Useful Plants and Traditional knowledge in the Tucumano-Boliviano Forest

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Preface

This work was undertaken as a part of the *Biodiversity and economically important species of tropical Andes project* (BEISA). During the last two years the BEISA project has supported studies of the local flora in Bolivia and Ecuador, and students from the Universidad Mayor de San Andrés of La Paz and Pontificia Universidad Católica of Quito have been gathering information about ethnobotany and ecology of the plants in the tropical Andes.

The present thesis was conducted within the Botany group of the Biological Institute of the University of Aarhus, Denmark, and is submitted as a partial fulfillment to obtain the degree Master of Science (M.Sc.). It is based on fieldwork conducted from April to June 2005 in 4 non-indigenous farming communities in Chuquisaca (Bolivia) and it is intended for submission to *Economic Botany* and has therefore the form of an article manuscript.

This work contains lists of useful species from the Tucumano-Boliviano forest and values of relative importance of each species. These values have been calculated according the number of uses of each species reported by the local informants. It also identifies the factors that are affecting the local people's use of the species and it shows that the traditional knowledge of non-indigenous farming communities is not static, but is changing with a mixture of abandonment of use, accumulation and transference of knowledge.

It is recognized that the local informants have the intellectual property of the local names and uses of the species in the *Tucumano-Boliviano* forest. The compilation, analysis and interpretation of the information are the product of the present thesis.

This thesis has been under the supervision of Dr Finn Borchsenius, nevertheless any mistake is my responsibility.

Aarhus 21 December 2005

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Useful Plants and Traditional Knowledge in the *Tucumano-Boliviano* Forest

Abstract.

In this ethnobotanical study of four non-indigenous farming communities at two sites of *Tucumano Boliviano* forest in the southern part of Bolivia useful plants of the *Tucumano Boliviano* forest were identified and the relative value of these plants to the local people was evaluated. In addition, the influence of social and geographic factors on people's traditional knowledge of the plants was investigated. In one of the sites the communities are isolated in that they do not have direct road access, while the communities at the other site have direct road access for nine months of the year. Semi-structured interviews and statistical ethnobotanical and ecological methods were employed in the study. The results indicate that the most important use of the plants (according to the number of reports) is for food (825 reports, 25 species). It was seen that isolation, birth-place, gender and age of the informants were the most important factors that are related to the informants' knowledge of traditional useful plant. The knowledge of these non-indigenous farming communities is dynamic and show processes of loss as well as transfer and accumulation of knowledge.

Prefacio

Este trabajo fue emprendido como parte del proyecto Biodiversidad y especies económicamente importantes de los Andes Tropicales (BEISA). Durante los dos últimos años el proyecto BEISA ha apoyado estudios de la flora local en Bolivia y Ecuador y estudiantes de las Universidades Mayor de San Andres de La Paz y Católica de Quito han estado recolectando información etnobotánica y ecológica de las plantas en los Andes tropicales.

La presente tesis fue desarrollada en el departamento de Botánica del Instituto de Ecología de la Universidad de Aarhus, Dinamarca, y es presentado como un parcial requerimiento para obtener el grado de Magister en Ciencias (M.Sc.). Está basado en el trabajo de campo desarrollado desde abril a junio del 2005 en 4 comunidades campesinas no indígenas en Chuquisaca (Bolivia) y se intentará presentar a la revista Botánica Económica, por lo tanto esta escrito en formato de manuscrito.

El trabajo contiene listas de especies útiles del Bosque Tucumano-Boliviano y valores de importancia relativa de cada especie. Estos valores que han sido calculados de acuerdo al número de usos de cada especie reportados por los informantes locales. Además de ha identificado los factores que afectan al uso de las especies por los pobladores locales y muestra que el conocimiento tradicional de las comunidades campesinas no indígenas no es estático, pero esta cambiando en una combinación de abandono de uso, acumulación y transferencia de conocimiento.

Se reconoce que los informantes locales son autores intelectuales de los nombres locales y usos de las especies útiles del Bosque Tucumano-Boliviano. La recopilación, análisis e interpretación de la información son producto de la presente tesis.

Esta tesis ha estado bajo la supervisión del Dr. Finn Borchsenius, sin embargo cualquier error en el presente documento es mi responsabilidad.

Aarhus 21 Diciembre del 2005

Alain L. Carretero Mendoza

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A mis amigos en Dinamarca, Bolivia y Ecuador quienes me han ayudado durante los últimos 2 años y finalmente un especial agradecimiento a mi familia: Elena, Germán, Victor, Leslie, Marcela, Moises y Maria por su permanente apoyo.

Plantas útiles y Conocimiento Tradicional en el Bosque Tucumano-Boliviano

Resumen.

En este estudio etnobotánico de 4 comunidades campesinas, no indígenas en dos sectores del bosque Tucumano-Boliviano en el sur de Bolivia se ha identificado: las plantas útiles del bosque Tucumano-Boliviano y el valor local relativo de estas plantas para la gente local fue evaluado. Adicionalmente, la influencia de factores sociales y geográficos sobre conocimiento tradicional de la gente respecto a las plantas útiles de las plantas fue investigado. En un sector del área las comunidades son aisladas y sin vías de acceso, mientras que las comunidades del otro sector tienen acceso directo durante 9 meses del año. Encuestas semiestructuradas y métodos estadísticos etnobotánicos y ecológicos han sido empleadas en este estudio. Los resultados indican que el uso más importante de las plantas (de acuerdo al número de reportes) es para alimentación (825 reportes, 25 sp.). Se ha encontrado que aislamiento de la comunidad, lugar de nacimiento, género y edad de los informantes fueron los factores más importantes que están relacionados al conocimiento tradicional de las plantas útiles. El conocimiento de estas comunidades campesinas no indígenas es dinámico y muestra procesos de perdida tanto como transferencia y acumulación de conocimiento.

Introduction

Although the picture of pristine and untouched ecosystems has been very powerful and has influenced the strategies of many conservation NGO's, it has become increasingly clear that such virgin habitats hardly exist, if at all (see e.g. McNeely 1994, Willis et al. 2004). Human beings and human societies are an integral part of biodiversity, and according to their way of using natural resources, they can be promoters of its sustainable use or drivers of its disappearance (Calvo 2003). The human-environment relationship is multifaceted, because the cultural features of this relationship vary among societies and among people (Hart et al. 1996).). Nevertheless some general features can be discerned: often the strategies of interaction with the environment consist of a combination of trade agriculture and subsistence agriculture, and also involve the extraction of resources from the forest (Coomes 1996).

Wild plants and animals are particularly important for populations in rural areas, because these people depend directly on the extraction of local species to fulfil part of their daily needs, such as wood, food, medicine, and construction materials (see Boom 1987; Prance et al. 1987; Phillips et al. 1994). A plant's significance can be defined by the importance of the role it plays within a certain culture (Hunn 1982). The wider and more intensive a plant's use is, the larger is its significance (Hays 1974). A specific plant's significance is influenced by the ecological and perceptual features of the plant such as abundance, height and colour, as well as by its potential use (Turner 1988). The latter is influenced by factors such as chemical composition and life form.

In an attempt to go further than simple lists of local names and uses, during the last few decades, ethnobotanists have focussed on finding ways to express the non-commercial value that a forest has for local people in quantitative ways (e.g., Boom 1987; Prance et al. 1987; Phillips et al. 1994). Recently, ecological concepts, models and methods have been used increasingly to work with ethnobotanical data in order to create indexes and to asses the variation and richness in traditional knowledge of an individual or a community (e.g., Begossi 1996; Benz et al. 1999; Byg and Balslev 2001, 2004; Ladio and Lozada 2004). The aim of such studies has generally been to gain a better understanding of the human-environment relationship and the factors affecting it and to find better ways to describe plant knowledge patterns.

According to Barth (1995) knowledge is what people employ to interpret and act on the world: feeling as well as thoughts, embodied skills as well as taxonomies and other verbal models. At present is widely accepted that traditional knowledge is a body of knowledge built by a group of people through several generations by living in close contact with nature (Johnson 1992) and indigenous knowledge is a subcategory inside traditional knowledge, being then a sustainable traditional knowledge used by communities, people and nations that are indigenous (WIPO 2001; Stoll and Von Hahn 2004).

The majority of ethnobotanical works have involved indigenous populations, assuming that the indigenous environmental knowledge could play an important role for conservation (Hanazaki et al. 2000), while non-indigenous communities have been usually ignored due to the assumption that their knowledge is less interesting or less related to the forest than that of indigenous people (Lawrence et al. 2005). However, several studies have recognized the importance of ethnobotanical investigations among non-indigenous groups (e.g. Pinedo-Vasquez et al. 1990; Phillips and Gentry 1993) because these, as any other human group, also stand in a complex relationship with their ecological surroundings, as it is essential for their survival.

Change and abandonment of traditional customs and thus loss of plant knowledge through time have been recorded in many indigenous communities (Benz et al. 2000; Ladio and Lozada 2004; Byg and Balslev 2001, 2004). These changes depend on multiple social, political, economical, and environmental factors, and can show the loss, transference, or transformation of knowledge (Byg and Balslev 2004).

In Bolivia, some general studies about useful plants have been conducted mainly in the Andean region (e.g. Cárdenas 1943, 1989; De Lucca and Zalles 1992; Oblitas 1992), lowland tropical rainforests (Boom 1985, 1987; Moretti et al. 1990; Hinojosa 1991; Vargas, 1997; Bourdy et al. 2000; Vargas and Jordán 2003; Macía 2004) and dry forests (Birk 19995; Hart et al. 1996; Toledo 1996, 2003;), and they have mainly focussed on indigenous populations. However, studies dealing with montane forests (e.g. Heredia 1998) and studies focussed on farming communities are rare and basically descriptive.

The study presented here is a quantitative ethnobotanical study of traditional plant use and knowledge among non-indigenous farming communities in a montane area of

Bolivia. The study focuses mainly on analyzing patterns of traditional knowledge of useful native species from *Tucumano-Boliviano* forests. The aim was to demonstrate that non-indigenous farming communities in Bolivia also live in a complex interrelationship with their natural environment, as it has been reported from non-indigenous communities in the Amazon basin.

In order to do so, plant species currently used by the area's inhabitants were recorded the significance of the different species was evaluated based on their usefulness to the local people In addition, the relationship between the historic and present uses of plants on the one side, and social and geographic factors, that could be affecting local informants' plant knowledge, on the other side was investigated.

More specifically, the following hypotheses were tested in order to investigate and characterize this interrelationship:

1. The non-indigenous communities in the study area use the resources of the *Tucumano Boliviano* forest as part of their subsistence strategy

2. The local significance of the useful species (as indicated by the frequency and widespreadness of use and the qualities attributed to them) is affected by geographic characteristics (especially the degree of isolation) of the communities and by the biological, ecological and morphological characteristics of the species (e.g., abundance, height, life form).

3. Isolated communities know more and depend more on the useful species from the *Tucumano Boliviano* forest than communities with more contact with urban centers.

4. Differences in age, gender and birthplace are reflected in the way the informants make use of the plants.

5. Informants' knowledge is dynamic and can show processes of knowledge accumulation, abandonment, and transference as an effect of social and geographic factors.

Study area

The study was carried out in the Serranía de las Chapeadas region, located in the Palmar county, Culpina municipality, in the Chuquisaca department (figure 1A). The following four communities were selected among the six that compose the Palmar county to conduct the study: Orocote, Palmar, El Abra, and Cañón Verde. These communities were selected considering factors such as their degree of isolation and the number of families in each to ensure a sufficient number of interviews from each community (table 1).

