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What Happens to Traditional Knowledge and Use of Natural Resources When People Migrate?

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The study investigates traditional knowledge of forest plants in a community (La Quetzal) inhabited by people who returned to Guatemala at the end of the civil war, after 10–12 years in exile in Southern Mexico, and now are in the process of constructing a new community in the Lacandon jungle in the Petén, Guatemala. We ask if the basis of knowledge and the use of natural resources change when people migrate. The relevance of vascular plant diversity for consumption and other daily needs of the population is explored. Relatively few species are presently used, with the exception of timber species, where knowledge seems to be increasing. Traditional knowledge has been maintained in certain areas such as medicine. Nature as such is regarded as important primarily as potential monetary capital and not for its subsistence capital. We find that the refugee situation has led to the introduction of global consumption patterns. Still there continues to be a dynamic local intuitive knowledge arising directly from practical experiences. Two interlinked factors have been the driving forces altering the knowledge and the use of natural resources by the people in La Quetzal: Change in the natural environment and change in the social and economic environment.

KEY WORDS: ethnobotany; forced migration; resettlement; traditional ecological knowledge; non-timber forest products; Maya Biosphere Reserve.

INTRODUCTION

Traditional ecological knowledge (TEK) of indigenous-rural people has been recognized, accepted, and used by scientific experts in a number of areas, in particularly those related to resource management problems in

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various parts of the world (Anaya, 1996; Huntington, 2000). TEK comprises a practical component of natural resource use activities and is important in people's perceptions of their role within ecosystems and how they interact with natural processes (Ampornpan and Dhillion, 2003; Ford and Martinez, 2000). TEK may be defined as a cumulative body of knowledge, practice, and belief—evolving by adaptive processes and handed down through generations by cultural transmission—about the relationship of living beings (including humans) with one another and with the environment (Berkes, 1993, 1999; Ellen, 2000; Gadgil *et al.*, 1993). Thus, TEK implies a close link between people and places.

What happens to TEK when large groups of people migrate from their traditional areas for reasons ranging from armed conflicts, war, and poverty to lack of development opportunities or the lure of better opportunities in other places?[3] We explore how the interaction between natural and sociocultural conditions influences people's ethnobotanical knowledge and use of plant resources.

Rural migrants often settle in places that are quite different from their place of origin and have to adapt to new social, economic, and natural environments. This situation challenges beliefs, values, knowledge, technology, exchange systems, and many other aspects of their lives, including their recognition and use of natural resources. In most rural communities in developing countries, natural resources are important to ensure livelihoods, and thus one way to find out how migrants relate to their new environment is to study their knowledge and use of plant and forest resources.

Just as the causes of migration are complex, so are the effects, and its impact can rarely be characterized as solely positive or negative. In migrant contexts such as the one that is the focus of this paper, new settlers may ignore community-level regulatory mechanisms that are important for ensuring sustainable resource use. The impact of migration may thus result in increased land pressure, competition for resources, and resource conflicts between hosts and newcomers, often leading to land degradation. However, migrants may also bring knowledge and practices that are new to the area of arrival that in turn may lead to development. Change in the production and consumption pattern of migrating people could be related to a change in their TEK.

Even though TEK is considered important in the sustainable development of the natural resources in local communities worldwide, it is eroding at a fast pace (UNESCO, 1994). Social and economic changes to-

[3]It should be remembered that migration is not a new phenomenon. What is new is the enormous scale of migration. According to ILO, the number of international labor migrants is now approaching 100 million (ILO, 2003). If we add refugees and internally displaced people, the number becomes much higher.

wards more globalized production and consumption patterns have large impacts on traditional societies. The number of people who have access to industrial products increases rapidly and dependence on living resources declines, resulting in change of knowledge and altered practices with regard to such resources. The widespread loss of specialized vocabulary, names for plants, animals, and places and discourse associated with peoples' relationships to land and other life-forms, is a great obstacle for the transfer of TEK (Etkin, 2000; Shrestha and Dhillion, 2003). There are only a few places in the world, often in isolated areas, where traditional systems of resource management are still in force (see discussion in Gadgil *et al.*, 2000). This study of TEK begins with species identifications and classification (ethnobiology) and proceeds to the consideration of people's understandings of ecological processes and their relationship with the environment.

Wild foods and particularly plants still play an important role in the diets of many agropastoral societies, and act as a buffer in the periods of seasonal scarcity (Caballero and Mapes, 1985; DeeWalt *et al.*, 1999; Gustad *et al.*, 2004). Moreover, for many people the gathering of wild resources is the only source of cash income. Throughout the tropics new efforts are being made to manage forest resources in a sustainable way as responses to the widespread and rapid forest conversion, which threatens not only biological diversity, but also economic and social sustainability in rural areas. These efforts depart from previously accepted sustained-yield doctrine in that they both promote timber and non-timber forest products industries and protect biodiversity while providing for human welfare and improved economic and social equity. This combination of development with biodiversity conservation has received considerable attention through promotion of the "extractive reserve," such as the Maya Biosphere Reserve (Reining and Heinzman, 1992). The extraction of non-timber forest products by rural people is believed to be compatible with conservation as long as there is low environmental impact (Momberg *et al.*, 2000). However, reserves can be protected over the long term only through the satisfaction of human needs from surrounding areas that are already cleared of forest or otherwise significantly disturbed (Shriar, 2001).

To address the central questions this study investigated plant diversity in a neotropical moist forest in Petén and the ethnobotanical knowledge of a migrant community inhabiting this forest.[4] We explored the relevance of vascular plant diversity regarding consumption and other daily needs of

[4]The study on which this paper is based is affiliated to and draws on results from the anthropological research program "Forced migration and social reconstruction among returned refugees in Petén, Guatemala," and seeks to contribute to the policies of sustainable management of natural resources in the context of migrating people settling in a different/new natural environment.

the population. We further examined to what degree knowledge of natural resource use is transmitted/exchanged and the quality of this knowledge in relation to previous knowledge and the local availability of plant resources.

THE MIGRANT COMMUNITY AND THE STUDY AREA

The study area comprises the local community of La Quetzal, selected parts of the surrounding area belonging to the Cooperative Union Maya Itzá, and an area situated within the protected Maya Biosphere Reserve (MBR). It is located in the neotropical Lacandon rainforest in the Maya Biosphere Reserve, department of the Petén, Guatemala, and constitutes the southernmost part of the Yucatan tableland, a low limestone plateau of 400 m maximum elevation and the southern terminus of the Yucatan Peninsula Biotic Province (Goldman, 1951). The climate is seasonal, dry from November to May wet from June to November when most of the annual rainfall (average 1738 mm) occurs (Salazar and Cancino, 1998). Mean monthly temperatures range between 22°C and 29°C with annual maxima of 27–37°C and minima of 17–23°C (SEGEPLAN, 1992). The reserve is covered by subtropical moist forest. The canopy is partly deciduous, with certain species losing their leaves during the dry season that extends from February to June. The distribution of certain species in Petén is probably due to the selection and protection of certain species by the ancient Maya, forming forest communities with high densities of useful native trees (Gomez-Pompa and Kaus, 1990; Lundell, 1937). The property of the cooperative consists of old growth forest as well as agricultural area and common property forest. There are relatively few cedar, *Cedrela odorata*, and mahogany (caoba), *Swietenia macrophylla*, as a result of earlier heavy logging (Mutchenick and McCarthy, 1997). The effects of the exploitation of chicle, *Manilkara zapota*, can also be observed (Nations, 1992; Reining and Heinzman, 1992; Schwartz, 1990).

Until the mid-1960s the vast region of Petén was sparsely populated; as late as 1960 there were only 24,000 inhabitants (CONAP, 1989; Schwartz, 1990). In the early 1960s, the national government opened Petén to colonization and land distribution, and the population had increased ten-fold, to approximately 311,000, by 1990, the majority being immigrants from other departments of Guatemala. With a fifty-fold increase in land used for agricultural production, by the mid-1980s Petén had lost 60% of its forested area (Schwartz, 1990). To counteract further deforestation, the Maya Biosphere Reserve (MBR) was established in January of 1990, comprising 1.6 million hectares or about 40% of the Petén department (USAID/GOG, 1991).

Fig. 1. Map showing the location of the cooperative of Unión Maya Itzá in Guatemala.

La Quetzal is a community of approximately 1,100 inhabitants whose return in 1995 was the culmination of a long process of movement that started in the late 1960s and early 1970s, when thousands of poor peasants moved from different parts of the central highlands, mainly the departments of Huehetenango, Alta and Baja Verapaz, and San Marcos, to the tropical lowlands of Ixcán and Petén, where they obtained land and organized agricultural cooperatives to make a living. This move was part

of a colonization program led by the Catholic Church and supported by the Guatemalan government to reduce the pressure for land reforms in the highlands (Dennis *et al.*, 1988). A few years after the initial settlement, the increasingly violent conflict between guerrilla rebels and the army forced the peasants at first into hiding in the jungle (Falla, 1992), and eventually across the border to Mexico, where they were received by international aid organizations and settled in refugee camps in Southern Mexico. With the initiation of the peace process in the early 1990s, a permanent solution to the refugee problem became a central issue in the negotiations between URNG (Guatemalan National Revolutionary Unit)[5] and the Guatemalan government.

