Bioremediation, Biodiversity and Bioavailability ©2011 Global Science Books

Cultural Transmission on Palms among Ese Eja Communities in Peru

Matías Pérez-Ojeda del Arco[1,3*] • María de los Ángeles La Torre-Cuadros[1,2,3] • Carlos Reynel[1,3] • Infierno and Sonene communities[4]

[1] Herbario Forestal MOL. Facultad de Ciencias Forestales. Universidad Nacional Agraria La Molina. Apdo. 456 Lima, Peru
[2] World Agroforestry Centre (ICRAF). Federico Basadre km 4.200, Pucallpa, Ucayali, Peru
[3] Foro Etnobiología Peru
[4] Ese Eja – Madre de Dios, Peru

Corresponding author: * **matias841@hotmail.com**

ABSTRACT

In this research paper we propose a reflection about the context of the cultural transmission related to the use of palms for two of the Ese Eja communities in Peru. This work was done in the communities of Infierno and Sonene between 2009 and 2010. A stratified random sample was used to interview 31 residents in Infierno and 30 in Sonene. These were grouped into 4 age categories (15-29, 30-44, 45-59, 60 and over) and divided by gender. Previous botanical records for palms of the region were used, selecting 21 species which were verified in the field by the researchers. Visual stimulus guides were created and semi-structured interviews were held, evaluating the knowledge of palms, knowledge transmission paths and learning contexts. Furthermore, information on the perceived state of the conservation of the studied species in both communities was taken into account. The majority of the interviewees mentioned having learned in their childhood and in the field, however, the contexts are changing for the transmission of traditional ecological knowledge of palms, including new forms of learning of youth and in the school. The main cultural transmission path was vertical. Use of palm leaves for housing construction is used as example and how the dynamics of knowledge is influenced by the cultural transmission paths is explored. We conclude that the theoretical transmission model does not reflect entirely what this research has found in terms of Ese Eja TEK stability over time.

Keywords: Amazonia, Arecaceae, knowledge acquisition, Takana, traditional ecological knowledge
Abbreviations: TEK, Traditional ecological knowledge

INTRODUCTION

Traditional ecological knowledge (TEK) has been described as an accumulating body of knowledge resulting from the relation of humans with each other and with their environment (Berkes 1993). Its construction implies that it is the result of the dynamics of the environmental and socio-cultural changes (Alexiades 1999, 2003; Eyssartier *et al.* 2006) which is transmitted across generations due to cultural transmission (Berkes *et al*. 2000; Eyssartier *et al.* 2008).

Research on cultural transmission is strongly linked to the field of specialization of those undertaking the study, with a natural science focus by for example Cavalli-Sforza and Feldman (1981) and Hewlett and Cavalli-Sforza (1986); and from other perspectives, Henrich and Boyd (1998), Henrich and Gil-White (2001) and Henrich (2002), among others.

This study uses the definition initially presented by Cavalli-Sforza and Feldman (1981) and used by Hewlett and Cavalli-Sforza (1986) and Reyes-García *et al.* (2009) where cultural transmission is defined as the process of social reproduction in which knowledge, behavioral patterns and cosmological beliefs are communicated and acquired.

Cavalli-Sforza and Feldman (1981) point out that cultural transmission in pre-industrial contexts occurs along three distinct paths which are not mutually exclusive: 1) parents to children (vertical transmission); 2) from any individual of the same generation (horizontal transmission); and 3) from individuals of the parents' generation to the children's generation (oblique transmission).

However, compared to other topics studied within ethnobiology, there are few research studies which have demonstrated the process by which the information is transmitted from one generation to another. Qualitative studies include the work of Ruddle and Chesterfield (1977), Ruddle (1991, 1993), Murphy (1992) and Zarger (2002) while quantitative research includes investigations conducted by Hewlett and Cavalli-Sforza (1986), Ohmagari and Berkes (1997), Lozada *et al*. (2004, 2006), Eyssartier *et al*. (2006, 2008) and Zent (2009a).

According to Hewlett and Cavalli-Sforza (1986), the importance of the cultural transmission models lies in the possibility of understanding the conservation, loss and dissemination of cultural innovations. For example vertical transmission is highly conservative and assumes individual variation in which the innovations are disseminated slowly within a society. In contrast, horizontal knowledge transmission allows a fast diffusion of new knowledge if there is constant contact with the transmitters. The combination of the horizontal and oblique transmission paths involving multiple transmitters to one receiver generates a higher level of uniformity of knowledge within a social group, while it permits generational cultural changes (Reyes-García *et al.* 2009; Reyes-García 2010).

Due to the fact that TEK has contributed to understanding biodiversity and creating strategies for its conservation (Muller-Schwarze 2006), changes in its distribution can play a definitive role in future use and management of resources. This makes measuring TEK essential, through the use of comparative and replicable research in the topic of knowledge transmission (Wyndham 2002; Cristancho and Vining 2009; Zent 2009b, 2009c).

We chose knowledge about palms within the body of

Received: 12 March, 2011. Accepted: 28 May, 2011.

Original Research Paper

TEK, due to the importance of this botanical family for the Amazonian region (Goulding and Smith 2007). Firstly it is a typical characteristic of (Kahn *et al.* 1988; Kahn 1990) as well as conspicuous and important in the ecology of the tropical forests (Henderson *et al*. 1995; Balslev *et al*. 2008), and secondly palms form the plant family which is probably most widely used by indigenous and colonist populations who live there (Henderson *et al.* 1995; Paniagua *et al.* 2007), with various ethnobotanical studies affirming this statement (Prance *et al.* 1987; Pinedo-Vásquez *et al*. 1990; Lawrence *et al*. 2005).

Given this context, knowledge about palms and their uses is important in order to understand how tropical rainforests with its diverse ecological niches can be utilized and managed sustainably (Balslev *et al.* 2008). However, it is above all the role they play in the subsistence strategy in the Amazonian populations, that the knowledge about them constitutes a relevant example of the diversity of knowledge about resources from tropical forests in general (Paniagua *et al.* 2007), permitting us as a result to recognize processes of exchange and loss of knowledge (de la Torre and Macía 2008).

The Esa Eja

The Ese Eja form an Amazonian indigenous group belonging to the linguistic family Takana and are dispersed between Peru and Bolivia (Chavarría 2002), with four communities in Peruvian territory: Infierno, El Pilar, Palma Real and Sonene (Alexiades 1999). Until a few years ago they formed a nomadic society, but today are settled in specific locations. Social and political changes have favored the penetration of a market economy in the region and led to the migration of the settled populations from the headwaters to lower-lying locations (Alexiades 1999; Peluso and Alexiades 2005). Exactly these kind of changes can cause that cultural transmission strategies change over time in a society (Reyes-García 2010), as found by Alexiades and Peluso (2009) with the Ese Eja attributing much of their present-day knowledge of medicinal plants to contact with agents external to their culture.

In this study we discuss the context of cultural transmission related to the use of palms for two of the mentioned Ese Eja communities, determining the initial stage of learning, ways of learning, transmission paths and location of transmission. This study also intends to support the hypothesis of cultural flexibility as found by previous studies of this society. The results obtained about the perspective of conservation of biological and cultural diversity are systematized, compared and interpreted. This study endeavors to be a contribution which enriches the studies of cultural transmission for the ethnobiology discipline.