Socio-economic features

The communities are characterized mainly by being non-indigenous, farming communities. According to some old documents (of uncertain authenticity) indigenous Guarani were living in the area of Palmar and Cañón Verde during the colonial period. The oldest of the present inhabitants could in addition tell that the Guarani groups were beginning to be replaced by the first non-indigenous settlers coming into the area from the highlands. The last Guarani left the area during small pox and measle epidemics in the 1950's. The actual farming communities in Bolivia were founded on the basis of former working families of dissolved "haciendas" during the time of the agrarian reform in 1953 (Calvo 2003).

According to their accessibility the communities can be classified as isolated sites (Orocote and Palmar) or non-isolated sites (El Abra and Cañón Verde), which are separated by 70 km. El Abra and Cañón Verde are administratively the same community, but are geophysically separate communities 8 km apart from each other. Both have direct road access during the dry period, but they are located at different distances from the *Tucumano-Boliviano* forest (table 1). Therefore they are considered as separate communities in the analysis. Both communities existed before the construction of the road leading to these communities. There are no precise data about the age of the road that leads to Cañón Verde, but it is known that the construction of the road that leads to El Abra started approximately around 1970. Orocote and Palmar on the other hand, have no direct road access, and in order to reach these communities it is necessary to travel by foot for approximately 13-14 hours from the nearest road.

In search of improving their living conditions, many of the inhabitants of these communities, especially the younger ones, migrate temporarily to urban centres or to Argentina. In addition to this temporary emigration from the area, there is also internal migration among the studied communities, which in contrast is permanent. Locally, the highest migration occurs from the most isolated communities towards the non-isolated. In addition, there is also immigration to the area of people coming from the highlands.

Land use

Cattle raising is one of the most important economic activities in the area, and is carried out in an extensive manner in natural forest areas, where the cattle are left to forage. Cattle and pig raising is for the market as well as for family consumption, while goat and sheep raising is mainly for family consumption. The agricultural system consists on swidden agriculture generally taking place on steep mountains slopes. Main crops are traditional corn, peanut, and chilli. Commercial timber extraction is carried out by the inhabitants of the region in a selective manner, and it is mainly focussed on species such as cedar (*Cedrela sp*, Meliaceae), walnut (*Juglans australis,* Juglandaceae) and "quina colorada" (*Myroxylon peruiferum*, Leguminosae). The extracted timber is sold to intermediaries and mills. In addition, timber extraction for household consumption also takes place. This mainly encompasses species such as mountain pine (*Podocarpus parlatorei*, Podocarpaceae) (DHV Sudamerica 2004).

Vegetation

According to the region's vegetation map Orocote and Palmar are located on a plain characterized by agricultural fields, grazing grounds and secondary vegetation at the border of the *Tucumano-Boliviano* forest, which is a vegetation unit defined as a dense, evergreen, semi deciduous, submontane forest. El Abra and Cañón Verde are located in the Chaco Serrano, a vegetation unit defined as a caducifolious, montane and submontane sparse forest (DHV Sudamerica 2004). However El Abra is located in the transition area between the two vegetation units (figure 1B). The study only encompassed useful plants from the *Tucumano-Boliviano* forest.

Tucumano-Boliviano forest (Dense, evergreen, semi deciduous, montane forest)

These forests are characterized by a physiographic landscape dominated by medium-height to high mountain ranges and hills, with moderately steep to very steep slopes, with an altitudinal range from 1000 m to 1500–2000 m above sea level. Precipitation varies from 1100–1500 mm per year. The forest is generally dense and tall, with a dominance of evergreen species. The most characteristic species are: "barroso" (*Blepharocalyx salicifolius*, Myrtaceae), "lapacho" (*Tabebuia lapacho*, Bignoniaceae), "quina blanca" or white cinchona (*Lonchocarpus lilloi*, Leguminosae) and walnut (*Juglans australis*, Juglandaceae) (DHV Sudamerica 2004). The *Tucumano-Boliviano* forest existing in the study area is one of the few remaining uninterrupted forest tracts of this type in good conservation state in Bolivia, and constitutes a recognizable endemism centre (Holst et al. 1997).

Chaco Serrano forest (Sparce, deciduous, submontane forest)

This forest type is situated in a landscape composed of medium-sized mountain ranges, with steep and very dissected slopes, with heights ranging from 700 m above sea level to 1500 m, with precipitation around 700–1300 mm per year, characterizing a dry to semi-humid climate. The forest is small to medium-sized, the cover of the tree layer is in general less than 50%. The most characteristic species are: "chari" (*Piptadenia viridiflora*, Leguminosae), "villca" (*Anadenanthera colubrina*, Leguminosae), "tajibo" (*Tabebuia impetiginosa*, Bignoniaceae), "palo blanco" (*Calycophyllum multiflorum*, Rubiaceae), white laurel (*Nectandra angusta*, Lauraceae) and guava (*Myrcianthes pungens*, Myrtaceae) (DHV Sudamerica 2004).

Methods

Fieldwork was carried out during the dry season (April–June) of 2005. On each site a meeting was conducted with the inhabitants and the community leaders to present the study, explain the vegetation types of interest, and to collect preliminary information about the informants. In order to make these explanations more clear visual techniques were used (e.g. paper boards).

Key informants

Working closely with the community leaders, four key informants were selected at each site considering factors such as gender, a reputable thorough knowledge of wild plants, time availability, and willingness to participate.

On each site, key informants elaborated on an individual basis, a free listing of the native useful plants of the *Tucumano-Boliviano* forest on each of the use categories established a priori (table 2). This method allows to determine the useful species known for each site (Campos and Ehringhaus 2003). The free lists were based on the folk names of the species given by each of the key informants (e.g., "zarzamora"). The same common name may sometimes be used to denote more than one botanical species, which in that case can be said to constitute one "folk species" (see Phillips and Gentry 1993; Hanazaki et al. 2000, Lawrence et al. 2005).

In order to verify the scientific identity of the folk species, botanical specimens of the species considered useful in the community were collected together with at least one of the key informants. The collected samples were identified and deposited at the Bolivian National Herbarium (LPB), the Chuquisaca Herbarium (HSB), and the Herbarium of the University of Aarhus (AAU) [A. Carretero numbers 1355–1841].

Semi-structured interviews

Based on the free listing of useful plants, separate forms were created for semi-structured interviews for isolated and non-isolated sites, respectively. The forms contained questions on the present day as well as historic uses of the folk species mentioned by more than 1 key informant at each site and which were said to have more than 1 use. Species with only one use type and mentioned only by one of the key informants were not included in the semi-structured interviews.

Informants for the semi-structured interviews were selected in collaboration with the community leaders in a stratified random sampling procedure, considering factors such as age and gender. This method was employed in order to ensure a representative coverage of the four communities.

A total of 54 interviews were conducted in the isolated sites and 57 interviews were conducted in the non-isolated sites. Each interview lasted around 35–45 minutes, and each informant was interviewed only once and individually, to avoid influence from other informants on the answers. The order of the species in the interviews was changed for each informant, in order to avoid a systematic error in the answers as a result of tiredness towards the end of the interview. The majority of the inhabitants do not speak any indigenous languages, therefore all interviews were conducted in Spanish.

The distinction between historical plant use and current plant use could be relevant in terms of understanding the process of collective plant knowledge changes in a community (Byg and Balslev 2001; Ladio and Lozada 2004), for this reason each of the informants were asked about the current and historical uses of each of the species included in the interviews. They were also asked about the frequency of collection of the species (table 3), and the quality of the species for each of the use types that the informant reported (table 4); additional information about age, gender, and place of birth of each informant was collected.

Data analyses

In order to determine the similarities among the group of useful species mentioned in interviews with key informants of isolated and non-isolated sites, Jaccard's similarity index was used (Mueller-Dombois and Ellenberg 1974). This index is based on species presence or absence, and relates the number of species that two sites have in common to the total number of species at the two sites and it is defined as:

$JI = [c/ (a+b+c)] \times 100$,

where c is the number of species in common, a is the number of species unique to site A, and b is the number of species unique to site B. In order to calculate this index the two isolated and the two non-isolated communities were considered as each one site, respectively.

In order to compare knowledge and use patterns between all four communities, only the species common to all of them were used. For these shared species different measures of their use and local importance were calculated, such as number of uses, frequency and heterogeneity of use, and quality of the products according to perceptions of local people. In addition to already existing measures of species' importance such as 'use values' (UVs, Phillips & Gentry 1993) another measure of the importance of plants was constructed in the form of 'multiple values' (MVs) (modified from Turner 1988) (table 6). The multiple values take into account the frequency with which a certain plant product is used as well as the quality which informants accord to a product. Multiple values were calculated for each species taking into account all uses of a species in order to compare it with the other indicators of significance (e.g. use values). In addition, MVs for species were calculated for each use category separately in order to identify the most important species used within each use category. Use values and multiple values were calculated for all communities together as well as separately for the isolated and non-isolated communities, respectively. Pairwise correlation tests were carried out (using Pearson´s product-moment correlation coefficient) in order to find possible correlations among the different indicators of species importance and use (based on values for all communities and all uses) (table 6). In all statistical analyses, separate analyses were carried out for historic and current uses, respectively, and folk species were used as the unit for the analyses.

For each informant, different measures of his or her plant use were calculated both with regard to current plant use and with regard to historic plant use (historic plant use was defined as comprising both current and outdated uses) (table 7). Informant diversity and equitability values and species diversity and equitability values (table 6, 7) were calculated following Byg and Balslev (2001), but using Shannon Wiener's diversity index instead of Simpson's index as the basis for calculation (see also Begossi 1996). Pairwise correlation tests (using Pearson´s product moment correlation coefficient) were carried out, in order to test for possible correlations between the different measures of informants' knowledge. In addition, linear multiple regression analyses were used to test for possible relationships between informants' use of plants and socio-economic factors such as gender, age, and village location. To this end the different measures of informants' use of plants were used as dependent variables in separate analyses and the socio-economic factors were used as independent factors. Normality of the variables was evaluated by means of skewness and kurtosis values. Variables which had skewness and kurtosis values between –1 and +1, were considered not to deviate too much from a normal distribution (which would have invalidated the use of multiple regression analyses). All variables used were found to fall within this range and did therefore not need to be transformed prior to analyses.

The multiple regressions were carried out as stepwise regressions, starting with a full model containing all the independent variables (table 5) and their first order interactions, and then eliminating non-significant factors (α=0.05) in a backward selection approach until no more non-significant factors were contained in the model. This model was considered the final model, and significance values for this model were evaluated using standard least squares calculations. The interaction "community-birthplace" was not included in the model, because not all possible combinations of different birthplaces and present community were represented in the informants. Likewise, higher order interactions were not included, because of the relatively small sample size, in which a lot of possible combinations of the higher order interactions would not have been represented.

To gain a better understanding of the significant interactions found in the multiple regressions and to obtain a much finer detail of the differences among the different factors, several post-hoc linear regression analyses and variance analyses (ANOVA) were carried out. All correlation, regression and variance analyses were carried out using JMP version 5 for Windows.

Results

Use and floristic diversity of useful plants

During the free listing by the key informants in the four communities, 78 useful folk species were identified for the *Tucumano-Boliviano* and correspond to 78 scientific species and 5 unknown species. Of the 78 folk species, 38 were trees (48.7%), 5 shrubs (6.4%), 25 herbs (32.0%), 8 species (10.3%) were grouped together as lianas, vines, epiphytes and hemi-epiphytes, and 2 species (2.6%) were not collected and hence not classified.

In the semi-structured interviews, the use and importance (and variation herein) of 60 folk species was evaluated. The 60 folk species correspond to 62 scientific species distributed among 35 plant families (appendix I). Of the 60 folk species, three could not be identified with scientific names. Of the 60 folk species, 39 were common to all four communities and all the statistical analyses were carried out on the basis of these 39 folk species.