What distinguishes La Quetzal (and returnee communities in general) from most peasant communities in Guatemala is that it is multiethnic. Internally people identify themselves and are identified by others by language—eight Mayan languages are spoken in the community in addition to Spanish, the lingua franca and spoken more and less fluently by most people. Some 10% of the population use Spanish as their mother tongue.[6] The inhabitants of La Quetzal returned collectively to Guatemala in April 1995 after 10–12 years in exile in Southern Mexico. They had established the cooperative, Unión Maya Itzá, before returning in order to buy the land. With the assistance of UN agencies, government agencies, and NGOs the returnees started to build a new community in the unpopulated rainforest. The cooperative owns 5924 hectares, 80% of which is located within the boundaries of the core area of MBR, implying that the use of most of its land has to be approved by CONAP (Consejo Nacional de Areas Protegidas), the national entity in charge of the protected areas in Guatemala.[7] After four years of negotiations, a forest management plan was signed whereby the cooperative is allowed to extract timber for commercial purposes from their forest located in the core area. The rest of the land has been set aside for settlement and agricultural purposes, mainly for use by individual households.

Each household was allocated a piece of land in the village (50×50 m) where they have constructed two houses, one where they sleep and store clothes and valuables and one where they cook and eat. The houses are

[5]URNG is a coalition of the three guerrilla groups, EGP (Ejercito Guerrillero del Pueblo), FAR (Fuerzas Armadas Rebeldes) and ORPA (Organización Revolucionaria de Pueblo en Armas) and the communist party PGT (Partido Guatemalteco de Trabajo), established in 1982.

[6]The following Mayan languages are spoken in the community: *q'eqchi'*, *q'anjob'al*, *mam*, *popti'*, *k'iché*, *chuj*, *ixil* and *ch'orti'*. The first five are spoken by rather large groups of people, the last three by only a few persons.

[7]The returnees bought an old *finca* (farm) that had been in private hands since the 1970s, at the same time as it had become part of the MBR. Eventually, they succeeded in legalizing the purchase, aqreeing to a series of rules and regulations associated with protected areas.

surrounded by a home garden with a variety of plants and fruit trees such as bananas, orange, lime, and mango, giving shade and protecting against the intense dry season heat. The farmland is located outside the village and here they mainly grow maize for their own consumption, selling only the surplus to itinerant merchants. The production of commercial crops such as chilli and pepitoria is rather limited. People in La Quetzal are expecting to get cash incomes from timber extraction by the cooperative once this activity is fully operational.

METHODOLOGY

The ethnobotanical study was incorporated into a broader research program on causes and consequences of forced migration that was already in progress. Even though the community was selected prior to the design of the ethnobotanical study, the characteristics of the community were well suited to meet its objectives.

The ethnobontanical study is based on a combination of botanical and anthropological fieldwork (Stølen, 2000, 2003, 2004).[8] In the MBR a complete botanical survey was made of five one-hectare plots representing the vegetation and environment of the local communities. The plots were divided into 10 m × 10 m subplots, and each subplot was surveyed by registering, measuring, and tagging all trees with a diameter at breast height (dbh) greater than 10 cm. Vines as well as understory vegetation (herbs, shrubs, and small palms) with a dbh less than 10 cm were registered. In addition, a one-hectare plot was selected for ethnobotanical studies. Three criteria were used for selecting this plot: It should be located in the vicinity of the settlement area, villagers had to use the area regularly, and it had to be in a forested relatively homogenous area with no roads, rivers, etc. The choice of the plot was based on conversations with key informants living in the village and more specifically with one cooperative member with thorough knowledge of the area who assisted in our work.

Interviews with key informants (11 men and 8 women) were conducted in Spanish. Some were interviewed as couples and thus the information could not be separated for statistical analysis. Information from 10 men and 5 women was used in the statistics on plant use. The key informants were selected on the basis of their knowledge of natural resources and plants in particular, and therefore did not constitute a representative sample of the community. The informants were members of the

[8] Anthropological fieldwork was carried out between 1998 and 2002, while the ethnobotanical fieldwork was carried out between November 1999 and November 2000.

cooperative's forestry committee, health promoters who had attended a medicinal plant course, and midwives. Thus the results most likely reflect an overestimation of the general level of knowledge in La Quetzal. Our concern has been, however, to document existing plant knowledge in the community. The age of the informants ranged between 22 and 60 years, and the five largest ethnic groups were represented. Only people over 45 were adults when they migrated from the highlands to the rain forest, and they are now considered old and are referred to as such. The informants were interviewed separately and paid a daily wage. In addition to the group of 19 key informants, more informal interviews were carried out with children and adolescents.[9]

The ethnobotanical field survey used the "walk in the woods" method—walking from subplot to subplot. If informants encountered anything they recognized, they were encouraged to name the plant and describe its characteristics as well as possible uses. They were also asked where they had obtained the knowledge. To acquire an indication of the market value of the plants used, informants were asked if they would sell, trade, or buy a particular product derived from that species. The interviews were conducted as a conversation in the forest lasting about two hours, on topics related to construction, timber, commercial species, medicinal plants, and food primarily obtained from collection of plants, but also from fishing and hunting. These visits to the forest lasted altogether some four-to-five hours.[10]

Only three women were interviewed while walking from subplot to subplot in the forest: two came along with their husbands, and one, who had lived for several years in the forest when she was a guerrilla soldier in Guatemala in the 1980s, was interviewed alone. Women claimed to fear the forest and to lack knowledge concerning plants. We asked the women willing to be interviewed, but unwilling to enter the forest to take me to the places where they collected plants for various uses. Information about women's knowledge concerning forest plants was also collected in the anthropological study upon which we draw in this paper.

[9] When this sample was made, the social anthropologist had been living and working in the community for several months and had acquired comprehensive knowledge of the sociocultural conditions.

[10] A survey was also conducted in home gardens, using the same questions as for the forest plots. The results will be the subject of another paper. Here the survey provided additional knowledge on the general importance of plant species in the community (Nesheim, unpublished data).

DATA ANALYSIS

Most ethnobotanical studies assume implicitly that informants' answers are representative of present day usage of plant products. Only very few studies distinguish between actual use and knowledge of uses (Byg and Balslev, 2001). Most knowledge of plant species properties reported in the study is not currently being used by the informants. Some informants also reported knowledge of a species' characteristics, but did not know of any uses to which they might be put.

The different use categories of species were established based on interviews with the informants, corresponding closely to those of Prance *et al.* (1987). We used seven categories: construction (which included all structural and outdoor uses of wood), medicine, commercial, food, firewood, tools and craft, and other (ornamental, perfume, toy and music). Species with multiple uses were placed into each relevant category. For each category of use, the percentage of knowledge and use of the species was calculated. Several of the use categories may be considered artificial, as many indigenous use categories do not include general terms, for example, uses subsumed under the terms "craft" and "construction" are all individually named. Twenty-five percent of informants had to recognize utility of a species for it to be assigned to one or more use categories.

In order to defermine to what degree and in what form knowledge had been transmitted each informant was asked where they had obtained the knowledge. The origin of the knowledge was then categorized according to the geographical area in which it was acquired by the informants.

All the species in the inventory were identified if possible in the field by vernacular name. Later they were identified on the basis of their taxonomic name using reference material in the relevant major herbaria such as The Field Museum in Chicago, the Missouri Botanical Garden, the New York Botanical Garden, the Royal Botanical Gardens, Kew, and the Natural History Museum, London. The Flora of Guatemala, the Checklist of Mesoamerica, and the Checklist of the Vascular plants of Belize were used as keys to identify species. Voucher specimens collected for all the species are deposited at the Universidad de San Carlos (USAC) in Guatemala City.

RESULTS

FOREST COMPOSITION

A total of 307 species of trees ≥ 10 cm dbh, vines, and herbs were registered in the subplots. Under-vegetation was registered in 25% of the sub-

plots. The species represented 78 families, of which the Fabaceae, Rubiaceae, and Bignoniaceae families were the most speciose. These families also had the highest number of individuals (Nesheim *et al.*, 2003). Vines were relatively abundant, while there were few herbs registered in the plots (Nesheim *et al.,* in press/unpublished). The species appearing most frequently in the plots were individuals of *Casearia* sp., *Trophis* sp., *Pouteria* sp. and *Sebastiania* sp. Tagged palms were relatively few. A likely reason, confirmed by the informants, is that the abundant canopy palm, *Sabal mauritiiformis* (botán), was cut for construction of houses.

USES OF TREE SPECIES AND NON-TIMBER FOREST SPECIES

The informants identified 79 plants, 22% as potentially useful (Table II). Ten species mentioned as useful were not present in the plot (Nesheim *et al.*, 2003). There was a clear difference between the number of species reported as useful and the numbers presently used by the informants (Fig. 2). The species being used are common on a wide geographic range and many are being commercialized, e.g., *Swietenia macrophylla (mahogany/caoba), Neurolaena lobata* (3 puntas), *Spondias mombin* (jocote jobo), *Bursera simaruba* (indio desnudo).

