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Wild food plants used by the indigenous peoples of the South American Gran Chaco: A general synopsis and intercultural comparison

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Summary

The Gran Chaco is the most extensive wooded region in South America after the Amazon Rain Forest, and is also a pole of cultural diversity. This study summarises and updates a total of 573 ethnobotanical data on the use of wild food plants by 10 indigenous groups of the Gran Chaco, as published in various bibliographical sources. In addition, estimates are given as to the levels of endemicity of those species, and intercultural comparative analyses of the plants used are made. A total of 179 native vegetable taxa are used as food of which 69 are endemic to, or characteristic of, this biogeographical region. In all, almost half these edible species belong to the Cactaceae, Apocynaceae, Fabaceae and Solanaceae botanical families, and the most commonly used genera are *Prosopis*, *Opuntia*, *Solanum*, *Capparis*, *Morrenia* and *Passiflora*. The average number of food taxa used per ethnic group is around 60 species (SD = 12). The Eastern Tobas, Wichi, Chorote and Maká consume the greatest diversity of plants. Two groups of indigenous peoples can be distinguished according to their relative degree of edible plants species shared among them be more or less than 50 % of all species used. A more detailed look reveals a correlation between the uses of food plants and the location of the various ethnic groups along the regional principal rainfall gradient. However, consumption of most of the foods mentioned in this study is under threat for ecological, legal and cultural reasons.

Introduction

Numerous authors have focused attention on the fact that the conservation of phytogenetic resources is inseparable both from the attempts made to save the cultures associated with them, and from improvements in the quality of life of those persons who, despite the poverty in which they live, selflessly provide us with this knowledge. In addition, when the resources considered include food plants, studies such as these contribute valuable elements with which to reverse the global trend towards dietary simplification, a trend that has negative consequences for health, nutritional balance and food security (IPGRI, 2005).

The American Gran Chaco is a biogeographical region in the centre of South America which stretches from tropical to subtropical latitudes (18°S - 31°S), between longitude 57° and 66° West. It is the most extensive continuous area of dry forest in South America and the most extensive wooded region after the Amazon Rain Forest (THE NATURE CONSERVANCY et al., 2005). The Gran Chaco covers a total surface area of 1,066,000 km²; straddles four countries: Argentina (62.19%), Paraguay (25.43%), Bolivia (11.6%) and Brazil (0.77%), and includes three main subregions: Humid Chaco in its eastern portion, with annual mean precipitation of 1000 mm, Central Chaco (700-800 mm), and Dry Chaco in its western portion (500-700 mm) (Fig. 1). This region involves a mosaic of ecosystems, with a predominance of dry subtropical forest (in the west) and subhumid forest (in the east), – which has adapted to a marked seasonality in precipitations – including savannahs, steppes, and large areas subject to seasonal flooding, as well as transition areas between

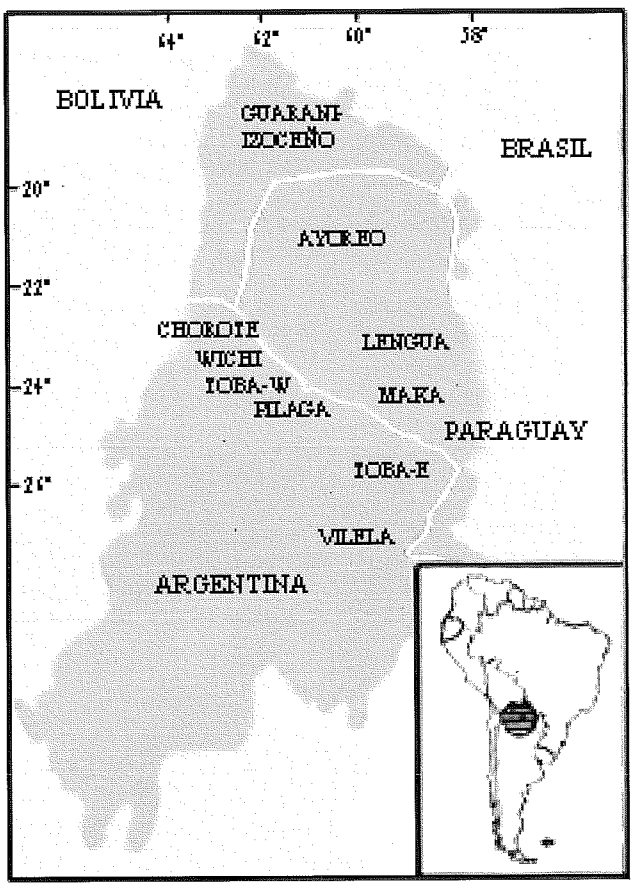

Fig. 1: Location of South American Gran Chaco and Ethnic Groups

these formations. Over 3400 species of plants are found in the region, of which approximately 400 are endemic (The Nature Conservancy et al., 2005). Knowledge of its plant diversity is still incomplete, and in fact none of the countries involved has yet a treatment of the flora in their respective areas. That is partly why the term "endemic" used here alludes to plants whose greatest area of distribution is in Gran Chaco, although they may also be found in neighbouring regions (generally known to be "characteristic of the region").

The Gran Chaco is also a center of cultural diversity. For approximately 7000 years the human groups that live there have developed a culture that is closely linked to the natural resources of the region. The ethnic groups that have survived were, until recently, nomadic and semi-nomadic hunter-gatherers, fishermen and incipient horticulturists. They include representatives of the Zamuco (Ayoreo and Chamacoco), Guaycurú (Toba, Pilagá, Mocoví), Arawak (Chané), Lengua-Maskoy (Lengua, Sanapaná, Guaná, Angaité), Matako-Maka (Chorote, Nivaklé, Maká, Wichi), and Lule-Vilela (Vilela) linguistic families, with a total of some 20 languages and 30 dialects. In the past, the gathering of food plants was vitally