MATERIALS AND METHODS

Study area

The work was conducted in the indigenous communities of Infierno and Sonene, located in the province of Tambopata, department of Madre de Dios, Peru (**Fig. 1**).

Both contain two main natural landscapes along its territory: the floodplains and the terra firme forests (IBC 2001). The climate is hot and semi-humid with mean annual temperatures of 25-27°C and annual rainfall of 1700 mm (Chumpitasi 2003).

The indigenous community of Infierno (12° 49′ S and 60° 13′ W) is located on both sides of the Tambopata River, 40 min by road from the closest city: Puerto Maldonado (IBC 2001). The population of Infierno is of approximately 600[1] inhabitants, consisting of Ese Eja inhabitants and people of Andean origin, as well as *mestizos* as a result of marriages between these groups mentioned. Additionally there are some indigenous riverside families displaced from other places including Tacana from Bolivia, Ashaninka and others (Alexiades, pers. comm., 12th Feb., 2011). It is uncommon to hear people speaking in the Ese Eja language but many inhabitants confirm their descent. The most important economic activities are agriculture, agroforestry, hunting, fishing, collecting *Bertholletia excelsa*, extracting the edible palm heart of *Euterpe precatoria*, charcoal production, extracting the fruit of *Mauritia flexuosa* and animal rearing (IBC 2001), though ecotourism has become an important source of income in recent years. There is a pre-primary, primary and secondary school as well as a health post.

Fig. 1 Map showing location of Infierno and Sonene communities in Madre de Dios.

The indigenous community of Sonene (12° 34′ S and 68° 42′ W) is located on the right bank of the Heath River, which forms the Peruvian-Bolivian border. The main access route is by river, a journey of 5-8 h from the city of Puerto Maldonado. At present there are 25 families in the community of approximately 150[2] inhabitants, nearly entirely Ese Eja. The language is still spoken in nearly all the domestic units. The main subsistence activities are hunting and collecting "Brazil nut" (*Bertholletia excelsa*) in the rainy season, with subsistence agriculture and extraction of timber. In the dry season there is fishing, collecting river turtle eggs on the beaches of the Heath River and *Geonoma deversa* leaves. There is a pre-primary and primary school as well as a health post.

Both communities are adjacent to the Tambopata National Reserve, a Protected Natural Area of the Government of Peru, created in the year 2000 with an area of 278 284 ha characterized by direct use, permitting some sustainable anthropic activities (INRENA 2003).

Selection of species

Nine previous lists of palms registered in the province of Tambopata were reviewed (Moussa *et al.* 1992; CI 1994; Huamán 1995; CI 1997; Alexiades 1999; Chavarría *et al.* 2000; Piana 2000; Sears 2001; Alvarez 2008). The information was verified with the Guide to American Palms (Henderson *et al.* 1995), botanical collections in both communities and verbal confirmation of their presence by the inhabitants with informal interviews. A final list of 21 species was obtained (**Annex 1**) and visual stimuli were prepared using photographs from previous studies and the botanical collections during this study.

Ethics

Following practical guidelines of the Code of Ethics of the International Society of Ethnobiology (ISE 2008), the project was presented to each community in the study and to the "Federación Nativa del río Madre de Dios y Afluentes" (FENAMAD), the community-based organization of the "Asociación Interétnica de Desarrollo de la Selva Peruana" (AIDESEP), for its approval, which was satisfactory, and in the same way to the Management of the Tambopata National Reserve.

Selection of the interviewees

Inhabitants with both surnames of Ese Eja origin were selected in each community, verifying the information with the oldest inhabitants to reduce bias by historic migration processes and adoption

of external surnames. A stratified random sample was created (Bernard 1995; Albuquerque *et al.* 2008) determining four age categories, starting at 15 years as average age at which individuals reach an acceptable knowledge level for field activities (Hewlett and Cavalli-Sforza 1986; Ohmagari and Berkes 1997; Reyes-García *et al.* 2006), discarding the normal learning curve of children (Wyndham 2009; Zent 2009a) and using a range of 15 years for each category as suggested by Zent (2009a). The variable gender was considered (Pfeiffer and Butz 2005) for each age category and a proportional division of the sample was done (N=54, n=31 for Infierno and N=50, n=30 for Sonene) according to the size of each category. Confidence used was 95%.

Data collection

Semi-structured interviews were held with 31 people in Infierno and 30 people in Sonene between December 2009 and May 2010 (16 weeks). The interview consisted of three parts. The first is related to five aspects of knowledge transmission in relation to the most frequent use of palms which the interviewee mentioned: when learned, how learned (if it was by own initiative or taught by others), who taught them, where this was taught and if they taught somebody else in turn. Similar questions were used by Lozada *et al*. (2004, 2006). The second part is related to TEK, in which visual stimuli were used to confirm if the interviewee knew the palm by its common Spanish name, its name in Ese Eja, if he/she could recognize the observed species and if he/she knew at least one use. If they mentioned the common name of the palm, a value of 1 is assigned, if not the value of 0 is assigned, and consecutively with the three remaining questions. A similar approximation was used by Reyes-García *et al.* (2009) with a list of 15 plants of 92 for the Tsimane. The third part is related to the local perception of the conservation status of each of the species the interviewee mentioned as knowing. The technique of "pile sort" (Martin 1995) was used in which the interviewee grouped the visual stimuli according to local categories established with focus groups and informal interviews. Firstly they were asked to group in "species most commonly used in your community". Secondly, again using all the species mentioned as known by the interviewee, organizing the visual stimuli by "very commonly found" "rarely found" and "no longer found" of the species within the communal territory. A similar approximation was used by Potvin and Dalle (2004). Additional notes were made about the extraction forms of the resource.

Data analysis

Responses to each of the five aspects under consideration within the part of the knowledge transmission were grouped and percentages of frequency of mention for each question were calculated.

In order to visualize the distribution of TEK, data matrices were constructed calculating a relative score per species and subsequently the sum of the 21 scores (21 palm species) which constitutes the total theoretical knowledge of evaluated TEK for each interviewee.

In order to measure the relation between age and the TEK score obtained, we looked for the determination coefficient between them, taking them as independent and dependent variable respectively. Linear relations for each age category and community are established.

The responses for each species were added up within the categories "very common", "rarely found" and "no longer found", obtaining percentages of mention.

The answers relating to uses mentioned for each of the species studied were also added up.

The collected botanical samples were dried at the Forestry Herbarium (MOL) of the Forestry Science Faculty at the National Agrarian University, La Molina and taken to the herbarium of the Natural History Museum of San Marcos (USM) for its identification. The Herbarium Vargas (CUZ) of the San Antonio de Abad University, Cusco was visited to compare data of botanical collection of palms.

RESULTS AND DISCUSSION

Transmission context

1. Stage of learning

The majority of the interviewees of both communities indicate having learned of the uses of the species during their infancy, followed by youth and then adulthood (**Fig. 2**). Only one person responded not knowing when he learned in Infierno.