The species reported to be useful comprise 34 plant families (Nesheim *et al.*, 2003). All the species in the Arecaceae family can be used for some purpose (see also DeeWalt, 1999; Prance *et al.*, 1987). Other plant families rank high with regard to use because of timber qualities. The Fabaceae family included the highest number of timber species, used for construction and sold. Forty-seven species (14%) were used for construction, 23 (7%) for medicine, 22 (6%) commercialized, 22 (6%) as possible food sources, 13 (4%) were mentioned as useful for firewood and seven species (2%) could be used to make tools and crafts (Fig. 3). The "other" category contains three species: one ornamental species, *Ardisia paschalis*, reported to smell good and used as perfume. *Olyra glaberrina*, which could be used as a musical instrument, and *Subin* sp., whose fruits could be used to make earrings or toys.

All informants knew at least seven species and most people knew about 19 different species (Table I). Thirty-six of the species reached the 25% level of knowledge and use by the informants (Table I), the majority (40%) due to their widespread use for a single application. For instance, *Sabal mauritiiformis* (botán) is used mainly in construction, and *Neurolaena lobata* (3 puntas) is used to cure malaria. Of other species, 27% could be used for two purposes, such as, for instance, food and medicine. Eight species 10% represent three use categories and three

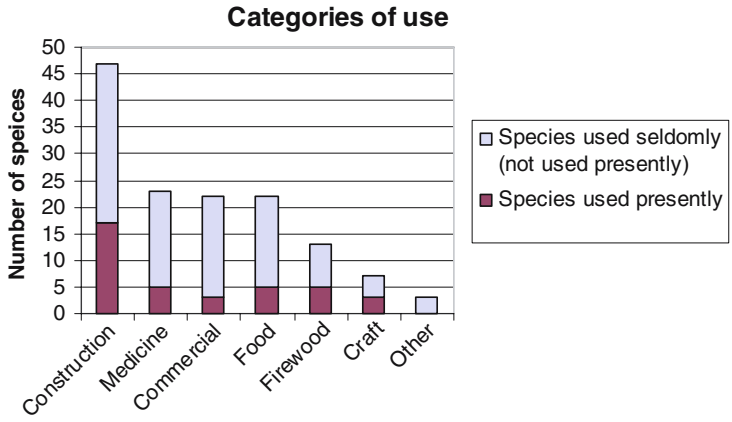

Fig. 2. The distribution of species in different use categories. The commercial column illustrates species sold by the cooperative (19) and species sold by the individual (3).

species 4% are associated with four use categories. These are: *Swietenia macrophylla* (mahogany/caoba), classified as first-class timber in commerce and used to make crafts such as furniture, as medicine to cure fungi on the feet, and in construction; *Cedrela odorata* (cedar), like mahogany, is classified as first-class timber in commerce, and is used for crafts, for construction, and as diabetic medicine. *Cryosophila stauracantha* (escoba) can be eaten the palm heart, used to stop bleeding, the leaves can be used for thatching roofs, though they are not of as good a quality as *Sabal mauritiiformis*, and they can be used to make brooms. Despite this, *C. stauracantha* was not valued and rarely used. It is important to recognize that species reported to be useful are not necessarily being used currently by the informants (Table II).

Construction

About 17 species of the 47 mentioned as useful for construction, were commonly recognized as timber species in the community due to their resistance to rotting and wood-eating insects (Table II). Among the most frequently used species were *Sable mauritiiformis* (botán) and *Manilkara zapota* (chico zapote). House walls were made mostly of thin posts of young erect trees of a large variety of species. More recently a few people replaced the thin posts

Table I. Different Levels of Use: Species with 25%[a] Level of Use, the Most Common Plants (C)[b] and a Common Minimum (7)[c]

Family	Scientific name	Vernacular name	Level of use
Fabaceae	*A. cornigera* (L.) Willd	Subin	25%, C
Euphorbiaceae	*A. latifolia* Sw	Mahauva/capulin	25%, C
Rubiaceae	*A. yucatanensis* Standl	Son	25%
Ulmaceae	*A. hottlei* (Standl.) Standl	Luin	25%
Apocynaceae	*A. cruentum* Woodson	Malerio Colorado/quino	25%, C
Anacardiaceae	*A. graveolens* Jacq	Jobillo	25%
Fabaceae	*B. leucocalyx* (Britton & Rose) Barneby & J.W. Grimes	Guaciban	25%
Moraceae	*B. alicastrum* Pittier	Ramon blanco	25%
Burseraceae	*B. simaruba* (L.) Sarg	Indio desnudo/chaca negro /jiote	25%, C, 7
Guttifera	*C. brasiliense* (Standl.) Standl	Santa maria	25%
Cecropiaceae	*C. peltata* L	Guarumo	25%, C, 7
Meliaceae	*C. odorata* L	Cedar	25%
Arecaceae	*C. elegans* Mart	Xate hembra	25%, C
Arecaceae	*C. oblongata* Mart	Xate jade	25%, C
Arecaceae	*C. tepejilote* Liebm. ex Mart	Pakaya	25%, C, 7
Arecaceae	*C. ernesti-augusti* H. Wendl	Xate cola de pescado	25%, C
Costaceae	*C. pulverulentus* C. Presl	Hierba acida/caña de cristo/caña fistola	25%, C, 7
Fabaceae	*Dialium guinaense* (Aubl.) Steud	Tamarindo	25%
Arecaceae	*D. orthacanthos* Mart	Bayal	25%
Moraceae	*Ficus* sp	Matapalo	25%
Guttifera	*G. intermedia* (Pittier) Hammel	Mangio/mulacte	25%, C
Caricaceae	*J. dolichaula* (Donn. Sm.) Woodson	Papaya de monte/ceibillo	25%
Sapotaceae	*M. zapota* (L.) P. Royen	Chico zapote	25%, C
Asteraceae	*N. lobata* (L.) R. Br. ex Cass	3 puntas	25%, C, 7
Piperaceae	*P. auritum* H.B.K	Momón/santa maría	25%, C, 7
Sapotaceae	*P. durlandii* (Standl.) Baehni	Zapatillo hoja ancha	25%
Sapotaceae	*P. sapota* (Jacq.) HE. Moore & Stearn	Zapote mamay	25%
Bombacaceae	*P. ellipticum* (H.B.K.) Dugand	Amapola	25%, C
Arecaceae	*S. mauritiiformis* (H. Karst.) Griseb. & H. Wendl. ex Griseb	Botán/iguano (young individual)	25%, C, 7
Euphorbiaceae	*S. tuerckheimiana* (Pax & K. Hoffm.) Lundell	Chechén blanco	25%
Anacardiaceae	*S. mombin* L	Jocote jobo	25%
Bignoniaceae	*S. riparium* (H.B.K.) Sandwith	Bejuco sobatch/bejuco blanco	25%
Meliaceae	*S. macrophylla* King	Mahogany/caoba	25%, C
Combretaceae	*T. amazonia* (J. F. Gmel.) Exell	Canxan/peine	25%
Moraceae	*T. racemosa* (L.) Urban	Ramón colorado	25%, C
Fabaceae	*V. lundellii* (Standl.) Killip ex Record	Danto	25%, C

[a]Twenty-five percent of the informants had to recognize a species for it to reach this level.
[b]This category includes 19 species that most of the informants knew. It is based on the judgement by the authors.
[c]All informants, 19 men and women knew seven plant species.

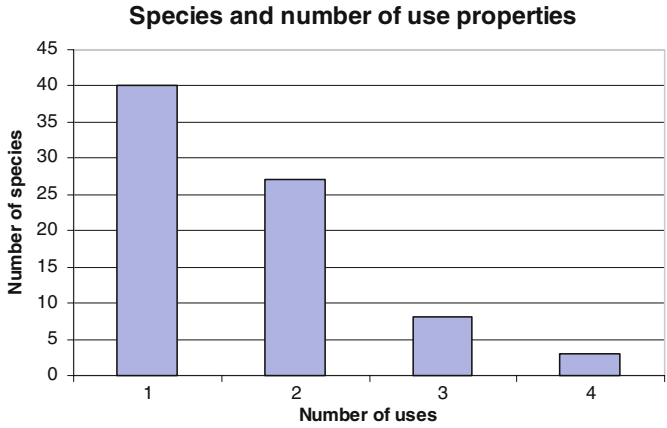

Fig. 3. The distribution of species used for several applications.

with timber boards of *Calophyllum brasiliense* (santa maría), *Lonchocarpus castilloi* (manchiche), *Pseudobombax ellipticum* (amapola), or *Aspidosperma cruentum* (malerio colorado) (species resistant to insect attack, and not too heavy). Some people also used *Swietenia macrophylla* (caoba) for timber boards, but it was generally judged as too valuable for this purpose, and better suited for furniture.

Roofs were made either of thatched palm leaves of *Sabal mauritiiformis* (botán) (about 50%) or of corrugated iron sheets. Most people preferred palm leaf roofs for their kitchens because they were cooler in the summer. According to our informants, thatched roofs would last several years depending on how thick the thatch was made. After five years in the community people had still not changed their thatched roofs. In most instances whole trees were cut down to reach the leaves, only on young trees could leaves be cut leaving the tree standing. A few other species, such as *C. stauracantha*, were mentioned as potentially useful for the same purpose, though not of as good quality so no one used them. There were few fully grown *S. mauritiiformis* trees close to the village.