Among the 62 scientific species mentioned in the interviews most of the taxonomic families were represented by 1 or 2 species, while a few families were represented by more species. These were: Leguminosae represented by 11 species (5 Mimosoidea, 5 Papilionoidea and 1 Caesalpinoidea), Myrtaceae by 6 species, Piperaceae by 4 species and Bignoniaceae by 3 species

During the semi-structured interviews 3,922 reports of current uses of the 60 folk species were collected distributed among the following categories: food, medicine, construction, technology (with the sub categories tools and basketry), fodder, firewood, veterinary medicine, and miscellaneous (with the sub-categories ornamental, toxic, and others) (appendix I).

In a regional context, the food category had the highest number of current use reports (825 reports), with a total of 25 species identified by the local informants (figure 2). The five species with the highest Multiple values for food were: *Myrcianthes sp1* (Myrtaceae)**,** *sp1*(Myrtaceae), *Rubus spp* (Rosaceae), *Capparis prisca* (Capparaceae) and *Myrcia sp2* (Myrtaceae). Four of these species have fruits that are directly eaten while in the forest and are available from November to January, while the leaves of *sp1*(Myrtaceae) are used in the preparation of breakfast infusions, and are collected all year long.

Construction was the second largest use category, with 593 reports of current use by the local informants, for 27 species. *Schinopsis haenkeana* (Anacardiaceae)*, Myroxylon peruiferum* (Leguminosae)*, Enterolobium contortisiliquum* (Leguminosae)*, Juglans australis* (Juglandaceae) and *Tabebuia sp1* (Bignoniaceae) had the highest Multiple values for construction. The first two species were considered the best ones to use as "palcas" (a local name for the poles that hold wires for fences, and which are selected for this purpose species with a very high resistance against decomposition). The last three were the preferred species to make beams and laths for house construction.

Thirty-five species with 498 uses were identified and reported as medicinal plants by the local informants. Among the species with the highest Multiple values for medicine were found: *Acacia aromo,* used to cure infected wounds (locally called "lepras"), *Piper spp* (Piperaceae), *Equisetum spp* (Equisetaceae), *Plantago spp* (Plantaginaceae). and *Triumfetta semitriloba* (Tiliaceae)*,* all used to treat illnesses such as cold, cough, fever, stomach and liver pain, t these plants are locally known as “plantas fresco”, i.e. “cold plants”. In the Kallawayas (medicine-men, or healers from the Andes) terminology some disorders are caused by an excess of heat or cold, and thus can be cured with the appropriate use of “cold” plants or “hot” plants, respectively (Bastien 1987).

Within the technology category there were 24 species (with 313 reports) used for the manufacture of agriculture gear, domestic tools, furniture, rope and baskets. Among the species with the highest Multiple value for technology were: *Terminalia trifolia* (Combretaceae) used for making handles for axes and mattocks, *Enterolobium contortisiliquum* and *Cedrela sp.* used for making furniture and domestic tools, Leguminosae-Papilionoidea *sp1* and *Cordia alliodora* (Boraginaceae) used for building ploughs, beams, and yokes, and *Parabignonia chodatii* (Bignoniaceae) used as rope to tie up roofs and fences.

Twenty-eight species in 439 reports were recognized by the informants as the most important food for their domestic animal. Among the ones with the highest Multiple values for forage were: *Chrysophyllum gonocarpum* (Sapotaceae), *Maclura tinctorea* (Moraceae), *Ximena americana* (Olacaceae), *Myrcianthes sp1* (Myrtaceae) and *Acacia aromo* (Leguminosae).

Within the firewood category, 24 species were identified as species with the best heat value during wet season (359 reports), where *Anadenanthera colubrina*, *Myroxylon peruiferum*, *Tabebuia sp1*, *Acacia aromo* and *Schinopsis haenkeana* (Anacardiaceae) had the highest Multiple values for firewood.

Seven species (59 reports) were identified as species with a veterinary use, here *Acacia aromo* and *Pogonopus tubulosus* (Rubiaceae), used to heal castration wounds of small domestic animals (such as pigs and sheep), had the highest Multiple value.

Local valuation of species

Jaccard’s similarity index showed a very high similarity among the interviews at both the isolated and non-isolated sites (JI= 65), with 39 folk species common to both sites (appendix I).

There were high and positive correlations between the Use value (UV), the Use consensus value (UC*s*), and the Informant diversity value (ID*s*) ($P < 0{,}001$), which means that all these indexes showed the same variation of the species valuation. The spell out Informant equitability value (IE*s*) showed a low and negative correlation with UV and UC (P= 0.01), which means that the variation shown by the IE is different to the one shown by the other indexes.

The UV range for the 39 species showed that the highest values are concentrated on very few species (figure 3), while the majority of species have low UVs and hence have few uses and are typically mentioned by few people.

Comparing the non-isolated and isolated sites, it was seen that out of the 15 species with the highest UV in each site, 11 species were the same, and almost all had more than two current uses reported (table 8). The species with high UV had generally low IE values. Species´ UV recorded in the isolated sites were usually higher than UV recorded in non-isolated sites.

Ranking species according to UV and Multiple value (VM) resulted in similar lists of most important species, but the exact order of some of the important species varied slightly depending on whether UV or VM were used to rank them (table 9).

Traditional knowledge patterns among the informants

Historic and current useful plant uses

In the case of historic uses, it was seen that there were high and positive correlation between the Species diversity value (SD*i*) and the number of species previously used (R^2= 0.956; P <0.0001), while there was a low and negative correlation between the number of species previously used and the Species equitability value (SE*i*) (R^2= -0.424; P <0.0001). Similarly, for present day uses, it was seen that there was a high and positive correlation between the Species diversity value and the number of species currently used (R^2= 0.931; P <0.0001), and the correlation between the species equitability value and the number of species currently used was negative (R^2= -0.356; P= 0.005).

Multiple regression analyses identified community, gender, age, place of birth and the interaction age-place of birth as the main factors related to informants' current use. A similar analysis carried out for the historical use identified community, gender, age, birthplace and the interactions birthplace-age, gender-birthplace, and gender-age as the main factors related to the historical use (table 10).

In order to understand better how the historical and current species uses are influenced by the interaction between the informants' birthplace and age post-hoc analyses were performed

Post-hoc regressions of historical and current uses on informants' age showed that the non-migrant informants from isolated sites (n= 30), non-migrant informant from the non-isolated sites (n= 27), and the informants that migrated from areas with a different vegetation type (n= 37) presented the same pattern, showing a positive relationship between the knowledge and current use of the species and the age of the informants (figure 4A and 4B).

However, for migrants from isolated sites with similar vegetation type and who had moved to non-isolated sites, the relationship between current use and the informants' age (n= 17), showed the opposite pattern: where the number of currently used species decreased with increasing age of the informants age (figure 4A). The age-related pattern for this group of migrants was, however, different in the case of historic plant uses: here there was no difference in the number of species previously used between younger and older informants (figure 4B).

Multiple regression analysis revealed that the historical and current species use varied significantly according to the informants' place of birth ($P = 0.007$ and $P < 0.001$, respectively). Post-hoc analyses showed that informants, who migrated from isolated sites with similar vegetation types towards non-isolated sites, knew a higher number of species than the informants, who migrated from areas with different vegetation types. The historical use among the informants that migrated from isolated sites with similar vegetation types towards non-isolated communities, and the non-migrant informants, whether from the isolated or non-isolated sites, did not vary significantly (figure 5). A similar analysis with the current species use revealed that informants, who migrated from the isolated communities with similar vegetation types towards non-isolated communities, currently used a higher number of species than the informants, who migrated from areas with a different vegetation type, and the non-migrant informants from the non-isolated communities. However there were no significant differences between the migrant informants from the isolated sites and the non-migrant informants from isolated sites (figure 5).

With respect to the community to which the informant belonged, the multiple regression analysis revealed that knowledge and current species use showed significant differences among communities ($P = 0.008$ and $P = 0.007$, respectively). Post-hoc analyses showed that the Cañón Verde informants knew less species that informants coming from the other three communities. Concerning current species use, Cañón Verde informants use a lower numbers of species than the informants from Orocote and Palmar, but there were no significant differences with El Abra informants. The informants from El Abra were found to use an intermediate number of plants, meaning that there were no significant differences neither with the communities where more species were used nor with communities where less species are used (figure 6).

The multiple regression analysis also revealed that the current use were significantly related to informants` gender ($P = 0.003$), in such a way that male informants from all communities used a higher number of plants than female informants.

The historical plant use in relationship with gender cannot be explained without considering the interactions found on the multiple regression analyses among gender-birthplace ($P = 0.03$) and gender-age ($P = 0.04$). Post-hoc analyses showed significant differences among informants that came from areas with different vegetation types, where men knew more plants than women. Similar analyses with the interaction gender-age showed that for both men and women plant use had a strong positive relationship with age, but that knowledge in general tended to be higher among male informants.

Knowledge distribution among informants

Multiple regression analysis, where equitability is considered as a dependent variable, identified that the historical and current uses SE*i* indexes are related to informant's age (table 10). The results showed that younger informants presented higher values for SE*i* ($P = 0.004$), where the highest SE*i* values reveal more homogeneity of the historical and current species use among informants (figure 8).

Knowledge variation according to use categories

Considering all studied communities, it was seen that species used as medicine were the ones showing the highest reduction in the percentage of species used by the informants (24%), whereas the species used for construction (7%) and technology (6%) were the ones that show the least reduction in the percentage of species currently used by the informants (figure 9).

Discussion

Richness of useful plants

The communities in the study area interact with their environment and make use of the forest´s resources to satisfy some of their basic needs. The number of useful native species registered in this study is lower than those reported from other studies with non indigenous farming communities in the *Tucumano-Boliviano* forest in Bolivia (Heredia 1998) and in tropical montane cloud forests in Costa Rica (Kappelle et al. 2000). However, these differences are not so large and are most likely due to the higher data collection intensity employed in these other studies. While in this study the key informants were only one time interview, in the others they used multiple interviews or they walked in the forest with the key informants (table 11).

In comparison to similar studies on non-indigenous people in the Peruvian Amazon (Phillips et al 1994, Stagegaard et al. 2002) the number of useful species is much lower in the present study. There may be many possible explanations for these differences. The most convincing seem to be the following: Firstly, in the present study only the plants from one vegetation type were included, while many other studies have included plants from all available vegetation types. Secondly, the biodiversity in the study area is lower than in lowland rain forest areas where most other studies on non-indigenous groups have been carried out. From the literature it can be seen that the diversity of the plant resources is reflected in people's interrelationship with their environment (Bennett 1992, Salick et al. 1999) expressed in the knowledge and use they make of plants. Hence, environments more diverse have more rich and abundance of the most useful species than less diverse environments (Phillips et al. 1994), because in the more diverse environments the people have more opportunities for experimenting and learning about plant uses. Thirdly, the non-indigenous communities which have been studied in the Peruvian Amazon, have historically been related to indigenous communities and have adopted many of the techniques of the extinct indigenous cultures (Phillips et al. 1994). In contrast, the majority of the inhabitants of the communities in the study area do not show any relationship or indentification with the few remaining Guarani settlements close by. It has been shown in a study in Bolivia that Quechua farmers in Apillapampa, in the Andes, use higher numbers of medicinal plants than indigenous Yuracares Trinitarios people in the more diverse Amazonian rain forest. This indicates that neither the biodiversity nor the ethnic identity by themselves are decisive, but that the maintenance of traditions plays an important role in the transmission and survivial of knowledge of plant uses (Vandebroek et al 2004).

Local valuation

The distribution of Use value (UVs) [figure 3] shows that the number of important species (with high number of uses in the study area) is very low, most of these species are trees, while the majority of species in the study area have few uses and hence a low value. This coincides with the pattern reported by Phillips et al. (1994).