Due to the fact that contact with nature is of vital importance for acquiring knowledge (Atran *et al.* 2004), the ease of observing palms in the Ese Eja territory and their described multiple uses (Lawrence *et al.* 2005), would appear to favor this learning at an early stage. This statement is backed up by constant interaction between Amazonian indigenous communities and this botanical family (Balick 1984; López-Zent and Zent 2002; Albán *et al.* 2008).

However, learning during the youth stage is more common in the community closer to the city (Infierno) than in the more remote (Sonene), which can be interpreted as a kind of delayed learning. Ferreira de Athayde (2003) describes a similar case for knowledge of the Kaiabi in Brazil and Zent (2009b) for the Jotï in Venezuela, in agreement with the theoretical suggestion by Ruddle and Chesterfield (1977) and Ruddle (1991, 1993) when they point out that there is an age division for different learning activities and specific contexts. Interestingly, one interviewee aged 44 years of Infierno said: "*No, I didn't teach this to my children because they grew up with their mother in Puerto Maldonado...*" His two sons, now both youth, have returned to the community and know of palms, but assure that they have learned belatedly.

2. Ways of learning

In both communities the majority mentioned having learned by being taught by other people (**Fig. 3**). Only one person responded not knowing how he learned in Infierno.

In both categories similar results were obtained in accordance with ways of learning described in previous studies, learning and transmitting socially between individuals or also derived from personal experience resulting from the individual's interaction with the natural context (Alcorn

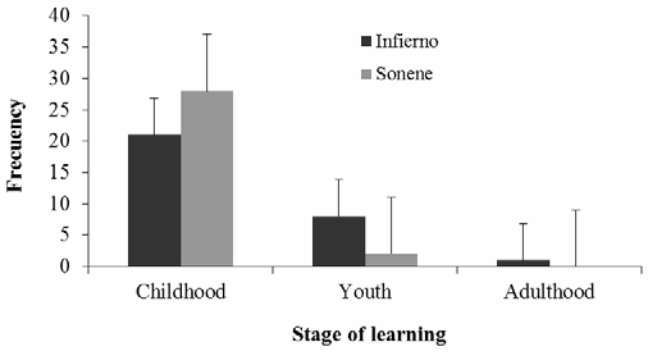

Fig. 2 Stages of learning in Infierno and Sonene

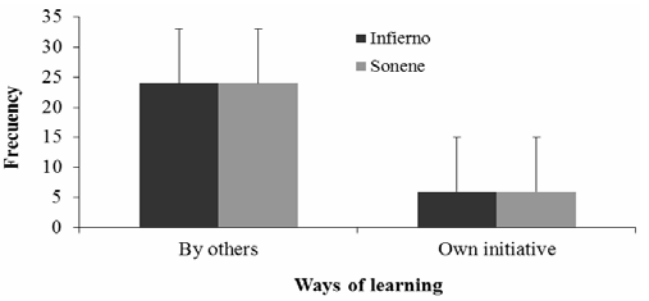

Fig. 3 Ways of learning in Infierno and Sonene.

1995; Ladio and Lozada 2003; Lozada *et al.* 2004). Alexiades (1999) suggests that individual experimentation is an important form of learning among societies with highly organized and well developed plant knowledge.

This has not been the case for the Ese Eja over their history, given that the flora previously played a smaller role than the fauna in their ideological and religious universe compared to other Amazonian societies (Alexiades 1999; IBC 2001; López-Zent 2009). Based on this, one can understand the low level of responses of learning through own initiative. One of the possible interpretations as referred to by Alexiades (1999) is that in recent years there is a higher level of individual experimentation related to the medicinal use of flora compared to the past. The following testimony which was gathered in the field, *"Nobody will give you anything, you need to be smart, observe and practice"* sums up these changes in the form increased learning on the voluntary and personal level (Ferreira de Athayde 2003; Cristancho and Vinging 2009).

3. Transmission paths

In both communities vertical transmission predominates (**Fig. 4**).

Various researchers have found similar situations including Hewlett and Cavalli-Sforza (1986), Ohmagari and Berkes (1997), Robinson (2003) and Lozada *et al.* (2004, 2006).

On the other hand, the three knowledge transmission paths are not mutually exclusive and can take place simultaneously over a lifetime. Two examples illustrate this statement: a) the example of the interviewee in Infierno whose sons grew up in the city. Both have received more information from their age peers as stated in their interview responses, stressing the importance of horizontal transmission in the period after childhood and closer to adulthood. b) When a group of youths of 14, 16 and 17 were accompanied to the field there was a spur of the moment extraction of the "hearts" of *Euterpe precatoria.* While one of the palms got stuck among the vines of the canopy when it was felled, one of the youths reminded the other *"how his father did"* to release the existing tension, allowing the palm to complete its fall. A clear example is described by Ruddle and Chesterfield (1977) and Ruddle (1991, 1993) in which apprentices of their parents compares knowledge, as reinforcement among same age peers through horizontal transmission (Zarger 2002).

Very little oblique transmission was found, limited mostly to those of adult age.

4. Location of transmission

The majority responded having learned in the forest (**Fig. 5**).

The field remains the perfect place for learning about palms, similar to the findings of Lozada *et al.* (2004, 2006) about wild plants in Patagonia. Within the concept "field" we include the forest and the swidden field because often each place has palm species which occur in one of the two places in a specific manner. The house is identified as the place where the parts of the palms are brought from the field to undertake some specialized tasks, like weaving coverings for roofs of *Geonoma deversa*, ripening harvested fruit from *Oenocarpus bataua*, *Oenocarpus mapora*, *Mauritia flexuosa*, *Bactris gasipaes*, weaving baskets with leaves from *Attalea phalerata*, *Attalea butyracea*, *Attalea maripa*, *Phytelephas macrocarpa*, among other activities. The house in this context involves mostly vertical transmission, while the field allows other options. The three places mentioned coincide with those found by Murphy (1992) and Atran *et al.* (2002) as appropriate places for learning TEK.

The case of the school is noteworthy in spite of the low percentage of mention. This could be a new physical context for learning about palms for the Ese Eja, similar to what was found by Zent (2009b) and Cristancho and Vinging (2009) for the Itza'Maya in Guatemala with diverse TEK components, deducing that the lack of direct contact with nature has promoted a more conceptual and abstract knowledge.

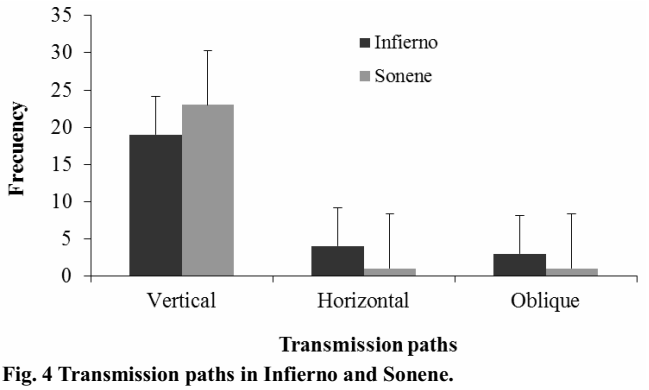

Fig. 4 Transmission paths in Infierno and Sonene.

