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HERBAL KNOWLEDGE ON NICARAGUA'S ATLANTIC COAST: CONSENSUS WITHIN DIVERSITY

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ABSTRACT: This article examines knowledge of medicinal plants, both among the people of Nicaragua's Atlantic Coast and among the scientific community. Data collected during an 809-household, five-community survey in 1990 and a ten-community botanical collection in 1991 are used to estimate the distribution of medicinal plant knowledge among the region's six ethnic groups. The list of 162 plants identified during this project is compared with other research results to provide the reader with a framework for understanding the distribution of medicinal plant knowledge.

While a few plants are widely thought to have medicinal properties, the majority of identifications come from only one or two informants, demonstrating a pattern of consensus within diversity. Discussion focuses on the impact of methodology on the gathering of data, on the distribution and durability of medicinal plant knowledge, and on the proprietary nature of such knowledge.

INTRODUCTION

The conservation of medicinal plant knowledge is a topic of increasing interest, importance, and indeed, of some urgency.[1-5] Clinicians and public health workers in the United States are increasingly becoming interested in ethnomedicine, for practical as well as personal reasons. Although many original papers and books continue to document botanical ethnomedicine, few authors attempt to describe the distribution of knowledge within a society, or the effects of methodology in assessing such knowledge.[6-8] There is, however, a growing discussion concerning the profitability of plant-derived medicine, the ownership and sale of plants and their germplasm, and the proprietary nature of indigenous ethnobotanical knowledge.[9-16]

Recent years have seen the publication of major works on medicinal plants from South America[17-18] and the Caribbean.[19-20] Nevertheless, the two most comprehensive works on Central America and the Caribbean are

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now more than a decade old.[21-22] Soon-to-be-published but not specific to medicinal plants, the Missouri Botanical Gardens' *Flora de Nicaragua*[23] will contain the largest inventory of Nicaraguan botany to date. Several works on medicinal plants from within Nicaragua have appeared in recent years,[24-28] including one booklet describing fifty plants from the Atlantic Coast.[29] Previous to this last study, carried out by the Ministry of Health in Bluefields, *Ministerio de Salud-Región Autónoma Atlántico Sur* (MINSA-RAAS) and published by the National Center for Popular and Traditional Medicine in Esteli, all investigations had failed to identify more than twenty-five medicinal plants each.[30-32] However, the MINSA-RAAS team tentatively identified nearly a hundred species in all. I worked on this project from June 1988 until its abrupt end on October 22, when Bluefields was levelled by Hurricane Joan, or Huracán Juana, as it was known in Nicaragua.

I returned to Bluefields in the fall of 1989, and with the help of six research assistants carried out an 809-household, 5-community survey during the first months of 1990, followed by a botanical collection in 1991. A formal list of the plants identified is presented elsewhere.[33] In the present article I provide an analysis of ethnobotanical methodology, its impact on formal botanical knowledge, and its relationship to indigenous knowledge and intellectual property rights. I show that medicinal plant knowledge is not as concentrated as much among specialists (herbalists and traditional healers) as is often reported. Instead, there is a gradient from the most to the least knowledgeable persons, just as there is a gradient from the most to the least commonly used medicinal plants. Although ethnobotanical surveys are more likely to 'discover' common uses, even standard treatments are often missed.

I also speculate on the impact of the expansion of health care on the use of medicinal plants. I hypothesize that the intrusion of biomedicine into an area previously served only by traditional healers has had two major—yet contradictory—effects. As modern medicine became available, popular health behavior shifted toward doctors and pills, and away from medicinal herbs. However, a relatively lower status also accompanied the availability and low cost of Western medicine, thereby increasing the social status of its competitor—traditional, popular, or ethno-medicine. And, finally, I place myself among those that are beginning to argue for intellectual and economic justice in relation to indigenous knowledge. The information presented here belongs to the people of Nicaragua's Atlantic Coast, not to me and not to the scientific community. However, it has been lent in good faith, and in good faith I present it.