The results from this study show that 55.1% of the species identified as useful by the key informants are trees or shrubs. The anatomy of the plants plays a very important role with regard to their value as measured by UVs and MVs, since woody species have potentially more different uses due to the greater number of structurally different parts in comparison with herbs and epiphytes. In addition it has been suggested that species' perceptual characteristics (e.g. size, color, smell), as well as other factors such as their frequency and distribution affect the importance and use of different plant species in a culture. More visible species such as trees and shrubs should hence be more well-known and have more importance to a culture than herbs, bryophytes, mushrooms and lichens (Turner 1988).

Similar to what has been reported by Byg and Balslev (2001), in this study there was a tendency for those species with high UV*s* to have low Informant equitability value (IE*s*) [table 8]. Such a pattern indicates that the most important species are used in a heterogeneous way by the informants, that is, some informants use the species for a very large number of purposes while others use the same species for a few things. In contrast, the species with fewer uses are used in more homogeneous ways, that is, the informants who use the less important species, use them for the same few uses in the communities in each sector.

UVs and MVs are different ways of evaluating the importance of useful species. Nevertheless, they identify a similar group of species (table 9) as being the most important ones for the informants. The UV identifies those species with most uses, while the MV identifies those species which are considered to have the best quality for a particular use and which are used most frequently by the informants. UVs and VMs should not be seen as mutually exclusive, but rather as complementary indices. The information they generate can play an important role in the decision-making process in connection with conservation and management projects. UVs can help identify the species with the highest potential and actual numbers of uses. Such information is of great value for agroforestry programs, since species with multiple uses would be more attractive candidates for cultivation in such systems. MVs can on the other hand help identify which use of a species is the most important one, especially in the case where several uses are equally often mentioned. The differences can be illustrated by the species *Chrysophyllum gonocarpum*. According to the frequency of reports, it is mainly used for fodder and firewood (with 67 reports for each), while use for food comes in on the third place (with 63 reports). However, if we look at the MVs in general, use for fodder (MV = 1004) and food (MV = 604) turn out to be the most important uses according to the quality and frequency of use, while firewood (MV = 22) comes in on the fifth place in the rank order of all the uses for this species (Appendix I).

Patterns of traditional knowledge

Location of the communities and actual plant use

The geographic location of the communities was seen to be one of the most important factors, which influence the actual use of plants in the study area. It was seen that the informants living in Orocote and Palmar use more species than the informants in Cañon Verde (figure 6). This may be due to the higher degree of isolation of these two communities, and the related lower availability of modern goods and services. It has been shown on indigenous communities of Mexico (Benz et al 2000), Ecuador (Byg and baslev 2004) and rural populations in USA (Nolan and Robbin 1999) that their knowledge of plant use was influenced by the geographic remoteness and modern goods and services. Other factors such as differences in the environment and the age of the communities may, however, also be responsible for the differences between Amazonian farming communities in Perú settles in the same area (Coomes 1996, Coomes and Barham 1997).

Gender related patterns and actual plant use

In all the communities included in this study there was gender related division of labor with the men being responsible for the economic activities and the women for household related activities. It is thus the men who are mainly responsible for agriculture and cattle raising. The women do, however, assist in critical tasks such as planting and harvesting of crops and taking care of the smaller domestic animals such as pigs and sheep. But the main tasks of the women consist of raising the children, preparing the meals, and collecting fire wood. The same gender related division of labor has been reported from indigenous communities Guaranies assented close the study area (Hart et al. 1996) and Shuars in Ecuador (Byg and Balslev 2004).

The observed gender related division of labor influences the ways men and women interact with the environment, both with regard to how often they encounter different vegetation types and with regard to the kinds of plant uses they learn about and attach importance to. The division of labor is thus reflected in gender differences in actual use of plant (Figure 7).

Knowledge variation between communities

A notable change in knowledge is observed in the informants from the community of El Abra. Previously, the people from El Abra were using similar number of plants (the sum of plants that are not being used any more as well as presently used plants) than the informants of Orocote and Palmar, but were using more plants than the informants of Cañon Verde (figure 5). With regard to present day actual plant use, the informants of El Abra show a reduction in the number of plants used, in such a way that now they use less plants than the informants in Orocote and Palmar. However, they still use more plants than the informants of Cañon Verde (figure 5).

Administratively, El Abra and Cañon Verde are considered to be one community. It is therefore interesting that, nevertheless, the informants in El Abra and Cañon Verde exhibit differences in their use of plants (Figure 5). Considering that Cañon Verde and El Abra have similar accessibility there must be other factors which influence the knowledge levels in these two communities. Although it has not been directly investigated in this study, it is possible that the greater distance from Cañon Verde to the *Tucumano-Boliviano* forest influences the use that people from Cañon Verde make of the plants from this forest type. Since the people from Cañon Verde need to expend more physical energy in order to access the *Tucumanon-Boliviano* forest, it seems plausible that they prefer to satisfy many of their basic needs using plants from more accessible vegetation types. Such a change has been demonstrated in a study of the Mapuches in Patagonia, Argentina, where traditionally used species have been replaced with plant species that can be found closer to the community (Ladio and Lozada 2004).

Knowledge variation within communities

According to the analyses presented here there was not only a significant variation in plant use between different communities, but also within communities. Variation in present day plant use was thus significantly related to the interaction between age and birthplace. While most informants showed an increasing use of plant numbers with age, migrants who had moved from isolated areas to non-isolated areas, showed the opposite pattern (figure 4A). This pattern seems to indicate an abandonment of plant use over time in those people, who migrated from isolated to non-isolated areas. Such an interpretation is supported by the fact that immigrants from other areas with similar vegetation types generally use equal or higher numbers of plants than non-migrants living in the isolated parts of the study area (figure 5). In addition, these migrants also deviate from the other informants with regard to the relationship between age and the number of species used previously. While the other informants show a gradual increase in age with regard to the recollection of past use of plant species, the informants who migrated from isolated areas with similar vegetation type to non-isolated communities do not show such an increase with age (figure 4B). That is, old migrants do not know significantly more plant species used previously than young migrants from isolated areas with similar vegetation.

At the same time, there is a positive correlation between informants' age and the time they have been living at the present location ($r^2=0.74$; $P<0.0001$). This means that the longer a migrant from an isolated area with similar vegetation type has been living in a non-isolated area, the less plants does he or she use at present (figure 4A).

Other studies have reported of loss of interest in traditional or local plant uses and have in many cases related this to the availability of industrially manufactured products and alternative ways of subsistence such as wage work, commercially oriented agriculture or emigration to urban centres (Anyinam 1995, Benz et al. 2000, Joyal 1996). Frequently, the availability of such alternative subsistence strategies depend on the proximity to urban centres, which give access to modern goods and services (Zent 1999).

Migration has existed throughout the whole of human history and has frequently been described as a complex human phenomenon. The background for migration seems, however, to be simple: the search for adequate living conditions. What constitutes the latter is culturally defined. Migrants are usually looking for better opportunities and are prepared to change in order to satisfy their needs. Although migration is thus driven by need, those who migrate need to have a capacity for change and to have personal resources such as an enterprising spirit. Thus migration is often regarded as "brain drain" where the more capable people leave (see Miyagiwa 1991). The patterns encountered in this study can be interpreted in the way that those informants, who migrate from isolated areas with same vegetation type to non-isolated communities, are those who are the most dynamic members of their community and those who are most predisposed to changes. This is reflected in the large number of species that they used before they moved as well as in the rapid abandonment of the habit of using plants to satisfy their basic needs in their new (less isolated) place of settlement (figure 4A and 4B). We could thus say that in the study communities there are signs of a local "brain drain" from isolated to less isolated sites.

Among the informants who immigrated from other areas with other vegetation types, and those informants who were born in the area and not migrated, it is seen that the number of actually used species increases throughout their lives. A large number of plant uses are learned early in life but the number of plants used increases then gradually throughout the rest of life (figure 4A and 4B). This kind of age-related variation in plant use has been encountered in several studies of indigenous communities and has been interpreted as a sign of gradual accumulation of knowledge (e.g. Caniago and Sieber 1998, Begossi et al. 2002, Ladio and Lozada 2004). As mentioned earlier age related patterns of plant use can also indicate loss of knowledge (Phillips and Gentry 1993), but in that case we would expect a more abrupt change in the numbers of plants used and known

With regard to the migrants who come from areas with different vegetation, their increasing plant use can be regarded as a gradual learning process. This learning probably consists of a combination of knowledge transference from the people already established in the area and of individual experimentation. In this way, the migrants gradually incorporate the use of the new species in their subsistence practices. It has from other areas been shown how non-indigenous communities can adopt plant uses and knowledge when they are in contact with indigenous communities (e.g., Atran et al. 2002, Campos and Ehringhaus 2003). There are also examples of small-scale farmers who within 50 years in a new environment develop more appropriate agricultural techniques and thus adjust to the new environmental conditions (Hiraoka 1995, Begossi 1998).

Distribution of knowledge among the informants

The process of personal learning and experimentation is not only reflected in an increasing number of plants used throughout life, but also in an increasing specialization of plant use in the informants. This is reflected in the decreasing Species equitability values (SE*i*) values with increasing age of the informants (figure 8). That means that younger informants use all the species they know to more or less the same degree, while older informants use some species a lot and others only very little.

Variation in use according to use category

As has been reported from farmers living in montane forest areas in Costa Rica (Kappelle et al. 2000) and non indigenous in southerast Perú (Phillips and Gentry 1993), this study show that use of plants for medicinal purposes is most sensitive to changes in the plant use habits of the people (figure 9). The majority of the most important medicinal species are herbs and shrubs and they are being replaced by industrially manufactured pharmaceuticals. In contrast, some of the most important categories of use, according to the number of reports, such as construction and technology, show the least reduction in use percentage.

Depending on the life form of the plant, the manner, frequency and intensity of exploitation, the removal of biomass will have different effects on the individual, species or population (Bennett 1992). Trees are especially vulnerable to intense and frequent cutting due to the longer time span that elapses before their start reproducing, their low biomass production and specialized habitat requirements (Cunningham 2001). Although tree cutting in tropical forests does not necessarily imply forest destruction (Putz 1992), the alteration of the population structure of tree species through the removal of individuals is therefore likely to have more serious consequences than in the case of shrubs or herbs. This risk is especially high when non-sustainable exploitation methods are used and when the exploitation pressure persists over lengthy periods of time.

Conclusion

Out of the necessity of survival the farming communities in the study area have established an interrelationship with the natural environment where they make use of the plant resources of the *Tucumano-Boliviano* forest to supplement their agricultural produce, especially with regard to food, medicine and construction materials. The interrelationship between the local people and the forest is important due to the crucial role of local people, indigenous as well as non-indigenous, with regard to the sustainable management of biodiversity. In this case, this is the more important since the study area contains one of the last tracts of continuous *Tucumano-Boliviano* forest in good conservation state (Holst et al. 1997).

Presently, only few species have a high relative value for the inhabitants of this montane forests area of Bolivia. The majority of the most important species are trees, which have the highest potential number of uses. The results obtained in this study as well as in other studies of non-indigenous communities of the Amazon basin, clearly support the notion that the interaction of several dynamic biological, ecological and social factors (such as the life form, anatomy and richness of species and the traditional practices of a village) influence the number of species used as well as the relative value of the used species (Turner 1988, Bennett 1992, Phillips et al. 1994, Salick et al. 1999, Vandebroek et al 2004).

In addition to these biological and ecological factors, geographic and socio-economic factors also influence the traditional knowledge and use of plants. The geographic position of the community affects both the degree of isolation (with respect to access to urban centres), the distance to the forest and the availability of other vegetation types. In addition to the differences between communities there were also differences within each community and these were seen to be related to gender, age and birthplace.

