13,14). There have been numerous publications put forth delineating the complexities of these interactions and suggesting possibilities for future direction. Among these works are ones that discuss forces of globalization as underlying complexities in related scenarios, and that give noteworthy suggestions for socially responsible cross-cultural exchange (15,16). Perhaps less controversial and more socially responsible mechanisms for poverty alleviation and ecologically sustainable community development lie in different and more immediately tangible directions.

One alternative that can circumvent potential issues and provide viable *in situ* and *ex situ* conservation solutions and support for indigenous communities is the promotion of respect and select integration of traditional healing in national health care systems. It is essential to note here that traditional healers and their healing systems rely more comprehensively on the individual in the context of healthful environmental surroundings than does the western biomedical model (1).

Medicinal plants are found in forested areas throughout Central America (C.A.) and the world, and indigenous peoples have used them in traditional healing for many thousands of years. By studying these relationships between plants and people, we can explore the ability of rainforest resources to deliver health and wellness options to many groups of people. Benefits can be seen that are applicable to modern day healing in numerous situations, and they can give the world a very practical reason to minimize destruction in these regions. Approximately 80% of the world's population relies on traditional healing for primary care (17)—this is clear evidence that there are substantial market forces that value traditional healing and medicinal plants. Key objectives would include preservation of invaluable medicinal plants by preserving their native areas, as well as preservation of indigenous healing knowledge held by populations in those areas. Plainly, there are intellectual property and cultural issues that need to be addressed. Some plants and traditions are sacred, or used in a ritual context that must be respected. However, many healers share the view that useful botanical treatments should be shared with other people as long as economic and other benefits return to the indigenous communities and their environments.

The rainforest areas and traditional knowledge are declining rapidly. How can valuable flora and knowledge be identified in a timely fashion, so that conservation resource use claims can be made and real benefits can be seen quickly? Rapid Ethnobotanical Surveys (RES) hold the answers to this question.

RES, the subject of this study, is our newly developed ethnobotanical field programming methodology. It involves the indigenous traditional healers, who know their areas well, as participatory researchers and partners in our mission: elucidating rare, disappearing, previously unreported medicinal plants in their niches of high ecological integrity to construct economically viable resource management and conservation initiatives in select localities, as appropriate. RES can be used to jumpstart the construction of creative programming, by discovering and stratifying areas of relative promise for ecologically sustainable and culturally ethical community development via traditional healing. The RES can be used in conjunction with the already developed Rapid Ecological Assessment (REA) to affix relative importance to conservation strategies (i.e., triage conservation programming based on the ecology of the area and the species of medicinal flora in the region, as gleaned by the REA and RES respectively, in unison).

The application of the RES in the present study was done with traditional Q'eqchi' Maya healers as partners. This participatory research project was meant to demonstrate the efficacy of our newly developed RES model, to begin the ethnobotanical inventory of the remote and rugged Maya Mountains region, Belize, C.A., and to highlight the utility of the healers' involvement in broader impact programming such as conservation through traditional healing. This valuable information must be added to the wealth of extant works on the subjects of Maya ethnobotany and healing and community-based conservation. This addition would preserve the information and environment for future generations, and assist not only with healing the sick in a way that will benefit both earth and man, but also perhaps with the generation of fresh revenue streams for the continued preservation of the Maya Mountains areas and their cultural traditions. These new, broader impacts could be facilitated directly by the Q'eqchi' Maya healers through the continued development of ecologically and culturally ethical programming in the region and could be based out of *Itzama.*

Itzama ("place of healing spiritually and with herbs") is a name chosen by the Belize Indigenous Training Institute (BITI) and their associated Q'eqchi' Healers Association (KHA) to represent an innovative community-based conservation program aimed at the preservation of their rainforests and deep cultural traditions via traditional healing and medicinal plants (18,19). The present study suggests the applicability, need and promise for such an endeavor in the area.

Belize and the Maya

Belize is bordered by Mexico to the north, Guatemala in the west and south, and the Caribbean Sea

to the east; at 22,966 km sq., it is approximately the area of Israel. The former British colony gained its independence in 1981 and currently has a population of just over 280,000 people. There are six major ethnic groups: Creole, Mestizo, Garifuna, Maya, and East Indian. The Maya people are the original indigenous inhabitants and currently reside predominantly in the northern and centrally located districts of Corozal and Cayo, and in the southernmost Toledo district. In Belize, there are three major groups of Maya: Q'eqchi', Mopan, and Yucatec. The Q'eqchi' Maya are predominantly localized in remote Toledo.