important for the Gran Chaco Indians, since it allowed them to complement their diet with the resources obtained from hunting, fishing and the extraction of honey. The information currently at our disposal on the use of these resources by these people is incomplete, taking into account that we only know the uses made by ten (10) of the ethnic groups present in the region. Although sketchy data on other groups is available, we only have in-depth, detailed and reliable botanical and ethnographical information on these ten ethnic groups, whose population roughly accounts for some 2/3 of the Indians of the Gran Chaco. The most important historical sources that exist on the topic are the data included in the doctoral thesis of FILIPOV (1996) – as yet unpublished – for the Pilagá; for the Wichi the studies of ARENAS (2003) and MARANTA (1987) (for the Masá, Lhukutáx and Bermejeño dialectal groups); for the Ayoreo the studies by SCHMEDA-HIRSCHMANN (1998; 1994); for the Maka and the Lengua those of ARENAS (1982; 1981) respectively; for the Chorote the study by ARENAS and SCARPA (2007); for the Toba Ñachilamole'ek or "Toba-Pilagá" (hereafter the "Western Toba") that by ARENAS (2003), for the "Eastern Toba" of the Gran Chaco (Qómlé'ek and Takshék groups) those by MARTÍNEZ CROVETTO (1964) and VUOTO (1981); for the Vilela the study by MARTÍNEZ CROVETTO (1965), and that by BOURDY (2002) for the Guaraní-Izoceño or "Chiriguanos" of the Bolivian Chaco. In addition, there is fragmentary information on the use of one or more species as food by several ethnic groups in this region in diverse bibliographical sources (indicated in Materials and Methodology). As can be seen, the information we have was contained in a great variety of publications from different countries, some of which have been little spread, or remain unpublished. Hardly any of them contain quantitative analyses of any kind on the endemicity of the species used, or on the relative exclusivity of each ethnic group in the use of each one of the species. Lastly, no comparative analyses on this subject have been conducted to date among the ethnic groups of the Gran Chaco.

The purpose of this study is to summarise information on the plant food species used by ten ethnic groups in the Gran Chaco, making a descriptive statistical analysis, estimating the levels of endemicity of the plants used and providing an intercultural comparison of their use.

Materials and methods

The works mentioned above as background information were used in first place as bibliographical sources; then, various scientific articles investigating the use of one or more food species for different ethnic groups of the Gran Chaco were consulted. They included articles by ARENAS and GIBERTI (1987a; 1987b and 1993); ARENAS (1999; 2004); ARENAS and ARROYO (1988); ARENAS et al. (1986); MARANTA and MAZZEI DE PLANAS (1985); ARENAS and SCARPA (1999; 2003); and that by SCARPA and ARENAS (2002). Besides those indicated, other works of importance were consulted with the aim of specifying the degree of endemism of the food plants previously identified, such as the "Flora of the Southern Cone" data base (IBODA, 2009), and the studies made by PRADO (1991), SCARPA (2000); and the Gran Chaco Americano Ecoregional Assessment (THE NATURE CONSERVANCY et al., 2005). The botanical nomenclature referred to in many of these studies was updated in accordance with "Flora del Cono Sur" data base (IBODA, 2009), and the TROPICOS data base of the Missouri Botanical Garden (Tropicos.org, 2009). However, certain ethnobotanical data presented in this paper and detailed in the Discussion and Conclusions, are unpublished. They were recorded by Pastor Arenas during fieldwork with the Lengua ethnic group at the Republic of Paraguay, and by the author with the Chorote people in

Tab. 1: Basic features of ethnic groups whose edible plants were considered

Gran Chaco ethnic group	Linguistic Family	Geographical location	Ecological region	Bibliographical sources	Population
Ayoreo	Zamuco	NW Paraguay 22° S- 60° W	Seimiarid Chaco	Schmeda-Hirschmann (1994; 1998)	2016*
Chorote	Mataco-mataguayo	NW Argentina 22° S – 62° 30' W	Seimiarid Chaco	Arenas & Scarpa (2007)	2613**
Guaraní-izoceño	Tupí-guaraní	SE Bolivia 19° S – 62° 30' W	Seimiarid Chaco	Bourdy (2002)	9000***
Lengua-Maskoy	Lengua-Maskoy	South-center of Paraguay 23° S- 60° W	Central Chaco	Arenas (1981)	13065*
Maka	Mataco-mataguayo	South-center of Paraguay 23° 30' S- 59° 30' W	Humid Chaco	Arenas (1982)	1282*
Pilagá	Guaycurú	North-center of Argentina 24° 30' S- 61° W	Central Chaco	Filipov (1996)	4465**
Eastern Tobas **Western Tobas (Toba-Pilagá)**	Guaycurú	NE Argentina 26°/27° S - 59° W North-center of Argentina 23° 30' S – 62° W	Humid Chaco Seimiarid Chaco	Martínez Crovetto (1964); Vuoto 1981 Arenas (2003)	69452**
Vilela	Lule-vilela	NE Argentina 27° S- 59° W	Humid Chaco	Martínez Crovetto (1965)	?
Wichi	Mataco-mataguayo	NW y North-center of Argentina 23° 30' S – 62° W	Seimiarid Chaco	Arenas (2003); Maranta (1987)	40036**

* DGEEC (2003); **INDEC (2005); ***Bourdy (2002)

North-west of Argentina.
Tab. 1 shows the linguistic filiation, geographical location, ecological region, bibliographical sources and total population of the ethnic groups considered in this study. In the ethnographic literature (BRAUNSTEIN, 1983; SUSNIK, 1972) these indigenous peoples are considered to be "typically chaquenian", with the exception of the Guaraní-Izoceño. The latter were included here because they have lived for many centuries in a chaquenian area – from an ecological point of view –: the swamps of the Izozog in the Republic of Bolivia (THE NATURE CONSERVANCY et al., 2005). Moreover, as an extra-Chaco ethnic group living in the Chaco, it is very interesting from a comparative perspective to compare their food species with those of the typical chaquenian indians. Unlike the Toba, the sources of data on the Wichi come from areas relatively close to each other and ones that are environmentally similar (west of the province of Formosa and east of Salta), so they were grouped together in a single category. However, it should be pointed out that according to the authors (ARENAS, 2003; MARANTA, 1987), the ethnobotanical data cited refer to different tribes and dialectal divisions, such as those of the Masá, Lhukutax and Bermejeños, among others.
The intercultural comparison was made by using two kinds of techniques. One of them consisted in calculating, as a measure of similarity, the absolute and relative quantities of the food species shared between each of the ethnic groups studied, which are presented in the form of a 10 x 10 double-entry matrix (Tab. 4). The other method consisted in applying a hierarchical clustering analysis to a 179 x 10 presence-absence matrix (Tab. 2), which resulted from expressing in quantitative binary form the uses of food species for each of the ethnic groups ("1" assigns use and "0" non-use). This grouping analysis was made by using as a measure of similarity a simple correlation index calculated with "Cluster 3.0" software (by HOON et al., 2002), the results of which are shown in the form of a dendogram in Fig. 6.