BACKGROUND

The Atlantic Coast of Nicaragua is a remote and undeveloped area of great geographic, climatic, and botanical diversity. Annual rainfall ranges from less than half a meter in the northern mountainous continental divide to well over five meters in the southeast rain forest. Ecosystems range from dry savannah to pine forest in the north to various types of rain forest, palm swamp and mangrove littoral in the south.

The region is also characterized by ethnic diversity and historical marginalization. There were two major language groups living in Nicaragua at the time of the Conquest, Misumalpan (Matgalpan, Miskitu, and Sumu) and the Chibchan (Cuna, Guatuso, Talmancan, Rama, and Voto). Of these, only the Miskitu, Sumu, and Rama Indians remain. Originally colonized by the British in the 1600s, the region was reincorporated into Spanish-speaking Nicaragua just before the turn of the century.[34] North American influence has remained strong throughout the last 150 years, as lumber, bananas, gold and the prospect of a trans-oceanic canal brought U.S. companies to 'the Mosquito Coast'.[35]

The Atlantic Coast of Nicaragua is geographically, historically, economically, and culturally isolated from western Nicaragua. The 'Coast' is itself divided into the northern and southern regions, between which there is surprisingly little contact. The Southern Atlantic Autonomous Region (RAAS-*Región Autónoma Atlántico Sur*) is politically and economically centered in the city of Bluefields. Puerto Cabezas, in the north, is the capital of the Northern Atlantic Autonomous Region (RAAN). Transportation on the Coast is by way of boat. There are very few roads linking the villages, or linking the region to the west. Most people travel by dugout canoe, but there are several diesel-powered river boats and a few speed boats. Villages throughout the southern Coast are hours or even days from Bluefields.

There are six distinct ethnic groups living in the region. Spanish-speaking Mestizo are numerically dominant, making up more than half of the 300,000 people living on the Coast today.[36] Many Mestizo are relative newcomers to the Coast, as eastward migration of Mestizo *campesinos* followed land takeovers by landholders and agroindustry during the 1960s and 1970s under the Somoza regime. Nicaraguan Creole culture is centered in Bluefields, but only makes up a quarter of the urban population,[37] and perhaps only a tenth of the rural population.[38] Creoles derive from both African and English heritage, and speak a Caribbean Creole dialect of English in the home. Although similar to the Creole in many ways, the Garífuna (Black Carib, Garinagu) are a distinct group with roots in Africa

and in the Caribbean. Nicaraguan Garífuna number less than 2,000, speak Creole English, and live for the most part in the village of Orinoco in the Pearl Lagoon area.[39]

Of the three indigenous groups, the Miskitu are the largest, comprising between 75,000 and 100,000 individuals.[36,40-45] Miskitu culture is centered on the Rio Coco along the Honduran border. Most Miskitu speak both the Miskitu language and Creole English. Many speak Spanish as well. The Sumu are the next largest indigenous group in eastern Nicaragua, with a total population of approximately 8,000.[36] The Sumu live in several inland riverine villages in the central and northern areas of Nicaragua's Atlantic Coast, and speak either of two Sumu dialects—Twahka and Ulwa.[46] Many speak Miskitu and/or Creole English and/or Spanish as well. The Rama number less than 1,000, speak Creole English almost exclusively, and for the most part live on Rama Cay in Bluefields Lagoon.[32,47]

Biomedical health care in RAAS before 1979 was dependent on a very limited medical and public health system. The 1979 revolution was followed by a rapid increase in health care, especially in rural areas. Both the number of physicians and the number of medical encounters more than tripled between 1978 and 1982, from 10 to 36 and from around 40,000 to over 160,000, respectively. Vaccination coverage increased from less than 50% to more than 90% during the first five years of the revolution.[37,48] Pharmaceuticals as well as services were provided free of charge. Several new clinics were built; many were expanded. Modern health care reached out from its enclave in Bluefields to dozens of villages throughout the Coast.