Two vine species, *Arrabidaea floribunda* (bejuco pimienta) and *Stizophyllum riparium* (bejuco sobatch), and also strips of bark from *Alchornea latifolia* (capulín) served to lash poles and beams together, mostly in animal sheds. Nails were preferred for the main houses if affordable because they lasted longer. Floors were made of soil mixed with water, which was smoothed and left to dry.

Medicine

Twenty-three species were reported as having medicinal properties, but only five species are currently used. The five species, *Aspidosperma cruentum* (malerio colorado), *Bursera simaruba* (indio desnudo/chaca colorado), *Piper auritum* (momón), *Swietenia macrophylla* (caoba), and *Neurolaena lobata* (3 puntas), grow in most of Guatemala, and several of the species were sold as medicinal plants at the regional markets in Santa Elena, the departmental capital. The five species were used to cure malaria, fungus infections on the feet, coughs, and in relation to child birth. Nine of the informants said that they had collected forest species for medicinal purposes, but the majority refer to the same species, *N. lobata* (3 puntas), used to cure malaria, which also grows in open areas, such as within the borders of the village. Species growing in open, disturbed areas are generally short-lived and fast-growing species with high population turnover rates, and are referred to as pioneers or ruderals. Several informants remarked that when "pills" did not work, plant medicine was used, and the reverse. Still, in general they preferred going to the clinic because of a lack of knowledge and faith in medicinal species. Older people (45–60 years) say they do not know the plants in their new community, and that there were a lot more medicinal plants in the highlands of Guatemala. The health workers at the clinic, although they had taken a course in plant medicine, said that they use western pharmaceutics. Those who use plant medicine were referred to as "naturistas." The most frequent illnesses in the community were malaria, diarrhoea or stomach problems, influenza, and cough. Snakebites also occur, but rarely. For other illnesses not recognized by western medicine such as *mal de ojo*[11] — the evil eye, *susto*[12] — fear, and *quebradura de hueso*[13] people visit healers who use medicinal plants to treat them. Several of the plants used by the healers and midwives are found in their home gardens. Home garden species are also used by a few people to cure stomach problems and influenza.

Food

About 50% of the people collect edible plants from the forest, and all extract non-timber forest products for food occasionally, useually in the

[11] *Mal de ojo* is believed to affect children, especially small ones, as a result from a glare or stare (deliberate or accidental) from another person. Pregnant women, drunkards, and people who are mentally retarded are believed to be particularly dangerous.

[12] *Susto* is the result of shock or fright, believed to cause the blood to circulate slowly; symptoms are an excess of sleep, lack of appetite, elevated temperature, thirst and weeping.

[13] The translation of "quebradura de hueso" is bone fracture but the meaning of the word is pain in the bones/body.

course of other daily activities. Twenty-two species were recorded as potential food, but only five, *Chamaedorea tepejilote* (pakaya), *Pouteria sapota* (zapote mamey), *Licania platypus* (sunza), *Piper auritum* (momón), and *Dialium guianense* (tamarindo), were reported to be consumed. Fruits were the most commonly mentioned food from the forest, while the buds of several palms were also eaten, but except for *C. tepejilote* (pakaya) these were not collected regularly. Only one person said that he used to collect fruits and fungi during the appropriate seasons. The informants do not consider themselves to be using the forest for food, and the women especially resist going to the forest because of fear of snakes and other animals. Other non-timber forest products being used for food were snails, crabs and mushrooms. Some community members also went hunting deer and tepesquintle (*Cuniculus paca*) with their dogs.

Commercial Species

Nineteen of the 22 commercialized species were timber, the most important being *Swietenia macrophylla* (mahogany) and *Cedrela odorata* (cedar). The timber species are sold by the cooperative and do not therefore provide a direct income for the families, though they benefit from them through shared goods.

Household economic strategies include crop/milpa production and the harvesting of three "xate" species, *Chamaedorea elegans* (xate hembra), *C. oblongata* (jade), and *C. ernesti-augusti* (cola de pescado). The leaves of these species are cut and sold to a company that ships them to the USA and Europe to be used for flower arrangements. The collection of xate is an important source of income for a number of families, and especially the young men and boys. One-third of the informants collected xate for sale regularly. Several informants estimated that about 70 people collected xate occasionally, while about 30 people did so regularly. The collection of xate leaves for sale was something they learned from a local NGO when settling 5 years ago, when they were given a 3-day course on how to harvest the leaves.

A potential commercial species is *Desmoncus orthacanthos* (bayal), the rattan species of the New World, which can may be used to weave baskets for sale. There are a few people who know this skill from earlier times, but few of them currently practice it due to lack of time. One of the informants said that he used to extract chicle gum, a latex harvested by cutting cross-sections in the outer bark of the tree *Manilkora zapota*, but no longer did so. Chicle gum is no longer marketable in this area, due to the industry substitution of synthetic latex (Salafsky *et al.*, 1993) and *sorva* gum from Brazil

(Nations, 1992). The informants said that there where a few additional timber species, such as *Brosimum alicastrum* (ramón blanco) and *Bursera simaruba* (indio desnudo), being sold at the market in addition to the species being sold through the cooperative, but they themselves did not sell anything. Apart from this, one man had collected seeds from seven different timber species in the forest to plant on his land for future sales, and there was also a group of five people who, having completed a medicinal plant course, collected species to make medicines for sale in the community, though there was only limited demand. A honey project had been started with little success in the forest by a group of women, and a few people sold deer and tepeszuintle they hunted with their dogs.

Tools and Craft

Seven species were mentioned as potentially useful for tools and craft, but only three, *Cedrela odorata* (cedar), *Swietenia macrophylla* (mahogany/caoba), and *Alchornea latifolia* (capulín), were commonly used. About 120 meters in board length of *Swietenia macrophylla* (mahogany) and *Cedrela odorata* (cedar) were given to community members for personal use in their houses and some people used the wood to make furniture. Strips of bark from *Alchomea latifolia* (capulín) were useful for carrying meat during hunting trips, or agricultural products back from the fields. Household equipment other than furniture was mostly plastic, though *Quararibea funebris* (mahauva holol/batidor) was mentioned as useful to make ladles.

Firewood

All 13 species were occasionally used for firewood, but five species were recognized as having more desirable firewood characteristics, such as being easily split, lighting easily, and burning slowly: *Brosimun alicastrum* (ramon blanco), *Alseis yucatanensis* (son), *Pouteria durlandii* (zapotillo hoja ancha), *Sebastiania tuerckheimiana* (Chechén blanco), and *Coccoloba belizensis* (papaturro). However, it was qenerally agreed that almost all trees could be used for firewood. When the community was established the whole area was covered with mature forest, and many have, until recently, just been collecting firewood around their house. Several people mentioned that during the last half year they had rented a chainsaw and a car to collect enough firewood for several months.

Traditional Ecological Knowledge

There is a clear distinction in levels of TEK between men and women (Fig. 4). Our results indicate that most of the men have some knowledge of a mean of 47 species, while the women had a mean knowledge of 15. While traditionally women have expertise in medicinal plantes (Begossi, 2002), in La Quetzal forest plant resources have largely become the concern of men, and several women, including the midwife, said that they sent the men to collect medicinal plants in the forest. However, we were told that a few women had bought medicinal plants from salesmen visiting the community.

Most informants' knowledge of plants concerned useful species (Fig. 4). This pattern was most obvious for women, where 60% had knowledge only of useful species. Informants with knowledge of species with no use potential were relatively few (men with a mean of nine, and women with a mean of one). The category "knowledge — no use", included either very abundant species, or species having a negative property, such as the plant being infested with aggressive ants (e.g., *Acacia* sp.). Important for the interpretation of the results is that the category of uncertain answers was relatively high—the men were uncertain about a mean of 10 plant species, and the women of four.

The results indicate that people have been flexible and local knowledge has been absorbed at every stage of migration. The highest proportion of knowledge regarding plant resources, 42%, was reported as having been acquired in La Quetzal (Fig. 5).— 25% from neighbors or from neighboring communities, and 15% through different NGO courses, e.g., forestry, cutting xate, and also plant medicine. These courses were given to the settlers as part of the international assistance granted to the returnee population, but also because, by settling inside the Maya Biosphere Reserve, they had to follow a management plan and were thus introduced to forest inventories and the concept of sustainable use of forest resources.