Results

In Tab. 2 (Appendix), the food plant species used by the indigenous groups of the Gran Chaco are grouped together in alphabetical order, according to the botanical family to which they belong, with an indication as to which of them are endemic, which are eaten by each ethnic group and the parts used. A total of 179 native plant taxa are used as food of which 69 are endemic or characteristic of this phytogeographical region. These plants belong to 46 botanical families in all, although almost half of them (46.5 %) are of the Cactaceae (27 species), Apocynaceae, Fabaceae and Solanaceae (19 species each) families. Other botanical families of alimentary importance are the Capparaceae (6 species), Arecaceae, Myrtaceae, Passifloraceae (5 species each) and the Nymphaceae (3 species) (see Fig. 2).
The botanical genera with the highest number of food taxa are *Prosopis* (Fabaceae) with 11 taxa; *Opuntia* (Cactaceae) with 9; *Solanum* (Solanaceae) with 6; *Morrenia* (Apocynaceae), *Harrisia* (Cactaceae) and *Capparis* (Capparaceae) with 5 taxa each (Fig. 3).
Fig. 4 gives the proportions of the plant parts used as food: 65% correspond to fruits, 13% to leaves and, to a lesser extent (under 10%), to other plant parts. Among the latter, the most important are the starchy underground organs (rhizomes, tubers and roots) of 29 species (16% of the total).
Descriptions of the forms in which plant foods are obtained, carried, prepared and eaten, as well as the indigenous names of the plants used, are not given here; they can be consulted in the bibliographic materials that serve as a source for this study (cited previously). Briefly, it can be said that Gran Chaco Indians follow simple technical procedures to prepare and/or consume plant foods; their culinary techniques do not involve the use of numerous ingredients

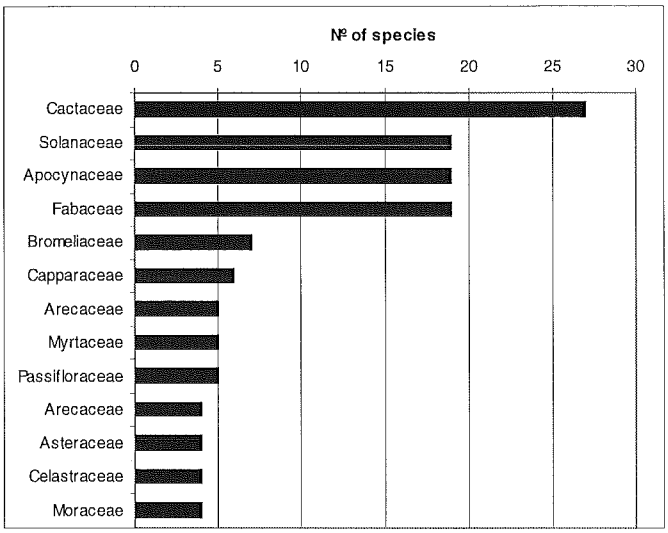

Fig. 2: Major botanical families with edible taxa

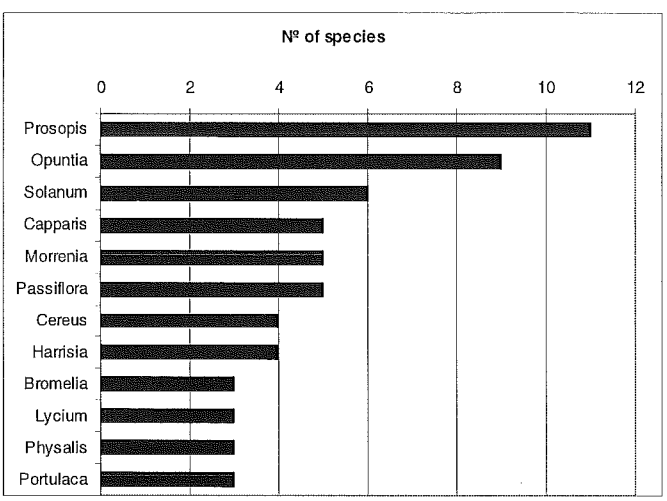

Fig. 3: Botanical genera with highest food taxa

or complex preparation processes. The main forms of preparing plant foods are boiling, roasting, spit-roasting, toasting, baking, grinding and burning. Processing techniques may vary according to the type of product, phenological stage of the parts used, and of the quantities available at a given moment. Consumption frequently involves the adding of seasonings, the most important of which are animal fats (especially fish), "plant salt" prepared from the vegetable ash of some twelve species in all, as well as pungent, sour condiments of vegetable origin. As regards the moment of consumption, vegetable products may be gathered and consumed directly in the forest or carried to the settlements for immediate or later consumption. There are two major groups of edible plants as a function of their time of availability; the most important one is disposable at different moments of the rainy season – between October and March –, that is considered a time of plentifulness (involves all edible fruits). The another one involves, mainly, "famine foods" that are available during the autumn and winter period – between May and September –, involving all underground organs and stems.
Fig. 5 shows the total number of food plants for each of the indigenous groups considered as well as the number of endemic species used.
Tab. 3 shows these values as well as the proportions of identified food