Several hundred *brigadistas* (health care volunteers) were recruited, trained, and organized to carry out vaccination, education, and sanitation campaigns.[49-50] Both preventive and curative care were brought to the previously unserved rural population. As utilization of Western health services expanded, outreach to traditional healers also began. Midwives were contacted and provided with training and with sterile equipment. Traditional healers were invited to a regional conference. A project known as the 'rescue of popular medicine' (*rescate de medicina popular*) was begun, and a survey of ethnobotany and traditional medicine was accomplished.[29]

The medical ethnobotany of the region falls within the larger category of traditional medicine. For the purpose of this paper, traditional medicine is defined as that delivered by herbal remedies, by midwives (*parteras*), and by spiritual healers. Spiritual healers on the Coast work under a variety of names: *curandero* (Mestizo), bush-doctor, obeah-man or science-man (Creole), snake doctor (Rama) and *sukya* (Miskitu, Sumu, and Ga-

rífuna).[31-32,51] The interplay among the various ethnomedical traditions is extremely complex. Healers of one ethnicity often claim mentors from another, use terms from outside languages, and even claim support from the official health system, from gods or spirits, or from teachers from other countries. Although spells, spirits, dreams and rituals are integral to the region's ethnomedical matrix, herbal medicine forms the foundation of traditional practice.

METHODS

The research from which this report derives was initiated in 1986, and has continued to the writing of this paper. A total of 20 months of field work was completed in Nicaragua. The quantitative data used in this paper were collected: 1) in 1990 by an 809 household survey in the city of Bluefields and in the villages of Rama Cay, Kakabila, Orinoco and Karawala, and 2) in 1991 by botanical collection in Rama Cay, Bluefields, Pearl Lagoon, Kakabila, Pueblo Nuevo, Orinoco, Marshall Point, Tortuguero, Puerto Cabezas, and Waspam (Figure 1).

The 1990 survey was designed so that all six ethnic groups would be represented, and so the data would be somewhat representative of the Atlantic Coast as a whole. A total of 809 households participated, 507 from the city of Bluefields and 302 from the four outlying villages. The urban sample was determined by mapping all 5,167 households in Bluefields, then surveying every tenth household. The survey in Bluefields was carried out by six research assistants and was supervised by the author. Most surveys in Bluefields were conducted in Spanish. The village interviews were conducted by the author, the vast majority in English. I was able to obtain an interview in over 85% of the village households. About 90% of the respondents were women, as the female head of household (*ama de casa*) was the preferred informant.

The survey was carried out from January to March of 1990. It was designed to gather basic health care information: vaccination, breast feeding, childbirth practices, and utilization of biomedical and traditional services. The questions regarding medicinal plants were twofold. First, we asked whether anyone in the household had used medicinal plants in the last year. Next, we asked the respondent to name as many medicinal plants as she could, and to tell us which illnesses were treated with each. We did not prompt, nor did we support, confirm or negate answers. We only noted additional data (part of plant used, dosage, synonyms, effects) when

FIGURE 1

Research Sites on Nicaragua's Atlantic Coast

it was spontaneously provided. The data were entered on disk within a week of collection; unclear or missing data were usually verified with a second visit to the house.

Preliminary identification of the more common plants was accomplished by dozens of interviews with herbalists and traditional healers, and by crosschecking published and unpublished sources.[18-22,25-32,42,52-54] Botanical collection was carried out with the help of many of these healers in 1991. Subsequent botanical identifications were made at the University of Wisconsin Herbarium and the Missouri Botanical Gardens. Specimen vouchers were deposited at the Nicaraguan National Herbarium in Managua, and with both the Missouri Botanical Gardens and the University of Wisconsin Herbarium. A complete list of the vouchered plant specimens is published elsewhere,[33] and includes scientific name, common names in up to six languages, ethnicity and number of informants, illness for which the plants is used, and selected references which also mention the specific plant. In this present article, I compare the four best lists of medicinal plants for Nicaragua's Atlantic Coast: I) my study,[33] II) the study done by the regional ministry of health MINSA-RAAS,[29] III) a study by Philip Dennis,[31] and IV) plants listed in Franklin Loveland's dissertation.[32]

