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FACTORS AFFECTING LOCAL KNOWLEDGE OF PALMS IN NANGARITZA VALLEY, SOUTHEASTERN ECUADOR

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ABSTRACT.—Our investigation of factors and processes affecting local knowledge of natural resources focuses on knowledge loss and knowledge transfer between communities, and on the way socioeconomic circumstances affect the knowledge levels of individuals. The study took place in southeastern Ecuador in an area inhabited by an indigenous group as well as by settlers of mixed origin from other parts of Ecuador. We used quantitative statistical methods to study processes and factors affecting people's knowledge of palms. The results indicated that both loss and transfer of knowledge were taking place. Village placement and context were seen to be the most important factors with regard to people's knowledge and to the processes of knowledge loss and transfer. In addition, factors such as ethnicity and gender also seemed to play a role.

Key words: knowledge loss, knowledge transfer, marginality, quantitative ethnobotany, Shuar.

RESUMEN.—En este estudio se han investigado los factores y procesos que afectan al conocimiento local de los recursos naturales. El enfoque de nuestro trabajo se centró en la pérdida y en la transferencia de conocimiento entre las comunidades, así como también en la forma en la cual las circunstancias socio-económicas afectan al nivel de conocimiento de cada individuo. El estudio se llevó a cabo en el sureste de Ecuador, en un área habitada tanto por un grupo indígena como por colonos de origen diverso provenientes de otras partes de Ecuador. Se han utilizado métodos estadísticos cuantitativos para estudiar los procesos y factores que afectan al conocimiento de las personas en relación a las palmas. Los resultados indican que además de pérdida está habiendo transferencia de conocimiento. La situación y contexto de la aldea parecen ser los factores que más influyen en el conocimiento de las personas y en los procesos de pérdida y transferencia de conocimiento. Además los factores étnicos y de género parecen jugar también un papel relevante.

RÉSUMÉ.—Dans cette étude nous discutons des facteurs et des processus qui influent sur la connaissance locale des ressources naturelles. Nous nous intéressons surtout à la perte de connaissance, à la transmission de celle-ci entre différentes communautés et à la façon dont des circonstances socio-économiques agissent sur le niveau de connaissance des individus. L'étude s'est déroulée dans le sud-est de l'Équateur où coexistent une communauté indigène ainsi que des immigrants d'origine mixte issus de régions autres de l'Équateur. Des méthodes statistiques quantitatives ont été utilisé dans le but d'étudier les facteurs et les processus qui influent sur les connaissances des individus touchant les palmiers.

Les résultats montrent que la perte tout comme la transmission des connaissances sont des processus qui ont toujours cours en ce moment. L'emplacement du village et son contexte constituent les facteurs les plus importants en ce qui concerne les connaissances des gens et les processus de perte et de transmission. De plus, d'autres facteurs tels que l'ethnicité et le sexe semblent également jouer un rôle.

INTRODUCTION

Local or traditional knowledge and management systems have in recent decades become increasingly used as models for sustainable development and resource utilization (Coomes 1995; Gliessman 1992). However, local technologies and knowledge of resource utilization as well as the natural environments they deal with seem to be rapidly disappearing (Bennett 1992; Benz et al. 2000; Dasmann 1991; Joyal 1996; Ladio 2001; McNeely 1992). This has lead to two different approaches among researchers and practitioners of conservation and local resource management. One approach has been to make as many and detailed as possible inventories of local knowledge of plants and animals before this knowledge is irretrievably lost. Records of the knowledge are then published and/or stored in databases together with corresponding voucher specimens, where they may be more or less accessible to the general public and to the people from where it originated in particular (Agrawal 1995). The other approach focuses on the ways knowledge and management systems evolve, how people adapt to changing circumstances, which factors influence their decision making and how knowledge is accumulated, transmitted and lost (Alcorn 1995; Brodt 2001; Coomes 1995; Oldfield and Alcorn 1987; Ruddle 2000; Wiersum 1997).

The philosophy behind the first approach is related to biological *ex situ* conservation in gene and species banks advocated by some conservationists. However, this approach to nature and knowledge conservation has been criticized for trying to preserve a frozen picture of knowledge, practices or gene pools of one moment in time, removed from its natural and cultural context (Agrawal 1995; Oldfield and Alcorn 1987). The second approach, too, has a counterpart in the fields of ecology and conservation, where recent decades have seen an increasing focus on dynamics and processes (Simberloff 1988). The two approaches should, however, not be seen in opposition to each other, but instead as complementary with their differing foci: the first one being more static and content-oriented, the second one being more dynamic and process-oriented. Our study belongs to the more process-oriented kind, focussing on knowledge loss, transmission and transformation, and on how social and economic factors might influence these processes.

Knowledge Loss and Acculturation.—Knowledge loss is often seen as the consequence of what is called acculturation processes, which can be divided roughly into two categories, "loss of interest" and "loss of learning opportunities," although it is not always possible to distinguish clearly between the two.

Loss of interest in traditional or local knowledge about plants and other natural resources can be due to the availability of alternative industrially manufactured products and opportunities for alternative livelihood strategies, such as wage work, cash-oriented agriculture, or migration to urban centers (Anyinam

1995; Benz et al. 2000; Joyal 1996; Ladio 2001; Ladio and Lozada 2001). People may prefer these alternatives because they are perceived to be superior (Sillitoe 1998) or because traditional practices are time consuming or stigmatized, especially those of ethnic minorities (Luoga et al. 2000). Often, alternative livelihood options depend on proximity to urban centers, which gives access to a greater variety of consumer goods and to services such as schooling and health care (Zent 1999).

Loss of opportunities for learning may be due to the disappearance of whole vegetation types or particular species that formerly provided important natural resources to local communities (Anyinam 1995). Extinction or decline of plants and animals quickly leads to the demise of detailed associated knowledge, though some anecdotal information or stories about certain ancient uses may persist. Other factors leading to knowledge loss include efforts by national or religious authorities to integrate or assimilate minority groups. Such efforts, whether in the name of civilization, religion, economy or conservation, may include incentives for or prohibition of traditional practices or resource use (Anyinam 1995; Zent 1999). Nationalization or privatization of community resources may lead to changes in resource use practices and loss of the associated knowledge as well.