The results demonstrate that traditional knowledge is not static, but dynamic and variable. The differences between communities as well as between individuals in the same communities indicate that the habits of use are changing with some people abandoning some plant uses, while at the same time, knowledge is being transferred between people and learning is taking place. Due to the construction of roads, the region's social and economic context is undergoing increasing changes. Considering the tendencies of plant use change observed in this study, it seems likely that increasing road access will in the future lead to loss of knowledge of plant uses.

By explicitly differentiating between historic and present day plant use it becomes possible to register reduction in plant use over time. In the study area, the reduction in plant use was least for timber based uses (e.g. construction and tools), which exert the highest pressure on the forest, since whole plant individuals are killed in the process and trees are usually slowly growing and long lived. Even though the total use of plants has been reduced the extractive pressure seems therefore to have remained constant over time.

The failure of numerous development and conservation projects has amply demonstrated that the support and involvement of the local people are a basic requirement for the success of any project. The information generated in this ethnobotanical study contributes to a better understanding of how the farmers in the study area perceive their natural environment, how they interact with the forest and how they value the forest's plant resources. Taking account of this information in the planning and implementation of future conservation and development projects in the area may be crucial to their outcome.

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Table 1. Socioeconomic and ecologic characteristics of the villages

Carácter	**Orocote**	**Palmar**	**El Abra**	**Cañon Verde**
Isolate degree	Isolated. 13-14 hours walk from the nearest road.	Isolated. 13-14 hours walk from the nearest road.	Motorized access during 9 months of the year. 1,5 hours walk from the closest road in the wet season.	Motorized access during 9 months of the year. 1/2 hours walk from the closest road in the wet season..
Population §	387 people	491 people	239 people	196 people
Informants	13 male; 13 female	15 male; 13 female	16 male; 15 female	16 male; 10 female
Economic activity	subsistence farming	subsistence farming	Farming, wood retail	Farming, wood retail
Source of energy	Firewood	Firewood	Firewood and gas,	Firewood and gas,
Electricity energy	No	No	Solar panels in some houses	Solar panels in some houses
Services of education	Until 4º school	Until 2º highschool	Until 4º school	Until 8º school
Services of healt	No	health center with 1 doctor and 1 nurse.	No	No
Comunication	Radio communication	public telephone	Radio communication	Radio communication
Religión	Catholics and others	Catholics and others	Catholics and others	Catholics and others
Community more cross	Palmar (8 km)	Orocote (8 km)	Cañon Verde (5 km)	El Abra (5 km)
Main resorce *	TB y CS	TB y CS	CS y TB	CS y TB
Distance to TB	15-20 minutes long walk	15-20 minutes long walk	35- 40 minutes long walk	1.5 hours long walk
Altitude	1100 m	1100 m	1100 m	800 m

§ Source: Health center of Palmar. Present registers of 2004.

* Main resource: Main accessible types of vegetation to people and they are described as *Tucumano-Boliviano* forest (TB) and *Chaco Serrano* (CS).

Table 2. Use categories.

Category	Subcategory	Description
Food		Primary and secondary foods
Medicine		Related with health
Construction	Light	Posts and wood for fences and stables
	Heavy	Posts and wood for the house (such as beams, walls, ceilings, braces)
Technology	Tools, furniture and kitchen utensils	Parts used for the construction of tools for agriculture (rudder, plow, handles of hoe, shovels, etc), trays, plates, spoons, doors, tables, windows, etc.
	Basketwork/cords	Cords for moorings, ropes, cords, baskets
Firewood		Species that can be used as firewood even at humid times
Forrage		Plants eaten by domestic animals
Veterinary		Plants used to cure domestic animals
Miscelaneous	Ornamentals, tintures, rituals	Used in ceremonies, dress, coloring of textiles, and ornamentals
	Toxics	Poison, used bait, rubbers to catch animals
	Others	Shampoo, soap, to tan leathers, others

Table 3. Frequency of collection

Code	Explanation
1	Never used, but knows the use because he heard it or saw others use it
2	Used not very often
3	Used regularly
4	Used always or frequently

Table 4. Quality of species for each specific use

Code	Explanation
1	Not known
2	Low quality
3	Medium quality
4	High quality

Table 5. Variables used in the different analyses, and their levels.

Independent variables	Type of variable
Community	Nominal (4 levels: Orocote, Palmar, El Abra, Cañon Verde)
Birthplace	Nominal (4 levels: born in isolated village; born in non-isolated village; migrated from isolated to non-isolated village; migrated from village outside study area)
Gender	Nominal (2 levels: man; woman)
Age	Continuous

Dependent variables	Type of variable
Number of species used before	Continuous
Number of species used at present	Continuous
Use value (UV)[1]	Continuous
Multiple value (MV)[2]	Continuous
Informant diversity value (ID)[1]	Continuous
Informant equitability value (IE)[1]	Continuous
Species diversity value (SD*i*)[1]	Continuous
Species equitability value (SE*i*)[1]	Continuous

[1] Following Byg and Baslev (2001); [2] Modified of Turner (1988)

Table 6. Quantitative measures calculated to determine the importance of the species according to the informants in the *Tucumano-Boliviano* forest.

Measure	**Calculation**	**Description**
Use value (UVs)	$UV_s = \sum n_{is} / n$ n_{is} = number of uses informant *i* knows for species *s*; n = Total number of informants	Measures the average reports of uses informants know for a species.
Informant diversity value (ID*s*)	$IDs = -\sum[(n_{is}/ r_{Is}) \times \ln (n_{is} / r_{Is})]$ r_{Is} = Total reports of use of all informants $_I$ for species *s*	Measures how many informants use a species and how its use is distributed among them. Values range between 0 and the number of informants using it.
Informant equitability value (IE*s*)	$IEs = IDs / IDs\ max$ ID*s* max = ln of total number of types use of specie *s*	Measures how the use of a species is distributed among informants independently of the number of informants using it. Values range between 0 and 1.
Use consensus value (UCs)	$UC_s = (2n_s/n) - 1$ n_s = number of people using a species *s*	Measures how large the degree of accordance is between informants concerning whether they regard a species as useful or not. Values range between – 1 and + 1
Multiple value (MV)	$VM_s = \sum F_s \times C_s$ F_s = collection frequency of species *s*; C_s = quality of species *s* for each used	Measures the actual importance of species to the local population based on the collection frequency and quality.

Table 7. Quantitative measures calculated to measure informants' knowledge of the useful plants.

Measure	Calculation	Description
Species diversity value (SD*i*)	$SDi = - \sum[(n_{is/} r_i) \times \ln (n_{is\,/}\, r_i)]$ r_i = Total uses that informant *i* knows	Measures how many species an informant uses and how evenly his uses are distributed among the species. Values range between 0 and the number of species used by the informant.
Species equitability value (SE*i*)	SE*i* = SD*i* / SD*i* max H max = ln of total number of types use of informant *i* knows	Measures how evenly an informant makes use of the palms he knows, independently of the number of palms used. Values range between 0 and 1.

Table 8. Index used for the valuation of the species between isolated (Orocote y Palmar) and non-isolated (El Abra y Cañon Verde) villages. NR = Number of reports, UV = Use Value and IE*s* = Informant equitability value.

Isolated villages				**Non-isolated villages**			
Specie	**NR**	**UV**	**IE*s***	**Specie**	**NR**	**UV**	**IE*s***
Acacia aromo	83	1.54	0.85	***Myrcianthes sp1***	80	1.40	0.89
Myrcianthes sp1	74	1.37	0.90	***Acacia aromo***	76	1.33	0.85
Anadenanthera colubrina	73	1.35	0.89	*Maclura tinctorea*	74	1.30	0.89
Myrciaria sp1	73	1.35	0.85	***Chrysophyllum gonocarpum***	69	1.21	0.90
Chrysophyllum gonocarpum	72	1.33	0.90	***Myroxylon peruiferum***	60	1.05	0.87
Myroxylon peruiferum	66	1.22	0.87	***Parabignonia chodatii***	47	0.91	1.00
Syagrus cardenasii	60	1.11	0.87	*sp3* Myrtaceae	48	0.84	1.00
Capparis prisca	58	1.07	0.93	***Enterolobium contortisiliquum***	46	0.81	0.95
Terminalia triflora	56	1.04	0.93	***Tabebuia sp 1***	45	0.79	0.88
Juglans australis	54	1.00	0.89	*Piper spp*	44	0.77	1.00
Enterolobium contortisiliquum	54	1.00	0.89	*Ximena americana*	43	0.75	0.94
Parabignonia chodatii	46	0.98	1.00	***Tecoma stans***	42	0.74	0.92
Schinopsis haenkeana	50	0.93	0.96	***Schinopsis haenkeana***	42	0.74	0.91
Tecoma stans	48	0.89	0.95	***Terminalia triflora***	40	0.70	0.99
Tabebuia sp1	47	0.87	0.89	***Anadenanthera colubrina***	38	0.67	0.93
Rubus spp	47	0.87	1.00	*Myrcia sp2*	37	0.65	0.99
sp3 Myrtaceae	46	0.85	1.00	*Rubus spp*	37	0.65	1.00
Inga cf. saltensis	43	0.80	0.96	*Capparis prisca*	36	0.63	0.99
Piper spp	42	0.78	0.99	*Juglans australis*	35	0.61	0.97
Myrcia sp2	41	0.76	1.00	*Cordia alliodora*	34	0.60	0.93
Maclura tinctorea	40	0.74	0.94	*Cedrela fissilis*	31	0.54	0.97
Pogonopus tubulosus	36	0.67	0.91	*Tipuana tipu*	31	0.54	0.98
Ximenia americana	32	0.59	0.59	*Leguminosae-Pap sp1*	31	0.54	0.99
Plantago australis	31	0.57	1.00	*Equisetum spp.*	30	0.53	1.00
Inga marginata	28	0.52	0.94	*Pluchea sagittalis*	25	0.44	1.00
Triumfetta semitriloba	26	0.48	1.00	*Inga cf. Saltensis*	22	0.39	0.98
Cedrela fissilis	26	0.48	0.98	*Plantago australis*	19	0.33	1.00
Equisetum spp.	26	0.48	1.00	*Triumfetta semitriloba*	18	0.32	1.00
Lauraceae sp2	24	0.44	0.95	*Maranta incrassata*	16	0.28	1.00
Tipuana tipu	24	0.44	0.91	*Inga marginata*	16	0.28	0.97
Leguminosae-Pap sp1	22	0.41	0.96	*Syagrus cardenasii*	16	0.28	1.00
Adianthum raddianum	17	0.31	1.00	*Podocarpus parlatorei*	16	0.28	0.88
Cordia alliodora	16	0.30	0.97	*Pogonopus tubulosus*	16	0.28	0.97
Maranta incrassata	13	0.24	1.00	*Myrciaria sp1*	13	0.23	0.82
Myrsine coriaceae	12	0.22	1.00	*Lauraceae sp2*	13	0.23	0.96
ni *sp1*	6	0.11	1.00	*Myrsine coriaceae*	8	0.14	1.00
Pluchea sagittalis	6	0.11	1.00	ni *sp1*	5	0.09	1.00
Podocarpus parlatorei	3	0.06	1.00	*Micrograma squamulosa*	3	0.05	1.00
Micrograma squamulosa	1	0.02		*Adianthum raddianum*	0	0.00	

Table 9. Comparison of the averages of the Use value (UV) and multiple value (MV) of the 15 most important species according to the informants of 4 communities. NR: total number of reports of use of the species.