RESULTS

The first major result is that there are indeed quite a few plants that are used medicinally in the region. The four studies mentioned above identified a total of 214 different medicinal plants (181 by species, 27 by genera, and 6 by family). Of the 214 plants, 162 were mentioned in my 1990 house-to-house survey and 113 were collected in 1991 and deposited in Managua, Wisconsin and/or St. Louis. As many as 109 were mentioned during the MINSA-RAAS *rescate de medicina popular* project in the mid-1980s.[29] Some 23 were identified by Dennis[31] and 25 were presented in Loveland's 1975 dissertation.[32] Loveland's list was compiled from his own anthropological work and from four published and unpublished sources. The degree of overlap among these studies supports the validity of the data. The fact that each attempt yields new data suggests a wealth of yet undiscovered information (Table 1).

The second major conclusion is that medicinal plant knowledge is dispersed widely, although unevenly, throughout the region. Examining frequencies we see a highly skewed distribution of medicinal plant use. Seventy-seven plants (47%) were mentioned only once during my 1990

TABLE 1

Comparison of Four Ethnobotanical Studies on Nicaragua's Atlantic Coast

	I. *Barrett* (1994)		II. *CNMPT** (1992)		III. *Dennis* (1988)	
		162			# plants	
II. *CNMPT** (1992)	109	77	# plants		# plants in common	
		162		109		
III. *Dennis* (1988)	23	16	23	11		
		162		109		23
IV. *Loveland* (1975)	25	12	25	9	25	2

*Centro Nacional de Medicina Popular Tradicional (National Center for Popular Traditional Medicine).

survey and 1991 field collection. Fifty-three plants were mentioned between 2 and 10 times, while 24 plants were mentioned at least 11 but not more than 50 times. Eight plants were each mentioned more than fifty times, with three of these being mentioned by more than 100 informants. A total of 1,636 of the 2,135 remedy reports (plant/illness relationships) gathered during the 1990 survey were traced to specific identifiable plants. Fully 75% (1,213) of the remedy reports belonged to only 23 species. Please see Table 2.

Medicinal plant knowledge follows ethnic, socioeconomic, geographic, and professional distributions. Rural respondents and village-based ethnic groups can name more plants than can their urban cousins. Tables 3 and 4 demonstrate the spatial and ethnic distributions of medicinal plant knowledge. In Bluefields, although half of the respondents could name at least one medicinal plant, only a third reported the use of medicinal herbs by a family member within the last year. In the villages, more than two thirds of the respondents could name herbs, and almost 90% reported that a family member had used plant medicine within the last year. Within Bluefields, traditional medical knowledge was held disproportionately by the Creole.