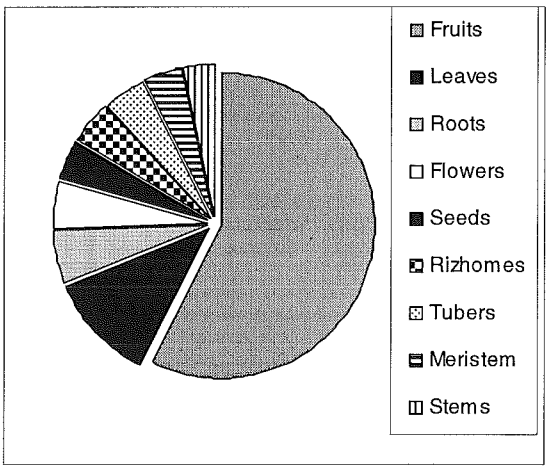

Fig. 4: Plant parts used as food

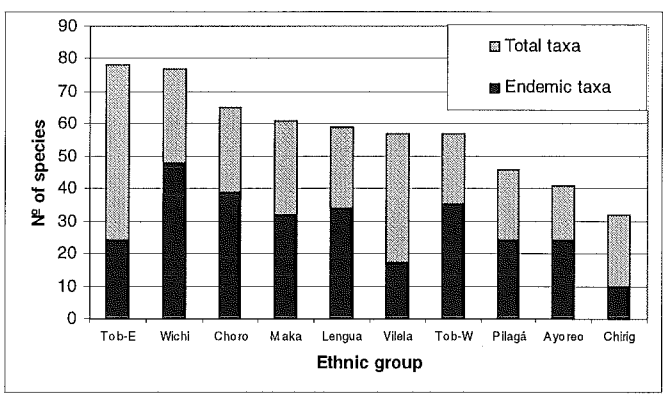

Fig. 5: Edible wild plants used by each indigenous group

species used by each ethnic group; the percentage of endemic plants used per ethnic group compared to total food taxa and in terms of the total number of endemic species. The average number of edible species used per ethnic group is 60 (SD= 12). As can be seen, the Wichi, Western Tobas and Chorote are the indigenous peoples that consume the largest number of species, while the Wichi, Chorote and Eastern Tobas record the highest values for endemic plants used, both in terms of the total used by each ethnic group and in relation to the total number of endemic food plants. Regarding the levels of exclusivity in the use of food plants, ⅓ of the species studied here (60) are only consumed by a single ethnic group, while 60% of them are used by one or two ethnic groups alone. Tab. 4 (Appendix) is double entry and shows for comparative purposes the absolute and relative quantities of food plants that ethnic groups studied here share between themselves. As another comparative measure to quantify the shared edible plant items, the last column of the table is a "sharing index" calculated on the basis of the sum of the number of plants each ethnic group consumes in common with the others. Fig. 6 is the dendrogram which resulted from applying the hierarchical clustering method to the presence-absence matrix of use of food plants (Tab. 2), as another form of intercultural comparison.

Discussion and conclusions

Since the publication of articles used as sources for this study, several changes have occurred in the botanical nomenclature of food plants given, including those arising from a review of the genera *Opuntia*, *Cereus*, *Morrenia*, *Canna* and *Oxalis*, among the most important. The Asclepiadaceae, which contains several food plants, is presently submerged within the Apocynaceae by most systematists. Additionally, *Opuntia vulgaris* (MARTÍNEZ CROVETTO, 1965; 1964; SCHMEDA-HISRSCHMANN, 1998; ARENAS, 1982; 1981), and *O. paraguayensis* (for the Toba, Vilela, Ayoreo, Maká, and Lengua respectively), are presently considered to be wild forms of the cultivated species *O. ficus-indica*, as it is stated in the "Flora of Southern Cone" data base (IBODA, 2009). As regards the applications of each plant species, it is worth mentioning that the indigenous people can make use of different organs from each one of them, with which they can prepare, as well, different types of meals. As an example, mention can be made of the varied culinary preparations made from the species of *Morrenia*, of which the unripe fruits are eaten raw, the ripe fruits are roasted, while the tender leaves and stalks are used in salads, with each one of them being seen as differentiated ethnobotanical data. According to comparative data analysed by ARENAS and SCARPA (2007) for different ethnic groups of this region, the number of total food preparations is calculated to be, on average, approximately twice that of edible species used by each indigenous group. So it is estimated that the edible plants of the Gran Chaco (179) would have to yield some 358 culinary preparations in all, of which 138 are of course unique to this part of the world since they are prepared from endemic species (69).

Results show that the highest proportion of edible plant parts

Tab. 3: Edible wild plants used by ethnic group

ETHNIC GROUP	Total taxa	% of total plant used	Endemic taxa	% of endemic plant used	% of total endemic taxa
Western Toba	78	44	24	31	34
Wichi	77	43	48	62	69
Chorote	65	36	39	60	56
Maka	61	34	32	52	46
Lengua-Maskoy	59	33	34	58	49
Vilela	57	32	17	30	24
Eastern Toba	57	32	35	61	50
Pilagá	46	26	24	52	34
Ayoreo	41	23	24	59	34
Guaraní-Izoceño	32	18	10	31	14

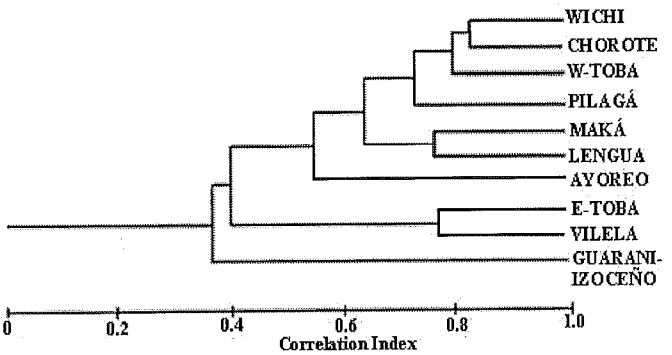

Fig. 6: Tree diagram of the comparative analysis of edible plants used by ethnic groups obtained through Clustering Method

corresponds to fruits. This is fairly common in other parts of the world; however, the high percentage of edible cacti recorded is rather unusual. The contribution of this botanical family is not only relevant in terms of the diversity of species used – many of cacti are arborescent – but also for their abundance in today's degraded forest, and for the varied preparations and types of organs used. In fact, the Gran Chaco is probably one of the regions with greatest diversity of edible cactus roots recorded in the world (SCARPA and ARENAS, 2002). However, both in terms of availability of resources, volumes gathered and nutritional value, the main foods of vegetable origin are undoubtedly the fruits of the species of the genera *Prosopis* spp. (Fabaceae) – whose representatives form extensive wooded communities which are at times monospecific –, *Geoffraea decorticans* (Fabaceae) and *Ziziphus mistol* (Rhamnaceae). Similarly, these trees are significant since they belong to one of the few species whose fruits are consumed – and often stored – by all the ethnic groups of the Gran Chaco. Species of Apocynaceae (mostly vines), and of Capparaceae also yield foods of great importance, both for their variety and abundance in the forests of the Chaco. At present, practically all other edible plants listed in Tab. 2 are minor or occasional foods, being scarcely represented in the diet of all ethnic groups. The studies by FREYRE et al. (2000), CHARPENTIER (1998), and ROZYCKI et al. (1997), may be consulted for information on the nutrient composition of the principal food resources of this region.

The reasons why very low values of food plants used were recorded for certain ethnic groups (Fig. 5) appear to vary considerably. The fact that the Guaraní-Izoceños use only 50% of the average number of plants used by the other groups (32 species) is probably due to the fact that they have always obtained most of their foods of vegetable origin from agricultural activity, and not as a result of directly gathering them from the forests like the other ethnic groups of the Chaco. For the Ayoreo, the low number of vegetable products gathered (41 species) appears to be due, on the other hand, to the considerable number of taboos that expressly forbid the consumption of numerous foodstuffs (SCHMEDA-HIRSCHMANN, 1998), which are freely used by the other groups. Lastly, the low value recorded for the Pilagá (46 species) is probably due to the constraints of the fieldwork conducted with them.