Most of the people now residing in La Quetzal left the highlands in the 1970s and spent five to 7 years in Ixcán, living in dense rainforest as part of a colonization project, and it was here that they acquired 28% of their plant species knowledge. The vegetation was similar to the cooperative, and the area was far away from commercial centres and with little infrastructure. During the subsequent 10–12 years in refugee camps in Mexico, a further 15% of current forest resource knowledge was learned. In the refugee camps people had access to land, potable water, electricity, good roads and transport, opportunities to earn money, and to learn Spanish, as many spoke only their indigenous language, and how to read and write. Moreover, their children received education and health services, and they learnt how to organize themselves to address their problems (Stølen,

Table II. Species and Use Categories

Construction	Medicine	Food	Commercial	Firewood	Craft/tools
Acacia dolichostachya S.F. Blake. Vn: Gesmo	*Acacia cornigera* (L.) Willd. Vn: Subin	*A. cornigera* (L.) Willd. Vn: Subin	*A. cruentum* Woodson. Vn: Malerio colorado	***A. yucatanensis* Standl. Vn: Son**	***Alcornea latifolia* Sw. Vn: Mahauva/capulín**
Acosmium panamense (Benth.) Yakovlev. Vn: Chichipate	*Ampelocera hottlei* (Standl.) Standl. Vn: Luin hembra	*A. floribunda* (H.B.K.) Loes. Vn: Bejuco pimienta	*Astronium graveolens* Jacq. Vn: Jobillo	*B. alicastrum* Pittier. Vn: Ramon blanco	*Castilla elastica* Sessé. Vn: Hule
A. yucatanensis Standl. Vn: Son	*A. floribunda* (H.B.K.) Loes. Vn: Bejuco pimienta	*Bactris* sp. Nv: Jauacte/biscoyol	*Balizia leucocalyx* (Britton & Rose) Barneby & J.W. Grimes. Vn: Guaciban	***C. belizensis* Standl. Vn: Papaturro**	***C. odorata* L. Vn: Cedro**
***A. hottlei* (Standl.) Standl. Vn: Luin hembra**	***A. cruentum* Woodson. Vn: Malerio colorado**	*B. alicastrum* Pittier. Nv: Ramon blanco	*C. brasiliense* (Standl.) Standl. Vn: Santa maria	*Guarea glabra* Vahl. Vn: Cedrillo	*C. stauracantha* Heynh.) R. Evans. Vn: Escoba
A. floribunda (H.B.K.) Loes. Vn: Bejuco Pimienta	*A. graveolens* Jacq. Vn: Jobillo	*Cecropia peltata* L. Vn: Guarumo	*C. odorata* L. Vn: Cedro	*Piper* sp. Vn: Cordonsillo	*D. orthacanthos* Mart. Vn: Bayal
***A. cruentum* Woodson. Vn: Malerio colorado**	*B. simaruba* (L.) Sarg. Vn: Indio desnudo	***C. tepejilote* Liebm. ex Mart. Vn: Pakaya**	***Chamaedorea ernesti-augusti* H. Wendl. Vn: Cola de pescao**	***P. durlandii* (Standl.) Baehni. Vn: Zapotillo hoja larga**	*Q. funebris* (La Llave) Vischer. Vn: Batidor
Aspidosperma megalocarpon Müll. Arg. Vn: Malerio blanco	*C. peltata* L. Vn: Guarumo	*Costus pulverulentus* C. Presl. Vn: Caña de cristo	***Chamaedorea oblongata* Mart. Vn: Jade**	*P. copal* (Schltdl. & Cham.) Engl. Vn: Copal	***S. macrophylla* King. Vn: Caoba**
***A. graveolens* Jacq. Vn: Jobillo**	*C. odorata* L. Vn: Cedro	*C. stauracantha* (Heynh.) R. Evans. Vn: Escoba	***C. elegans* Mart. Vn: Xate hembra**	*Rinorea guatemalensis* (S. Watson) Bartlett. Vn: Violetta serrana/bacelaq	
Amphitecna latifolia (Mill.) A.H. Gentry D. Dietr. Vn: Hueso de sapo/pellejo de sapo	*C. pulverulentus* C. Presl. Vn: Caña de cristo	*Cymbopetalum* sp. Nv: Anona silvestre	*Cojoba arborea* (L.) Britton & Rose. Vn: Cole coche	***S. tuerckheimiana* (Pax & K. Hoffm.) Lundell. Vn: Chechen blanco**	

***B. leucocalyx* (Britton & Rose) Barneby & J.W. Grimes. Vn: Guaciban**

B. alicastrum Pittier. Vn: Ramon blanco

Bucida buceras L. Vn: Pucte

***B. simaruba* (L.) Sarg. Vn: Indio desnudo**

***C. brasiliense* (Standl) Standl. Vn: Santa maria**

C. peltata L. Vn: Guarumo

C. odorata L. Vn: Cedro

***C. arborea* (L.) Britton & Rose. Vn: Cole coche**

C. pulverulentus C. Presl. Vn: Hierba acida/Caña de cristo

C. stauracantha (Heynh.) R. Evans. Vn: Escoba

E. folkersii Krukoff & Moldenke. Vn: Pito

Jacaratia dolichaula (Donn. Sm.) Woodson. Vn: Papaya de monte

***N. lobata* (L.) R. Br. ex Cass. Vn: 3 puntas**

Pimenta dioica (L.) Merr. Vn: Pimienta

P. auritum H.B.K. Vn: Momón/Santa Maria

Piper sp. Vn: Cordonsillo

***D. guianense* (Aubl.) Steud. Vn: Tamarindo**

Garcinia intermedia (Pittier) Hammel. Vn: Mangio/mulacte

Inga sp. Vn: Bitz

Jubaea chilensis (Molina) Baill. Vn: Coroso

L. platypus (Hemsl.) Fritsch. Vn: Sunza

Palmae. Vn: Posh/ capuka

Pimienta dioica (L.) Merr. Vn: Pimienta

***P. auritum* H.B.K. Vn: Momon /Santa maria**

Erythrina folkersii Krukoff & Moldenke. Vn: Pito rojo

L. platypus (Hemsl.) Fritsch. Vn: Sunza

Lonchocarpus castilloi Standl. Vn: Manchiche

Ormosia schippi Standl. & Steyerm. Vn: Colorin

P. ellipticum (H.B.K.) Dugand. Vn: Amapola

Schizolobium parahyba (Vell) S.F. Blake. Vn: Plumajillo

Simaruba bursera (L.) Sarg. Vn: Indio desnudo

Swartzia cubensis (Britton & P. Wilson) Standl. Vn: Llora sangre/Cátalox

Simira salvadorensis (Standl.) Steyerm. Vn: Saltemuch

Trichilia pallida Sw. Vn: Chile chacalaca

Trophis mexiana (Liebm.) Bur. Vn: Ramon

***Trophis racemosa* (L.) Urban. Vn: Ramon colorado**

Table II. Continued

Construction	Medicine	Food	Commercial	Firewood	Craft/tools
C. stauracantha Heynh.) R. Evans. Vn: Escoba	*Siparuna thecaphora* (Poepp. & Endl.) A. DC. Vn: Sorio	***P. sapota* (Jacq.) H.E. Moore & Stearn. Vn: Zapote mamey**	*S. macrophylla* King. Vn: Caoba		
Cupania belizensis Standl. Vn: Chonte	***Smilax* sp. Vn: Sarsaparia**	*S. mauritiiformis* (H. Karst.) Griseb. & H. Wendl. ex Griseb	*Terminalia amazonia* (J.F. Gmel.) Exell. Vn: Canxan		
***Cymbopetalum mayanum* Lundell. Vn: Candelero**	*S. mombin* L. Vn: Jocote jobo	*S. mombin* L. Vn: Jocote jobo	*Vatairea lundellii* (Standl.) Killip ex Record. Vn: Danto		
Dalbergia glabra (Mill.) Standl. Vn: Bejuco quivish/muc	***S. macrophylla* King. Vn: Caoba**	*Thevetia ahouai* (L.) A. DC. Vn: Huevo de chuchu	*Vochysia guatemalensis* Donn. Sm. Vn: San Juan		
***D. guianense* (Aubl.) Steud. Vn: Tamarindo**	*T. ahouai* (L.) A. DC. Vn: Huevo de chuchu		*Zanthoxylum ekmanii* (Urb.) Alain. Vn: Lagarto		
E. folkersii Krukoff & Moldenke. Vn: Pito					
G. glabra Vahl. Vn: Cedrillo					
L. platypus (Hemsl.) Fritsch. Vn: Sunza					
***L. castilloi* Standl. Vn: Manchiche**					
***Manilkara chicle* (Pittier) Gilly. Vn: Chico zapote**					

M. zapota (L.) P. Royen. Vn: Chico zapote
Philodendron sp. Vn: Mimbre
Philodendron sp. Vn: Mocosai
Palmae. Vn: capuka/posh
Pouteria reticulata (Engl.) Eyma. Vn: Zapotillo hoja fina
P. sapota (Jacq.) H.E. More & Stearn. Vn: Zapote mamey
P. copal (Schltdl. & Cham.) Engl. Vn: copal
***P. ellipticum* (H.B.K.) Dugand. Vn: Amapola**
Quararibea funibris (La Llave) Vischer. Vn: Molinio hojo batidor
***S. mauritiiformis* (H. Karst.) Griseb. & H. Wendl. ex Griseb. Vn: botan/iguano**
***S. parahyba* (Vell.) S.F. Blake. Vn: Plumajillo/ guanacaste**
A. cornigera (L.) Willd. Vn: Subin
A. paschalis Donn. Smith Vn: Chilil

Olyra glaberrima Raddi. Vn: Sacate de bajo

Table II. Continued

Construction	Medicine	Food	Commercial	Firewood	Craft/tools
S. tuerckheimiana (Pax & K. Hoffm.) Lundell. Vn: Chechen blanco					
S. salvadorensis (Standl.) Steyerm. Vn: Saltemuch					
S. mombin L. Vn: Jocote jobo					
S. riparium (H.B.K.) Sandwith. Vn: Bejuco Sobatch					
S. cubensis (Britton & P. Wilson) Standl. Vn: Palo llora sangre/catalox					
S. macrophylla King. Vn: Caoba (mahogany					
***T. amazonia* (J.F. Gmel.) Exell. Vn: Canxan**					
T. racemosa (L.) Urban. Vn: Ramon colorado					
***V. lundellii* (Standl.) Killip ex Record. Vn: Danto**					

Note. Species in bold are used presently. With regard to the categories "construction" and "firewood," bold letters illustrate appreciated species. Regarding "commercial speices" bold letters illustrate species sold by the individuals in the community. The category "other" includes species used for orrnments, perfumes, toy and music. Vn: Vernacular name.