Belize harbors the largest barrier reef in the western hemisphere and is home to some of the most intact tropical rainforest in C.A. In fact, roughly 80% of the forests in Belize are still "intact" (20). Rainfall ranges from approximately 50 inches in the north to 170 inches per year in the south, allowing for a large floristic diversity between the northern and southern regions (21). Geologically, Belize is quite diverse as well. It consists of sandy and limestone rich soil in the north and south that is dominated by lowland seasonal rainforest and pine savannah. This savannah and lowland seasonal rainforest is aggressively transected by the remote and rugged granitic-volcanic and limestone-rich Maya Mountains (and their unique biological niches) in the south. The range is home to some of the most pristine and untouched mountainous tropical rainforest in all of C.A. This environment has nurtured rich cultural traditions that have survived to the present day. Traditional healing is still widely practiced, especially in southern Belize. Indeed, a majority of the Q'eqchi' Maya use traditional healing as their primary source of health care. The World Health Organization has demonstrated that this is not a phenomenon isolated only to this area (17).

The Q'eqchi' Maya are concentrated in southern Belize, where a large area of the remaining rainforest on which they depend exists. Toledo is by far the most untouched and remote region of Belize. With about three dozen villages (~15,000 people), the paucity of development in Toledo has allowed for the preservation of some of the most pristine tropical rainforest in the Americas. However, with the completion of a paved highway, access to this district has opened a window of opportunity ideal for development. This development must be culturally and environmentally appropriate, such as the ecologically sustainable community development and culturally relative health care exemplified by Itzama.

Like most native peoples, the Q'eqchi' Maya recognize an entire pharmacopoeia of medicinal plants as a part of a well-defined healing tradition (22). What is unique about this tradition in C.A. is the use of a large number of primary rainforest species. They maintain intact traditional medical systems as part of their culture today, but, not unlike elsewhere, this knowledge is disappearing quickly for a multitude of reasons. These reasons are largely economic in nature and inextricably linked with the destruction of our life-sustaining rainforests. Also, for complex reasons, including economics, there has been a fundamental cultural divergence of the younger generations as they forsake their cultural traditions for the way of the "modern world." This acculturation, however, is now accompanied by a recently growing recognition of necessity to maintain cultural traditions and heritage.

A cultural healing tradition that has used nature to treat both primary and complex ailments for over 4,000 years has much to offer the world and must not only be documented, recorded and saved as heritage, but can also be developed appropriately by the Maya for their own primary healthcare. It can also generate community-based microenterprises for ecologically sustainable community development and preservation of the rainforests and the deep cultural traditions therein (18,19).

The Maya have their primary healthcare addressed, both preferentially and out of necessity, by their traditional healers. The local realities, much like elsewhere in the developing world, are such that western allopathic treatments are offered only at regional hospitals and their few clinic outposts. The nearest clinic in this area is hours away in Punta Gorda, Belize. Out of local primary healthcare provisions, via traditional healers, could grow possibilities for regional, national and international revenue generating strategies (e.g., organic, fair trade and sustainable herbal products propagation and harvesting). These types of strategies are especially feasible in this day and age, when western drugs are increasingly considered a last resort, and when more and more people are using effective and non-toxic natural alternatives. This is evidenced by the growing trends of both Lifestyles of Health and Sustainability (LOHAS) and Complementary and Alternative Medicine (CAM) markets (1,23,24). There can be the responsible development of sustainable, fair-trade, phytomedicines to allow for fresh revenue streams for conservation and culturally ethical community development initiatives (18,19).

During the past decade, a dramatic increase in the global demand for medicinal plant remedies in particular demonstrates the growing interest in these products as an effective alternative to western health systems (1,17,23,24). However, most of these plants are taken from the wild, and, as a result, hundreds of species are now threatened with extinction because of a lack of implementation of sustainable growth and harvest techniques—a fact that works against global health and must be remedied as soon as possible. Due to

local, national and international harvesting pressures and concurrent deforestation trends, traditional healers have to forage further and further from their local areas to procure the plants they use to heal their people. Inappropriate massive harvesting patterns may also have negative effects on specific ecosystems in these areas, which could lead to the extinction or reduction of other species.

The preservation of medicinal plants, as mentioned earlier, is a key objective of the biodiversity component in several conservation projects in Belize and the world at large. It is highlighted as a key objective in the Belize Biodiversity Action Plan 1998-2003 (Medicinal Plants 4.7.8).