Imposition of a national language and schooling system, which may eliminate the idioms in which knowledge is embedded and the time available for learning, observing and practicing more traditional knowledge and technologies may inhibit transmission of traditional knowledge of resources (Benz et al. 2000; Luoga et al. 2000; Ohmagari and Berkes 1997). Likewise, emigration to urban centers often interrupts the transmission of local knowledge, which in large part may have to be learned through practice and observation in close proximity to the resources themselves rather than through language (Sillitoe 1998).

Knowledge Transfer and Transformation.—Even if traditional knowledge is not lost, it may be transformed, as new technologies and products are incorporated into local or traditional knowledge systems. These processes occurred in ancient and recent times, and continue to this day (Agrawal 1995; Brodt 2002). Not only do "traditional" peoples incorporate new, modern technologies, but nonindigenous or immigrant groups also sometimes acquire local knowledge and resource management systems. The most well-known example is probably that of the Amazonian *ribereños* or *caboclos*, small-scale farmers of mixed origin who settled along rivers in the Amazon basin several hundred years ago (e.g., Hiraoka 1995). These "neo-traditional" groups (Begossi 1998) have developed successful subsistence systems incorporating elements learned from indigenous as well as nonindigenous sources. Another Amazonian example of newcomers' knowledge accumulation is that of Japanese immigrants to Brazil who, within fifty years, have managed to develop an intensive and apparently sustainable form of cash-oriented agriculture (Subler and Uhl 1990). In addition to exchanges between areas and communities, *in situ* development of new techniques, products and resources continuously happens within communities, leading to the creation of new practices and knowledge and to the loss of the old ones.

Importance of Socioeconomic Factors.—How knowledge loss, transfer, and creation balance each other depends on a multitude of factors, both within the human communities, and in the social, political, economic and ecological environment. Among the most often mentioned influential factors are gender, age, education, and wealth. The effect of these may yet depend on other factors and therefore vary from setting to setting. For example, differences in men's and women's knowledge will depend on the degree of gender-related division of labor in a society (Berlin et al. 1981). Wealth may also have different effects depending on specific circumstances. Wealthier people may or may not have an interest in promoting common resource management systems depending on potential gain and availability of other options (Holmes 2003; Varughese and Ostrom 2001). Similarly, increasing formal education has in some cases been associated with a decrease in local environmental knowledge (Luoga et al. 2000; Ohmagari and Berkes 1997); at other times, it has lead to more sustainable resource use practices and environmental awareness (e.g., Godoy 1994). Nevertheless, with an increasing number of studies based on comparable quantitative methods we hope it will be possible to identify more general mechanisms lying behind the varying influence of factors such as education or wealth.

Processes of knowledge loss, transfer and transformation, and the importance of socioeconomic factors are the subject of this study, which took place in the Andean foothills of southeastern Ecuador sloping down towards the Amazon basin. The area is inhabited by the Shuar, an indigenous group with additional settlements further down in the Amazon basin. Within the last five decades, settlers of mixed ethnic origin have arrived from the Andean highlands in search of land, bringing very different agricultural practices and ways of life. This setting is representative of what is happening in many places, not only in the rest of South America, but also in other parts of the world. Apart from its representativeness, the juxtaposition of two different communities with different histories, cultures, and experiences provides a good opportunity to study processes such as knowledge loss and knowledge transfer within changing human and natural contexts. Although dynamic processes ideally would be investigated through long-term studies, research reality seldom allows this. Instead, inferences about ongoing processes of knowledge loss and knowledge transfer can be made by analyzing patterns of knowledge distribution at one moment in time (Zent 1999). This is the approach followed in the present study, focusing on the following three questions related to changes in knowledge:

First, to what degree does acculturation lead to knowledge loss among the indigenous population of the area? We address this question by looking at the age-related distribution of knowledge (see Phillips and Gentry 1993). We expected that older generations would have significantly more knowledge than younger ones. Such a pattern can be either a result of lifelong learning and gradual knowledge accumulation or of knowledge erosion. In the case of knowledge erosion, however, we would expect that there would be a more pronounced knowledge gap between different age groups, because knowledge loss often is a very abrupt process (e.g., Hanazaki et al. 2000; Phillips and Gentry 1993). In addition to age-related patterns, we recorded whether certain reported practices or uses had disappeared from the area.

Second, to what degree is knowledge transfer taking place? Much learning takes place early in life (Zarger 2002). Individuals will, however, keep accumulating as well as modifying and re-evaluating knowledge throughout life on the basis of present and past personal experiences (Garro 2000). Therefore, we investigated whether people's birthplace and residence time in the area had an effect on their knowledge levels. In addition to comparing how much people knew we also compared what they knew, i.e., what plant species were used for which purposes. Similar use of the same plants would indicate knowledge transfer between the two ethnic groups.

Third, is it possible to identify factors operating at the scale of the individual, household, village, or community that affect people's knowledge levels? Especially in situations where the social, economic and physical environment is rapidly changing, it is important to know which factors influence knowledge in which ways. We used quantitative statistical analyses to identify socioeconomic factors that show relationships with people's knowledge levels. Although statistical correlations do not prove causal relationships and are prone to many sources of error, we believe they can be used profitably as the basis of cautious interpretations. Moreover, quantitative statistical methods make it easier to conduct comparisons between different studies and settings and, with an increasing number of studies available, may in time enable us to discern specific from general tendencies.

STUDY AREA

The field work took place in a part of the Nangaritza river valley (lat. 4°14'–4°26' S, and long. 78°37'–78°40' W) in southeastern Ecuador in Zamora-Chinchipe province. At 800–1000 m above sea level, the area is located between the Andean cordillera and the Amazon basin. Partly as a consequence of this transition zone placement the area is characterized by high biodiversity. The natural vegetation consists of lower montane rain forest (Neill 1999), which so far has been spared large-scale destruction (Palacios 1996).

The original inhabitants of the area belong to the ethnic group of the Shuar, also sometimes called Jívaro. Both names have sometimes been used as a general term referring to five different but related ethnic groups. Here we use the name "Shuar" in a more restricted sense, referring to the group that sometimes has been denoted "Untsuri Shuar" in the literature (Bennett et al. 2002; Descola 1996; Harner 1972). The traditional way of life of this group was seminomadic and based on swidden agriculture. People lived in isolated family households, periodically shifting their habitation whenever essential resources such as game or certain wild plants became scarce.