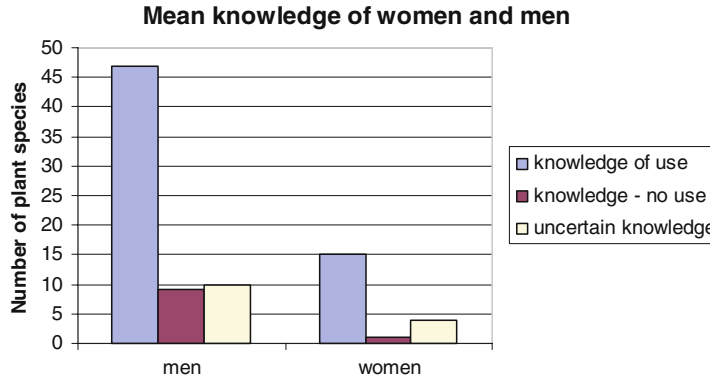

Fig. 4. The different knowledge of species with regard to men and women.

2000). A further 2% of plant knowledge was picked up from the west coast of Guatemala, as a few people in the community migrated seasonally to the coast for work while still living in the highlands of Guatemala. The common knowledge category (13%) represents plant knowledge shared by people across regions and countries.

DISCUSSION

Use of Plant Forest Resources by the Returnee Community

The total number of potentially useful species identified in our study of La Quetzal (79%) is similar to the results of a study by Mutchenick and McCarthy (1997), also in the Petén region (67%). However, the number of species currently collected and used in La Quetzal is only 38.[14] Differences in background and access to external resources between the people in the two studies probably influence these results. The subjects of Mutchinick and McCarthy's study have lived longer in the area and thereby acquired more knowledge. In addition they lacked the external assistance of money and products that the returnee population of La Quetzal received, and are thus more dependent on natural resources. A study by Atran *et al.* (2002) comparing knowledge of natural resources among native Maya Itza and two migrant communities in the Petén region comprising ladinos and Maya Q'eqchi, respectively, finds that the immigrants who have lived in

[14]This number leaves out the timber species sold by the cooperative, as the focus is on the individual level.

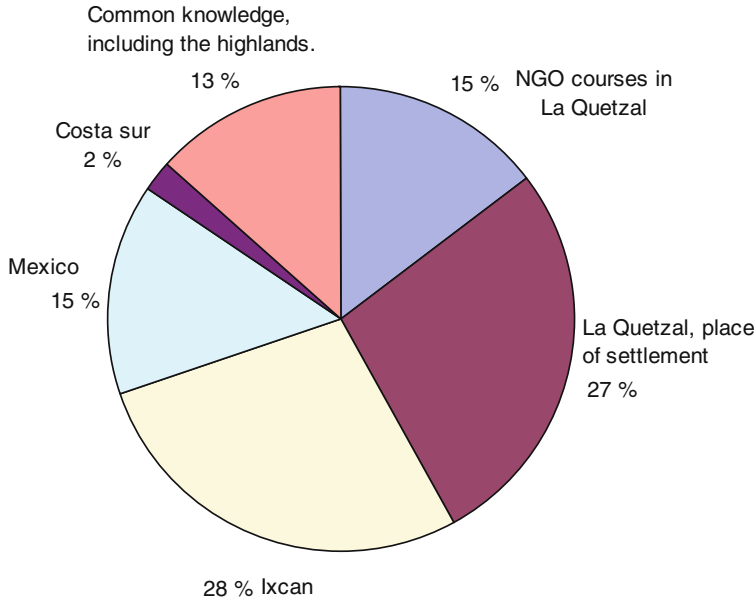

Fig. 5. Sources of knowledge.

the area for a long time, and especially the Q'eqchi community have less knowledge than the native group. It would seem that migrants generally are not very interested in learning about natural resources in their new settlement. Our study in the multiethnic community of La Quetzal did not statistically categorize differences between ethnic groups. Local people, however, often mentioned such differences. The Q'eqchi were referred to as more traditionalist, especially the older Q'eqchi, a trait that possibly counteracts the willingness to adopt new environmental knowledge (Carr, 2004; Stølen, 2004). In the study by Atran *et al.* (2002) the locality of the groups, i.e., the ladino community interacting and learning from the neighboring Maya Itzá community, in contrast to less interaction between the Maya Itzá community and the more distant Q'eqchi community, may have influenced the results.

Construction

Knowledge of the number of construction species is relatively high in La Quetzal (47) comparated to Mutchenick and McCarthy's (1997) study (29). This may be due to the fact that La Quetzal was built recently and

required a lot of construction materials. In addition, among men knowledge of timber species confers status since the cooperative earns income from logging. Some men involved in logging related work had opportunities to go on forestry courses that involved species inventories in the area to be logged carried out with outside experts.

Medicinal Plants

Comerford documents the use of several medicinal plants in the Petén region which are similar to those reported here (Comerford, 1996). They report however several species not identified as useful in our study, e.g., *Protium copal*, *Laetia thamnia*, *Pauteria sapota*. Comerford (1996), in a study undertaken in San Andres, an old community in the center of the Petén region known for its healers, identified 81 medicinal plants. In La Quetzal, although 23 species were reported as having medicinal properties, only five were collected. Still, an important fact in Comerford's study is that all the medicinal species were found in secondary forests and in home gardens, front yards, and open places—none in primary forests. This could indicate that it is the plant species found in near by surroundings, not necessarily forest species, that are collected by people in the Petén region. Several authors have noted that useful species are found at higher densities in secondary forests, so their collection involves less travel (Ampornpan and Dhillion, 2003; Comerford, 1996; Grenard, 1992; Toledo *et al.*, 1992). In our study, too, a higher density of useful species including medicinal species were found in the informants' home gardens (Nesheim, unpublished data). Home garden species generally have a wider climatic and regional growing range, as many are semidomesticated, and are thus used to a greater extent than many primary forest species.

The general attitude in La Quetzal of a lack of faith in the medicinal properties of plants, with few people knowing which plants to use and how, is probably influenced by the time spent in refugee camps in Mexico, where the returnees had access to pharmaceutical remedies as part of relief assistance. Currently, a Cuban doctor provides almost free medicines and assistance, although this is only a short-term arrangement. There is a clear trend in our study towards use of western medicine.

Food

The facts that the forest is the men's working area, while food traditionally is women's responsibility, and that the women generally do not go

into the forest account for the few species collected. It is possible that forest food plants may never have been an important part of their diet, as the highland environment is relatively deforested (Atran *et al.*, 2002). Corn is important in all aspects of Maya life (Emch, 2003) and their main diet based on agriculture/milpa production of corn and beans has not changed during the different stages of migration. Haenn (1999) explored a more extreme situation, in which the colonists see the forest only as land to be cleared for agriculture. Such attitudes are not found in our area of study, probably because the conservation of the forest was a prerequisite for settling in the protected area of the Maya Biosphere Reserve. The time spent hiding in the jungle and dependent on its resources, as well as currently living in a forestry community are other important influencing factors.

Commercialisation of Species

Xate was the single most important forest product of economic value being exploited by individual settlers in La Quetzal. Another study comparing the income strategies of colonist communities and natives, concludes that cutting xate is typical of the inexperienced new settler (Reining *et al.*, 1992). The study also concludes that colonists are more dedicated to crop production or agriculture than to forest harvesting (Reining *et al.*, 1992), as is also the case in our study of La Quetzal. The problem of being dependent on only one product is vulnerability to market demand and the possibility of over-harvesting (Browder, 1992; Nepstad, 1992; Padoch, 1992), making future income possibly insecure. At present it is important for the resettlers that xate has a developed and organized market: such a market is lacking for other non-timber forest products (NTFPs) in the area.

There have been other attempts to utilize the forest in La Quetzal, but they are relatively few and have had varied success, as illustrated by the examples of chicle gum (*Manilkara zapota*), honey, and medicinal products. Whether an individual chooses to utilize the forest for market-oriented production depends on the market, the cost of production and transportation to markets, which may in many instances be of varied quality. It is possible that the market potential of NTFPs is possibly a lot higher than it now seems. Petén has a history of forest culture where extraction of xate has been practised for at least 30 years, and NTFP-use is a heritage of more than 100 years (Reining and Heinzman, 1992; Schwartz, 1990). In a market study in a similar forest type in Veracruz, Mexico, more than 160 species are recorded as marketable (Ibarra-Manriquez *et al.*, 1997), illustrating the high value of these forests as well as their significant contribution to social welfare.