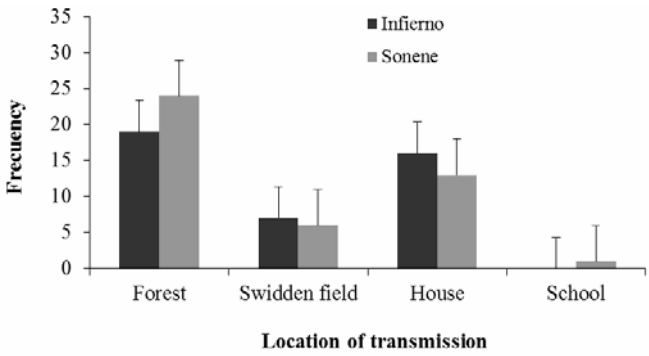

Fig. 5 Location of TEK transmission.

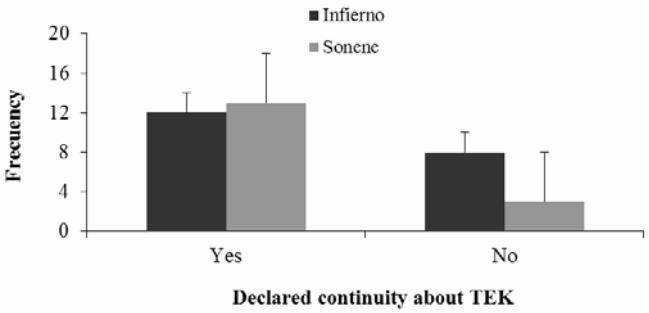

Fig. 6 Declared continuity about TEK in Infierno and Sonene communities.

5. Declared continuity about TEK

In both communities the majority mentioned having transmitted their acquired knowledge, but in Sonene at a higher percentage than in Infierno (**Fig. 6**). The lowest age category of 15 to 29 years was ruled out (32% and 46% of the population in the study for Infierno and Sonene, respectively), due to the high number of negative responses mentioning not having transmitted knowledge to their children as they do not yet have any children. 40% of interviewees in Infierno mentioned not having taught anybody, which could explain an interruption in TEK transmission of palms, which had been documented in the older generations. This partial or interrupted continuity of traditional knowledge is similar to what was found by other researchers (Benz *et al.* 2000; Lee *et al.* 2001; Heckler 2002; Brosi *et al.* 2007).

Assuming this interpretation, the way of vertical transmission found as principal transmission path of TEK in both communities, does not reflect the proposal of Cavalli-Sforza and Feldman (1981) and Hewlett and Cavalli-Sforza (1986) in terms of cultural stability over time as is the case Infierno.

Distribution

A higher score of evaluated TEK is observed in Sonene than in Infierno, in all the age categories (**Fig.7a, 7b**). We observe a continuity trend of TEK which does not include all the evaluated contents as stated in the declared continuity.

In Infierno the first age category presents a more homogenous TEK than in the three others. Individuals deviating from the general trend were found in all age categories, interpreted as possessing a poor TEK if they are below the TEK trend for their age category or outstanding if they are above the trend. This disparity found in Infierno and not perceived in Sonene can explain the differences in TEK between communities: Firstly, through the way of learning by own initiative which involves individual experimentation as described by Alexiades (1999). Secondly, a possible delay in acquiring TEK was where the younger generations are not experiencing the same learning opportunities as before. Thirdly, the better access which Infierno has to the market due to its geographical location, which leads to a reduction in TEK and a specialization of activities related to the market, for example villagers specialize in making roof coverings (*Geonoma deversa*). Fourthly, there is a larger predominance of non-indigenous people in Infierno than in Sonene. More contact with non-indigenous people leads to changes in TEK, starting with the fact that this is acquired in different ways according to the time of settling of each community as suggested by Atran *et al.* (2002).

In Sonene a more homogenous trend was found in TEK with few individuals deviating from the trend in each age group, presenting a typical learning curve (Wyndham 2009) which was also observed for Infierno though in a more dispersed way.

The coefficients of determination (r^2) are very weak for Infierno, while for Sonene they are stronger in all age categories. Variables apart from age are affecting the TEK score, but this is not the case for Sonene.

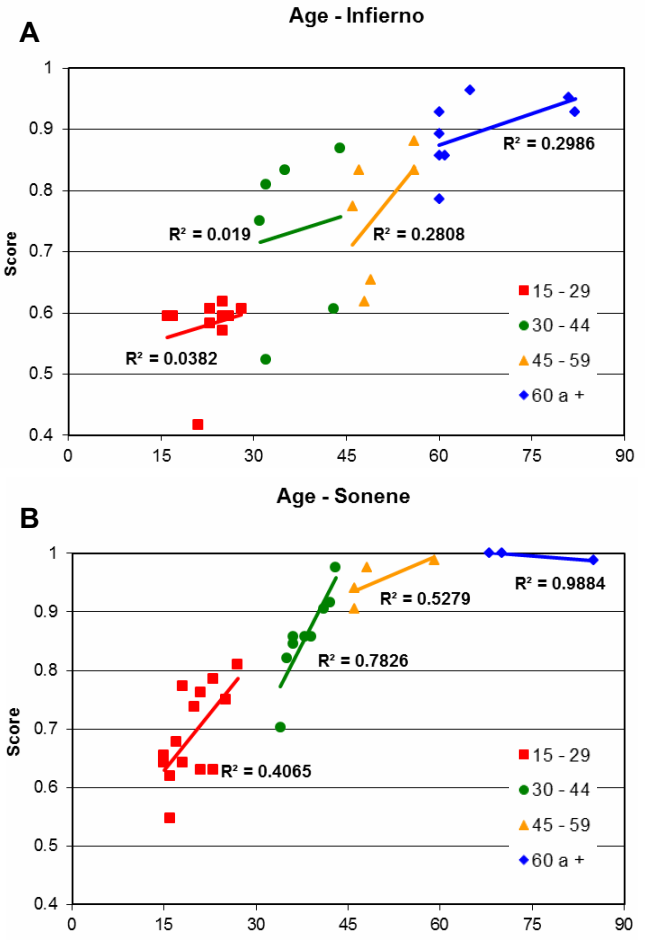

Fig. 7 Palm knowledge distribution. Four age categories in Infierno (**A**). Four age categories in Sonene (**B**).

Local perception of the conservation status of palms

In Infierno the palms considered to be most widely used were *Mauritia flexuosa* (30%), *Euterpe precatoria* (18%), *Oenocarpus bataua* (15%) and *Geonoma deversa* (12%). The rest were mentioned with a percentage lower than 5% except *Bactris gasipaes* and *Iriartea deltoidea* with 6%. *Mauritia flexuosa* and *Geonoma deversa* show a low percentage of mention in the category "very common" (9% and 35%) and more in the categories "rarely found" (58% and 45%) or "no longer found" (23% and 20%).

In Sonene the palm considered as most widely used was *Geonoma deversa* (70%) while all the rest obtained a percentage lower than 5%. This species shows a high percentage of mention in the category "very common" (73%) and low in the categories of "rarely found" (27%) or "no longer found" (0%).

In both communities a diminishing of the resource is perceived, but more evidently in Infierno. The extraction techniques of the resource varied depending on the species: using axes, trunk climbers with ropes for the extraction of the fruit of *Mauritia flexuosa* and *Oenocarpus bataua* and, cutting complete stems and cutting only leaves, leaving the apical section, for leaf extraction of *Geonoma deversa*.