A biodiversity hotspot (25), the Maya Mountains of Belize are valuable in terms of not only biodiversity, but also cultural heritage, potential for demonstrating the need for the conservation of medicinal plants, and potential for assisting with the generation of fresh revenue streams for the preservation of the rainforests and the deep cultural traditions therein (18,19).

Maya Mountains Study Area: Background for RES

The Maya Mountains, which remain one of the largest examples of ecological integrity in C.A., are at the heart of the Yucatan peninsula and contain a broad range of resources (including medicinal plants) that have been used by the Maya for millennia (19). Due to their remoteness and unique nature, they constitute an ideal setting in which to look for rare, disappearing and previously unreported Maya medicinal botanical species of import. Mountainous regions have been noted to host high cultural and biological diversity (26) and the unique climate differentials and geologic attributes coupled with model conservation practices have allowed for preservation of a spectacular array of botanical species diversity in southern Belize. Recent surveys of Belize have indicated that species richness in this area is quite high and may include species not currently described (27).

The mountain range is low but heavily dissected, transects the southern region of Belize, and is less than 1200m in elevation (4000ft) at its highest point. This range is not terribly high, but it is comprised of extremely challenging terrain due in part to the constant weathering of its volcanic spine and limestone apron (quite predominant in the south). These mountains have been consistently eroded and incised to their current state by some of the highest rainfall in C.A. Much of the landscape is rainforest-laden jagged karst terrain, cleft by immense sinkholes, deep canyons, sheer cliffs, and towering spire formations. It is the one great range situated in the lowland Maya areas, and contains the only deposits of volcanic materials in the vicinity (28). These mountains receive the highest rainfall and coolest temperatures in the region, which, in combination with their unusual volcanic soils, means that they have the unusual distinction of supporting plants that are not found elsewhere in close proximity.

A good distance from modern population centers, difficult to trek, and guarded by protective status conferred by the Government of Belize, the Maya Mountains are among the last great little-known wilderness areas left in C.A. As such, they are one of the only remaining areas where unreported species of flora may be uncovered (27). This area presents a remarkable opportunity for comparative studies in species availability, distribution, ecology and ethnobotany.

Scientifically, the area began to be explored in the mid 19th century. Geologists conducted preliminary surveys at this time (28,29), biologists performed assessments (30,31), and archaeologists began work around the range (32,33,34), although no sustained program was ever initiated in the mountain interior until the Maya Mountains Archaeological Project (MMAP) was begun years later.

The MMAP, initiated in 1992, is a multidisciplinary investigation program begun by Peter Dunham. Among the many multidisciplinary investigations facilitated by the MMAP were ethnobotanical operations directed by Todd Pesek and botanical operations hosting renowned collectors over the years (35,36,37,38,39). These were the first ethnobotanical studies of the area and resulted in the observation of many species, as well as preliminary collections of species, that may be unique to their Maya Mountains niches.

Collectors and scientists have found this mountain range a treasure trove of botanical resources (25,27,30,31,35,36,37,38,39,40,41). The floral biodiversity is especially rich along the southern flank—where the geology is the most diverse, the topography is the most dissected, and the weather is the most extreme (27,28,29,30,31,40,41). Furthermore, this area has the highest rainfall in the region, which varies dramatically from the northern slopes and northern Belize due to the moisture laden Caribbean winds precipitating their contents on the southern slopes (21,42).

Muklebal Tzul and Ek Xux are among several large canyons that cut back into the volcanic spine of the range, and represent truly exceptional case study possibilities investigated preliminarily on the MMAP (19). The headwaters of Ek Xux are further explored as a part of the present study. Ek Xux (the easternmost of the two), cuts deeply through the limestone and has refilled with a broad flat alluvial bottomland making for an extremely rich soil for botanical complexities and rich ecosystems. Muklebal is larger but less mature, and so has not yet etched through the limestone; rather, its floor is very dissected and broken into a series of steep ridges.

The ethnobotanical efforts carried out on the MMAP have been continued by Pesek since their inception in 1999. Taken together, these studies revealed that the Maya Mountains offer a wide array of medicinal plants of extreme importance to the Maya, and include those that are either rare or nonexistent outside of their unique and sheltered biological niches within the Maya Mountains. These plants are not in the lowland areas of the Maya heartland. This fact was recognized by this work in both lowland and upland areas and in conjunction with the development of the only formally published consensus study on Q'eqchi' Maya ethnobotany of southern Belize (22). This study demonstrates a strong ethnobotanical consensus of the Q'eqchi' Maya of southern Belize in their lowland habitats, but it does not include many of the upland species of the Maya Mountains previously elucidated by Pesek. Another work, the Checklist of Vascular Plants of Belize, with common names and uses, lists numerous collection sites presenting many collection arrays throughout Belize, but none of them are within the inimitable niches of the Maya Mountains (42).