Vines, Tools, and Craft

Although most tropical forest inventories do not include vines, they are thought to have an important impact on forest structure and are also important for ethnobotanical reasons (Phillips, 1991; Phillips and Gentry, 1993). Vines are likely the most forgotten resource, neglected by ethnobotanists and hardly utilized by the people. A few informants mentioned that they knew a vine species (*Arrabidaea* sp.) that could be used as a remedy against snake bites or gastritis, others said that a vine species could be used as a coffee substitute, but few or none used them for these purposes today. Some said that they use vines to lash poles together or to carry heavy loads when the preferred tools were not affordable, but these were not distinguished as separate species. As there is no tradition of using vines it was easier and more efficient to buy tools in the store.

Potential Knowledge, Traditional Knowledge and Local Knowledge

The high correspondence in the results between knowledge and use supports Berke's statement that knowledge is related to use and practice (Fig. 2). Knowledge that is being maintained, transferred, or exchanged is knowledge that serves a purpose. People's knowledge of plant species was often connected to a story relating to their past as internally displaced in the jungle before crossing the border to Mexico, or in a few cases relating to a past as a guerrilla soldier in the same jungle. As noted above, much of this knowledge is at present rarely used, but presumably can be called upon when needed. It is notable that several informants stated that it is only people with a special interest in natural resources who have knowledge of forest resources.

Those in the community who had lived in the highlands of Guatemala, in general the older people, have seen a considerable change in resource use and consumption. In the highlands ecological knowledge was received from parents and grandparents, through seeing them collecting and using the species. The processes of knowledge transmission have changed from such "long-term learning" to "short-term learning," i.e., being told or taught through courses. This change may be part of the reason why people have changed their resource use and consumption patterns.

The traditional knowledge and use of plant resources found in this study were related mainly to the cure of psychosomatic and spiritual illnesses, such as *susto* and *mal de ojo*. As these illnesses are not recognized by western medicine, related TEK is transferred and maintained when people

migrate from place to place, generally using the same plant species, which are brought along during migration and subsequently cultivated in home gardens. They are generally not forest species, but grow in open areas.

Most of the resettlers picked up their knowledge of forest plant resources along the route of migration as needed. This is not traditional, ecological knowledge, as it does not have a temporal dimension nor does it relate to belief systems. It may be defined as local knowledge (see discussion in Berkes, 1999; Ellen, 2000). Local knowledge can combine the insights of ancestral knowledge, practical experience, the knowledge of other neighboring local peoples, regional scholarly traditions, and scientific or official knowledge acquired through, for example, agricultural extension officers, (Ellen, 2000; Dhillion and Gustad, 2004; Gadgil *et al.*, 2000). It is important to see if there exists local knowledge to help monitor and respond to changes in the ecosystems.

Men's Versus Women's Knowledge

There are two reasons why men have absorbed more knowledge of forest plant resources than women (Fig. 4). First, most of the resettlers knowledge concerned construction species (Fig. 2) and construction is men's labor. And second, in La Quetzal women tend to stay in and around the house most of the day, where as in the open highlands they went out to collect plants. The rigidity of the existing sexual division of labor greatly limits married women's opportunities; indeed, some older women speak little Spanish and many do not know how to read and write—making learning more difficult. The division of labor may have had profound effects on consumption patterns of both food and medicinal plants. However, although most women do not collect forest plants themselves, they, especially the midwifes, may influence the collection of plants by telling the men what to collect.

Confused Knowledge of Forest Species

The relatively high level of confusion in identifying forest species (Figs. 4, 5) is likely an effect of people having recently settled in the area. Confusion because of similarities among species is compounded by the fact that there are eight different native languages spoken in the area, so there are many names and many pronunciations of the same names. In several cases informants knew the properties of a species but did not know its name. Most people in the study have a common experience of plant resources, having lived in Ixcan, Guatemala, and Chiapas, Mexico, where they

picked up relevant knowledge. A general response when people settle in a different natural environment is that they are averse to risks, opting for what is familiar, and they are unfamiliar with benefits of forest resources (Reining *et al.*, 1992). As seen in many other studies, young people do not show any interest in learning about forest resources, and do not see this type of knowledge as valuable for personal development (Ampornpan and Dhillion, 2003; Gadgil *et al.*, 2000).

Sources of Knowledge

Knowledge about the natural environment and ways of managing biological resources have changed dynamically as the people of La Quetzal moved from one region to another. In Ixcan, for instance, they were highly dependent on the natural environment. Learning was a matter of necessity because there was little infrastructure (e.g., a lack of roads), and the area was isolated with long distances to commercial centers (Stølen, 2000).

Later, during the 10–12 years in the refugee camps in Mexico, the living conditions were quite different and relatively little was learnt regarding natural resources. Rather, they were introduced to global consumption patterns and market supplies, which greatly influenced their consumption preferences and how they looked upon the means to acquire desired products.

Settlement in La Quetzal in the MBR had both positive and negative effects for the people. They were given training and aid in forest management, as they had to follow a management plan, and some young men have attended courses to learn about plant forest resources with a focus on ecotourism, as a means to earn extra money. However, most of the courses required Spanish and writing skills—quite different from traditional learning through example and experience. Consequently, this path of learning was feasible for only a few people, mostly men, although they were later able to serve as sources of knowledge for their neighbors in the community.

SUMMARY AND CONCLUSION

There is a high level of plant diversity in the study area and a high number of usable species (Table II). We found that there has been a change in consumption patterns as a result of the migration, and traditional ecological knowledge has largely been replaced by global knowledge. The continuity of traditional practices utilizing medicinal plants is most likely because the plant species used are common all over Guatemala and grow in open areas.

According to other studies in Western Petén, the people of La Quetzal utilize fewer plant species than neighboring communities. The major reason for this is probably related to their status as returnees, which implies that they received assistance from a number of aid organizations after their return to Guatemala, something that in turn has reduced their dependency on natural resources. Nevertheless, knowledge about timber species is quite high and is increasing. Timber species are used both for house construction as well as commercially. People believe that timber will become the backbone of the economy and development of the community in the future, and they are, therefore, perhaps more prone to acquire knowledge about timber species than others. Other plants that are used and collected fit into a category of common plants with a wide distribution, many of which are found in the markets.

Two interlinked factors have been the driving forces altering the knowledge and use of natural resources by people in La Quetzal: the change of natural environment and the change of social and economic environment. The degree of their dependence on natural resources has varied from one place to another, depending, among other things, on economic opportunities and social conditions, proximity to markets, and the relief assistance associated with their status as refugees. By and large it seems that it is primarily increased access to commercial products that has caused the reduction in their use of natural resources.

Forest resources will always operate as a safety net for people living in or close to forests, and the potential value of these forests and their contribution to sustained social welfare is great. Traditional landscapes have changed and global–local distinctions are blurring, but there will continue to be a dynamic local, intuitive knowledge arising directly from practical experiences. On the other hand, migrating people cannot be expected to transfer and apply knowledge about natural resources to new places. The social and cultural contexts must be considered in both planning and management decisions regarding human migration and the use of natural resources.

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REFERENCES

Ampornpan, L. A., and Dhillion, S. S. (eds.) (2003). *The Environment of Na Haeo, Thailand: Biodiversity, Non-Timber Products, Land Use and Conservation*, Craftsman Press, Bangkok.

Anaya, J. (1996). *Indigenous Peoples in International Law*, Oxford University Press, New York.

Atran, S., Medin, D., Ross, N., Lynch, E., Vapnarsky, V., Ucan Ek, E., Coley, J., Timura, C., and Baran, M. (2002). Folkecology, cultural epidemiology, and the spirit of the commons. *Current Anthropology* 43: 421–450.

Begossi, A., Hanazaki, N., and Tamashiro, J. Y. (2002). Medicinal plants in the Atlantic Forest (Brazil): Knowledge, use and conservation. *Human Ecology* 30(3): 281–299.

Berkes, F. (1993). Traditional ecological knowledge in perspective. In Inglis, J. T. (ed.), *Traditional Ecological Knowledge: Concepts and Cases*, Canadian Museum of Nature and the International Development Research Centre, Ottawa, pp. 1–9.

Berkes, F. (1999). *Sacred Ecology, Traditional Ecological Knowledge and Resource Management*, Taylor and Francis, Philadelphia.

Boom, B. M. (1987). Ethnobotany of the Chácobo Indians, Beni, Bolivia. *Advances in Economic Botany* 4: 1–68.

Browder, J. O. (1992). Social and economic constrains on the development of market-oriented extractive reserves in Amazon rain forest. *Advances in Economic Botany* 9: 33–41.

Byg, A., and Balslev, H. (2001). Traditional knowledge of *Dypsis fibrosa* (Arecaceae) in Easern Madagascar. *Economic Botany* 55(2): 263–275.

Caballero, J. N., and Mapes, C. S. (1985). Gathering and subsistence patterns among the Púrhepecha Indians of Mexico. *Journal of Ethnobiology* 5(1): 31–47.