At first sight, and considered globally, the high values recorded for exclusivity of uses (60% of the species used by one or two ethnic groups) probably account for very marked cultural particularities between the groups, taking into account that most of them share territories with similar ecological characteristics. However, on considering the absolute and relative values (Tab. 4) of the species shared by all the ethnic groups, a more reliable vision of the situation emerges. In fact, in 45% of the total pairs of interethnic comparisons – 52% if the Guaraní-Izoceños are excluded –, the figure exceeds 50% of the species shared (and over 70% for 20% of the comparisons). In terms of their consumption of food plants, these results allow two groups of indigenous peoples to be broadly distinguished: one made up of ethnic groups which share over 50% of the species – Wichi, Chorote, Western Tobas, Pilagá, Lenguas and Maká –, and another of those who do so to a lesser extent – Ayoreo, Eastern Tobas, Vilela, Guaraní-Izoceño – (both sets of values are separated in Tab. 4 by an internal line). It can be presumed that the reasons for this high exclusivity are linked to both ecological and cultural factors. Maximum values of "Sharing Index" correspond to the Wichi (328), the Chorote (298) and the Western Tobas (295). Although these values also bear a relation with ethnohistorical and cultural factors which affect relations between ethnic groups, and considering the overwhelming population and territorial distribution superiority of the Wichi and Toba over the Chorote (Tab. 1), these results are in concordance with what is ascribed to the latter, in that they constitutes the Gran Chaco indigenous group with most harmonious relations with exogroups (CORDEU and DE LOS RÍOS, 1982).

The grouping obtained for edible plant uses of the different ethnic groups with the Cluster technique (Fig. 6) conforms to the interpretation of the results in Tab. 4, since the two sets of ethnic groups identified record very low values in the correlation index. However, the tree in Fig. 6 also shows close agreement between the indigenous groupings obtained – according to correlation index values – and the ecological characteristics of the territories occupied by them (Fig. 1 and Tab. 1). In fact, it can be seen that as a function of their edible plant uses, the ethnic groups are organised in terms of the principal rainfall gradient of the Gran Chaco (in a west-east direction), from the Chorote located in the far west of the Semi-arid or Western Chaco (longitude 63°), continuing towards the east of that phytogeographical district with the Wichi and Western Toba (longitude 62°), and with the Pilagá located in the Central or transitional Chaco (longitude 61°). Further east, there are two groups, one comprising the Lengua and Maká located between longitude 59° and 60° (towards the centre-east of the Gran Chaco, in the Republic of Paraguay) and another the Eastern Tobas and Vilelas located at longitude 59° towards the south-east of the region, in the Argentine Republic. An explanation for the low value recorded in the correlation index for the Ayoreo can be found in the reduced list of vegetable items they use, as a result of the associated taboos, as indicated above. The Guaraní-Izoceños, meanwhile, are confirmed as being a marginal ethnic people in contrast with the typically chaquenian groups, since despite sharing similar environments with the other groups, their use of wild food plants is clearly differentiated (Fig. 6). However, these results cannot be understood as "ecological determinism" in the use of food plants, since even those groups with high levels of species shared still reflect important differential nuances as regards plants consumed, and even more so regarding the cultural productions derived from their use. In fact, ARENAS and SCARPA (2007) proved that despite sharing a high percentage of edible plants, the proportion of common culinary preparations recorded between the Chorote and the Wichi was considerably lower than that. Therefore, these results would only appear to reflect the effective influence of the ecological environment on the selection of food plants made by indigenous peoples, as a substratum or framework for action in which cultures reveal their distinctive particularities in the use of wild plant resources.

It should be stressed that the consumption of most plant foods cited in this study, including those derived from endemic species, is now under threat for ecological, legal and cultural reasons. Among the former, the high levels of anthropogenic disturbance in the Gran Chaco, mainly as a result of the advancing agricultural frontier, extensive stockbreeding and forestry, are widely known (THE NATURE CONSERVANCY et al., 2005; MORELLO and HORTT, 1985). In the Argentine sector, this situation means that edible species from aquatic environments of the genera *Nymphaea, Canna* and *Typha*, for instance, which used to provide feculent rhizomes and pollen, are today in clear retreat as a consequence of the negative effect

of stockbreeding, mainly by their consumption by pigs and/or for the drying up of watering places (*Nymphaea* sp. has practically disappeared from the Argentine semiarid Chaco; last time it was collected by our research team was in 1982). The felling of palm groves of *Copernicia alba* and of *Thritrinax biflabellata* for pasture land, and to make way for oil prospection and exploitation in the west of the province of Formosa, has also entailed a considerable reduction in these food resources. It cannot be asserted with any degree of certainty whether the current lack of use by the peoples of the Gran Chaco of the species that have suffered this fate is due to cultural reasons, such as the loss of certain customs, or rather to the clear impossibility of finding them (ARENAS and SCARPA, 2007). The legal reasons that threaten neglect of these resources are a consequence of the current land ownership regimes that mean that the indigenous peoples have lost access to vast territories where their ancestors wandered freely in the past. This has meant that the humid azonal environments of the semi-arid Chaco – rapidly occupied by Criollo peasants to feed their cattle –, could no longer be used, with the consequent reduction in volumes and variety of the food plants gathered. The cultural factors that threaten their use, which are no less important, include the current loss of numerous practices and knowledge on the consumption of such species. This is evident in all the ethnic groups considered in this study due to the great cultural changes that they have undergone over the last century (ARENAS, 2003: 85-150). As the original peoples lose control and/or contact with their natural and cultural environments, either because they have been evicted from their habitats or because they are forced to live on highly degraded lands, their traditional ecological knowledge (TEK) and associated beliefs become less relevant in their lives. This leads to the eventual disappearance of very valuable knowledge, a phenomenon that has been called "extinction of experience" by MAFFI (1998), i.e., the radical loss of direct contact and traditional interaction with the surrounding environment.

This study summarises a total of 573 ethnobotanical data on edible plant species used by 10 ethnic groups of the Gran Chaco settled in Argentina, Paraguay and Bolivia. It records for the first time the food use made of the toasted seeds of *Phyllostylon rhamnoides* among the Lengua-Maskoy (Arenas, pers. comm.), as well as the boiled roots of *Manihot guaranitica* among the Chorote-iyowújwa (pers. obs.). The high number of species shared by most of the ethnic groups would appear to be further confirmation of the common characteristics already pointed out for the Chaco peoples as a unit (BRAUNSTEIN, 1983; MÉTRAUX, 1946; KARSTEN, 1932). Finally, the fact that the edible plants of Gran Chaco Indians include between 30% and somewhat over 60% of endemic species – depending upon the ethnic group –, is not only a warning sign on the importance of conserving them in view of the environmental degradation present in the region, but it also allows us to highlight and to appraise the particular contribution that this area of the planet makes to the world's food resources, and that the cultural practices of its indigenous people make to world culinary heritage.