Materials and Methods

With the financial, logistic, and field support of non-profit organizations Naturaleza, BITI, KHA, and Las Cuevas Research Station, an expedition for the purpose of the RES was organized and led by Pesek during the timeframe of 12-18 March 2005. The expedition team consisted of an ethnobotanist, an ethnographer of Maya descent, three Q'eqchi' Maya bushmasters, two representative and well-known senior practicing Q'eqchi' Maya traditional healers and spiritual guides, and a navigator and mapping specialist. The goal was to demonstrate, via our RES methodology, that there are many potentially rare, disappearing, and unreported medicinal plants in the Maya Mountains region of Belize. The RES was undertaken with informed consent of the Maya participants whose identities are not revealed as required in ethical guidelines. They supported the goal of identifying resources in these areas that are considered a Maya resource base.

The study focused on plants that the healers knew were not located in the lowlands—plants that they have not seen anywhere but in the inaccessible depths of the Maya Mountains. The group worked with a culturally relative plan devised in conjunction with BITI and the healers of the KHA. The plan was constructed during meetings between Pesek, V. Cal, and the healers. Pesek laid out the objectives of sampling healing plants that the healers had not seen in a long while, and consulted the healers and asked them how they could best accomplish this goal. Collectively and as collaborative partners, the team came up with the strategy of classifying findings in terms of scarcity (either naturally or due to trends toward disappearance). General groups were constructed in terms of last time seen. Rare and disappearing plants which had proposed locations in the depths of the Maya Mountains were to be placed into groups based on their last sighting by the healers once the flora were uncovered again in their seclusion. Furthermore, in addition to plant names in Maya, spiritual and ethnographic particulars of the plants, applications and usages, harvesting techniques and modes of preparation, specific ecological information was to be supplied on individual plants once elucidated. Information along the lines of when the plant was last seen, where it was last seen, and under what ecological circumstances, was also recorded.

With the support of the Government of Belize via the Department of Forestry, the team departed from Las Cuevas research facility in central Belize and made its way over the main divide of the Maya Mountains. The team followed navigable and quite fertile riparian canyons up and then down over the course of the rigorous seven day traverse. The course of the trek brought the group through a variety of protected areas including Chiquibul Nature Preserve and the Bladen Nature Reserve, and thus allowed for observation and collection in rich riparian ecosystems of considerable ecological integrity.

Ethnographic information and plants were collected, with the healers and bushmasters as participatory researchers. The healers played key roles in the field collections. Similarly, they played collaborative roles in the development and revision of data records and presentation manners. As has been the case with the past work of Pesek, the plant names are not reported with their use associations until appropriate protective intellectual property strategies have been put in place, and only then when the healers wish to make public their information in collaboration with Itzama in southern Belize.

Both live specimens and specimens for herbaria sheets were collected. As the specimens were gathered for the herbaria sheets, they were placed in folded newsprint between absorbent blotters and lightweight aluminum ventilators, and secured in a field press made of waterproof nylon, until they were transferred to a conventional plant press for drying out of the bush. The live specimens were carefully collected and carried by the healers for deposit and propagation in their medicinal gardens at Itzama. The specimens were preliminarily identified where possible and stored carefully until more complete analyses were feasible.

Collection of the species was made in the most environmentally benign ways possible. Minimally invasive techniques were practiced, effectively leaving as little trace of the expedition as possible. The healers

assisted directly with collections for this study and in doing so shared traditional methods of collecting plants.

According to Maya tradition and at the recommendation of our Maya partners, the group both started and ended the expedition with a ceremony requesting permission for our planned efforts. The ceremonies were honoring the *Tzul Tak'a*, who, in the Q'eqchi' Maya belief, is the *nahual* ("spirit") of the flora and fauna, and all that lives in the mountains and plains of the Earth.

The pre-expedition ceremony was held at the first camp, deep inside the Chiquibul Forest Preserve. It was directed toward Tzul Tak'a and our Earth Mother to ask permission to carry out such significant efforts as well as toward the plant spirits to ask them to reveal themselves (and all of their healing powers) to the team during such an important mission.