Applicability of cultural transmission: the case of leaf extraction for roof-thatching

A large diversity of the selected species was registered as used for roofs of homes (14 in Infierno and 15 in Sonene). However, we found in both communities roofs were constructed by *Geonoma deversa* or aluminium sheets. Only one home in each community was identified using leaves from *Attalea* spp.

Alexiades (1999) associates the use of *Attalea* spp. to the high mobility of the Ese Eja. Their leaves are easier to harvest and the roof is created faster than with *Geonoma deversa*. The time is less because the shape and architecture of the leaves permit less time-consuming roofing activity. *Phytelephas* spp. also seems to have been commonly used in the past due to easy access to its leaves and is presently used by other communities (Henderson *et al.* 1995). The use of leaves of *Wettinia augusta* and *Socratea salazarii*, for their natural distribution in hilly landscapes especially in headwaters, corresponds to the past as described for the Ese Eja and their migration process to low-lying areas (Peluso and Alexiades 2005; Alexiades and Peluso 2009).

Once the establishing of the group was determined, the need for longer-lasting roofs was eventually needed (Alexiades 1999) which led to the selection of *Geonoma deversa*. Subsequently unsustainable harvesting techniques like cutting complete stems of the palms (Flores 2000), the demands of the market and lack of knowledge of other sustainable techniques would affect the availability of the resource. *Geonoma deversa* is an example of this: "*In the past we left at 7 am after breakfast to bring 'palmiche' leaves, at 11 am we were back and at 4pm we had 10 woven coverings. Today we leave at the same hour and return at 4pm, things have changed...*" Western notions which differ from those of indigenous communities like "Conservation" (Alcorn 1993) have taken root in the way of thinking and acting, leading to the search of other options different from those known to the Ese Eja culture throughout their history (**Fig. 8**), for example the intervention of reforesting certain areas of the community of Infierno with *Geonoma deversa* or bringing *Lepidocaryum tenue*, an exotic species to the forests of Madre de Dios, while typical for the Amazonian north (Henderson *et al.* 1995), are some of these. Similar contexts have been analyzed by Sirén (2006) and Martinez-Ballestes *et al.* (2002).

Testimonials recorded in Infierno about knowledge

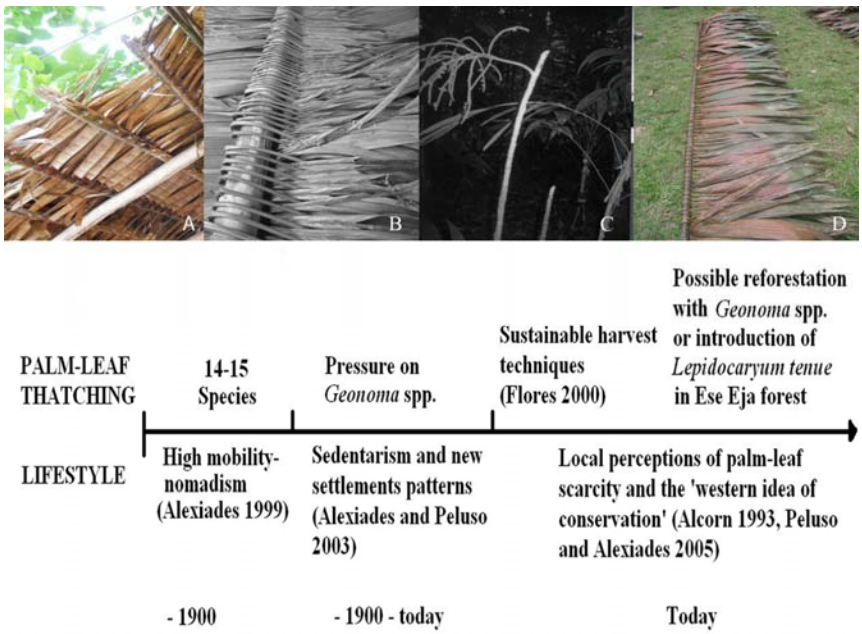

Fig. 8 Ese Eja cultural transmission and the case of leaf extraction for roof-thatching. Knowledge restricted to the past**:** Roof thatched with *Attalea* sp. (**A**). Present Knowledge: roof panels made with *Geonoma deversa* (**B**). *Geonoma deversa* unsustainable harvested (**C**). Possible future knowledge: roof panels made with *Lepidocaryum tenue* in San Martín, Peru (**D**).

regarding seeds or vegetative reproduction of *Geonoma deversa* did not mention this as Ese Eja knowledge, rather as a possible practice of replication after training from forestry engineers and agricultural technicians, etc. On the other hand regarding *Lepidocaryum tenue*, they confirm that this knowledge was acquired from friends of the same age but not of Ese Eja origin. This manifests itself in both cases, as suggested by Reyes-García *et al.* (2009), where horizontal transmission has a larger influence than vertical transmission during adult life. However, incorporating new knowledge with horizontal transmission considering its fast diffusion, does not guarantee a total permeability in the culture unless the practice brings clear positive results.

FINAL CONSIDERATIONS

Following the proposal of Cavalli-Sforza and Feldman (1981), Hewlett and Cavalli-Sforza (1986) and having found that the main cultural transmission path was vertical for TEK of palms, we would assume a generally stable knowledge over time in the Ese Eja culture. However, the reality is different: the context in which Ese Eja cultural transmission takes place nowadays, added to the presence of specific TEK found only in the older generations, and some of the interviewees stating a discontinuity, does not correspond to this theoretical premise and a continuation of TEK in its entirety. Some uses of palms no longer found in either of the communities like the variety of palms used for preparing roofs, names of palms unknown by the youth both conceptually and in identification of species in practice, are some of these examples.

In the TEK of Ese Eja palms, we found a similar case as described for their medicinal plants (Alexiades 1999; Alexiades and Peluso 2009), with the emergence of a converging of two non-exclusive processes: acquisition and accumulation. In both the cultural transmission paths and the diverse stakeholders involved play a fundamental role in each of the phases of the construction of TEK.

The context which surrounds the cultural transmission by the Ese Eja is also affecting the adoption of new proposals, emerging from a local perception of decreasing forest resources. Defined in this way, there is a degree of resilience with the inherent capacity of the indigenous communities in absorbing alterations which occur in their environment and reorganizing to adapt to changes (Berkes *et al.* 2000; Berkes and Folke 2002; Campos and Ehringhaus 2003; Berkes and Turner 2006; Salick and Byg 2007), giving way to a more selective TEK. An example of this is the way in which some plant uses are remembered but not practiced and new uses are learned and assimilated (Muller-Schwarze 2006).

There is an urgent need for new research about cultural transmission for ethnobiology through interdisciplinary approaches and the diverse theoretical models which have been proposed, due to the complexity of the topic and given the phase where this discipline is at present (Zent 2009c). Based on these conclusions, the present traditional and new contexts, which are occurring for indigenous societies like the Ese Eja, deserve to be recorded and accompanied in our contemporary present-day situation.

NOTES

[1,2] Information was collected and considered from the community register and Health Post data of the year 2009 for Infierno and 2010 for Sonene.