TABLE 2

Common Medicinal Plants of Nicaragua's Atlantic Coast

Species	*Family*	*# Informants Studies**
Citrus aurantifolia (Christ) Swingle	Rutaceae	147 I,II
Senna alata (L.) Roxb.	Caesalpiniaceae	120 I,II,III
Momordica charantia L.	Cucurbitaceae	114 I,II
Cymbopogon citratus (DC.) Stapf.	Poaceae	91 I,II
Anacardium occidentale L.	Anacardiaceae	70 I,II
Annona muricata L. (*A. americana*)	Annonaceae	65 I,II
Eryngium foetidum L.	Umbelliferae	59 I,II,III,IV
Psidium guajava L.	Myrtaceae	57 I,II
Sida acuta N.L. Burm.	Malvaceae	50 I,II,III
Cocos nucifera L.	Palmaceae	49 I,II
Ocimum micranthum Willd.	Labiatae	45 I
Allium sativum L.	Liliaceae	41 I,II
Senna occidentalis (L.) Link	Caesalpiniaceae	39 I,II,III
Stachytarpheta jamaicensis (L.) Vahl	Verbenaceae	35 I
Malachra alceifolia Jacq.	Malvaceae	35 I
Manihot esculenta Crantz	Euphorbiaceae	34 I,II
Piper jacquemontianum Kunth	Piperaceae	30 I,II,III
Cassia grandis L.	Caesalpiniaceae	29 I,II
Smilax spp.	Smilaceae	28 I,II
Zebrina pendula Schnizl.	Commelinaceae	26 I,II
Neurolaena lobata (L.) R. Br.	Compositae	25 I
Scoparia dulcis L.	Scrophulariaceae	24 I,II,III,IV
Zingiber officinale Rosc.	Zingiberaceae	22 I,II
Mimosa pudica L.	Mimosaceae	22 I,II,IV
Cecropia peltata L.	Moraceae	18 I,II,IV
Wedelia trilobata (L.) Hitche.	Compositae	17 I
Cinchona sp.	Rubiaceae	16 I,II
Piper auritum H.B.K.	Piperaceae	15 I
Cordia curassavica (Jacq.) R & S	Boraginaceae	12 I,II,III
Peperomia pellucida (L.) H.B.K.	Piperaceae	11 I,II
Musa spp.	Musaceae	11 I,II
Mangifera indica L.	Anacardiaceae	11 I,II,III
Myristica fragrans Houtt	Myristicaceae	10 I,II
Matricaria chamomilla L.	Asteraceae	10 I,II

*I = Barrett (1994); II = CNMPT (1992); III = Dennis (1988); IV = Loveland (1975).

TABLE 3

Use of Medicinal Plants by Location*

Bluefields	*Creole*	*Mestizo*	*Total*
N =	126	336	509
Family member uses herbs	50%	29%	37%
Can name herb(s)	63%	42%	50%

Villages	*Kakabila*	*Karawala*	*Orinoco*	*Rama Cay*	*Total*
N =	38	89	92	83	302
Family member uses herbs	97%	88%	97%	77%	89%
Can name herb(s)	92%	65%	91%	49%	72%

*Data from 5-community survey in 1990.

TABLE 4

Use of Medicinal Plants by Ethnic Group*

	Mestizo	*Creole*	*Rama*	*Miskitu*	*Sumu*	*Garífuna*
Total N =	355	155	81	64	62	58
No. that knew of plants	161	104	60	43	46	56
Average number of plants named	2.8	4.5	3.5	7.8	3.7	8.8
Total number of species names**	76	91	42	72	21	66
Total number of plant/illness relationships named	457	469	211	337	171	490

*Data from 5-community survey in 1990.
**Includes data from field collection in 1991.

Within the rural sample, the Rama of Rama Cay provided the fewest number of plant names and reported the least use of herbal medicine. The location of the village on a small island—unable to support a diverse botanical spectrum—may help explain this finding. The Sumu of Karawala also reported a slightly lower use of medicinal plants than did their Miskitu counterparts in Karawala and Kakabila. The Garífuna of Orinoco displayed

the greatest knowledge and use of medicinal plants, with more than 95% of respondents reporting knowledge and use of herbs.

Interestingly, of the 85 plants mentioned at least twice during my work, only two—*Eryngium foetidum* L. and *Scoparia dulcis* L.—were noted in all three of the other studies cited here. Of the 34 plants noted by 10 or more informants in my study, 6 were noted in my study alone, 18 were noted in one other study, and 10 were noted in two of the three other studies. Seventeen of the top 20 plants on my list were also identified by MINSA RAAS.