Specie	**UV**	**VM**	**NR**
Acacia aromo	1.44	2144	159
Myrcianthes sp1	1.39	2058	154
Chrysophyllum gonocarpum	1.27	1683	141
Myroxylon peruiferum	1.14	1622	126
Maclura tinctorea	1.02	1414	114
Anadenanthera colubrina	1.01	1279	111
Parabignonia chodatii	0.95	1212	93
Enterolobium contortisiliquum	0.91	1165	100
Terminalia triflora	0.87	1324	96
Capparis prisca	0.85	1088	94
sp 3 Myrtaceae	0.85	1116	94
Schinopsis haenkeana	0.84	1207	92
Tabebuia sp1	0.83	1018	92
Tecoma stans	0.82	1006	90
Juglans australis	0.81	1003	89

Table 10. Results of the multiple regression analysis of the quantitative measures (Nº sp, SEi) used to measure the present and historical use of the species onto social and geographic variables (and their first order interactions). The significance levels are indicated by asterisks in the following form: *** P < 0.001; ** P < 0.01; * P < 0.05; NS= not significant.

	Actual use		Historic use	
	Nº sp	SE*i*	Nº sp	SE*i*
R2	0.534	0.362	0.606	0.416
R2 Adjusted	0.463	0.212	0.546	0.278
Community	**	NS	**	NS
Birthplace	***	NS	**	NS
Gender	**	NS	**	NS
Age	**	*	***	**
Community-Gender	NS	NS	NS	NS
Community-Age	NS	NS	NS	NS
Birthplace-Gender	NS	NS	*	NS
Gender-Age	NS	NS	*	NS
Birthplace-Age	***	NS	***	NS

Table 11. Number of useful native species found in montane forests, based on different ethnobotanical studies.

	Kappelle et al. 2000	**Heredia 1998**	**Present work**
Country	Costa Rica	Bolivia	Bolivia
Village	Los Santos forest reserve	Chajra Mayu	Palmar, Orocote, El Abra, Cañon Verde
Characteristic of communities	Farmers, non-indigenous	Farmers, non-indigenous	Farmers, non-indigenous
Vegetation type	Montane cloud forest	Montane forest (Bosque Tucumano-Boliviano)	Montane forest (Bosque Tucumano-Boliviano)
Elevational gradient	2000-3000 m	1700-2300 m	800-2300 m
Interview type	Multiple interviews for each informant	Walking in the forest with each informant	Single interview for each informant
Number of key informants	14 farmers	withouth data	8 farmers
Number of native species	92 scientific species	91 scientific species	78 scientific species

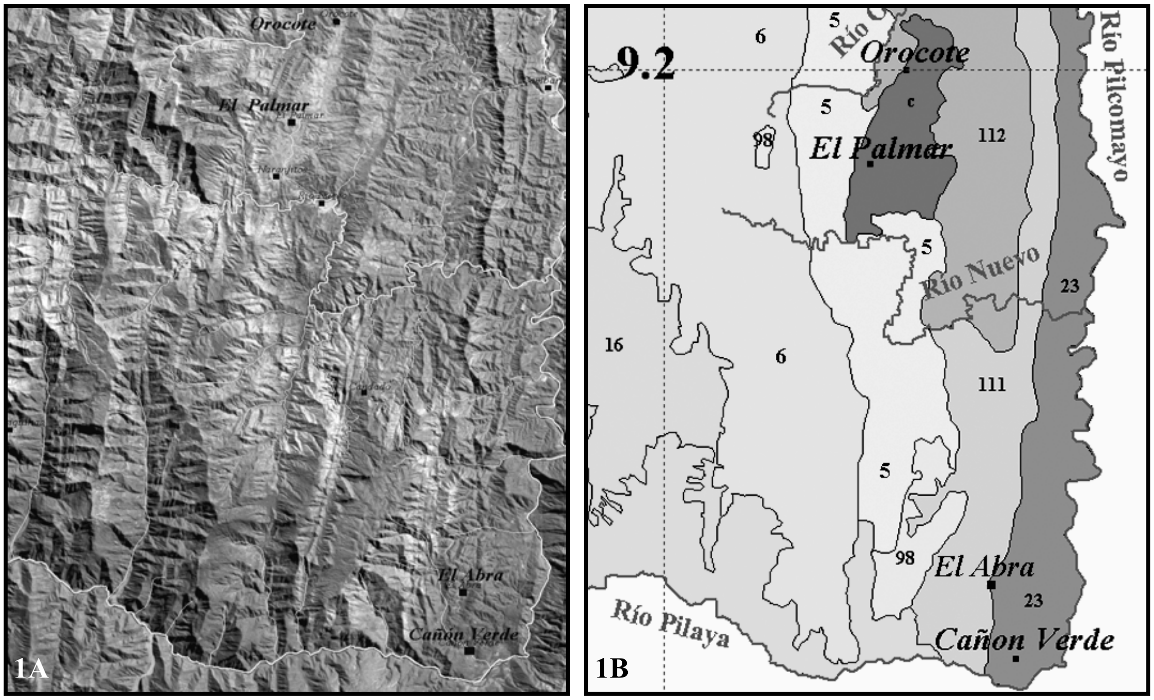


Figure 1A. Satellite image of study area. 1B Vegetation map (5= Dense, evergreen, semideciduous, montane forest; 23= Sparce, deciduous, submontane forest; 98= montane scrub vegetation; 111= Sparce, seasonally deciduous, montane forest; C= Agricultural fields, grazing grounds and secondary vegetation). Source: DHV Sudamericana (2004).

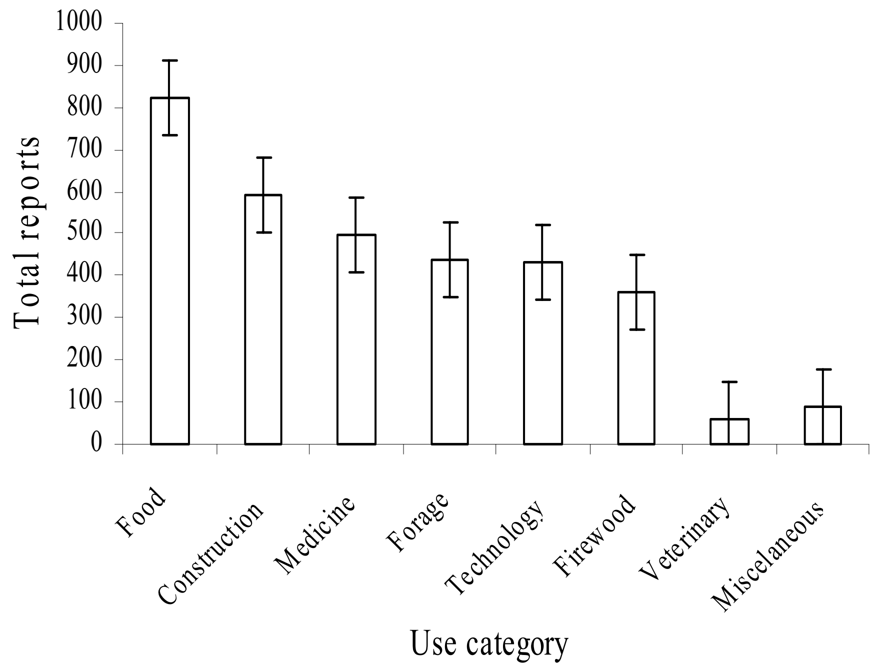


Figure 2. Number of reports of the use of species in each category in the *Tucumano-Boliviano* forest

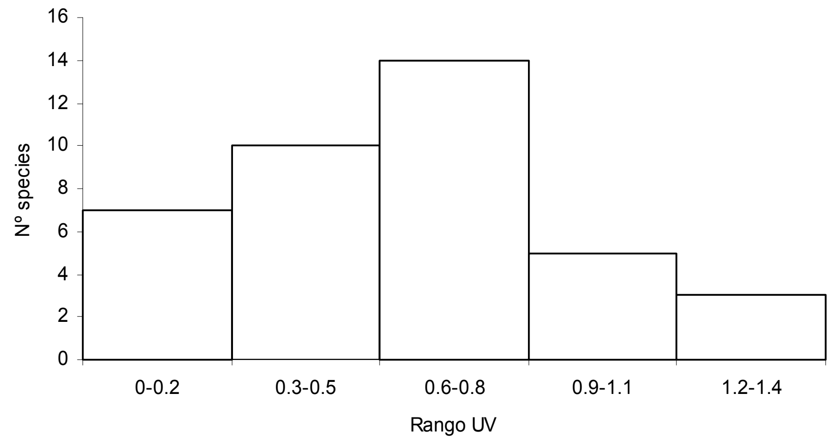
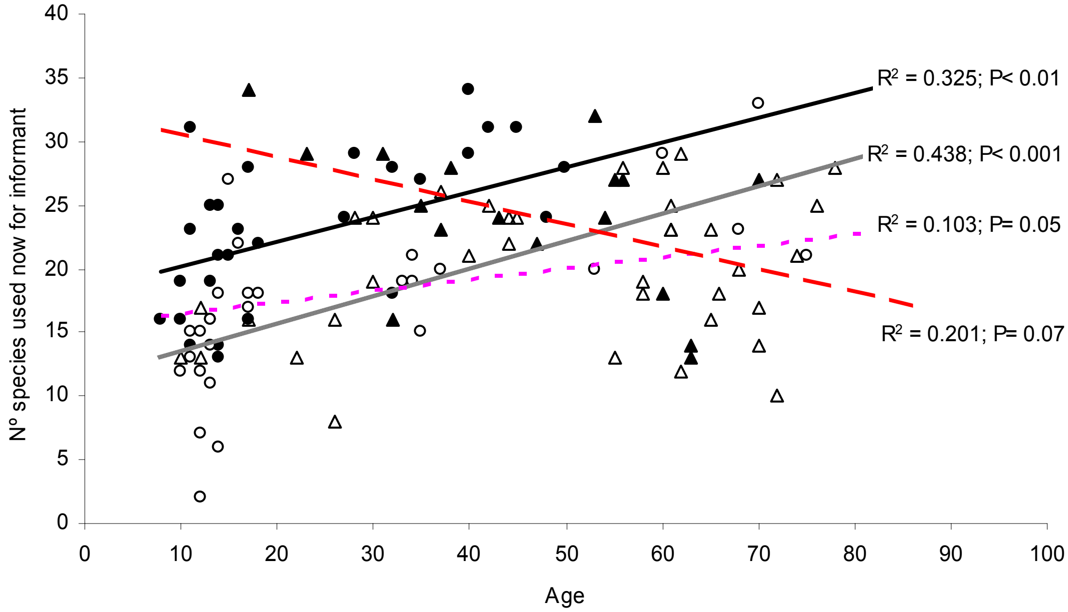


Figure 3. Distribution of the number of species ranked according to the Use value (UV).

4A



4B

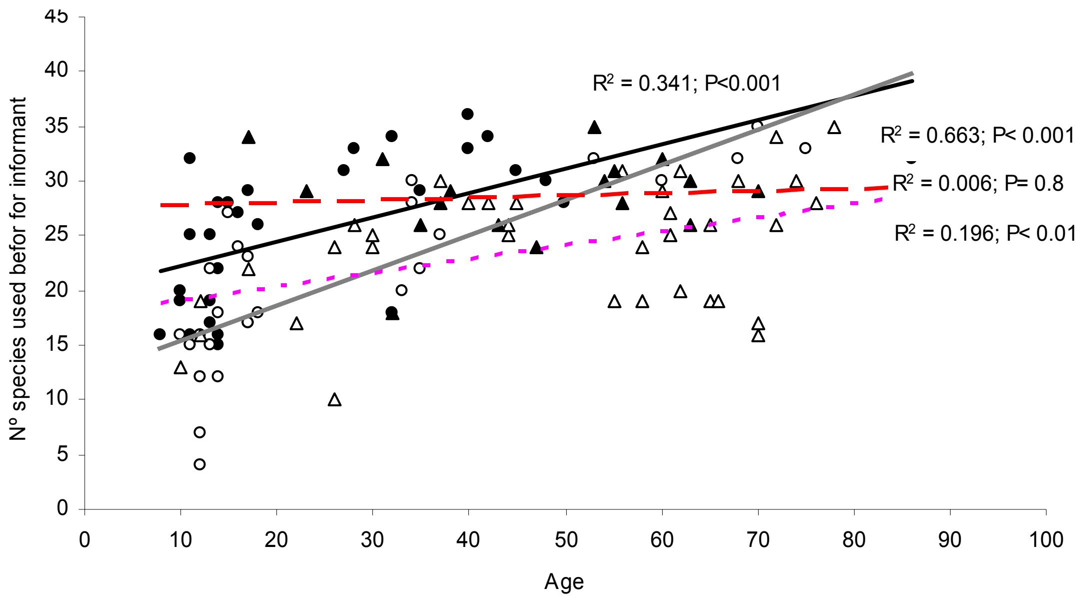


Figure 4. Variation in the number of species used presently (4A) and the number of species used before (4B) with regard to age and differentiating between informants born in different places. Informants who were born in the isolated site (solid circle and continuous line; n = 30), informants who were born in the non-isolated site (circle empty and diffuse continuous line; n = 27), informants who were born in other towns with different type of vegetation (empty triangle and line of small dashes; n = 37) and informants who were born in other towns with similar type of vegetation (solid triangle and line of long dashes; n = 17).