ACKNOWLEDGEMENTS

We thank the communities of Infierno and Sonene, FENAMAD and Forestry Herbarium MOL. Stanford Zent, Egleé L-Zent and María Chavarría made initial contributions to the project in 2009. Darren Sears assisted in the logistics. Miguel Alexiades and Ana Ladio contributed with critical comments on the preliminary results and the first draft. This work forms part of the Thesis towards obtaining the degree of Forestry Engineer of MPO in the National Agrarian University, La Molina in 2010 and was completed with financial support from the Tambopata Reserve Society and field equipment supplied by Idea Wild.

REFERENCES

Albán J, Millán B, Kahn F (2008) Situación actual de la investigación etnobotánica sobre palmeras de Perú. *Revista Peruana de Biología* **15**, 133-142

Albuquerque UP, Lucena RFP, Lins Neto E (2008) Selecao e escohla dos participantes da pesquisa. In: Albuquerque UP, Lucena RFP, Cunha LVFC (Eds) *Métodos e Técnicas na Pesquisa Etnobotánica* (2nd Edn), Comunigraf/ NUPEEA, Recife, Brazil, pp 21-40

Alcorn J (1993) Indigenous peoples and conservation. *Conservation Biology* **7**, 424-426

Alexiades M (1996) Collecting ethnobotanical data: An introduction to basic concepts and techniques. In: Alexiades M (Ed) *Selected Guidelines for Ethnobotanical Research*, New York Botanical Garden, New York, USA, pp

53-94

Alexiades M (1999) Ethnobotany of the Ese Eja: Plants, health, and change in an Amazonian society. PhD thesis, the City University of New York, New York, USA, 541 pp

Alexiades M (2003) Ethnobotany in the third millennium: Expectations and unresolved issues. *Delpinoa* **45**, 15-28

Alexiades M, Peluso D (2003) La sociedad Ese Eja: una aproximación histórica a sus orígenes, distribución, asentamiento y subsistencia. In: Huerta B, García A (Eds) *Los Pueblos Indígenas de Madre de Dios. Historia, Etnografía y Coyuntura*, International Work Group for Indigenous, Lima, Peru, pp 91-110

Alexiades M, Peluso D (2009) Plants of the ancestors, plants of the outsiders, Ese Eja history, migration and medicinal plants. In: Alexiades M (Ed) *Mobility and Migration in Indigenous Amazonia: Contemporary Ethnoecological Perspectives*, Berghan Books, Oxford, UK, pp 220-248

Alvarez M (2008) Evaluación de la diversidad de especies de palmeras en terrazas altas de Madre de Dios "CRIBATAMADD", distrito Las Piedras – Tambopata. Licenciatura Thesis, Universidad Nacional de Madre de Dios, 111 pp

Atran S, Medin D, Ross N, Lynch E, Vapnarsky V, Ucan ek' E, Coley J, Timura C, Baran M (2002) Folkecology, cultural epidemiology, and the spirit of the commons. A garden experiment in the Maya lowlands, 1991-2001. *Current Anthropology* **43**, 421-450

Atran S, Medin D, Ross N (2004) Evolution and devolution of knowledge: A tale of two biologies. *Journal of the Royal Anthropological Institute* **10**, 395-420

Balick M (1984) Ethnobotany of palms in the Neotropics. *Advances in Economic Botany* **1**, 9-23

Balslev H, Grandez C, Paniagua N, Møller AL, Hansen SL (2008) Palmas (Arecaceae) útiles en los alrededores de Iquitos, Amazonía Peruana. *Revista Peruana de* Biología **15**, 121-132

Benz B, Cevallos J, Santana F, Rosales J, Graf S (2000) Losing knowledge about plant use in the Sierra de Manantlan Biosphere Reserve, México. *Economic Botany* **54**, 183-191

Berkes F (1993) Traditional Ecological Knowledge in Perspective. In: Inglis JT (Ed) *Traditional Ecological Knowledge: Concepts and Cases*, Ottawa International Program of Traditional Ecological Knowledge and International Development of Research Centre, Ottawa, Canada, pp 1-9

Berkes F (2000) *Sacred Ecology. Traditional Ecological Knowledge and Resource Management*, Taylor & Francis, Philadelphia, USA, 313 pp

Berkes F, Folke C (2002) Back to the future: Ecosystem Dynamics and Local Knowledge. In: Gunderson HL, Holling CS (Eds) *Panarchy: Understanding Transformations in Human and Natural Systems*, Island Press, Washington DC, USA, pp 121-146

Berkes F, Turner N (2006) Knowledge, learning and the evolution of conservation practice for social-ecological system resilience. *Human Ecology* **34**, 634-836

Bernard R (1995) *Research methods in Anthropology. Qualitative and Quantitative Approaches* (2nd Edn), AltaMira Press, California, USA, 584 pp

Brosi B, Balick M, Wolkow R, Lee R, Kostka M, Raynor W, Gallen R, Raynor A, Raynor P, Lee Ling D (2007) Cultural erosion and biodiversity: Canoe making knowledge in Pohnpei, Micronesia. *Conservation Biology* **21**, 875-879

Cavalli-Sforza L, Feldman M (1981) *Cultural Transmission and Evolution: A Quantitative Approach*, Princeton University Press, New Jersey, USA, 388 pp

Campos M, Ehringhaus C (2003) Plant virtues are in the eyes of the beholders a comparison of known palm uses among indigenous and folk communities of southwestern Amazonia. *Economic Botany* **57**, 324-344

Chavarría M (2002) *Eshawakuana, Sombras o Espíritus. Identidad y Armonía en la Tradición Oral Ese Eja* (1st Edn, Vol I), FORTE-PE, Lima, Perú, 205 pp

Chavarría M, Galvez-Durand C, Garcia A, Saavedra E (2000) *Taller de Lengua y Cultura Ese Eja. Informe Final.* FORTE-PE, Puerto Maldonado, Perú, 71 pp

Chumpitasi J (2003) Tamshi hemiepífitas "tamshi": Usos, características de producción y conservación en la comunidad nativa de Infierno, Tambopata, Madre de Dios, Perú. MSc thesis, Universidad Nacional Agraria La Molina, 200 pp

Conservation International (1994) The Tambopata-Candamo Reserved Zone of Southeastern Perú: A Biological Assessment. RAP Working paper 6, 183 pp

Conservation International (1997) Ecological characterization of the Candamo river valley, Perú. Identification of Ecosystem-wide information relevant to impact assessment of exploratory drilling for hydrocarbons. Conservation International, Washington DC, USA, 75 pp

Cristancho S, Vining J (2009) Perceived intergenerational differences in the transmission of traditional ecological knowledge (TEK) in two indigenous groups from Colombia and Guatemala. *Culture and Psychology* **15**, 229-254

de la Torre L, Macía M (2008) La etnobotánica en el Ecuador. In: De la Torre L, Navarrete H, Muriel PM, Macía MJ, Balslev H (Eds) *Enciclopedia de las Plantas Útiles del Ecuador*, Herbario QCA & Herbario AAU, Quito, Ecuador, pp 13-27

Eyssartier C, Ladio A, Lozada M (2008) Cultural Transmission of Traditional Knowledge in two populations of North-western Patagonia. *Journal of Ethnobiology and Ethnomedicine* **4**, 25, Available online: www.ethnobiomed.com

