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ORIGINAL ARTICLE

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Archaeobotany of mound structures in Campo del Pucará, Catamarca, Argentina (1750–1450 B.P.): ceremonial use or rubbish dumps?

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Abstract The archaeobotanical macroremains discussed in this study were recovered from six mound structures at Campo del Pucará (Andalgalá, Catamarca, northwest Argentina), a site inhabited between ca. 1750 and 1450 B.P. (A.D. 200–500). The most important identified taxon was *Zea mays* var. *minima* (maize), *Acacia* sp., *Prosopis* sp., *P. nigra* or *P. alba*, *P. torquata* (Leguminosae of the Mimosoideae subfamily), *Phaseolus* sp., *P. vulgaris* var. *vulgaris*, *P. v.* var. *aborigineus*, undetermined *P. vulgaris* (beans) and *Cucurbita maxima* (winter squash). The plant remains represent the leftovers of food, fuel and building materials. Plants were grown and gathered in the near surroundings. The material identified most probably represents waste, however it could not be unambiguously attributed either to household or ceremonial activities.

Keywords Northwest Argentina · Archaeobotany · Zea mays · Cucurbita maxima · Mimosoideae · Phaseolus vulgaris

Introduction

Even though archaeobotany has gone a long way worldwide (Ford 1979; Hastorf and Popper 1988; Pearsall 1989 and many European researchers), it has been recognized as a discipline in Argentina only since the 1970s. But it is only since the late 1980s that there has been an exponential growth in archaeobotany there, which has diversified with the specialization of professionals (Capparelli et al. in press). This work deals with the archaeobotanical investigation of an archaeological site in northwest Argentina, Campo del Pucará (Andalgalá, Catamarca) which was inhabited between ca. 1750 and 1450 B.P. during the time of the Condorhuarsi—Alamito Culture (sensu Núñez Regueiro 1998). Archaeological research has been carried out at this site for more than four decades and has resulted in numerous research papers of different kinds (Núñez Regueiro 1998), but until now no archaeobotanical research has been carried out. This paper summarizes the results of a doctoral thesis, carried out at Tucumán National University, Argentina (Oliszewski 2004).

Campo del Pucará is located at 27°32′ S and 66°00′ W in the valley area of northwest Argentina (Fig. 1). It is characterized by the presence of archaeological sites in which organic remains can only be found charred. It is a valley of medium altitude (1650 m asl), with a dense river network, mild climate, and a high diversity of plant and animal resources within a small area. It is covered by grasslands and shrubs in the ecotone which results from human action, between the Yungas (cloud forest) and Monte (xerophytic shrubland) phytogeographical provinces (Núñez Regueiro 1998).

Campo del Pucará consists of 50 archaeological units distributed on three plateaus at 1700, 1800 and 1900 m asl (Fig. 2). The sites are currently considered to represent ceremonial centres of high ritual complexity (Núñez Regueiro 1998; Tartusi and Núñez Regueiro 1993). Each unit has a central depression surrounded by different structures among which there are two ceremonial platforms and three kinds of well-defined quarters (metallurgical workshop, rooms and sheds) where everyday activities might have taken place. To the west there is a mound ("main mound"), which is larger than the other structures (Fig. 3). The occupation of the site can be divided into two periods, Phase I, ca. 1750–1600 B.P. and Phase II ca. 1600–1450 B.P.

The studied archaeobotanical material comes from several so called "main mounds" of this kind, deposits of anthropogenic origin consisting of waste like ashes, coal, fragmented and partially burned remains of ceramics, lithic material, bone and plant material, shells and metal (Tartusi and Núñez Regueiro 1993).