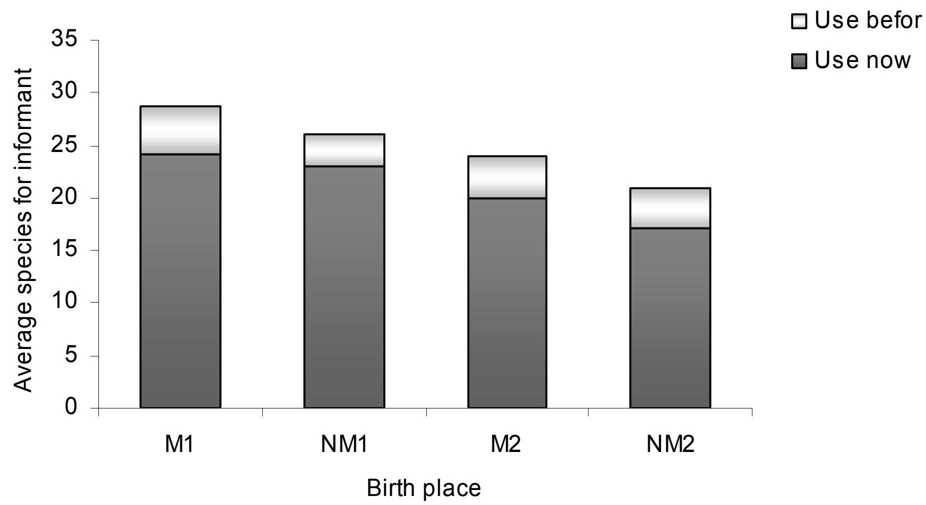


Figure 5. Variation of the knowledge according to the birthplace of the informants, differentiating between the number of species used before and the number of species used now. M1= migrant informants of the isolated site with similar type of vegetation, M2= migrant informants of another area with different type from vegetation. NM1= informants of isolated site who did not migrate and NM2= informants of the non-isolated site who did not migrate.

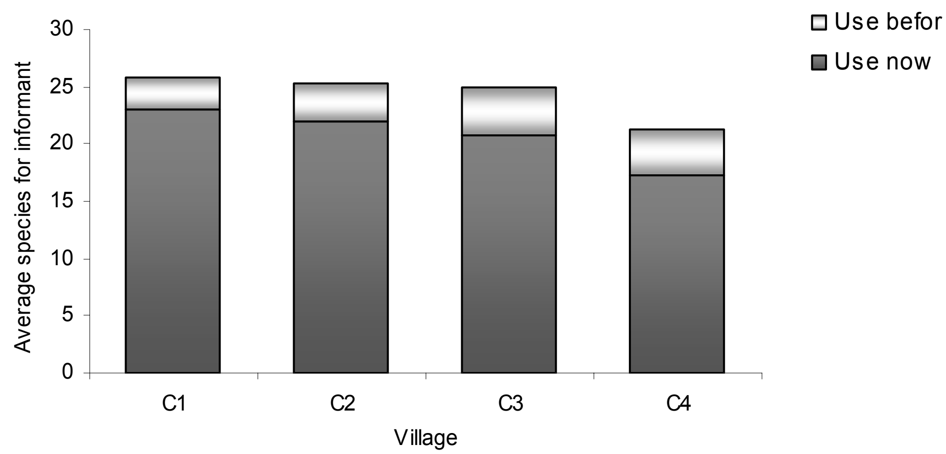


Figure 6. Variation of the knowledge according to the community, differentiating between the number of species used before and the number of species used presently. C1= Orocote, C2= Palmar, C3= El Abra, and C4= Cañón Verde.

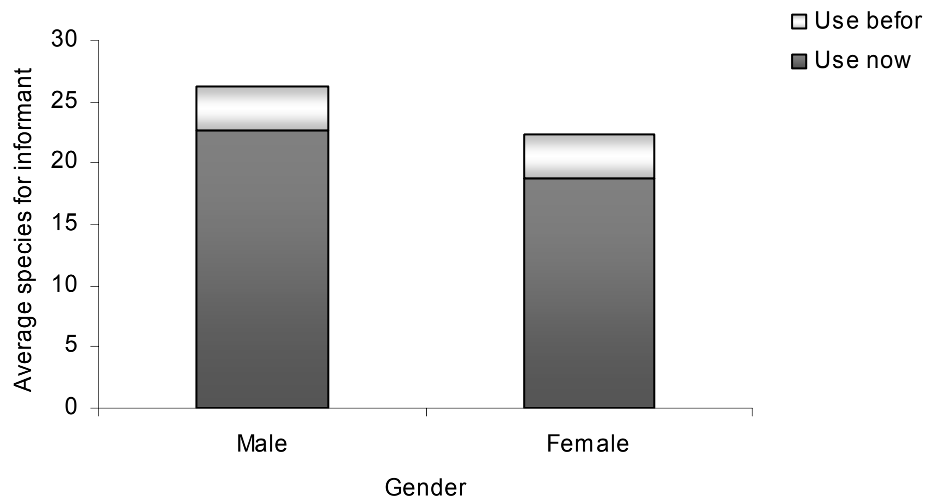


Figure 7. Levels of knowledge (historical use and present use) between male and female informants in 4 communities of the *Tucumano-Boliviano* forest.

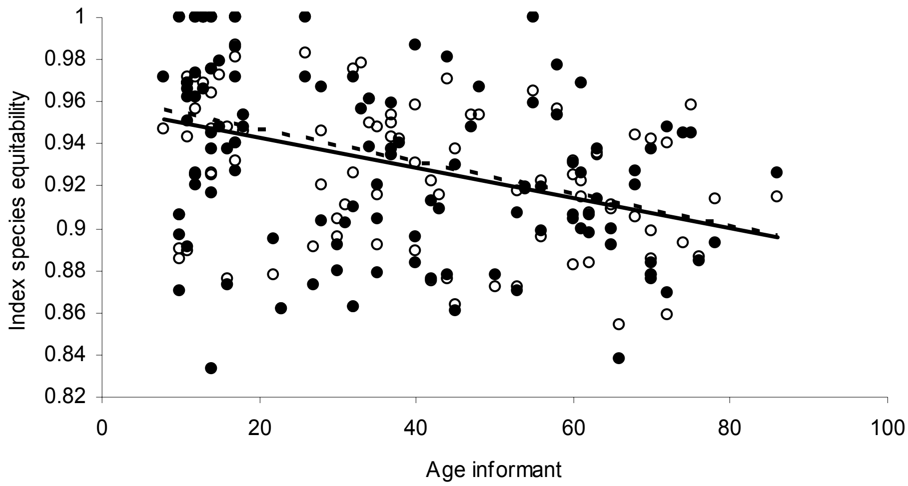


Figure 8. Variation of the Species equitability value (SEi) for historical use (empty circle and segmented line; R2 = 0.177; P = 0.004) and present use of the species (solid circle and continuous line; R2 = 0.136; P = 0.016) of 111 informants in 4 communities of the *Tucumano-Boliviano* forest.

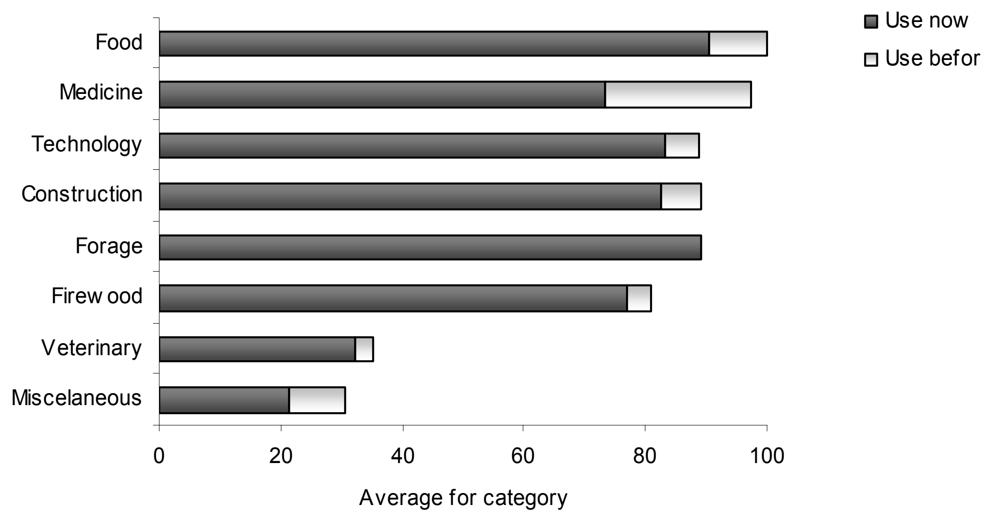


Figure 9. Variation of the knowledge by category of use according to 111 informants of 4 communities situated in the *Tucumano-Boliviano* forest. Change of the knowledge is expressed as the difference between the average of species used before and now.

Appendix 1. List of 78 folk species according key informant´s free list in *Tucumano-Boliviano* forest in South Bolivia. Actual uses of 60 folk species mentioned in 111 interviews in 4 Villages. A = El Abra; P = Palmar. Fd = Food; Me = Medicine; Co = Construction; To = Tools; Fi = Firewood; Fr = Forage; Ve = Veterinary; Or = Ornamental; Tx = Toxic; Ce = Cesteria; Ot = Others. For the species in the interview survey the number of informants and the multiple value are given. Life form of the species is indicated as following: a = Tree; b = Shrub; c = Herb; d = Epiphyte, liana, hemi-parasite. * = Folk taxa corresponding to more than one scientific species; (+) = uncertain identification All of these collections are with the code AC.