Of the three other studies described here, MINSA-RAAS's study was by far the largest. Their method was to interview local healers in communities from throughout the southern half of Nicaragua's Atlantic Coast. A total of 1,506 remedy reports were collected from 270 informants in 10 communities. Specimens were collected and sent to the National Herbarium in Managua for identification. MINSA-RAAS tended to note most of the plants that my subsequent study found to be used most frequently. Of the 85 plants mentioned to me by two or more informants, 60 (70%) were also noted in the MINSA-RAAS study. A report of this study has recently been published.[29]

Dennis worked in areas north of Puerto Cabezas, mostly in the village of Awastara. His method was to question knowledgeable Miskitu informants, noting how and when medicinal plants were used. He collected plants with Douglas Stevens, who deposited vouchers at the Missouri Botanical Gardens. Seven of the 23 medicinal plants identified in Dennis' article were not cited in any of the other studies. Fifteen were mentioned during my work.

Loveland compiled his list of medicinal plants from his own work, and from several unpublished works by previous researchers. Of the 25 species– or genera-identified plants provided by him, only 12 species were mentioned in my work. Another 12 were not found in any of the other three lists. These results demonstrate the unsurprising fact that small surveys tend to miss important plants, but more importantly they show that infrequently used plants tend to be vastly over-represented in smaller studies. The often-used technique of consulting only herbalists and traditional healers may add to this misrepresentation of ethnobotanical knowledge. Although healing professionals certainly have a disproportionate share of botanical knowledge, they are usually small minorities in their communities. Knowledge of medicinal herbs is widespread.

Data from other studies outside of Nicaragua's Atlantic Coast provides support for these arguments. Table 2 shows that many of the most commonly used plants on the Coast are known in other regions of Latin America. In general, the most widely known plants on the Coast are also

known widely throughout the hemisphere, and among the scientific community. The popularity of medicinal plants on the Coast demonstrates some consistency with comparable research, yet there is also significant diversity.

Most medicinal plants are not limited to single uses. Instead, there is both diversity and consensus in the utilization of medicinal plants. Some plants, such as guava (*Psidium guajava* L.), lime (*Citrus aurantifolia* (Christ.) Swingle), and malva (*Malachra aceifolia* Jacq.) have fairly circumscribed uses. Forty-four of 57 informants mentioning guava cited it as an anti-diarrheic, while 29 of 35 mentioning malva said that it was used for headache. Of the 147 people mentioning lime, 71 said that it was used for diarrhea and 42 said it was used for belly ache. Others, such as soursop (*Annona muricata* L.) and sorosi (*Momordica charantia* L.) have multiple uses. Sorosi was attributed 16 different uses by 114 informants, while soursop, mentioned by 65 informants, was described as being useful for nine different complaints. Hence, we have yet another example of a great degree of consensus within a broad field of diversity.

Because this is the first attempt in the region to quantitatively assess the use of medicinal plants, I cannot accurately estimate historical trends. I can, however, report that the vast majority of informants insist that medicinal plant knowledge is disappearing. Some attribute this to the introduction of modern medicine, some to the loss of plants following the 1988 hurricane, and some to the destructive effects of the U.S.-sponsored *Contra* War. Most, however, state that the use of medicinal plants is disappearing because of changing times. Young people, they say, are just not interested in learning plant lore. They would rather move to Bluefields or Managua, earn money, and join the cosmopolitan world portrayed by radio, television, and in books and magazines. Nevertheless, I am very happy to demonstrate that medicinal plant knowledge has not disappeared, but is in fact an integral part of contemporary life on Nicaragua's Atlantic Coast. Indeed, there may be an insurgent or impending ethnic revitalization on the Coast, especially among the Garífuna and Miskitu peoples. Growing awareness and pride in ethnic identity would help to slow the rate of loss of ethnobotanical knowledge.

The process of Westernization of medicine underway since the 1800s was accelerated during the 1980s by the expansion of health services under the *Sandinista* government. Although this process perhaps contributed to the loss of plant knowledge, it may also have in some instances facilitated a revival of ethnomedical identity and traditional values. At the time of the revolution, the Garífuna were reported to almost have lost their ethnic identity by Davidson[39] and by Holm.[55] However, I found a re-

markable degree of cultural pride during my time in Orinoco. Much of this was related to traditional medicine. I also found that many Miskitu, Sumu, and Rama expressed pride in their ethnomedical heritage, especially in contrast to imported, government-controlled medicine. I would argue that a resurgence in ethnic identity may in fact help to preserve medicinal plant knowledge.