Based on the analysis of plant macroremains, this work intends to study the plant resources of the human groups who lived in Campo del Pucará between ca. 1750 and 1450 B.P. The identified taxa are reported and described. The

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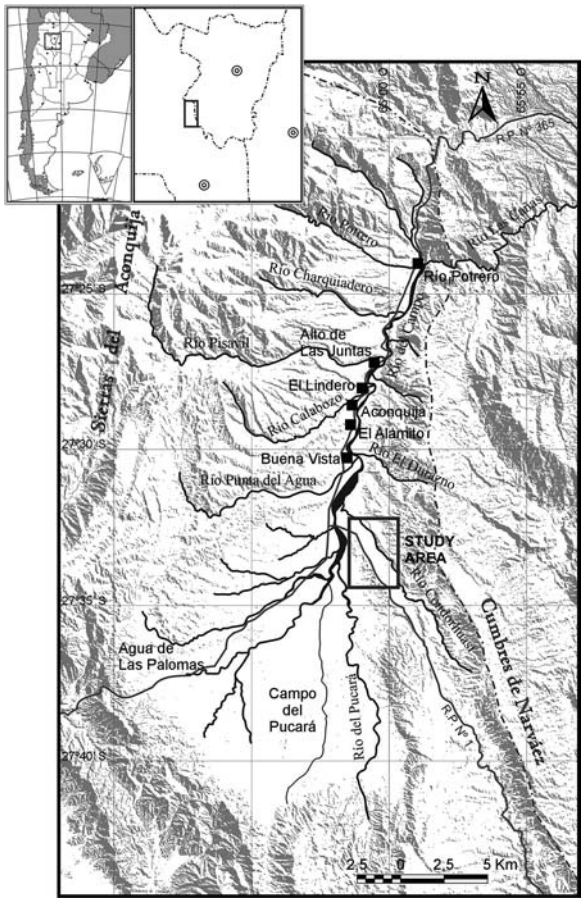

Fig. 1 Location of the study area

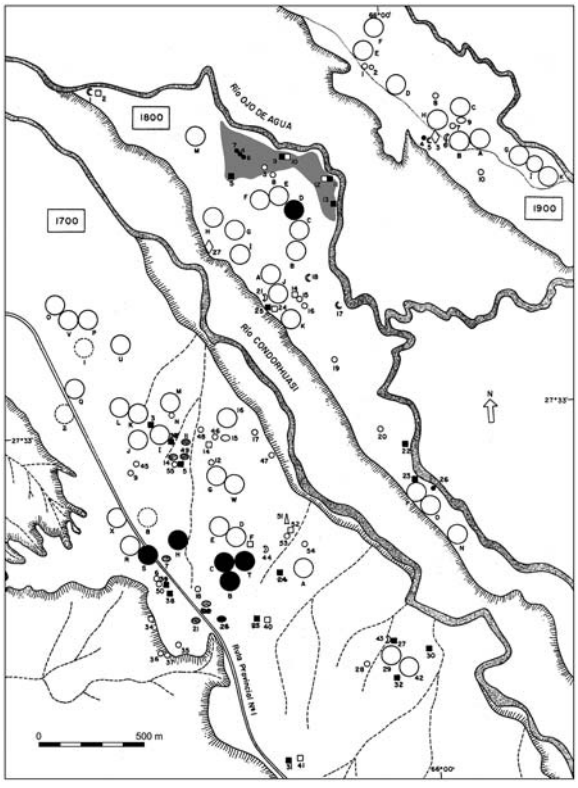

Fig. 2 Campo del Pucará archaeological units. Black circles: selected archaeological units; striped area: agricultural area (taken from Núñez Regueiro and Tartusi in press)

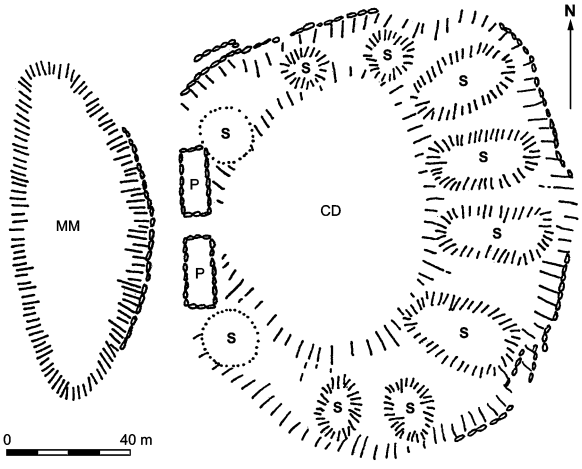

Fig. 3 Campo del Pucará archaeological unit scheme (taken from Tartusi and Núñez Regueiro 1993). MM, main mound; P, platform; CD, central depression; S, structure

main purpose of this paper is to interpret how people used the plants and what the possible role of the mounds was.