Acknowledgements

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Appendix

Tab. 2: Edible wild plants of Gran Chaco indians

Botanical Family	Scientific name	Lengua-Maskoy	Chorote	Wichi	Maká	Ayoreo	Western Toba	Pilagá	Eastern Toba	Vilela	Guaraní-Izoceño	Parts used
Achatocarpaceae	*Achatocarpus praecox* Griseb.				X	X						Fr
Aizoaceae	*Sesuvium portulacastrum* (L.) L.								X			Le
Amaranthaceae	*Amaranthus hybridus* L.										X	Le
Annonaceae	*Annona nutans* (R.E. Fr.) R.E. Fr.					X					X	Fr
	Rollinia emarginata Schltdl.								X	X		Fr
Apiaceae	*Eryngium ebracteatum* Lam.						X					Le
Apocynaceae	*Araujia angustifolia*											
	(Hook. & Arn.) Decne.								X	X	Fr	
	Araujia plumosa Schltdl.								X	X		Fr
	Aspidosperma quebracho-blanco											
	Schltdl.		X									Ba
	Cynanchum montevidense Spreng.		X									Fr
	Funastrum clausum (Jacq.) Schltr.		X	X			X	X	X	X	X	Fr
	Funastrum gracile (Decne.)											Fr - St
	Schltdl.		X	X			X					Fl - Le
	Gonolobus rostratus (Vahl)											
	Roem. & Schult.								X	X		Fr
	*Marsdenia castillonii**											
	Lillo ex T. Mey.	X	X	X	X	X	X	X	X			Ro - Fr
	*Marsdenia paraguaiensis**											
	Morillo					X						Ro
	*Matelea australis**(Malme)											
	Pontiroli									X		Fr
	Morrenia brachystephana*Griseb.		X						X	X	X	Fr
	*Morrenia odorata**											Fr - St
	(Hook. & Arn.) Lindl.	X	X	X	X	X	X	X	X	X	X	Fl - Le
	*Morrenia stormiana**(Morong)											
	Malme		X	X	X	X	X		X	X		Fr

Botanical Family	Scientific name	Lengua-Maskoy	Chorote	Wichi	Maká	Ayoreo	Western Toba	Pilagá	Eastern Toba	Vilela	Guaraní-Izoceño	Parts used
Apocynaceae	*Morrenia stuckertiana subsp. grandiflora*(Kurtz ex Heger) Malme			X								Fr
	Morrenia variegata(Griseb.) T. Mey.	X	X	X	X		X		X	X		Fr - St Fl - Le
	*Oxypetalum balansae*Malme				X							Fr
	Schubertia grandiflora Mart.			X	X		X		X	X		Fr
	*Schubertia schreiteri** Descole & T. Mey.		X	X			X					Fr
	Vallesia glabra (Cav.) Link		X	X			X	X				Fr
Araceae	*Philodendron bipinnatifidum* Schott								X			Tu
	Spathicarpa hastifolia Hook.					X						Tu
	Synandrospadix vermitoxicum (Griseb.) Engl.	X	X	X								Tu
	Taccarum weddellianum Brongn.					X						Tu
Arecaceae	*Acrocomia aculeata* (Jacq.) Lodd. ex Mart.					X						Fr - Mt Pi Fr - Mt
	*Copernicia alba** Morong	X	X	X	X	X	X	X	X	X		Pi
	Syagrus romanzoffiana (Cham.) Glassman								X	X		Pi
	Trithrinax campestris (Burmeist.) Drude & Griseb.			X								Pi
	*Trithrinax schyzophylla**Drude	X		X	X	X	X	X				Pi
Asteraceae	*Acmella oppositifolia* (Lam.) R.K. Jansen		X	X								Le
	*Cyclolepis genistoides** D. Don						X					Le - St
	Hypochaeris chilensis (Kunth) Hieron.									X		Le
	Tessaria integrifolia Ruiz & Pav.			X								Ba
Bignoniaceae	*Amphilophium cynanchoides (DC.) L.G. Lohmann*		X									Fr
Bombacaceae	*Ceiba chodatii (Hassl.) Ravenna*		X	X		X						Fr
Bromeliaceae	*Aechmea distichantha Lem.*	X			X				X	X		Fr
	Bromelia balansae Mez					X			X	X		Va - Bl
	Bromelia hieronymi Mez	X	X	X	X	X	X	X				Va - Bl - fr - Pi
	Bromelia serra Griseb.	X	X	X	X	X	X	X	X	X	X	Va - Bl - fr - Pi
	*Deutherocohnia meziana**Kuntze ex Mez	X									Bl	
	*Dyckia ferox**Mez			X								Le - Pi
	Pseudananas sagenarius (Arruda) Camargo								X		Fr	
Cactaceae	*Cereus argentinense** Britton & Rose								X	X		Fr
	*Cereus forbesii** Otto ex C.F. Först.		X	X			X	X				Fr
	Cereus stenogonus K. Schum.	X			X							Fr
	Cereus uruguayanus R. Kiesling								X	X		Fr
	*Cleistocactus baumannii** (Lem.) Lem.		X	X			X		X	X		Fr - fl
	*Echinopsis rhodotricha** K. Schum.	X	X	X			X		X	X		Fr fl Ro