Today, the Shuar in the Nangaritza valley live in permanent villages along the main river and its tributaries. They practice a form of swidden agriculture, growing traditional staples along with some cash crops and raising livestock. Villages usually consist of a nucleus comprising a school, soccer field, community building, and up to twenty households, with additional households located within an hour's walk of the village center. The Shuar are one of the most well organized ethnic groups in Ecuador and have their own local administrative units and a national federation. The federation represents the interests of the Shuar vis-à-vis the national state and is actively taking steps with regard to the preservation of their culture, e.g., in the form of written publications in their own language. It also actively provides modern commodities, such as radio communication equipment, and secures support from various Ecuadorian as well as foreign nongovernmental organizations (NGOs). Schools in Ecuador may teach in indigenous languages as well as in Spanish. In the study area, not all of the schools in the Shuar villages had teachers who were themselves Shuar and who could teach the children in Shuar. Nearly all of the Shuar in the area spoke and understood Spanish and interviews were conducted in Spanish, although plant names were recorded in Shuar. Shuar plant names have generally been spelled as indicated by informants.

In addition to the Shuar, colonists of mixed origin have arrived in the area since the beginning of the 1960s (Palacios 1996). Most of them originally came from highland areas (2000–3000 m) in the neighboring province (Provincia de Loja) near the towns of Amaluza and Saraguro. The climate in these areas is both drier and cooler. The vegetation around Amaluza consists of dry scrub vegetation and montane evergreen forest, while the vegetation around Saraguro is described as consisting of shrub vegetation and evergreen montane forest (Balslev and Øllgaard 2002; Neill 1999). In addition, grass *páramos* (Andean vegetation above the timberline) are found in the more elevated parts (> 2900 m) in both areas. The colonists mostly make a living as farmers cultivating subsistence and cash crops, to varying degrees engaging in cattle farming and timber extraction (Schulenberg and Awbrey 1997). These latter cash-oriented activities are more prominent among the colonists than among the Shuar.

Seven different villages (five Shuar villages and two colonist ones) are included in this study. The villages differ in size (ranging from 30–40 inhabitants to a few hundred), available facilities (such as village shops, church, school, and radio contact), setting, and accessibility. The most accessible village has electricity as well as a water supply and can be reached from the nearest road within an hour by boat (at the time of the study a road to this village was under construction). In contrast, the most remote villages can be reached only after three to four hours by boat and/or several hours of walking; these settlements generally lack electricity (apart from petrol or solar generators in some) and sometimes sanitary installations.

METHODS

Fieldwork was carried out from March through July 2001 and consisted of an interview survey of people's use and knowledge of palms and the collection of voucher specimens.[1] Altogether 90 interviews were conducted with 29 colonists and 61 Shuar. We attempted to conduct interviews with representatives of 10–20 households in each village (depending on village size) and to include about equal numbers of men and women (51 and 39, respectively) as well as representatives of different age groups (the youngest interviewee was 15 and the oldest one 75 years old).

Interviews were conducted with a fixed questionnaire covering the interviewees' socioeconomic situation (age, income, education, family size, etc.) as well as their knowledge of useful palms. Questions regarding palms were open-ended and centered around different use-categories established *a priori* and had the following form: which palms can be used for . . . [use category]? Researcher-determined categories were used in order to facilitate quantification and comparison between the two communities of different ethnic background. The use categories employed in the questionnaire were: "food," "construction," "medicine," "tools and artisanry," "firewood," "religious, ritual or decoration purposes," and "other uses." In addition, interviewees were asked if there were any palm uses or products that had gone out of use. The questionnaire was administered in Spanish, which was spoken fluently by all colonists and Shuar informants. Local palm names were recorded in Spanish or Shuar and as far as possible matched with voucher specimens and in the field. The local names were used as the basis for the analyses.

Palms were chosen as "model plants" for the study because they constitute a generally well recognized plant group among local people. Therefore, misunderstandings between researchers trained in western sciences and local people based on different concepts of plant groups can largely be avoided when working with palms. One exception to this was the case of the Panama hat plant, *Carludovica palmata* Ruiz & Pav. (Cyclanthaceae), which was sometimes mentioned during interviews as a useful palm even though it is not in the Arecaceae; in these cases, we included it in the analysis as part of those informants' emic category of useful palmlike plants. Most informants did clearly group the Panama hat plant and other Cyclanthaceae on one hand and the palms on the other.

Palms are among the most useful tropical plants and are abundant in the western part of the Amazon basin (Henderson et al. 1995). We have shown that Shuar and Mestizos recognize palms as a group, which suggests that they have a conceptual framework that would allow them to easily integrate knowledge about newly encountered palms by observation and experimentation.

In Ecuador, palms are used, cultivated or tended, and are generally considered very useful by rural people in most parts of the country, including the highlands (Borchsenius et al. 1998), where most of the colonists came from. We assumed that colonists would be favorably disposed towards learning about and experimenting with palms in their new surroundings, even though they had never before encountered the palm species present in the Nangaritza area. Therefore, palms should provide a good test case for investigating knowledge transfer between indigenous people and colonists and for discovering how quickly and to what degree newcomers adapt to the local natural environment.

Different measures of palm knowledge were calculated (Table 1). The simplest way to measure people's knowledge level is to count the number of species and uses they know. In addition, each person's relative knowledge (based on both number of uses and number of species known) compared to the "average informant" was calculated.

Multiple regression was used to test for statistical relationships between socioeconomic factors and palm knowledge. A backward elimination procedure was employed to select which factors should be included in the final model. Significance (at $\alpha = 0.05$) of the factors and of the model was evaluated by means of permutations (using *Permute! 3.4,* Casgrain 2001). The number of permutations was in all cases 999. The different measures of palm knowledge were employed as dependent variables in separate analyses, while the socioeconomic data listed

TABLE 1.—Dependent variables used in the analyses and the average values for these variables, as well as minimum and maximum values (in parentheses) found in the study and standard deviations.