The purpose of the post-expedition ceremony, held at Itzama, was twofold. Thanks were given to Tzul Tak'a, our Earth Mother, the *cosmos* ("creator"), and the plant spirits for the success of our endeavors, and the expedition team asked for their spirits to be balanced subsequent to the transformative journey that had been experienced.

Results and Discussion

The journey brought the team through rich and varied ecological and botanical niches. It was quite apparent that the species of flora corresponded closely to the underlying geology. Furthermore, the most species-rich and botanically diverse ecological niches were those in the vicinity of the delicate alluvial soils and in the riparian networks that cut into the mountainous spine.

Fifty-three ethnobotanically used plant species were uncovered, collected and analyzed. It is quite possible that there are new species among those collected, and further fieldwork, collections and analyses along these lines are currently underway. Thirty-five accessions were successfully identified to family and genus (Table 1) and eight were identified to species. Of the eight identified to species, one had not been prior reported to be in Belize. The accessions were collected in duplicate for herbaria specimens and as live plants (when possible) to be deposited in the Itzama herbarium and medicinal gardens (with hopes that they would take root in the microecosystems that the healers have established to mimic their native growing zones). The fifty-three plants were those that the healers knew to grow only in the mountains we explored. It is interesting to note that the first medicinal plant of importance was seen and collected on the second day. This was the day after the evening ceremony asking permission of Tzul Tak'a and the plant spirits. Amazingly, the plant, a climbing liana, was uncovered a few steps out of the camp after literally snagging the expedition team.

The species are used in the treatment of twenty-six distinct medical conditions recognized by the Maya (Table 2). Species used for the treatment of neurological disorders (epilepsy, headache, numbness), infectious disease (fevers, malaria, skin infections) and snakebites, represented the majority of the plants uncovered. This is consistent with patterns demonstrated by the previous consensus study, which was based on more easily available lowland species (22). Additionally, like the consensus study, there was a treatment for the culture bound syndrome *Susto* ("fear") uncovered by the RES.

There were four species that were reported by the healers to be extremely powerful plants with multiple uses. The healers had not seen over half of the species in more than twenty years. There were several finds that were pointed out as those the expedition should stop to appreciate, as it was likely that we would never see the species again. Furthermore, it became apparent that of the species noted to have disappeared more recently, several were seen last in satellite areas of high ecological integrity. Many of these satellite areas are not protected and in danger of destruction. Perhaps the potential presence of rare and disappearing species could be used to construct the appropriate arguments and support for their preservation.

The healers have their own traditional methods for recognizing plants, their healing attributes, energetics, and spirits, as well as other particulars related to their use in healing. This knowledge has merit that some are just now beginning to realize, and it should be preserved for the benefit of this and future generations.

The Maya Mountains offer both unparalleled splendor and diversity of medicinal flora. More detailed studies must be undertaken to document these species and their importance for future generations. We have begun detailed ethnographic and ethnobotanical inquiries and collections along these lines. We have also begun quantitative data collections, spatial analyses construction, and multidisciplinary collection of ecosystems services data to create viable conservation arguments with the healers. Additionally, there are many potential scenarios for the generation of revenue for community-based conservation purposes. Itzama offers the necessary ecologically sustainable and culturally ethical platform to ensure that all of the proper protocols are followed. This includes intellectual property rights for the Maya, novel community-based conservation initiatives, sustainable growth and harvesting of healing plants, Maya healing services, culturally relative healthcare programs, and poverty alleviation through the development of necessary ecologically sustainable community development initiatives.

We must facilitate this progression. One promising way to do this is to learn about plants with medicinal properties from traditional healers in terms of academics and knowledge-based systems, as well as economics and practical applications in primary care and global health and wellness. Traditional healing knowledge represents generations of invaluable human experience. Remarkably, many of the methods used by indigenous populations are common from region to region, despite the relative isolation from one another (1). This knowledge holds real possibilities, and the benefit derived from this knowledge should return to where it properly belongs. We need to work with traditional healers to devise creative economic applications that conserve both the rainforests and traditional healing knowledge. These applications must involve strategies to keep the benefits in the hands of the indigenous peoples who are the keepers of this healing wisdom, thereby economically bolstering the rural areas where the Maya live. The economic dividends attained from these plants should be returned to our earth in the regions where the benefits were discovered. We must effectively tether economic benefit to our living rainforests. Most indigenous cultures embrace a stewardship worldview, as opposed to the western anthropogenic construct, so an indigenous self-empowerment model may well effectively achieve this goal.