Materials and methods

For this archaeobotanical research, several mound structures were selected for their greater frequency of archaeobotanical macroremains (Fig. 2), B-0, C-0, H-0, S-0, T-0 and D-1. With the exception of the archaeological unit D-1 which is on the "1800 plateau", the selected units were very close to each other, on the "1700 plateau", at a distance of 100 to 500 m from each other. From the sites chosen, B-0 and C-0 belong to Phase I, while the rest correspond to Phase II (Núñez Regueiro 1998).

The macroremains were gathered from 2 m × 2 m squares in the central part of each mound. The excavation was carried out in artificially created levels of 10 cm each, since it was impossible to differentiate cultural and/or natural deposits at each level for flotation. All mounds had archaeological material down to a depth of 160 cm with the exception of T-0, in which the remains reached 120 cm. The total sample volume is 16000 cm^3 for B-0, C-0, D-1, H-0 and S-0 while it is 12000 cm^3 for T-0.

The macroremains were separated using a mechanical flotation system with a 1 mm sieve mesh. Of the entire specimens detected, their condition (complete or fragmented), the part of the plant (seed or endocarp), their size (length, width and thickness) and diagnostic morphological characters were noted. The identification was done with the help of reference collections (modern and archaeological), illustrated publications and specialized bibliography (citations see below, descriptions of the taxa). When necessary, microscopic analysis techniques were applied, too.

Table 1 List of identified taxa, with the number of specimens found at the site. All the remains were found in a carbonized state

	Structure	B-0	C-0	D-1	H-0	S-0	T-0		
Sample volume (l)[a]		16	16	16	16	16	12		
Taxa								N	%
Zea mays var. *minima*	grains, cupules, cob fragments	26	16	8	151	430	10	641	83.1
Cucurbita maxima	seed	–	–	–	1	–	–	1	0.1
Fabaceae Mimosoideae indet.	seeds and endocarps	–	1	2	1	–	1	5	0.7
Acacia sp.	seeds	–	–	1	2	2	–	5	0.7
Prosopis sp.	seeds and endocarps	4	10	7	2	8	–	31	4.0
Prosopis alba/nigra	seeds	–	10	7	2	7	–	26	3.4
Prosopis torquata	seeds and endocarps	–	2	1	1	2	–	6	0.8
Phaseolus sp.	seeds	1	–	–	1	2	–	4	0.5
Phaseolus vulgaris var. *vulgaris*	seeds	4	1	–	–	2	–	7	0.9
Phaseolus vulgaris var. *aborigineus*	seeds	–	-	2	–	4	–	6	0.8
Phaseolus vulgaris indet.	seeds	–	–	–	2	–	1	3	0.4
Indeterminata	fruits, seeds	4	5	5	11	11	–	36	4.7
Total (n)		39	45	33	174	468	12	771	100
Items/l		2.4	2.8	2.1	10.9	29.2	1.0	8.4	

[a]Total number of sample volume is 92

Results

In total, 1003 seed remains were recovered (171 during the excavation and 832 by flotation). Of these 771 could be identified. The number of specimens per flotation sample is given in Table 1. The find densities vary between 2.1 and 29.2 items/l, average: 8.4 items/l.

Morphological characteristics of the remains

Poaceae: Zea mays L.

Zea mays var. minima Bonafus (maíz perla, m. pororó, m. reventón, m. rosita) Maize was by far the most important plant taxon in the samples. In total, 641 specimens were identified, consisting of 562 grains, 67 cupules and 12 cob fragments (Fig. 4a, b). The measurements were carried out according to McBird (1994) and Miante Alzogaray and Cámara Hernández (1996) for cupules and cob fragments, and Parodi (1959) for grains.

There were three types of remains: (a) complete and fragmented grains, 4–6×3–5 mm in size, acuminate (pointed) in shape, round, long and wide, with a rough and uneven surface; the internal structure was porous and with hollows; (b) complete and vertically compressed cupules, 2–3×3–4 mm in size, half moon shaped. (c) cob fragments without grains and disorderly rows; in the cupules (2–3×3–4 mm), paired grain insertion points were seen.