Dependent variable	Description	Mean value (min; max)	Standard deviation
Number of palms	Total number of folk species a person mentioned as useful during the interview	5.4 (1;13)	2.75
Number of uses	Total number of uses a person knows summed across all palms she knows	14.12 (1;40)	8.05
Relative use value (RUV_i)	A measure of a person's knowledge relative to that of other people in the survey; calculated as the number of uses a person knows for a species divided by the average number of uses people know for this species and subsequently summed for all species and divided by the number of useful species	1 (0.015;12.64)	1.86

in Table 2 were used as independent (explanatory) variables. An aggregate variable called "wealth" was constructed by standardizing and summing all economic indicators (resulting in values between 0 and 1). Analyses were carried out once with this aggregate measure as one of the independent variables and once with all the separate economic variables, but without the aggregate variable. The multiple regression was used to simultaneously investigate our three main questions

TABLE 2.—Independent variables used in the analyses.

Independent variable	Variable type
Village	Nominal (7 levels)
Age	Continuous
Gender	Nominal (2 levels)
Ethnicity	Nominal (2 levels—Shuar and colonist)
Civil state	Nominal (2 levels—married and single)
Family size	Continuous (number of people in household)
Education	Continuous (years of formal school attendance)
Birthplace	Ordinal (3 levels—highlands, Amazon; Nangaritza valley study area)
Time in residence	Continuous (% of a person's lifetime spent in the area)
Number of small animals	Continuous (sum of chicken, ducks, guinea pigs, and turkeys a person owns)
Number of large animals	Continuous (sum of pigs, cows, and horses a person owns)
Number of crops	Continuous (0–12)
Farm size	Continuous (ha)
House materials	Aggregate ordinal (6 levels; the sum of the two separate ordinal values for roof and wall/floor materials respectively)
Wealth	Aggregate continuous (values ranging from 0 to 1 constructed by standardizing and summing the variables "no. of small animals," "no. of large animals," "no. of crops," "farm size," and "house materials"

(concerning knowledge loss, knowledge transfer and socioeconomic factors influencing knowledge levels). Knowledge loss was investigated by testing for an effect of age; knowledge transfer was investigated by testing for an effect of birthplace and residence time. The remaining independent variables (Table 2) were included to investigate possible sources of within-community heterogeneity.

Distribution and diversity of palm knowledge of colonists and Shuar was in addition compared by means of rank-abundance diagrams depicting the richness and abundance of uses and species known (Benz et al. 2000). Rank-abundance diagrams give an indication of how evenly knowledge is distributed within a community and whether high average knowledge levels are due to few very knowledgeable informants or evenly distributed knowledge among members of a community. To make rank-abundance diagrams for the two communities comparable despite differences in sample size, random samples of the same size as the colonist sample were taken from the Shuar sample and were ranked. This was repeated 100 times and on the basis of these 100 subsamples an average rank abundance curve for the Shuar was created.

RESULTS

Uses of 25 different folk species were recorded (Table 3). More detailed descriptions of the different applications of palms have been provided elsewhere (Byg 2002). There was considerable spread in the number of palms as well as number of uses reported by individual people (Table 1). No vouchers could be obtained for some palms that were mentioned only few times and that were said to be very rare or to be found only in other areas. These have nevertheless been included in the analyses as "folk-" or "ethno-species" (Phillips et al. 1994), and their identity has been inferred from relevant literature to the extent possible.

Knowledge Loss and Acculturation.—No significant effect of age on any of the knowledge indicators was found. Twenty-six informants reported outdated uses (mainly weapons/hunting gear and construction materials) for altogether nine palm species (Table 3). Rank abundance curves based on the number of uses and number of species known (Figure 1) were of a sigmoidal shape, similar for both communities, indicating a more or less normal distribution of knowledge. The curve for Shuar was, however, placed higher than the curve for colonists, indicating higher average knowledge levels among Shuar informants both with regard to palm uses and species.

Knowledge Transfer.—Neither birthplace nor residence time showed any significant relationship to palm knowledge in the multiple regression analyses.

Socioeconomic Factors.—The most important factors related to palm knowledge in our analyses were ethnicity, village location, gender, civil state, education, and different measures of agricultural practices (Table 4, Figures 2, 3). However, there were significant interactions between village location and most of the other variables, which implies that the relationship found between, e.g., people's education and palm knowledge depends on which village they live in. In addition, there

TABLE 3.—Folk species and their uses mentioned in 90 interviews comprising indigenous as well as nonindigenous people in seven villages in the Nangaritza valley in southeastern Ecuador.

Species (voucher no.) Local name (***Shuar***, *Spanish*)	Uses (no. of reports)	Previous uses (no. of reports)
Aiphanes weberbaueri Burret (JV680) ***awant***	Heart (3); fruits (2); drink (1)	Fruits: juice
Aphandra natalia (Balslev & A.J. Hend.) Barfod (no voucher, Bennett et al. 2002; Borchsenius et al. 1998) ***tinktiuki***	Heart (1); fruits (1)	—
Astrocaryum chambira Burret (no voucher, Bennett et al. 2002; Borchsenius et al. 1998) ***kumai***	Heart (1); fruits (1)	—
Bactris gasipaes Kunth (Byg28) ***uwi***, *chonta*	Heart (69); fruits (72); drink (14); larvae (5); thatch (1); hunting gear: bows (2), blowgun (14), spear (14); firewood (23); decoration: blowgun (1), fruits (1), leaves (3), spears (5); medicine: unknown (1), heart—anti-infectious (1), ear pain (7), purification (1), pain (1), leaves—ear pain (1); other: fruits—fodder (2); leaves—fodder (1), woven cloth (1); stem—musical instruments (1), furniture (2), flag pole (1), tiles (1), water container (2)	Stem: blowgun (5), bow (1), musical instruments (1), spear (7); leaves: ear pain (1), woven cloth (1)
Bactris setulosa H. Karst. (photo) ***kamanchar***	Heart (4)	—
Carloduvica palmata (Byg38) ***pumpuná***, *pajo toquillo*	Heart (3); thatch (2); other: leaves—woven fabrics (1), hats (1)	—
Ceroxylon amazonicum Galeano (photo) ***paik***, *ramo*	Decoration: leaves (7)	Leaves: Easter decorations (1)
Euterpe precatoria Mart. (Byg65) ***sakae***	Heart (30); fruits (1); house posts (4); thatch (3); hunting gear: bows (2), blowgun (2), spear (2); other: leaves—hats (1), traditional woven clothes (1)	Stem: blowgun (2), bows (1), spears (2)

TABLE 3.—Continued.