Botanical Family	Scientific name	Lengua-Maskoy	Chorote	Wichi	Maká	Ayoreo	Western Toba	Pilagá	Eastern Toba	Vilela	Guaraní-Izoceño	Parts used
Cactaceae	*Harrisia bonplandii** (Pfeiff.)											Fr fl
	Britton & Rose	X	X	X	X	X	X	X	X		X	Ro
	*Harrisia martinii** (Labour.)											Fr- fl-
	Britton	X		X				X	X	X		Ro
	Harrisia pomanensis											
	(F.A.C. Weber ex K. Schum.)											
	Britton & Rose subsp. *pomanensis**		X	X							X	Fr fl Ro
	*Harrisia tortuosa**											
	(Forbes ex Otto & D. Dietr.)											
	Britton & Rose				X							Fr
	*Monvillea cavendischii**(Monv.)											
	Britton & Rose	X		X	X	X	X					Fr
	*Monvillea phatnosperma**											
	(K. Schum.) Britton & Rose					X						Fr
	*Monvillea spegazzinii**											
	(F.A.C. Weber) Britton & Rose	X	X	X	X	X	X					Fr
	Opuntia anacantha Speg. var.											
	kiska-loro(Speg.) R. Kiesling*		X	X			X					Fr
	Opuntia anacantha Speg. var.											
	retrorsa(Speg.) R. Kiesling*								X	X		Fr
	Opuntia arechavaletae Speg.				X							Fr
	*Opuntia colubrina**A. Cast.			X			X					Fr
	Opuntia elata Salm-Dyck var.											
	*elata**	X	X	X	X		X					Fr
	Opuntia elata Salm-Dyck var.											
	cardiosperma (K. Schum.)											
	R. Kiesling		X	X				X	X			Fr
	Opuntia ficus-indica (L.) Mill.	X			X	X			X	X		Fr
	*Opuntia quimilo**K. Schum.		X		X							Fr
	Opuntia sulphurea Gillies ex											
	Salm-Dyck var. *pampeana* (Speg.)											
	Backeb.*		X	X			X	X				Fr
	Parodia sp.								X			Fr
	*Rhipsalis aculeata**F.A.C. Weber								X			Fr
	Rhipsalis lumbricoides (Lem.)											
	Lem. ex Salm-Dyck								X			Fr
	Selenicereus setaceus											
	(Salm-Dyck ex DC.) Werderm.								X	X		Fr
	*Stetsonia coryne** (Salm-Dyck)											
	Britton & Rose	X	X	X	X		X					Fr - Fl
Cannaceae	*Canna glauca* L.	X			X	X		X				Riz
	Canna indica L.	X			X				X	X		Riz
Capparaceae	*Capparis flexuosa (L.) L.*								X	X		Fr
	*Capparis retusa*Griseb.*	X	X	X	X	X	X	X	X	X		Fr
	*Capparis salicifolia*Griseb.*	X	X	X	X	X	X	X			X	Fr
	*Capparis speciosa*Griseb.*	X	X	X	X		X	X	X			Fr - Fl
												Le
	Capparis tweediana (Eichler)*											
	H.H. Iltis & X. Cornejo	X	X	X	X	X	X	X	X		X	Fr
	Crateva tapia L.								X	X		Fr
Caricaceae	*Carica quercifolia (A. St.-Hil.)*											
	Hieron.								X	X		Fr
	*Jacaratia corumbensis*Kuntze*	X	X	X	X	X	X	X				Ro
Celastraceae	*Maytenus vitis-idaea** Griseb.	X	X	X		X	X	X				Fr

Botanical Family	Scientific name	Lengua-Maskoy	Chorote	Wichi	Maká	Ayoreo	Western Toba	Pilagá	Eastern Toba	Vilela	Guaraní-Izoceño	Parts used
Celastraceae	*Schaefferia argentinensis* Speg.	X										Fr
Celtidaceae	*Celtis chichape* (Gardner) Planch.	X	X	X	X		X	X	X	X	X	Le
	Celtis iguanaea (Jacq.) Sarg.		X	X	X		X	X	X	X	X	Fr
Chenopodiaceae	*Heterostachys ritteriana* (Moq.)											
	Ung.-Sternb.				X			X				Le
	*Holmbergia tweedii** (Moq.) Speg.	X			X			X				Le
	Salicornia ambigua Michx.				X			X	X			Le
Convolvulaceae	*Merremia dissecta* (Jacq.) Hallier f.	X	X	X		X						Tu
Erythroxylaceae	*Erythroxylon myrsinites* Mart.					X						Fr
Euphorbiaceae	*Cnidoscolus albomaculatus*	X			X							Se
	*Jatropha grossidentata**											
	Pax & K. Hoffm.				X							Se
	*Manihot guaranitica**											
	Chodat & Hassl.		X	X								Ro
Fabaceae	*Acacia aroma* Gillies ex											
	Hook. & Arn.	X	X	X	X		X	X			X	Fr
	Geoffraea decorticans											
	(Gillies ex Hook. & Arn.) Burkart	X	X	X	X		X	X	X	X	X	Fr
	Geoffraea spinosa Jacq.	X	X	X	X	X				X		Se
	Inga uraguensis Hook. & Arn.								X	X		Se
	Macroptilium panduratum											
	(C. Mart. ex Benth.)											
	*Maréchal & Baudet**		X	X								Ro
	Prosopis alba Griseb.	X	X	X	X	X	X	X	X	X		Fr
	Prosopis alba var. panta Griseb.*				X		X					Fr
	Prosopis chilensis (Molina) Stuntz											
	emend. Burkart										X	Fr
	*Prosopis elata *(Burkart)*											
	Burkart x Prosopis nigra (Griseb.)											
	Hieron.			X			X					Fr
	Prosopis elata(Burkart) Burkart*	X	X	X	X		X	X				Fr
	*Prosopis fiebrigii*Harms*				X	X						Fr
	Prosopis flexuosa DC										X	Fr
	*Prosopis hassleri*Harms*							X				Fr
	Prosopis nigra (Griseb.) Hieron.	X	X	X	X		X	X		X		Fr
	*Prosopis ruscifolia*Griseb.*	X		X	X		X	X	X			Fr
	*Prosopis vinalillo*Stuck.*	X			X							Fr
	Senna obtusifolia (L.)											
	H.S. Irwin & Barneby										X	Se
	Senna occidentalis (L.) Link										X	Se
Marantaceae	*Maranta divaricata* Roscoe								X			Fr
	Thalia geniculata L.			X			X	X				Riz
Menispermaceae	*Odontocarya asarifolia*Barneby*		X	X			X	X				Riz
Moraceae	*Brosimum gaudichaudii* Trécul								X			Fr -St
	Ficus eximia Schott								X			?
	Ficus luschnathiana (Miq.) Miq.								X			Fr
	Maclura tinctoria (L.) Steud. var.											
	mora (Griseb.) Vázq.Avila		X	X					X		X	Fr
Myrtaceae	*Eugenia uniflora* L.								X	X		Fr
	Hexachlamys edulis (O. Berg)											
	Kausel & D. Legrand								X	X		Fr
	Myrcia selloi (Spreng.) N. Silveira								X			?
	Myrcianthes pungens (O. Berg)											
	D. Legrand								X	X		Fr