All in all, the correlation between diagnostic characters of the grains (size and shape), the cob fragments (disorderly rows and size of the cupules) and the cupules (width and height) identified all specimens as belonging to only one taxon, *Zea mays* var. *minima* Bonafus (McBird 1994; Miante Alzogaray and Cámara Hernández 1996; Parodi 1959).

Cucurbitaceae

Cucurbita maxima Duch. (zapallo, zapallo criollo). In this category there was only one specimen, however in excellent condition (Fig. 4c). It was a complete seed which measured 4×3 mm; the shape was elliptic, the surface uniform, smooth, glossy, curved. The seed coat was made up of branched cells. To sum up, the shape, size, and seed coat identified this specimen as *Cucurbita maxima* (Burkart 1974; Cabrera 1993; Pozner 1998; Zuloaga and Morrone 1999).

Fabaceae: Mimosoideae

Many seeds showed a distinct fine line on both faces in a horseshoe, U, elliptic or circular in shape, the fissure line (Boelcke 1945–1947). This character, diagnostic for *Mimosoideae* seeds, was the fundamental feature for the identification of the 73 specimens recovered of this taxonomic group.

Mimosoideae: seeds which were not further identifiable

One complete and four fragmented seeds were found of which neither the size could be measured nor the shape was clearly visible because the specimens were very damaged. The fissure line appeared only partially and did not show characteristic shapes. However, the presence of the fissure line indicated that the seeds belong to the Mimosoideae subfamily but a closer identification was not possible.

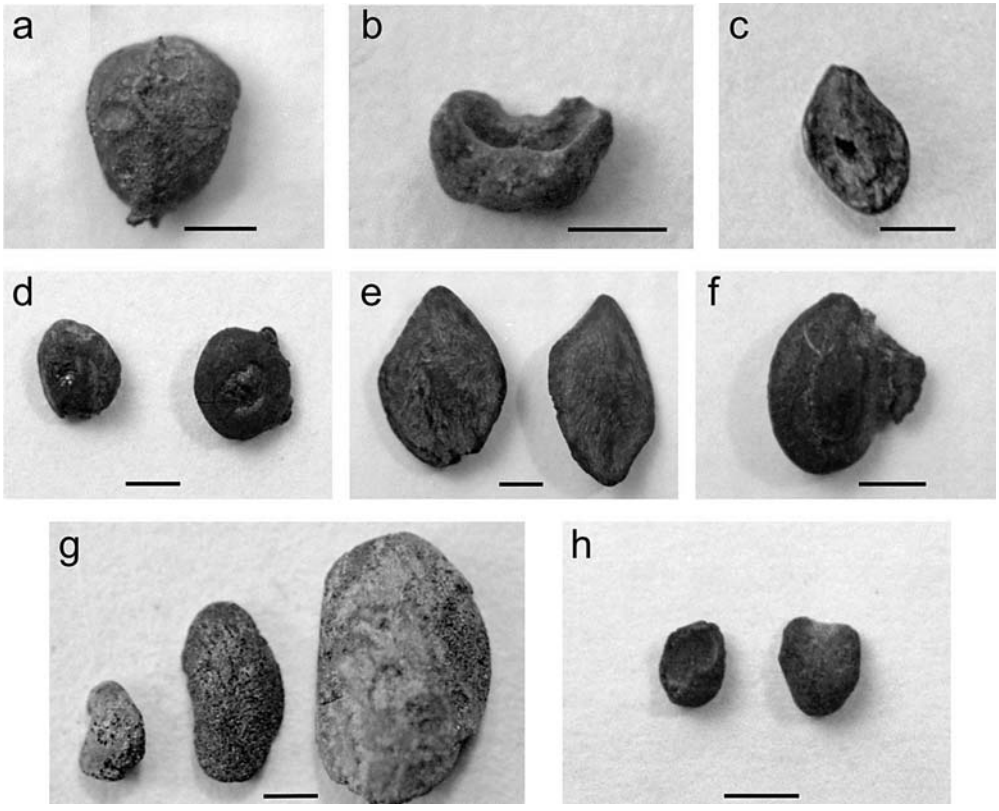

Fig. 4 **a** *Zea mays* var. *minima* grain; **b** *Zea mays* var. *minima* cupule; **c** *Cucurbita maxima* seed; **d** *Acacia* sp. seeds; **e** *Prosopis* sp. endocarps; **f** *Prosopis alba* or *P. nigra* seed; **g** *Phaseolus vulgaris*, left to right: undetermined, wild and domestic forms; **h** undetermined specimens; scale bar = 2 mm

Acacia sp. Adams Five complete seeds with sizes of 3.25–4.25×2.5–4 mm were found; their shape was oval and round. The fissure line did not show up diagnostic shapes. Because the seeds were small they could be identified as *Acacia* sp. due to their shape (Fig. 4d).