Species (voucher no.) Local name (***Shuar***, *Spanish*)	Uses (no. of reports)	Previous uses (no. of reports)
Geonoma sp. (Ruiz & Pav.) Mart. or *G. deversa* (Poit.) Kunth (no voucher, Bennett et al. 2002; Borchsenius et al. 1998) ***turuji***	Thatch (1)	—
Hyospathe elegans Mart. (Byg50) ***takanak***	Thatch (1)	—
Iriatea deltoidea Ruiz & Pav. (Byg44) ***ambakai***, *cacho de toro, palma negra, pambil, palma*	Heart (75); fruits (10); larvae (3); house posts (61); thatch (50); hunting gear: blowgun (7), bows (2), spear (19); firewood (55); decoration: leaves (3), spears (4), stem (1), carved figures (1), blowgun (1), unknown (1); Medicine: heart—purification/purgative (1), malaria (1), bile (1); other: stem—furniture (3), fences (3), flag pole (4), animal pens/stables (2), support for banana plants (1), tiles (1), wood work (1), temp. knife (1); young leaves—broom (1)	Stem: blowgun (1), bows (1), tiles (1), furniture (1), carved figures (1), fences (1), spear (4); heart: bile (1), purification (1); leaves: thatch (1)
Mauritia flexuosa L.f. (photo) ***achu***	Heart (29); fruits (26); larvae (1)	—
Oenocarpus bataua Mart. (Byg33) ***kunkuki***, *palma real*	Heart (61); fruits (43); larvae (9); house posts (1); thatch (4); hunting gear: spear (2), darts (4), blowgun (1), dart container (1), fish trap (7); basketry (5); firewood (5); decoration: cultivated as ornamental tree (1), leaves (14), dart container from young leaves (1); medicine: unknown (1), fruits—hair loss (1); heart—purification (1); other: fruits/seeds—key ring (1), oil (2); leaves—broom (4), candle sticks (1), fodder (1), dart container (1); shade tree for cattle (1), spoon (1)	Heart and fruit: food (1)

TABLE 3.—Continued.

Species (voucher no.) Local name (***Shuar,*** *Spanish*)	Uses (no. of reports)	Previous uses (no. of reports)
Oenocarpus mapora H. Karst (Byg49, Byg66) ***shimbi***	Heart (10); fruits (9); house posts (3); thatch (8); hunting gear: darts (2), fish trap (7), spear (1); basketry (3); firewood (1); decoration: leaves (1)	—
Pholidostachys synanthera (Mart.) H.E. Moore (no voucher, Bennett et al. 2002) ***kampanak***	House posts (2); thatch (14)	—
Phytelephas tenuicaulis (Barfod) A.J. Henderson (no voucher, Borchsenius et al. 1998; Henderson 1995) ***chapi***	Heart (1); fruits (1)	—
Prestoea ensiformis (Ruíz & Pav.) H.E. Moore (Byg39) ***tinkiwi***	Heart (46); fruits (5); house posts (4); thatch (19); hunting gear: arrows (1), blowgun (1), spear (1); basketry (2); firewood (1); decoration: leaves (2); other: young leaves—woven fabrics (1); spoon (1)	—
Socratea exorrhiza (Mart.) H. Wendl. (Byg48) ***kupat***	Heart (8); house posts (4); thatch (2); firewood (1); Medicine: heart—snake bite (4); other: stem—furniture (2); leaves—branding of canoes (1)	Heart: food (1); stem: house posts (1), furniture (1); leaves: thatch (1)
Wettinia maynensis Spruce (Byg31 & Byg32) ***terena,*** *huevo de toro, palma blanca, pambil*	Heart (16); fruits (1); larvae (2); house posts (57); thatch (64); hunting gear: blowgun (6), bow (2), spear (17); firewood (43); decoration: leaves (4), spears (2), stem (1); other: leaves—broom (6); stem—fences (1), flag pole (1), hen house (1), temporary knife (1)	Stem: blowgun (1), bow (1), spear (5), thatch (1),
? (no voucher) ***jiri***	Thatch (1)	—
? (no voucher) ***sakaryam***	Heart (1); fruits (1)	—

TABLE 3.—Continued.

Species (voucher no.) Local name (*Shuar, Spanish*)	Uses (no. of reports)	Previous uses (no. of reports)
? (no voucher) ***shinki***	Heart (1); fruits (1); larvae (1); house posts (1); thatch (1); hunting gear: bow (1), blowgun (1)	Stem: blowgun (1), bow (1)
? (no voucher) ***wiantiam***	Heart (1); fruits (1)	—
? (no voucher) ***wuanka***	Heart (4)	—
? (no voucher) ***yayu***	Heart (6)	—

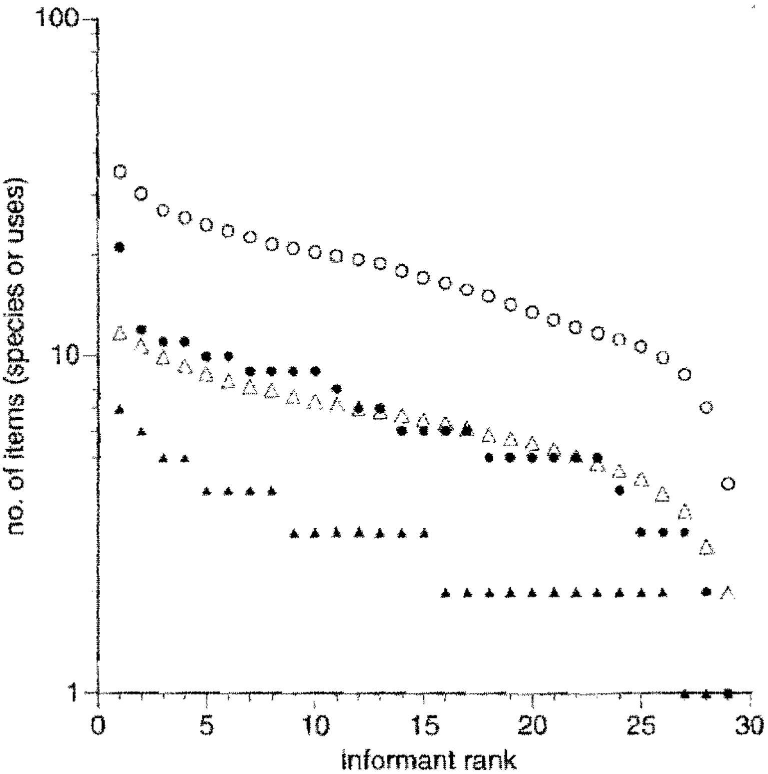

FIGURE 1.—Rank-abundance diagram for the number of palm uses (circles) and species (triangles) known by Shuar (clear symbols) and colonists (filled symbols), respectively. To obtain equal sample sizes for the two communities, 100 random samples of 29 interviewees were taken from the Shuar data set, and in each sample interviewees were ranked according to the number of uses or species known to create an average rank-abundance curve.