DISCUSSION

It is senseless to talk of the conservation of medicinal plant knowledge without some conception of 1) **what** knowledge needs to be conserved, 2) **who** currently holds that knowledge, 3) **who** wants to conserve the knowledge and **why**, and 4) **how** to study and conserve that knowledge in an accurate, representative, and just manner.

It is assumed by many writers that medicinal plants will serve us only if their active chemical constituents are isolated, extracted and/or synthesized, and distributed to patients via the biomedical/pharmaceutical capitalist market system.[4,10,56-57] Others recognize the role that medicinal herbs may play in health care systems among poor countries.[1,20,26] Still others stress the inherent value of indigenous knowledge, and its possible impact on the preservation of nature.[3,58,62] Amid this clamor, a few remind us that the knowledge in question is held by indigenous peoples, and hence not the property of researchers to do with what they will.[63-66]

Almost all authors agree that the destruction of natural ecosystems, combined with the loss of indigenous knowledge, threatens biodiversity, including medicinal plants. Biodiversity has in fact emerged from environmental groups' board rooms and journals to university lecture halls and negotiating tables worldwide. It is becoming increasingly acknowledged that biodiversity is decreasing at an alarming rate, and that this loss may in fact threaten human survival.[67-69] As Iltis[60] states:

> "Only an ecologically responsible people, sternly self-restrained in both resource use and human reproduction, can give this spaceship world of ours any realistic hope of bequeathing to its children a nature-rich, beautiful, and liveable earth."

It is also generally agreed that the majority of medicinal plant knowledge rests with the world's indigenous peoples. Within these societies, knowledge has been assumed to be almost exclusively within the purview of the traditional healer. The data presented in this paper suggest that a great deal of medicinal plant knowledge is dispersed throughout the

population. This gives weight to the argument that medicinal plant knowledge is held in common by an ethnic group or community. This in turn strengthens the argument that intellectual property rights can and should be considered group possessions. Medicinal plant knowledge belongs to the people who have developed, transmitted, and conserved it throughout the centuries.[70]

Ethnobotanists and ethnopharmacologists have consistently accepted the relationship between shared knowledge and validity; the fewer people who claim a medical effect, the less likely it is to be there. Random sample survey techniques have been shown to be fairly representative of population characteristics throughout the social sciences; they should be employed where practical in assessing regional medicinal plant knowledge. In addition to providing a more fair representation of medicinal plant knowledge, population studies will provide additional support to the growing demand for intellectual property rights for indigenous people.

Within Nicaragua, it is the ethnic minorities, the disenfranchised, and the rural poor that hold the vast majority of medicinal plant knowledge. These same groups benefitted from the 1979 Nicaraguan revolution, at least until the *Contra* war began to take its toll. Benefits came in the form of land reform, increased participation in government, an expanded health care system, and greater recognition of the rights of marginalized peoples. Most importantly for this discussion, the *Sandinista*-led government insisted that Nicaraguans become the arbitrators of disputes in production and ownership within Nicaragua. This demand for autonomy extended into scientific research, where internationalists were welcomed as equals, and into the Atlantic Coast, where the Autonomy project was launched.[71-73] There was great deal of international involvement in health care research, and in the Autonomy project, but very little in traditional medicine or ethnobotany.