Botanical Family	Scientific name	Lengua-Maskoy	Chorote	Wichi	Maká	Ayoreo	Western Toba	Pilagá	Eastern Toba	Vilela	Guaraní-Izoceño	Parts used
Myrtaceae	*Plinia trunciflora* (O. Berg) Kausel								X	X		Fr
Nyctaginaceae	*Boerhavia diffusa* L. var. *leiocarpa*											
	(Heimerl) Adams	X		X								Ro
Nymphaeaceae	*Nymphaea amazonum*											
	Mart. & Zucc.	X			X							Riz
	Nymphaea jamesoniana Planch.		X	X			X	X				Riz
	*Victoria cruziana**Orb.								X			Riz
Olacaceae	*Ximenia americana* L. var.											
	*argentinensis** De Filipps			X							X	Fr
Opiliaceae	*Agonandra excelsa* Griseb.										X	Fr
Oxalidaceae	*Oxalis brasiliensis* Lodd.								X			Tu
	Oxalis debilis Kunth								X			Tu
Passifloraceae	*Passiflora caerulea* L.				X				X	X		Fr
	Passiflora cincinnata Mast.	X			X	X					X	Fr
	Passiflora edulis Sims								X			Fr
	Passiflora foetida L.			X			X				X	Fr
	Passiflora mooreana Hook. f.	X	X	X	X	X	X	X				Fr
Poaceae	*Cortaderia selloana*											
	(Schult. & Schult. f.)											
	Asch. & Graebn.								X			?
Polygonaceae	*Coccoloba spinescens**Morong.	X										Fr
	Muehlenbeckia sagittifolia											
	(Ortega) Meisn.								X	X		Fr
	Ruprechtia triflora Griseb.										X	Le
Portulacaceae	*Portulaca cryptopetala* Speg.	X										Le
	Portulaca oleracea L.		X	X				X				Le
	Portulaca umbraticola Kunth	X			X							Le
Rhamnaceae	*Ziziphus mistol**Griseb.	X	X	X	X	X	X	X	X	X	X	Fr
Rubiaceae	*Guettarda uruguensis*											
	Cham. & Schltdl.					X						Fr
Santalaceae	*Acanthosyris falcata** Griseb.	X	X	X	X	X	X	X	X	X		Fr
Sapindaceae	*Allophylus edulis*											
	(A. St.-Hil., A. Juss. & Cambess.)											
	Hieron. ex Niederl.								X	X		Fr
	Allophylus guaraniticus											
	(A. St.-Hil.) Radlk.								X	X		Fr
Sapotaceae	*Chrysophyllum gonocarpum*											
	(Mart. & Eichler) Engl.								X	X		Fr
	Pouteria gardneriana (A. DC.)											
	Radlk.								X	X		Fr
	Sideroxylon obtusifolium											
	(Roem. & Schult.) T.D. Penn.	X	X	X	X	X	X	X	X	X	X	Fr
Solanaceae	*Capsicum baccatum* L.										X	Fr
	*Capsicum chacoënse**Hunz.	X	X	X	X	X	X	X	X	X	X	Fr
	Grabowskia duplicata Arn.								X	X		Le
	*Grabowskia obtusa**Arn.	X										Le
	Lycianthes asarifolia											
	(Kunth & Bouché) Bitter		X								X	Fr
	Lycium americanum Jacq.	X	X	X	X		X	X				Fr
	*Lycium cuneatum**Dammer		X	X								Fr
	Lycium nodosum Miers	X	X			X						Fr
	Physalis angulata L.			X								Fr
	Physalis pubescens L.		X	X			X	X				Fr
	Physalis viscosa L.	X	X	X	X		X	X	X	X		Fr

Botanical Family	Scientific name	Lengua-Maskoy	Chorote	Wichi	Maká	Ayoreo	Western Toba	Pilagá	Eastern Toba	Vilela	Guaraní-Izoceño	Parts used
Solanaceae	*Salpichroa origanifolia* (Lam.)											
	Baill.								X	X		Fr
	Solanum aloysiifolium Dunal										X	Le
	Solanum amygdalifolium Steud.										X	Le
	Solanum aridum Morong			X		X						Tu
	*Solanum hieronymi**Kuntze	X	X	X	X	X	X					Tu
	Solanum physaloides Dunal										X	Fr
	Solanum sisymbriifolium Lam.	X	X	X	X		X	X	X	X		Fr
	Vassobia breviflora (Sendtn.)											
	Hunz.								X	X		Fr
Typhaceae	*Typha angustifolia* L.								X			Riz
	Typha domingensis Pers.	X		X	X		X	X	X			Riz
Ulmaceae	*Phyllostylon rhamnoides*											
	(J. Poiss.) Taub.	X	X									Se
Urticaceae	*Urera baccifera* (L.) Gaudich.									X		Fr
Verbenaceae	*Lantana micrantha* Briq.				X							Fr
Vitaceae	*Cissus verticillata* (L.)											
	Nicolson & C.E. Jarvis			X								Ro

References: * : Endemic species; Fr: Fruit; Le: Leaves; Fl: Flower; St: Stem; Ro: Root; Ba: Bark; Mt: Meristem; Pi: Pith; Va: Vertical axis; Bl: Basal leaves; Tu: Tuber; Se: Seed; Riz: Rizhome

Tab. 4: Absolute (between brackets) and relative values of edible plants shared among the ethnic groups of the Gran Chaco (The relative values are expressed as percentages of the total number of edible plants used by each ethnic groups showed at the bottom).

	Lengua-Maskoy	Chorote	Wichi	Maká	Western Toba	Pilagá	Ayoreo	Eastern Toba	Vilela	Guaraní-Izoceño	Sharing Index
Lengua-Maskoy	x	56.9 (37)	53.2 (41)	75.4 (46)	63.2 (36)	69.6 (32)	65.9 (27)	32.1 (25)	36.8 (21)	37.5 (12)	**277**
Chorote	62.7	x	74.0 (57)	55.7 (34)	78.9 (45)	78.3 (36)	58.5 (24)	33.3 (26)	38.6 (22)	53.1 (17)	**298**
Wichi	69.5	87.7	x	63.9 (39)	96.5 (55)	89.1 (41)	63.4 (26)	37.2 (29)	40.4 (23)	53.1 (17)	**328**
Maká	78.0	52.3	50.6	x	66.7 (38)	71.7 (33)	65.9 (27)	35.9 (28)	40.4 (23)	40.6 (13)	**281**
Western Toba	61.0	69.2	71.4	62.3	x	82.6 (38)	53.6	33.3 (26)	36.8 (21)	43.8 (14)	**295**
Pilagá	54.2	55.4	53.2	54.1	66.6	x	46.3	30.8 (24)	29.8 (17)	40.6 (13)	**253**
Ayoreo	45.7	36.9	33.7	44.2	38.6 (22)	41.3 (19)	x	19.2 (15)	22.8 (13)	31.3 (10)	**183**
Eastern Toba	42.3	40.0	37.6	45.9	45.6	52.1	36.5	x	91.2 (52)	40.6 (13)	**236**
Vilela	35.6	33.8	29.8	37.7	36.8	36.9	31.7	66.0	x	31.3 (10)	**202**
Guaraní- Izoceño	20.3	26.1	16.8	21.3	24.5	28.2	24.4	16.4	17.2	x	**119**
Edible plants used by ethnic group	**(59)**	**(65)**	**(77)**	**(61)**	**(57)**	**(46)**	**(41)**	**(78)**	**(57)**	**(32)**	**x**