were also interactions between ethnicity and the variables gender and education. Despite these interactions, a few general tendencies can be discerned: Shuar have on average higher knowledge levels than colonists, men have higher knowledge levels than women, and married persons know more than unmarried persons. In addition, there was a positive relationship between the length of formal education (years of school attendance) and wealth on the one hand, and palm knowledge on the other hand. In models where the aggregate variable "wealth" was split up into its components, it was mainly the number of farm animals owned which was found to be significant, but no clear tendencies could be discerned as the relationship differed between villages.

For the dependent variable "relative use value" (RUV_i), no significant model was obtained with the aggregate variable "wealth." However, a near-significant model containing the independent variables village, age, gender, ethnicity, education, and the interactions ethnicity*gender, ethnicity*education, village*gender, and village*education was obtained.

TABLE 4.—Results of multiple regression analyses (carried out as a backward elimination procedure) of the relationship between various socioeconomic variables and people's knowledge of palm uses in seven villages in southeastern Ecuador. R^2 values indicate the proportion of variation explained by the model. Terms in brackets indicate the nature of a relationship where it was possible to discern general tendencies across all villages and ethnic groups. P-values should only be seen as approximate indicators of the significance of the models as the repeated testing in stepwise analyses leads to an inflation of α-levels (Sokal and Rohlf 1995).

Dependent variable	No. of uses known	No. of palms known	RUV_i
Model with aggregate variable "wealth"	village gender (men > women) ethnicity (Shuar > colonists) civil state (married > single) education (+) ethnicity*gender village*education village*gender $R^2 = 0.71$, $P = 0.001$	village gender (men > women) ethnicity (Shuar > colonists) civil state (married > single) education (+) wealth (+) ethnicity*gender ethnicity*education village*gender village*education village*wealth $R^2 = 0.80$, $P = 0.001$	no significant model could be obtained
Model without aggregate variable "wealth"	village gender (men > women) ethnicity (Shuar > colonists) education (+) ethnicity*gender ethnicity*education village*gender village*education $R^2 = 0.46$, $P = 0.01$	village gender (men > women) ethnicity (Shuar > colonists) education (+) large animals ethnicity*gender ethnicity*education village*gender village*education village*large animals $R^2 = 0.76$, $P = 0.001$	village gender (men > women) ethnicity (Shuar > colonists) education (+) large animals crops (+) ethnicity*gender ethnicity*education village*gender village*education village*large animals village*crops $R^2 = 0.76$, $P = 0.02$

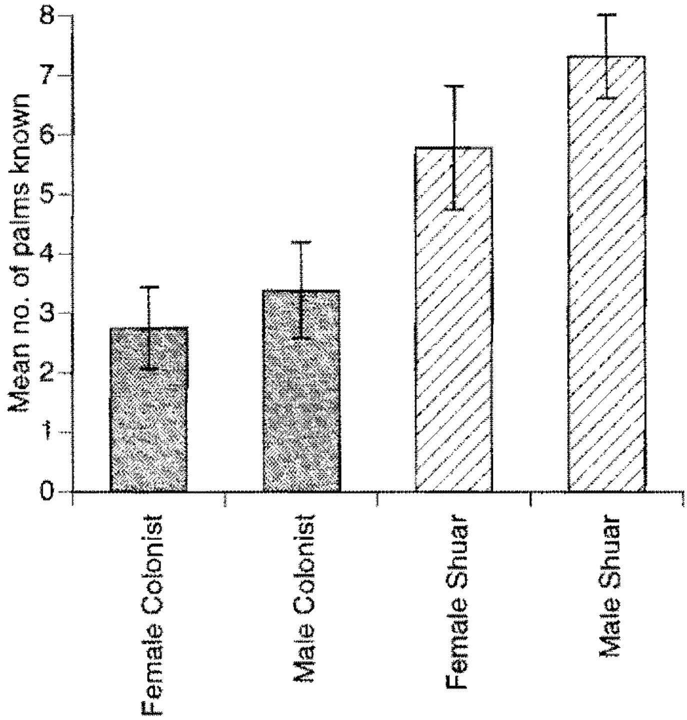

FIGURE 2.—Average palm knowledge for women and men in two different ethnic groups in the Nangaritza river valley in southeastern Ecuador. Error bars represent 95% confidence limits generated through permutation (without taking differences between villages into account).

DISCUSSION

Knowledge Loss and Acculturation.—The multiple regression analyses did not give any indications of knowledge loss among the Shuar: there were no clear tendencies for old people to know more about palms than young people. Neither did rank-abundance diagrams give indications of knowledge loss: the flat sigmoidal shape of the rank-abundance curve indicates that knowledge is approximately normally distributed and generally shared within the Shuar communities, with few people exhibiting either very highly or very low knowledge levels and the knowledge of the majority of people lying in between these two extremes. In the case of knowledge loss or expert knowledge, it would be expected that rank-abundance curves would be much steeper with few people (old ones or experts) having high knowledge levels and the majority having low knowledge levels.