A serious confounding variable is that many traditional healers today are elderly and their skills are not being passed along for various reasons, including the loss of biodiversity and economic infeasibility of younger generations spending time studying in order to procure the knowledge. However, interest among the younger generations is high as long as they can earn a living this way. With the proper model, this knowledge, along with the land, can be preserved for future generations.

By reinvesting in these areas and cultures, we can create a model for culturally ethical sustainable development. The medicinal benefits of the plants and the knowledge of the traditional healers can help the local population in obvious ways as they heal the sick and advance the health of those living in the region. By creating a livelihood system that protects the rights of the people and demonstrates the value of their communities, there may be a reversal of forest destruction. The benefits are not only local, but of great value to the global community as a whole.

Acknowledgements

We are grateful to Las Cuevas Research Station, Department of Forestry of the Government of Belize and the Government and people of Belize for field and logistic support.

This work was made possible through funding by Naturaleza (www.naturalezafoundation.org) via charitable donation made by Christine Rawlinson.

Table 1: Voucher number and taxonomic identifications of accessions uncovered on RES that were successfully identified to family and genus.

1.

Voucher Number	Family	*Genus*	*species*
1	Piperaceae	*Piper*	sp.
2	Rubiaceae	*Hoffmannia*	sp.
6	Piperaceae	*Piper*	sp.
9	Moraceae	*Dorstenia*	sp.
10	Piperaceae	*Piper*	sp.
11	Piperaceae	*Piper*	sp.
12	Piperaceae	*Piper*	sp.
13	Moraceae	*Dorstenia*	sp.
14	Verbenaceae	*Cornutia*	sp.
16	Passifloraceae	*Passiflora*	*coriacea* Juss.
18	Piperaceae	*Piper*	sp.
19	Gesneriaceae	*Columnea*	sp.
20	Monimiaceae	*Mollinedia*	sp.
22	Celastraceae	*Crossopetalum*	sp.
23	Piperaceae	*Piper*	sp.
24	Piperaceae	*Peperomia*	sp.
25	Costaceae	*Costus*	sp.
26	Piperaceae	*Peperomia*	sp.
27	Piperaceae	*Piper*	sp.
28	Piperaceae	*Piper*	sp.
30	Acanthaceae	*Razisea*	*spicata* Oerst.
31	Piperaceae	*Piper*	sp.
33	Gesneriaceae	*Columnea*	*purpurata* Hanst.
36	Piperaceae	*Piper*	sp.
38	Piperaceae	*Peperomia*	*alata* Ruiz & Pav.
39	Melastomataceae	*Miconia*	*oinochrophylla* Donn. Sm.
40	Melastomataceae	*Miconia*	sp.
41	Proteaceae	*Roupala*	*montana* Aubl.
43	Verbenaceae	*Aegiphila*	*elata* Sw.
45	Verbenaceae	*Aegiphila*	sp.
48	Asteraceae	*Mikania*	sp.
49	Acanthaceae	*Justicia*	*comata* (L.) Lam.
50	Solanaceae	*Solanum*	sp.
51	Piperaceae	*Piper*	sp.
52	Acanthaceae	*Justicia*	sp.

Table 2: Signs and symptoms, diagnoses, and applications along with numbers of associated plants uncovered for treatment.

Signs and Symptoms, Diagnoses, and Applications	Number of Plants Uncovered for Treatment
Afterbirthing (uncomplicated)	3
Afterbirthing (complications with placental adhesion)	1
Anemia	1
Backache	3
Birth control	1
Body aches	4
Childbearing (relaxes muscles)	1
Depression and Dementia	1
Diarrhea	1
Digestive problems	1
Epilepsy (Febrile and Nonfebrile Seizures)	12
Fever	5
Headache	6
Hematemesis	2
Hematuria	1
Madness	1
Malaria	1
Mending bone	1
Menstrual irregularities	1
Numbness	1
Pain	1
Skin infections	2
Snakebite	8
Susto (culture bound syndrome of fear)	2
Ulcers/recurrent stomach pain	1

* There were four plants uncovered which have multiple uses.

References

1. Pesek, T., Helton, L., and Nair, M. (2005). Healing Across Cultures: Learning from Traditions. EcoHealth Journal. 3(2).