Carr, D. L. (2004). Ladino and Qéqchí Maya land use and clearing in the Sierra de Lacandón National Park, Petén, Guatemala. *Agriculture and Human Values* 21: 171–179.

Comerford, S. C. (1996). Medicinal plants of two Mayan healers from San Andrés, Peten, Guatemala. *Economic Botany* 50(3): 327–336.

CONAP, Consejo Nacional de Areas protegidas (1989). *Estudio Técnico: La Reserva de la Biósfera Maya*, CONAP, Guatemala.

DeeWalt, S. J., Genevieve, B., Chávez De Michel, L. R., and Quenevo, C. (1999). Ethnobotany of the Tacana: Quantitative inventories of two permanent plots of Northwestern Bolivia. *Economic Botany* 53(3): 237–260. –>

Dennis, P., *et al.* (1988). Development under fire: The Playa Grande Colonization Project in Guatemala. *Human Organization* 47(1): 69–76.

Dhillion, S. S., and Gustad, G. (2004). Local management practices influence the viability of the baobab (*Adansonia digitata*) in different land use types, Cinzana, Mali. *Agriculture, Ecosystems* and *Environment* 101: 85–103.

Ellen, R. (2000). Local knowledge and sustainable development in veveloping countries. In Keekok, L., Holland, A., and McNeil, D. (eds.), *Global Sustainable Development in the 21st Century*, Edinburgh University Press, Edinburgh, pp. 163–186.

Emch, M. (2003). The human ecology of Mayan Cacao farming in Belize. *Human Ecology* 31(1): 111–131.
Etkin, N. L. (2000). Local knowledge of biotic diversity and its conservation in rural Hausaland, Northern Nigeria. *Economic Botany* 56(1): 73–88.
Falla, R. (1992). *Masacres en la selva: Ixcán, Guatemala (1975–1982)*, Editorial Universitaria, Guatemala.
Ford, J., and Martinez, D. (2000). Traditional ecological knowledge, ecosystem science, and environmental management. *Ecological Applications* 10(5): 1249–1250.
Gadgil, M., Berkes, F., and Folke, C. (1993). Indigenous knowledge for biodiversity conservation. *Ambio* 22: 151–156.
Gadgil, M., Rao, S. P. R., Utkarsh, G., Pramod, P., and Chhatre, A. (2000). New meanings of old knowledge: The people's biodiversity program. *Ecological Applications* 10(5): 1307–1317.
Goldman, E. A. (1951). *Biological Investigations in Mexico*, Smithsonian Institution, Publ. 4017, Washington, DC.
Gomez-Pompa, A., and Kaus, A. (1990). Traditional management of tropical forest in Mexico. In Anderson, A. B. (ed.), *Alternatives to Deforestation: Steps Toward Sustainable Use for the Amazon Rain Forest*, Columbia University Press, New York, pp. 43–60.
Grenard, P. (1992). The use and cultural significance of the secondary forest among the Wayapi Indians. In Plotkin, M., and Famolare, L. (eds.), *Sustainable Harvest and Marketing of Rain Forest Products*, Island Press, Washington, DC, pp. 27–40.
Gustad, G., Dhillion, S. S., and Sidibé, D. (2004). Local use, and cultural and economic value of products from trees in the parklands of the municipality of Cinzana, Mali. *Economic Botany* 58: 578–587.
Huntington, H. P. (2000). Using traditional ecological knowledge in science: Methods and applications. *Ecological Applications* 10(5): 1270–1274.
Ibarra-Manriquez, G., Ricker, M., Angels, G., Colín, S. S., and Colín, M. A. S. (1997). Useful plants of the Los Tuxtlas Rain Forest (Veracruz, Mexico): Considerations of their market potential. *Economic Botany* 51(4): 362–376.
ILO. (2003). http://www.ilo.org/public/english/protection/migrant/about/index.htm
Lundell, C. L. (1937). *Vegetation of Petén*, Carnegie Institution, Washington, DC.
Momberg, F., Puri, R., and Jessup, T. (2000). Exploitation of Gaharu, and forest conservation efforts in the Kayan Mentarang National Park, East Kalimantan, Indonesia. In Zerner, C. (ed.), *People, Plants and Justice*, Columbia University Press, New York, pp. 259–284.
Mutchenick, P. A., and McCarthy, B. C. (1997). An ethnobotanical analysis of the tree species common to the subtropical moist forests of the Petén, Guatemala. *Economic Botany* 51(2): 158–183.
Nations, J. D. (1992). Xateros, chicleros, and pimenteros: Harvesting renewable tropical forest resources in the Guatemala Petén. In Redford, K. H., and Padoch, C. (eds.), *Conservation of Neotropical Forests: Working from Traditional Resource Use*, Columbia University Press, New York, pp. 208–219.
Nepstad, D. C. (1992). Conclusions and recommendations, the challenge of non-timber forest product extraction. *Advances in Economic Botany* 9: 143–146.
Nesheim, I., Dhillion, S. S., and Stølen, K. A. (2003). Traditional knowledge of plant resourses in a resettelment community, La Quetzal, Petén, Guatemala. *SUM Working Paper* 2003/1, University of Oslo, Oslo.
Padoch, D. (1992). Marketing of non-timber forest products in Western Amazonia: General observations and research priorities. *Advances in Economic Botany* 9: 43–50.
Phillips, O. (1991). The ethnobotany and economic botany of tropical vines. In Putz, F. E., and Mooney, H. A. (eds.), *The Biology of Vines*, Cambridge University Press, Cambridge, pp. 427–475.
Phillips, O. L., and Gentry, A. H. (1993). The useful plants of Tambopata, Peru: I. Statistical hypotheses tests with a new quantitative technique. *Economic Botany* 47: 15–32.
Prance, G. T., Balée, W., Boom, B. M., and Carneiro, R. L. (1987). Quantitative ethnobotany and the case for conservation in Amazonia. *Conservation Biology* 1: 296–310.

Reining, C. , and Heinzman, R. (1992b). Nontimber forest products in the Petén, Guatemala: Why extractive reserves are critical for both conservation and development. In Plotkin, M., and Famolare, L. (eds.), *Sustainable Harves and Marketing of Rain Forest Products*, Island Press, Washington, DC, pp. 110–117.

Reining, C. C. S., Heinzman, R. M., Madrid, M. C., López, S., and Solórzano, A. (1992). *Non Timber Products of the Maya Biosphere Reserve, Petén, Guatemala*, Conservation International Foundation, Washington, DC.

Salafsky, N., Dugelby, B. L., and Terborgh, J. W. (1993). Can extractive reserves save the rainforest? An ecological and socioeconomic comparison of nontimber forest product extraction systems in Petén, Guatemala, and East Kalimantan, Indonesia. *Conservation Biology* 7 (1): 39–52.

Schwartz, N. B. (1990). *Forest Society, a Social History of Petén, Guatemala*, University of Pennsylvania Press, Philadelphia.

SEGEPLAN (Secretaria General del Consejo de Planificación Economica Nacional) (1992). *Region VIII*. APESAR, Santa Elena, Petén, Guatemala.

Salazar, M. E., and Cancino J. C. M. (1998). *Plan de manejo forestal "Cooperativa Union Maya Itzá" La Libertad, Petén, Guatemala.* Proyecto Centro Maya, Petén, Guatemala.

Shrestha, P. M., and Dhillion, S. S. (2003). Traditional medicinal plant use and diversity in the highlands of Dolakha district, Nepal. *Journal of Ethnopharmacology* 86: 81–96.

Shriar, A. J. (2001). The dynamics of agricultural intensification and resource conservation in the buffer zone of the Maya Biosphere Reserve, Petén, Guatemala. *Human Ecology* 29(1): 27–48.

Stølen, K. A. (2000). Creating a better life: Participatory communitarian development among Guatemalan returnees, *SUM Working Paper* 2000, 3, University of Oslo, Oslo.

Stølen, K. A. (2003). Constructing the future: Experiences of Guatemalan returnees. In Shanmugaratnam, N., *et al.* (eds.), *In the Maze of Displacement. Conflict*, *Migration and Change*, Norwegian Academic Press, Kristiansand.

Stølen, K. A. (2004). The reconstruction of community and identity among Guatemalan returnees. *European Review of Latin American and Caribbean Studies* 77.

Toledo, V. M., Batis, A. I., Becerra, R., Martínez, E., and Ramos, C. H. (1992). Products from the tropical rain forests of Mexico: An ethnoecological approach. In Plotkin, M., and Famolare, L. (eds.), *Sustainable Harvest and Marketing of Rain Forest Products*, Island Press, Washington, DC, pp. 99–109.

Tabuti, J. R. S., Dhillion, S. S., and Lye, K. A. (2003). Traditional medicine in Bulamogi County, Uganda: Its practioners, uses and viability. *Journal of Ethnopharmacology* 85: 119–129.

Turner, N. J., Ignace, M. B., and Ignace, R. (2000). Traditional ecological knowledge and wisdom of aboriginal peoples in British Columbia. *Ecological Applications* 10(5): 1275–1287.

United States Agency for International Development /Government of Guatemala (1991). *Plan de acción forestal para Guatemala*, Republica de Guatemala.