Family	**Species**	**Folk name**	**Life form**	**Collection place (Nº collection)**	**Use (Nº of informants; multiple value)**
Amaranthaceae	*Alternanthera pungens*	yerba y pollo	c	A (1715)	Not included in interview
Anacardiaceae	*Astronium urundeuva*	mara soto	a	P (1518)	Not included in interview
Anacardiaceae	*Schinopsis haenkeana*	soto, quebracho colorado	a	A (1606)	Me (1; 6), Co (58; 797), To (2; 22), Fi (30; 366), Fr (1; 16)
Araceae	*Taccarum sp1*	papa de vibora, mangara	c	A (1300)	Me (1; 8), Ve (4; 30)
Arecaceae	*sp1*	palma coco	a	P (1520), A (1708)	Fd (37; 326), Or (6; 89), Fr (33; 496)
Asteraceae	*Cnicothamnus lorentzii*	sejranillo	b		
Asteraceae	*Bidens pilosa*	saitilla	c	P (1511), A (1694)	Fd (5; 46), Me (13; 172), Fr (2; 21)
Asteraceae	*Pluchea sagittalis*	cuatro cantos	c	P (1515), A (15 68)	Me (31; 342)
Asteraceae	*Senecio sp*	maicha	c	P (1510)	Not included in interview
Betulaceae	*Alnus acuminata*	aliso	a	P (1372)	Not included in interview
Bignoniaceae	*Parabignonia chodatii*	bejuco blanco	d	A (1646)	Ce (93, 1212)
Bignoniaceae	*Tabebuia sp1*	lapacho amarillo	a	A (1540)	Me (1, 16), Co (40; 414), To (5; 50), Fi (45; 534), Fr (1; 4)
Bignoniaceae	*Tecoma stans*	guaranguay	a	P (1436)	Me (20; 258), Co (32; 317), To (17; 198), Fi (16; 167), Or (2, 22), Fr (3; 44)
Bombacaceae	*Ceiba insignis*	toboroche, joroche	a	A (1600)	Ce (28; 267)
Boraginaceae	*Cordia alliodora*	lapacho blanco, mendiola	a	P (1493), A (1701)	Co (24, 237), To (22; 251), Fi (3; 30), Fr (1; 6)
Bromeliaceae	*sp1*	payu	d	Whitout number	Not included in interview
Cactaceae	*Rhipsalis sp1*	waska waska	d	A (1550)	Fd (6; 60), Me (15; 158)

Appendix 1 (Continued)

Family	Species	Folk name	Life form	Collection place (Nº collection)	Use (Nº of informants; multiple value)
Cactaceae	*sp1*	cardón ulala	a	Whitout colection	Fd (21; 170), Me (1; 12), Or (3; 30)
Capparaceae	*Capparis prisca*	arasa	a	A (1566)	Fd (77; 840), Fr (17; 248)
Caprifoliaceae	*Sambucus peruviana*	mololo	a	A (1704)	Not included in interview
Chenopodiaceae	*Chenopodium ambrosoides*	paico	c	P (1513)	Fd (1; 16), Me (27; 322)
Combretaceae	*Terminalia triflora*	lanza, lanza amarilla.	a	P (1521), A (1596)	Co (4; 54), To (80; 1142), Fi (12; 128)
Commelinaceae	*Commelina sp1*	santa lucia	c	Whitout number	Not included in interview
Convolvulaceae	*Ipomea muricata*	ñetira	c	A (1699)	Not included in interview
Dioscoraceae	*Dioscorea multispicata*	karante	c	A (1551)	Fd (17; 164), Fr (3; 48)
Equisetaceae	*Equisetum bogotense*	cola y caballo *	c	A (1714)	Me (56; 649)
Equisetaceae	*Equisetum giganteum*	cola y caballo *	c	*same Equisetum bogotense*	*same Equisetum bogotense*
Ericaceae	*Gaylussacia cardenasii*	duraznillo	c	P (1360)	Not included in interview
Juglandaceae	*Juglans australis*	nogal	a	A (1632)	Fd (15; 186), Co (45; 457), To (3, 30), Or (26; 330)
Lauraceae	*sp1*	laurel blanco (+)	a	Whitout number	Me (3; 40), Co (15; 125), To (1; 6), Fi (1; 16)
Lauraceae	*sp2*	laurel morocho (+)	a	Whitout number	Me (1; 16), Co (29; 289), To (3, 21), Fi (3; 21), Fr (1; 6)
Leguminosae-Caesalpinoideae	*Anadenanthera colubrina*	cebil, villca	a	P (1497), A (1706)	Me (2; 24), Co (31; 322), Fi (59; 688), Fr (1; 16), Ve (2; 25), Ot (15; 204)
Leguminosae-Caesalpinoideae	*Acacia aromo*	sirao, tusca	a	A (1560)	Fd (1; 8), Me (35; 462), Co (24; 277), To (1; 16), Fi (40; 515), Fr (33; 512), Ve (25; 354)
Leguminosae-Caesalpinoideae	*Senna cf. pendula*	carnaval	a	A (1614)	Co (8; 76), To (6; 55), Fi (10; 95), Or (25; 338)
Leguminosae-Mimosoideae	*Enterolobium contortisiliquum*	timboy, pacara	a	P (1522), A (1556)	Me (1; 16), Co (55; 603), To (36, 438), Fi (1; 16), Txs (2, 24), Fr (2; 24), Ot (3; 44)

Appendix 1 (Continued)

Family	Species	Folk name	Life form	Collection place (Nº collection)	Use (Nº of informants; multiple value)
Leguminosae-Mimosoideae	*Inga marginata*	pacay kala, pacay abajeño	a	P (1446), A (1541)	Fd (26; 265), Fr (18; 220)
Leguminosae-Mimosoideae	*Inga cf. saltensis*	pacay alteño, pacay lanudo	a	P (1429)	Fd (56; 612), Fr (9; 117)
Leguminosae-Papilionoideae	*Erythrina rubrinervia*	cuñuri	a	A (1567)	To (20; 229), Or (1; 16)
Leguminosae-Papilionoideae	*Erythrina falcata*	ceiba	a	P (1507)	To (7, 68)
Leguminosae-Papilionoideae	*Myroxylon peruiferum*	quina colorada, quina roja	a	A (1679)	Me (3; 40), Co (59; 738), To (15; 188), Fi (48; 640), Ve (1; 16)
Leguminosae-Papilionoideae	*Tipuana tipu*	tipa	a	A (1702)	Me (4; 60), Co (30; 273), To (12, 142), Fi (5; 48), Fr (2; 32), Ve (1; 12), Ot (1; 16)
Leguminosae-Papilionoideae	*sp1*	tipilla	a	A (1703)	Me (3; 40), Co (10, 104), To (28, 313), Fi (11; 112), Fr (1; 9)
Marantaceae	*Maranta incrassata*	acherilla	c	P (1453), A (1278)	Fr (29; 438)
Meliaceae	*Cedrela fissilis*	cedro	a	P (1461), A (1648	Co (23; 262), tool (33; 382), Fi (1; 8)
Moraceae	*Ficus aff guaranitica*	ateniu	d	A (1636)	Fd (1; 12), Me (14; 182), Or (1; 6), Fr (6; 89)
Moraceae	*Maclura tinctorea*	mora, tata yegua	a	P (1467), A (1630)	Fd (8; 64), Co (35; 358), To (5, 47), Fi (16; 165), Fr (50; 780)
Myrsinaceae	*Myrsine coriaceae*	yuruma	a	P (1479), A (1590)	Co (10; 86), To (2, 20), Fi (1; 4), Txs (6; 48), Fr (1; 16)
Myrtaceae	*Myrciaria sp1*	huanquillo (+)	a	P (1482), A (1637)	Fd (15; 117), Me (1; 16), Co (26; 338), To (1; 16), Fi (30; 349), Fr (13; 204)
Myrtaceae	*Myrcia sp2*	wawincho, guinda	a	P (1508), A (1558)	Fd (74; 802), Co (1, 6), Fr (3; 48)
Myrtaceae	*Myrcianthes sp1*	guayabilla (+)	a	A (1608), P (1503)	Fd (101; 1278), Co (1; 9), Fi (8; 101), Fr (44; 670)

Appendix 1 (Continued)

Family	**Species**	**Folk name**	**Life form**	**Collection place (Nº collection)**	**Use (Nº of informants; multiple value)**
Myrtaceae	*Psidium guajava*	guayabilla (+)	a	same *Myrcianthes sp1*	same *Myrcianthes sp1*
Myrtaceae	*Siphoneugena occidentalis*	huanquillo (+)	a	same *Myrciaria sp1*	same *Myrciaria sp1*
Myrtaceae	*sp3*	arrayán (+)	a	A (¿?)	Fd (93; 1100), Fr (1; 16)
Olacaceae	*Ximenia americana*	limoncillo	a	P (1495), A (1611)	Fd (1; 12), Co (14; 135), Fi (5; 34), Fr (55; 773)
Orchidaceae	*sp1*	choclo choclo	d	Whitout number	Not included in interview
Phytolacaceae	*Petiveria alliacea*	anambo	c	A (1711)	Me (10; 89)
Piperaceae	*Piper cf. acutifolium*	matico *	b	P (1536), A (1544)	Fd (15; 157), Me (71; 836)
Piperaceae	*Piper hieronymii*	matico *	b	same *Piper cf. acutifolium*	same *Piper cf. acutifolium*
Piperaceae	*Peperomia cf steinbachii*	anís de monte	d	P (1443), A (1571)	Fd (19; 164), Me (2; 20)
Piperaceae	*Peperomia theodori*	gongona	d	P (1396), A (1554)	Me (7; 83)
Plantaginaceae	*Plantago australis*	llantén	c	P (1404), A (1629)	Me (50; 628)
Poaceae	*Chusquea lorentziana*	caña brava, kuri	c	P (1389)	Co (7, 66)
Poaceae	*sp1*	paja sibinga	c	Whitout number	Not included in interview
Podocarpaceae	*Podocarpus parlatorei*	pino de monte	a	A (1587)	Fd (2; 24), Me (1, 8), Co (4; 32), To (7, 55), Fi (5; 38)
Polypodiaceae	*Microgramo squamulosa*	polipol	d	P (1450), A (1609)	Me (4; 54)
Pteridaceae	*Adianthum raddianum*	culantrillo	c	P (1408), A (1619)	Me (17; 230)
Rosaceae	*Rubus boliviensis*	zarzamora *	b	P (1476), A (1549 A) A (1294)	Fd (83; 966), Me (1; 8)
Rosaceae	*Rubus bogotensis*	zarzamora *	b	same *Rubus boliviensis*	same *Rubus boliviensis*
Rubiaceae	*Pogonopus tubulosus*	quina quina, quina rosada	a	P (1538), A (1713)	Me (20; 254), Co (3; 36), To (2; 22), Fi (4; 41), Ve (23; 338)
Rubiaceae	*Psychotria sp1*	ramoneo	c	P (1355)	Fr (24; 368)
Sapotaceae	*Chrysophyllum gonocarpum*	aguay	a	P (1403), A (1548)	Fd (63; 604), Co (3; 26), To (4; 27), Fi (67; 22), Fr (67; 1004)

Appendix 1 (Continued)

Family	Species	Folk name	Life form	Collection place (Nº collection)	Use (Nº of informants; multiple value)
Solanaceae	*Capsicum chacoense*	aribibi, ají de monte	c	A (1697)	Fd (55; 692)
Solanaceae	*Cyphomandra betaceae*	tomate chilto	b	P (1456), A (1546)	Not included in interview
Solanaceae	*Solanum tripartita*	ñusku	c	P (1514)	Not included in interview
Solanaceae	*sp1*	libi libi	c	A (1639)	Not included in interview
Tiliaceae	*Triumfetta semitriloba*	cabeza y negro, cepa caballo	c	P (1425), A (1640)	Me (44; 507)
Verbenaceae	*Verbena cf.hispida*	verbena azul	c	P (1512)	Me (19; 270), Ve (3; 48)
Urticaceae	*Urera sp*	itapalla	b	Whitout number	Not included in interview
Unknown	*Indet. Sp1*	achicoria	c	A (1628)	Me (11; 112)
Unknown	*Indet. Sp2*	ojo y vaca	a	Whitout number	Fd (33; 321), Me (1; 16), Co (2; 28), To (1; 16), Fi (1; 9), Fr (18; 266)
Unknown	*Indet. Sp3*	zarzaparrilla	c	Whitout number	Me (7; 96)
Unknown	*Indet. Sp4*	chachacoma		Whitout colection	Not included in interview
Unknown	*Indet. Sp5*	yana yana		Whitout colection	Not included in interview