2. Davis, W. (1999). Clouded Leopard. Douglas and MacIntyre Publishing Group, Vancouver, B.C.

3. Grimes, B. (1996). Ethnologue: Languages of the World. 13th Ed. Dallas: Summer Institute of Linguistics.

4. Maffi, L. Ed. (2001). On Biological and Cultural Diversity, Smithsonian Institution Press, Washington and London, UK.

5. Buenz, E. (2005). Country development does not presuppose the loss of forest resources for traditional medicine use. Journal of Ethnopharmacology. 100 (2005) 118-123.

6. Maffi, L. (2001). Language, Knowledge, and Indigenous Heritage Rights. in Maffi, L. Ed. On Biological and Cultural Diversity. Smithsonian Institution Press, Washington and London, UK. 412-432.

7. Hanski, I. (2005). Landscape fragmentation, biodiversity loss and the societal response. EMBO Reports. 6(5): 388-392.

8. WWF. (2004). Living Planet Report 2004. Gland, Switzerland: World Wildlife Fund.

9. United Nations Food and Agricultural Organization (2000). Global forest resources assessment 2000. (FAO Forestry Paper 140. United Nations). Retrieved 03 August 2005 from FAO Website: www.fao.org/forestry/fo/fra/main/

10. Arnason, J., Catling, P., Small, E., Dang, P., Lambert, J. Eds. (2005). Biodiversity & health: focusing research to policy. Proceedings of the international symposium, held in Ottawa, Canada, October 25-28, 2003. NRC Research Press, Ottawa, ON.

11. Hall, G. and Patrinos, H. Eds. (2006). Indigenous People, Poverty and Human Development in Latin America: 1994-2004, Palgrave Macmillan, UK.

12. Hayden, C. (2003). When Nature Goes Public: The Making and Unmaking of Bioprospecting in Mexico. Princeton University Press, Princeton, NJ.

13. Berlin, B. and Berlin, E. (2003). NGO's and the process of prior informed consent in bioprospecting research: the Maya ICBG project in Chiapas, Mexico. UNESCO, Blackwell Publishing Ltd, Oxford, UK.

14. Nigh, R. (2002). Maya Medicine in the Biological Gaze. Current Anthopology. 43(3) 451-477.

15. Alexiades, M. (2004). Ethnobiology and Globalization: Science and Ethics at the turn of the Century. in Carlson, J. and Maffi, L. Eds. Ethnobotany and Conservation of Biocultural Diversity. Advances in Economic Botany, 15. The New York Botanical Garden Press. Bronx, New York.

16. Bannister, K. and Barrett, K. (2004). Weighing the Proverbial "Ounce of Prevention" against the "Pound of Cure" in a Biocultural Context: A Role for the Precautionary Principle in Ethnobiological Research. in Carlson, J. and Maffi, L. Eds. Ethnobotany and Conservation of Biocultural Diversity. Advances in Economic Botany, 15. The New York Botanical Garden Press. Bronx, New York.

17. World Health Organization (2002). WHO Traditional Medicine Strategy 2002-2005. Geneva, Switzerland (WHO/EDM/TRM/2002.1).

18. Pesek, T. (2003). About Naturaleza. Retrieved 20 July 2005 from Naturaleza, Inc Website: www.naturalezafoundation.org/

19. Dunham P. and Pesek T. Eds. (2000). Progress Report Monograph of the 1999 Season of the Maya Mountains Archaeological Project (MMAP) (Prepared for the Government of Belize and National Geographic Society).

20. Pariser, H.S. (1998). Explore Belize. 4th Ed. Hunter Publishing, Inc., Edison, N.J.

21. Hartshorn, G., Nicolait, L, Hartshorne, L., Bevier, G., Brightman, R., Cal, J., Cawich, A., Davidson, W., DuBois, R., Dyer, C., Gibson, J., Hawley, W., Leonard, J., Nicolait, R., Weyer, D., White, H., and Wright, C. (1984). Belize, Country Environmental Profile. Trejos Hnos., San Jose, Costa Rica.

22. Treyvaud-Amiguet, V., Arnason, J., Maquin, P., Cal, V., Sanchez-Vindaz, P., and Poveda, L. (2005). A Consensus Ethnobotany of the Q'eqchi' Maya of Southern Belize. Economic Botany. 59(1): 29-42.

23. Eisenberg, D., Davis, R., Ettner, S., Appel, S., Wilkey, S., VanRompay, and Kessler, R. (1998). Trends in alternative medicine use in the United States, 1990-1997: Results of a follow-up national survey. JAMA. 280: 1569-1575.

24. Wright, T. (2005). Herbs and Botanicals Update: Uncovering the latest developments in the herbs and botanicals market. Neutraceutical World. July 2005.