Despite the lack of statistical and numerical support, we found anecdotal evidence of knowledge erosion in the form of people's own perceptions. Older people would complain about the younger generation's lack of knowledge. In addition, Shuar informants would often refer to a Shuar community living on the other side of the nearby border with Peru as leading more traditional life styles and using many more palm products. This impression seems to be reliable and not the result of mystification of the unknown other or "lost tribes" on the other

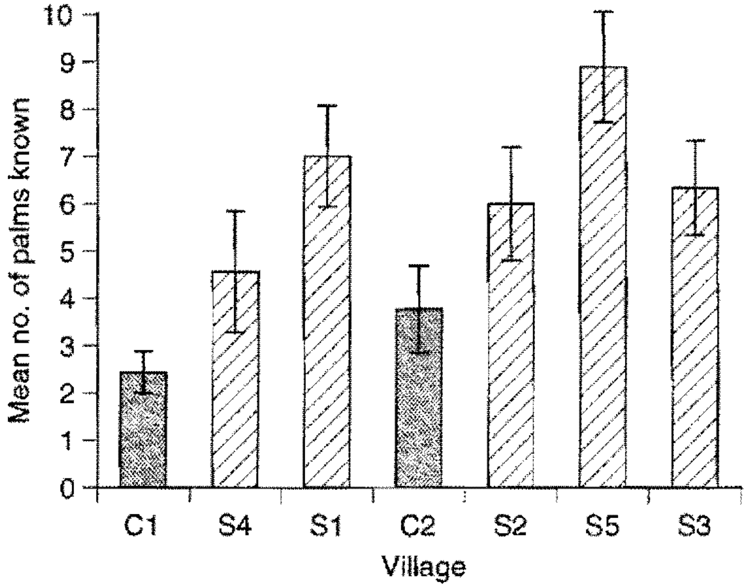

FIGURE 3.—Knowledge levels in seven villages in south-eastern Ecuador expressed as mean number of palms people knew. Hatched bars represent Shuar villages (S1–S5) and dark bars Colonist villages (C1–C2). Villages are arranged in order of approximate transportation time to nearest road with most accessible villages to the left. Error bars represent 95% confidence limits generated through permutation.

side of the border, since there were frequent visits between the two communities. The villages on the Peruvian side of the border are more marginal with regard to market access and transportation opportunities, which makes it plausible that they maintain traditions and practices which have been abandoned in the more accessible Ecuadorian villages.

In our study area, the Shuar village with highest average knowledge of palms (S5 in Figure 3) was one of the most remote, in the sense that it was situated along a tributary river, and people had to walk for two hours just to reach boat transport. Also, this village exhibited the more traditional low-density residence pattern rather than a centralized village pattern as in the other settlements. Houses were constructed over a broad area with a minimum walking distance of 10–15 minutes between neighbors. In contrast to the other villages, village S5 had not received much support from NGOs or the state for facilities such as health service, plumbing, or a school; in every sense of the word, it is more marginal than the other villages. In another physically remote village (S3 in Figure 3), more outside assistance had been offered (partly as a reaction to damages inflicted in this village by a severe flooding event in the area). Here, the village consisted of a core of government-built houses and a new school around a central square. Knowledge levels were much lower in this village than in village S5.

Marginality *vs.* availability of modern goods and services is decisive in determining the persistence of local knowledge and use of plant products (Begossi 1996; Benz et al. 2000; Gertsch et al. 2002; Ladio 2001). Replacement of palm products with modern goods seems also to have played an important role in the

Nangaritza area. Informants reported switching from palm products to manufactured alternatives if available, such as hunting gear (e.g., shotguns) and construction materials (e.g., corrugated iron). Use of some products seems to have been abandoned due to changing customs; e.g., now that Ecuador's indigenous groups have been officially "pacified," traditional weapons of war are used only for decoration. Overexploitation due to more effective tools and increasing human population densities may also influence how people use plants and think about them, as has been reported from other areas (Anyinam 1995; Gertsch et al. 2002).

Knowledge Transfer.—Birthplace (similar lowland environment *vs.* different highland environment) and length of residence time has a strong influence on people's choice of agricultural techniques (e.g., Dufour 1990; Pichón 1996). People settling in an unfamiliar environment adopt new and more appropriate techniques and knowledge slowly during the course of several years. We therefore expected that there would be a relationship between birthplace and residence time in the area on one hand and knowledge levels on the other. Contrary to our expectation, the multiple regression analyses did not show any such effect on knowledge about palms.

There were, however, indications of some knowledge transfer from Shuar to colonists. The same species were used for similar purposes both among colonists and Shuar (data not shown). Comparisons among different indigenous groups in the Amazon show that different uses for the same species and use of different species for the same purpose have evolved in the course of time in environments with overlapping species sets (Borchsenius et al. 1998; Gentry 1992; Kvist and Holm-Nielsen 1987). Therefore, it is highly unlikely that Shuar and colonists could have arrived at the same solutions as a result of parallel technical evolutionary processes. This hypothesis is supported by the fact that the colonist village, where people on average knew most about palms (C2 in Figure 3), was situated furthest from the road and closer to a Shuar village than any other colonist village. Both factors may promote knowledge accumulation among colonists. The long distance from roads and markets makes it difficult to sell agricultural products and to obtain external goods, promoting self-reliance and an incentive to use locally available products. At the same time, the proximity to the Shuar, who often came to this colonist village to obtain basic consumer goods from the small village shop, provided more opportunities to exchange knowledge and promote friendly relationships between members of the two communities. The importance of social contacts between ethnic (and other) groups in the promotion of knowledge transfer has been documented among different groups of colonists and indigenous people in one region in Guatemala (Atran et al. 2002). Further support for the importance of interethnic contact is provided by the fact that many of the non-indigenous colonists in village C2 provided Shuar names for palms rather than Spanish names.

Knowledge did not only seem to be transferred from Shuar to colonists, but also among Shuar themselves. For example, on several occasions we observed people bringing back "exotic" palms (i.e., not native to this area) from visits to relatives or friends in other parts of the Ecuadorian Amazon or people told us about palm species or uses they had observed in other places. This indicates that also so-called "traditional" knowledge and practices are constantly undergoing changes and transformations as has also been shown elsewhere (Brodt 2002), adding more perspectives and challenges to the issue of knowledge loss and conservation.

Socioeconomic Factors.—Several of the factors we analyzed exhibited relationships with palm knowledge (Table 4). Ethnic identity and village location emerged as the most important factors. Members of the Shuar communities knew on average many more palm species and uses than did colonists (Figure 2), which is also illustrated by the rank-abundance diagram (Figure 1). This is hardly surprising, considering that the Shuar are native to the area and their collective knowledge system has evolved in this area over a long time span.

Differences between villages seemed partly to be related to remoteness or marginality (Figure 3) and thus to the availability of modern goods and services. Several studies have shown how the availability of modern goods and services influences traditional practices and knowledge (Benz et al. 2000; Figueiredo et al. 1993; Redford and Stearman 1993). Although there was a tendency for more remote villages to exhibit higher average knowledge levels, this did not hold true in all cases. Other factors, which may be responsible for differences between villages in the same area, may be differences in the environment, historical reasons and village age (Coomes 1996; Coomes and Barham 1997). We are conducting a follow-up study to investigate possible differences in environment and availability of palms in the area.