Eyssartier C, Ladio A, Lozada M (2006) Transmisión de conocimientos tradicionales en dos poblaciones rurales del noroeste patagónico. Bariloche, Argentina, 18 pp

Ferreira de Athayde S (2003) Knowledge transmission and change in kaiabi (tupi-guarani) basketwork, southern Amazonian region, Brazil. MSc thesis, University of kent, Canterbury, UK, 65 pp

Flores C, Ashton M (2000) Harvesting impact and economic value of *Geonoma deversa, A*recaceae, an understory palm used for roof thatching in the Peruvian Amazon. *Economic Botany* **54**, 266-277

Godoy R, Brokaw N, Wilkie D, Colón D, Palermo A, Lye S, Wei S (1998) Of trade and cognition: Markets and the loss of folk knowledge among the Tawahka Indians of the Honduran Rain Forest. *Journal of Anthropological Research* **54**, 219-234

Goulding M, Smith N (2007) *Palmeras, Centinelas para la Conservación*. Asociación para la conservación de la Cuenca Amazónica (ACCA). Lima, Perú, 356 pp

Heckler S (2002) Traditional Ethnobotanical knowledge loss and gender among the Piaroa. In: Stepp J, Wyndham F, Zarger R (Eds) *Ethnobiology and Biocultural Diversity, Proceedings of the 7th International Congress of Ethnobiology.* University of Georgy Press, Georgia, USA, pp 532-548

Henderson A, Galeano G, Bernal R (1995) *Field Guide to the Palms of the Americas*, Princeton University Press, New Jersey, USA, 410 pp

Henrich J (2002) Decision-making, cultural transmission and adaptation in economic anthropology. In: Ensminger J (Ed) *Theory in Economic Anthropology*, Alta Mira Press, CA, USA pp 251-295

Henrich J, Gil-White F (2001) The evolution of prestige: Freely conferred status as a mechanism for enhancing the benefits of cultural transmission. *Evolution and Human Behavior* **22**, 1-32

Henrich J, Boyd R (1998) The evolution of conformist transmission and between-group differences. *Evolution and Human Behavior* **19**, 215-242

Hewlett BS, Cavalli-Sforza L (1986) Cultural transmission among Aka Pygmies. *American Anthropologist* **88**, 922-934

Huaman J (1995) Etnobotánica de las palmeras de la comunidad nativa de Infierno-Tambopata. BSc thesis, Universidad Nacional San Antonio Abad del Cusco, Cusco, Perú, 100 pp

INRENA (2003) *Plan Maestro de la Reserva Nacional Tambopata 2004-2008*. MINAG, Lima, Perú, 213 pp

IBC (2001) *Manejo comunitario de territorio en la comunidad nativa de Infierno (río Tambopata, Madre de Dios, Perú)*. Informe final, Amazon CBNRM Research Initiative, Lima, Perú, 103 pp

International Society of Ethnobiology (2008) Code of ethics, 11 pp, Available online: http://ethnobiology.net/

Kahn F, Mejia K, De Castro A (1988) Species Richness and Density of Palms in Terra Firme Forests of Amazonia. *Biotropica* **20**, 266-269

Kahn F (1990) *Las Palmeras del Arboretum Jenaro Herrera* (Provincia de Requena, Departamento de Loreto, Perú. Contribución al estudio de la flora y de la vegetación de la Amazonía peruana (1st Edn, Vol XVII) Conservatoire et jardín botaniques de genove, IRD, Lima, Perú, 341 pp

Ladio A, Lozada M (2003) Comparison of wild edible plant diversity and for a-ging strategies in two aboriginal communities of northwestern Patagonia. *Biodiversity and Conservation* **12**, 937-951

Lawrence A, Phillips O, Reategui A, Lopez M, Rose S, Wood D, Farfan A (2005) Local values for harvested forest plants in Madre de Dios, Peru: Towards a more contextualized interpretation of quantitative ethnobotanical data. *Biodiversity and Conservation* **14**, 45-79

Lee R, Balick M, Ling D, Sohl F, Brosi B, Raynor W (2001) Cultural dynamism and change. An example from the federated states of Mirconesia. *Economic Botany* **55**, 9-13

Lopez-Zent E (2009) "We come from Trees": The poetics of plants among the Jotï of the Venezuelan Guayana. *Journal for the Study of Religion, Nature and Culture* **3**, 9-15

Lopez-Zent E, Zent S (2002) Impactos ambientales generadores de biodiversidad: Conductas ecológicas de los Hotï de la Sierra Maigualida, Amazonas Venezolano. *Interciencia* **27**, 9-20

Lozada M, Ladio A, Weigandt M (2004) ¿Cómo aprenden y trasmiten el saber sobre plantas útiles los pobladores de una comunidad rural del Noroeste de la Patagonia? In: *Reunión Internacional "Mente y Cultura: Cambios representacionales en el aprendizaje"* 11-13 February, 2004, Centro Regional Universitario Bariloche de la Universidad Nacional del Comahue, Bariloche, Argentina, pp 1-13

Lozada M, Ladio A, Weigandt M (2006) Cultural transmission of ethnobotanical knowledge in a rural Community of Northwestern Patagonia, Argentina. *Economic Botany* **60**, 374-385

Martin G (1995) *Ethnobotany a Methods Manual (1st Edn)*, People and Plants Conservation Series, WWF, UK, 268 pp

Martinez-Ballestes A, Caballero J, Gama V, Flores S, Martorell C (2002) Sustainability of the traditional management of Xa'an palms by the lowland Maya of Yucatán, Mexico. In: Stepp J, Wyndham F, Zarger R (Eds) *Ethnobiology and Biocultural Diversity* (1st Edn), University of Georgia Press, Georgia, USA, pp 381-387

Moussa F, Kahn F, Henderson A, Brako L, Hoff M (1992) Las palmeras en

los valles principales de la Amazonia Peruana. In: Kahn F (Ed) *Las Palmeras de los Bosques Tropicales, Bulletin de L'institut Francais D'Etudes andines* (Vol **21**, 2), Lima Perú, pp 565-597

Muller-Schwarze N (2006) Antes and Hoy día: Plant knowledge and categoryzation as adaptations to life in Panama in The Twenty-first century. *Economic Botany* **60**, 321-334

Murphy I (1992) "And, I, in my turn, will pass it on": Indigenous education among the Kayapó Amerindians of central Brazil. PhD thesis, University of Pittsburgh, Pensilvania, USA, 369 pp

Ohmagari K, Berkes F (1997) Transmission of indigenous knowledge and bush skills among the Western James Bay Cree Women of Subartic Canada. *Human Ecology* **25**, 197-222

Paniagua N, Byg A, Svenning, J, Moraes M, Grandez C, Balslev H (2007) Diversity of palm uses in the western Amazon. *Biodiversity Conservation* **16**, 2771-2787

Peluso D, Alexiades M (2005) Urban ethnogenesis begins at home: The making of self and place admist Amazonia's environmental economy. *Traditional Dwellings and Settlements Review* **16**, 1-10

Pfeiffer J, Butz R (2005) Assessing cultural and ecological variation in ethnobiological research: the importance of gender. *Journal of Ethnobiology* **25**, 240-278