25. Myers, N., Mittermeier, R., Mittermeier, C., da Fonseca, G., and Kent, J. (2000). Biodiversity hotspots for conservation priorities. Nature. 403: 853-858.

26. Stepp, J., Castaneda, H., Cervone, S. (2005). Mountains and Biocultural Diversity. Mountain Research and Development. 25(3): 223-227.

27. Ironmonger, S., Leisnerm, R., and Sayre, R. (1995). Plant records from the natural forest communities in the Bladen Nature Reserve, Maya Mountains, Belize. Caribbean Journal of Science. 31: 30-48.

28. Bateson, J., and Hall, I. (1977). The Geology of the Maya Mountains, Belize (Overseas Memoir 3). London, England: Her Majesty's Stationery Office.

29. Dixon, C. (1956). Geology of Southern British Honduras with Notes on Adjacent Areas. Belize City: Government Printing Office.

30. Parker, T., Holst, B., Emmons, L., and Meyer, J. (1993). A Biological Assessment of the Columbia River Forest Reserve, Toledo District, Belize. Washington, DC: Conservation International (Rapid Assessment Program Working Papers Number 3).

31. Iremonger, S., and Sayre, R. (1994). The Bladen Nature Reserve, Toledo District, Belize: A Rapid Ecological Assessment. Arlington, VA: The Nature Conservancy.

32. Graham, E. (1987). Resource Diversity in Belize and Its Implications for Models of Lowland Trade. American Antiquity. 52(4):753-767.

33. Dunham, P., Jamison, T., and Leventhal, R. (1989). Secondary Development and Settlement Economics: The Classic Maya of Southern Belize, Prehistoric Maya Economies of Belize. in McAnany, P. and Isaac, B. Eds. Research in Economic Anthropology, 4. Greenwich, CT: JAI Press. 255-292.

34. McKinnon, J. (1989). Spatial and Temporal Patterns of Prehistoric Settlement, Procurement, and Exchange on the Coast and Cays of Southern Belize (unpublished PhD dissertation, Madison: University of Wisconsin, Department of Anthropology).

35. Dunham, P. (n.d.) The Maya Mountains Archaeological Project (MMAP): The Initial Reconnaissance Years. Proceedings of the First International Symposium of Archaeology. Bonor, J. Ed. Belmopan: Department of Archaoelogy, Government of Belize.

36. Dunham, P., Meurer, W., Davidse, G., Whittemore, A., Holst, B., Mooleedhar, V., Miller, T., Buchanan, J., and Matola, S. (1996). The Maya Mountains Archaeological Project (MMAP): Field Report of the 1996 Season (summary of 1996 results for the Government of Belize, National Geographic Society, KeyCorp; and Dart Foundation).

37. Dunham, P., Whittemore, A., Davidse, G., Holland, D., Mooleedhar, V., Miller, T., Wenninger, P., and Doherty, D. (1997). The Maya Mountains Archaeological Project (MMAP): Field Report of the 1997 Season (summary of 1997 results for the Government of Belize, National Geographic Society, and KeyCorp).

38. Dunham, P., Buchanan, J., Meurer, W., Saul, F., Blackmore, S., Stafford, P., Persson, V., Abramiuk, M., Goldstein, D., Prufer, K., Hays, R., Verenice, H., Kindon, A., Mustain, C., and Sheldon, S. (1998). The Maya Mountains Archaeological Project (MMAP): Field Report of the 1998 Season (summary of 1998 results for the Government of Belize, National Geographic Society, and Dart Foundation).

39. Dunham, P., Prufer, K., Hays, R., Kindon, A., Buchanan, H., Cap, B., Corbo, J., Pesek, T., Travis, R., Saul, F., Saul, J., Rose, S., Mai, H. (1999). The Maya Mountains Archaeological Project (MMAP): Field Report of the 1999 Season (summary of 1999 results for the Government of Belize and National Geographic Society).

40. Brokaw, N. and Lloyd-Evans, T. (1987). Report and Recommendations of the Manomet Bird Observatory—Missouri Botanical Garden Investigation of the Upper Bladen Branch Watershed, Maya Mountains, Belize, March 1997.

41. Meerman, J. and Williams, G. (1995). Maya Mountains Divide Traverse Expedition. Jan 16- Feb 4, 1995.

42. Balick, M., Nee, M., and Atha, D. (2001). Checklist of vascular plants of Belize, with common names and uses. New York Botanical Garden Press, New York.