Apart from ethnic background and village location, palm knowledge was also related to gender, education, and indicators of wealth and agriculture practices. Men knew on average more palm uses than women (Figure 2), but the strength of the relationship varied between the two communities and between the different villages. Gender differences with regard to ethnobotanical knowledge have often been observed and are usually related to gender-related division of labor (Hanazaki et al. 2000; Luoga et al. 2000; Styger et al. 1999). Among the Shuar, traditional gender roles assign house and homegarden chores to women, while typical male tasks are hunting, clearing of forest for new fields, house construction, and fabrication of tools (Harner 1972). Although to some extent palms are grown and protected in homegardens and fields, typical male activities entail a higher probability of encountering palms in the forest. In addition, harvest of most palm products requires physical strength and is therefore usually performed by men. Processing is sometimes performed by men (e.g., house construction materials and hunting gear) and sometimes by women (e.g., fruits and palm hearts).

A weak positive correlation between marriage and knowledge level may be due to the fact that married people have more responsibility for satisying the household's subsistence and cash needs (Table 4). If this entails more frequent collection and use of wild plants, it might contribute to higher knowledge levels.

Our study demonstrated a positive relationship between formal education and palm knowledge (though the relationship was dependent on ethnic community and village location). This may be due to the fact that children in the Nangaritza area received their schooling in the villages, mostly by teachers recruited from their own community. Therefore, school attendance did not remove them from the local cultural and natural environment for extended periods. Before and after school they were still expected to participate in household and farming chores, and it is in these contexts that traditional knowledge is typically passed on between the generations, by observation, imitation, and hands-on experience (e.g., Brodt 2002; Ruddle 1993; Zarger 2002). The positive relationship with length of formal education may indicate that individuals who are inclined towards acquiring formal knowledge also are the ones inclined towards or better at picking up traditional knowledge (Zent 1999). In addition, formal education may heighten people's awareness of different sources of knowledge and provide them with more tools to access knowledge (Godoy 1994). Introduction of "alien" knowledge does thus not necessarily lead to the loss of local traditional knowledge as long as it can be incorporated into the local context and people still have time and opportunity for, and interest in acquiring traditional knowledge and skills.

Another group of important factors related to people's palm knowledge were wealth-related variables (Table 4). In general, members of more well-to-do households knew more palms than members of poorer households. Wealth may affect people's use of wild plants by changing their dependence on forest products and also by determining which tools they have at their disposal for extracting and processing forest products (Takasaki et al. 2001). Previous studies have shown mixed tendencies, with both the poorest and the wealthiest people using most forest products while those with intermediate levels of wealth used least wild products (Barham et al. 1999). In the present study, wealth was mainly measured as agricultural assets, and therefore also reflects different agricultural practices. Extraction and management of natural resources such as plants is an integrated part of people's subsistence strategies, and decisions made with regard to agricultural practices, capital and labor investment will therefore also influence to what degree people extract natural plant products (Coomes 1996; Wiersum 1997). Household differences in agricultural practices may themselves be related to factors such as household history, labor and capital endowment, and past experiences (Coomes and Barham 1997; Scatena et al. 1996).

SUMMARY AND CONCLUSION

This case study, focused on knowledge of palms in southeastern Ecuador, investigated three different questions concerning knowledge loss, knowledge transfer, and the influence of socioeconomic characteristics on people's knowledge levels.

Knowledge loss among traditional people due to acculturation is often seen as one of the biggest threats to sustainable resource use. Indeed, loss of knowledge seemed to be taking place among the Shuar of the study area, although the statistical analyses (regression and rank-abundance curves) did not show age-related patterning. Rather, the Shuar informants reported their own perception that knowledge has been lost. One possible explanation for the lack of age-related patterns may be that the changes we would expect to find had already occurred during the previous generation, and could thus could no longer be detected among those presently living. The plausibility of such a scenario was supported by people's references to the more traditional Shuar living about a day's walk away in Peru.

At the same time, knowledge transfer from Shuar to colonists of mixed origin seemed to be taking place. This process was not so much evidenced by any relationship to birthplace or residence time in the area as by location of residence at the time of the study. In addition, Shuar and colonists shared some palm uses and names, especially in the most remote of the two colonist villages. Both the process of knowledge loss and of knowledge transfer thus seemed to be associated with remoteness or marginality of villages, with increasing marginality favoring the preservation and transfer of knowledge. Similar results have been found in other studies and have been connected to the availability of modern goods and services and people's engagement in market economy. Geographic placement and village context seemed to be more important to both loss and transfer of knowledge than the time individuals had spent in the area.

Factors which have previously been used to explain knowledge loss or transfer (age, birth place, residence time) were found to be not significant in the present study. Nevertheless, processes of knowledge loss and transfer could partly be inferred from the geographic patterns revealed by the statistical analyses. The analyses showed that people's knowledge levels were related to their wealth, gender, marital status and education, but that these relationships to a large degree reflected ethnicity and residence. Generally, there were higher knowledge levels among Shuar than among colonists, and among men than among women. In addition, education, marriage, and wealth showed positive association with people's knowledge levels. It is, however, important to remember that statistical correlation does not imply a causal relation. As the present study also shows, the data must be examined carefully in the light of all available information lest important patterns be missed.

Heated debates about processes and importance of different factors in other academic disciplines such as ecology provide ample evidence for the impact of temporal and geographic scales of processes under investigation as well as of the research itself. Such effects of scale should also be taken into consideration in the case of both design and analyses of investigations of knowledge.

For understanding and predicting processes of knowledge loss and transfer, some factors are more important than others because they are variable. Marginality, remoteness and market integration are likely to change in the future; in southeastern Ecuador new roads are being built, giving easier access to markets. At the same time, populations continue to grow both by natural increase and immigration, which will change agricultural practices and natural resource management; traditional knowledge will inevitably change, too. This particular study suggests that some traditional palm uses persist and are taken up by newcomers across ethnic boundaries, while others are likely to disappear due to the availability of alternatives or declines in the populations of the plants themselves.

NOTE

[1] Specimens deposited at the herbaria of the University of Loja, Ecuador (LOJA) and AAU.

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