Phillips O (1996) Some quantitative methods for analyzing ethnobotanical knowledge. In: Alexiades M (Ed) *Selected Guidelines for Ethnobotanical Research*, New York Botanical Garden, New York, USA, pp 171-197

Piana R (2000) Traditional forest use and ecotourism at the Infierno native community: Two different income generating activities and their impact on local people economies. MSc thesis, Royal Veterinarian and Agricultural University, Copenhagen, Denmark, 75 pp

Pinedo-Vasquez M, Zarin D, Jipp P, Chota-Inuma J (1990) Use-values of tree species in a communal forest reserve in northeast Peru. *Conservation Biology* **4**, 405-416

Potvin C, Dalle S (2004) Conservation of useful plants: An evaluation of local priorities from two indigenous communities in Eastern Panama. *Economic Botany* **58**, 38-57

Prance G, Balee W, Boom B, Carneiro R (1987) Quantitative ethnobotany and the case for conservation in Amazonia. *Conservation Biology* **1**, 296-310

Ruddle K (1991) The transmission of traditional ecological knowledge. In: *2nd Annual Meeting of the Society for the Study of Common Property*, 26-29 September, 1991, University of Manitoba, Winnipeg, Canada, 26 pp

Ruddle K (1993) The transmission of traditional ecological knowledge. In: Inglis JT (Ed) *Traditional Ecological Knowledge: Concepts and Cases*, Ottawa International Program of Traditional Ecological Knowledge and International Development of Research Centre, Ottawa, Canada, pp 17-31

Ruddle K, Chesterfield R (1977) *Education for Traditional Food Procurement in the Orinoco Delta*, University of California Press, Ibero-Americana, 172 pp

Reyes-García V, **Huanca T, Vadez V, Leonard W, Wilkie D** (2006) Cultural, practical, and economic value of wild plants: A quantitative study in the Bolivian Amazon. *Economic Botany* **60**, 62-74

Reyes-García V, Broesch J, Parsa S, Calvet L, Fuentes N, Mcdade T, Tanner S, Godoy R, Huanta T, Leonard W, Martínez M, TAPS Bolivian study team (2009) Cultural transmission of ethnobotanical competence: An empirical analysis from a society of foragers. Tsimane' Amazonian Panel Study Working Paper Nº 41, TAPS, Massachusett, USA, 37 pp

Reyes-García V (2010) The relevance of traditional knowledge systems for ethnopharmacological research: Theoretical and methodological contributions. *Journal of Ethnobiology and Ethnomedicine* **6**, 32

Robinson F (2003) Distribution and transmission of traditional botanical knowledge in the changing social environment: A study of a Kenyah-Dayak community in Interior Borneo. MSc thesis, University of Kent at Canterbury in association with the Royal Botanic Gardens at Kew, Canterbury, UK, 88 pp

Salick J, Byg A (2007) *Indigenous Peoples and Climate Change*, University of Oxford and Missouri Botanical Garden, Oxford, UK, 32 pp

Sears D (2001) Palms of Posada Amazonas and the Tambopata Research Center. Rainforest expeditions, Lima, Perú, 54 pp

Siren A (2006) Natural resources in indigenous people's land in Amazonia: A tragedy of the commons? *International Journal of Sustainable Development and World Ecology* **13**, 363-374

Wyndham F (2002) The Transmission of Traditional Plant Knowledge in Community Contexts. In: Stepp J, Wyndham F, Zarger R (Eds) *Ethnobiology and Biocultural Diversity* (1st Edn), University of Georgia Press, Georgia, USA, pp 549-557

Wyndham F (2009) Environments of learning: Rarámuri children's plant knowledge and experience of schooling, family, and landscapes in the Sierra Tarahumara, Mexico. *Human Ecology* **38**, 87-99

Zarger R (2002) Acquisition and Transmission of Subsistence knowledge by Q'eqchi' Maya in Belize. In: Stepp J, Wyndham F, Zarger R (Eds) *Ethnobiology and Biocultural Diversity* (1st Edn), University of Georgia Press, Georgia, USA, pp 593-601

Zarger R, Stepp J (2004) Persistence of botanical knowledge among Tzeltal Maya children. *Current Anthropology* **45**, 413-418

Zent S (2009a) Methodology for Developing a Vitality Index of Traditional Environmental Knowledge (VITEK) for the Project "Global Indicators of the Status and Trends of Linguistic Diversity and Traditional Knowledge." Final Report on Indicator No. 2, 112 pp

Zent S (2009b) Traditional ecological knowledge (TEK) and biocultural diversity: A close-up look at linkages, delearning trends and changing patterns of transmission. In: Bates P, Chiba M, Kube S, Nakashima D (Ed) *Learning and Knowing in Indigenous Societies Today*, UNESCO, Paris, France, pp 103-121

Zent S (2009c) Genealogy of scientific representations of indigenous knowledge. In: Heckler S (Ed) *Landscape, Process and Power Re-evaluating Traditional Environmental Knowledge*, Berghan Books, Oxford, UK, pp 19-67

Annex 1

Latin name	Spanish	Ese Eja	Voucher
Astrocaryum gratum F. Kahn & B. Millán	Huicungo	Jajasie / Jajasiye	MP004, MP008
Attalea butyracea (Mutis ex L. filius) Wess. Boer	Shebón	Heméme	MP003
Attalea maripa (Aubl.) C. Martius	Shapajilla / Inayuca	Patiti oshe / Sakaná sopowi	MP029, MP030
Attalea phalerata Martius ex Spreng.	Shapaja	Eshihi	MP013, MP014, MP015, MP027
Bactris concinna C. Martius	Ñeja / Ñejilla	Sii	MP002
Bactris gasipaes Kunth	Pijuayo	Máe	--
Bactris hirta C. Martius	Ñejilla	Sii	MP017, MP018
Bactris macana (Martius) Pittier	Pijuayo de monte	Ebio Máe / Máe sisi	MP023
Chamaedorea angustisecta Burret	Sangapilla	Isa sisi shasha shie / Wisene	MP009, MP025
Chelyocarpus ulei Dammer	Sacha aguajillo	Takuasa iña poi / Yokiseai	MP020
Euterpe precatoria C. Martius	Huasaí	Isa / Yisa	--
Geonoma deversa (Poiteau) Kunth	Palmiche / Crisneja	Sípi	MP021, MP022, MP028
Hyospathe elegans C. Martius	Palmiche bravo	Tajatzahua / Kajatawa	MP001, MP005
Iriartea deltoida Ruiz & Pavón	Pona	Etii / Eki nei	--
Mauritia flexuosa L. filius	Aguaje	Takuasa / Kakuása	--
Oenocarpus bataua C. Martius	Ungurahui	Majo	--
Oenocarpus mapora H. Karsten	Sinami	Bajoi / Bajowi	MP010, MP011, MP012
Phytelephas macrocarpa Ruiz & Pavón	Yarina	Ome	MP024
Socratea exorrhiza (Martius) H.A. Wendland	Cashapona	Shatata / Shakaka	MP006
Socratea salazarii H.E. Moore	Cashapona de altura	Nena	--
Wettinia augusta Poeppig & Endlicher	Ponilla	Bisipo / Kisipo	--