Like many researchers, I entered the field with the hope of collaborating with local scientists. Unfortunately, there were no international agreements, standards, or regulations on ethnobotany under which I could work. Instead, I affiliated with the Nicaraguan Ministry of Health, both at the national and regional levels. In the absence of a formal agreement allowing for just compensation for the use of intellectual resources, I did what I could. I have consistently attempted to share my research with counterparts. I also brought many boxes of medicines and supplies to Bluefields, taught a short course on computers for the Health Ministry, and worked with several Central American solidarity organizations both within Nicaragua and in the United States. Like many fieldworkers, my greatest satisfaction was in returning with photos or small gifts for the vil-

lagers and urban poor with whom I worked. I consider the information contained in this article to be the property of these people, the people of Nicaragua's Atlantic Coast, loaned in good faith to me, and to the scientific community.

It seems that a new paradigm for medicinal plant research is indeed in the making. Merck Pharmaceuticals paid in advance to work with INBio in Costa Rica.[74] Columbia recognized indigenous rights to nearly half of its Amazon territory.[11] The World Resources Institue, the International Union for the Conservation of Nature, the International Society of Ethnobiology, the World Wildlife Fund, the Nature Conservancy, and many United Nations Agencies are working on this issue.[66] The National Cancer Institute is conducting a world-wide search for new pharmaceuticals, and assures host countries that it will "make its best effort to ensure that royalties and other forms of compensation shall be provided to the host country organizations and to individuals, as appropriate".[75]

I believe that democratic, grass-roots indigenous organizations are the place to start to create a new research paradigm. Analogously, movements led by developing nations might indeed be the best hope for the preservation of ethnobotanical knowledge. The emphasis on biodiversity and the stressed importance of indigenous knowledge at the 1992 world environmental conference in Rio de Janeiro, Brazil underscore these points. There is a growing consensus that developing nations and indigenous peoples deserve some sort of recompense for the valuable data extracted from within their borders. As Kloppenburg[76] states:

> "Third World nations are increasingly coming to recognize a simple truth that has long been well understood by the capitalist nations of the North: Plant genetic resources are a strategic resource of great value . . . These patterns may be ripe for a profound realignment. While it is clear that the status quo cannot be maintained, the shape of a resolution to the germplasm controversy is by no means self-evident."

The shape-to-come of the resolutions to North-South conflicts is indeed unknowable. However, if we were to use historical trends to foretell future ones, we would have to predict a continuing depletion of both plants and knowledge from the South, and a continuing concentration of wealth, knowledge, and power in the North. With the end of the cold war, many limits on the corporate exploitation of the labor and resources of the South have vanished. National-level structural adjustments within contemporary global economic restructuring invariably directs economic resources from social programs into debt-repayment and primary export

production. This often means increased exploitation of forests and fewer publicly funded parks and preserves.

In the realm of medical ethnobotany, resources are primarily intellectual. If a plant-derived chemical finds widespread medicinal use, profits are likely to fall to shareholders in pharmaceutical companies. Scientists as global citizens must recognize the legitimate interests of the South in protecting itself from the unfair patterns of the past.

One of the more promising avenues toward the preservation of medicinal plant knowledge lies in the integration of community organization, clinical knowledge, and ethnomedical tradition. This is, however, very difficult to achieve. As the directors of the Caribbean TRAMIL project state,

> "Our interest in this popular knowledge aims at facilitating people's efforts to take control over, as much as possible, their own health problems. However, we felt that it is important to set the boundaries between simple belief and what is of use and effective . . . This research must allow the involvement of communities of researchers in a common concern over health problems and in a reflection on solutions which are feasible and acceptable both technically and economically."[20]

Only time will tell if the growing movement to preserve the knowledge and the very existence of medicinal plants will be moderately successful or completely futile. Neither will we know for some time whether indigenous and popular movements will be successful in opening political and economic space for self-determination and preservation of cultural heritage. The struggle is an extremely important one, and one in which scientists play a crucial role. I conclude with a quote from Darrell Posey[66]

> "The current devastation of native peoples and the ecological systems that they have conserved, managed and intimately known for millennia require new and drastic steps to reorient world priorities. All channels and organizations—governmental, nongovernmental, professional, business—must work together to reverse the current momentum in the loss of cultural, ecological, and biological diversity of this planet."

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