Prosopis L. There were five complete and 15 fragmented seeds with a size of 4–5×3–4 mm; the shape was oval and pyriform (pear-shaped); the fissure line was partially visible but did not provide a diagnostic element. Besides, 11 endocarps (hard cover of the seed) of 8–9×4.5–6 mm were found (Fig. 4e). Based on these features the remains could be attributed to *Prosopis* sp. (carob tree) although the seeds were damaged.

Prosopis alba Gris or P. nigra (Gris.) Hieron (algarrobo blanco or algarrobo negro) There were 15 complete and 11 fragmented seeds with sizes of 3.5–5.5×3–4 mm, pyriform, oval and elliptic in shape with horseshoe shaped fissure lines, which are characteristic for both *Prosopis nigra* and *P. alba* (sensu Boelcke 1945–47). It was not possible to distinguish the two species clearly (Fig. 4f).

Prosopis torquata (Lag.) DC. (tintitaco) There were three complete and one fragmented seed with sizes of 4.75–6×3.25–4 mm; their shape was pyriform and the fissure line had a U-shape and was small in relation to the total seed surface. This is characteristic of *Prosopis torquata* (sensu Boelcke 1945–47). Two endocarps of 6×3.5 and 5.5×4 mm were also recorded (Boelcke 1945–47; Burkart 1952; Zuloaga and Morrone 1999).

Fabaceae: Phaseolus L.

20 macroremains belonged to the genus *Phaseolus* (Fig. 4g).

Phaseolus sp. (poroto) There were four cotyledon fragments; due to their fragmentary state, they could not be identified more closely than as *Phaseolus* sp.

P. vulgaris var. vulgaris L. (poroto común doméstico) There were six complete cotyledons and one complete seed with both cotyledons measuring 9–11.32×4–6.48 mm, long and kidney-shaped. The large size identifies these specimens as *P. vulgaris* var. *vulgaris* L. (domestic, French or kidney bean). These data were corroborated by the starch analysis which clearly placed the specimens into the domestic category on the basis of qualitative and quantitative characters (Oliszewski et al. 2002).

P. vulgaris var. aborigineus (Burk.) Baudet (poroto común silvestre) There were six complete cotyledons, 4.98–8×3.7–5 mm in size, also long and kidney-shaped. However, their small size ranked these samples in the wild category. This was confirmed by the starch analysis made on one of the specimens, resulting in the typical characteristics of wild common beans (Oliszewski et al. 2002).

P. vulgaris L. There were some complete kidney-shaped small seeds with sizes of 3–3.75×2–2.5 mm. Their size was similar to that of the wild common bean, but the starch analysis made on one of the specimens categorized them

as *P. vulgaris* var. *vulgaris* (Oliszewski et al. 2002). They may belong to a hybrid form halfway between the wild and domestic forms (Baudet 1977; Berglund-Brücher and Brücher 1976; Burkart 1952; Singh et al. 1991; Zuloaga and Morrone 1999).

Discussion and conclusions

Out of the 771 specimens recovered, 641 (83%) were identified as *Zea mays* (Table 1). Therefore, maize has to be considered as a main economic resource. 73 seeds belonged to the Fabaceae Mimosoideae, which are therefore in the second place with around 10% of the macroremains. 20 remains represented *Phaseolus* sp. (common bean), which made up around 3%. The scarcity of the latter can be due to taphonomic reasons as the seed is the edible part of the plant and one cannot expect it to have been deposited as rubbish in the "usual" archaeological record. The few specimens found were maybe seeds that were lost during the cooking process.

With regard to *Cucurbita maxima,* squash, even though it was present at a very low frequency (0.13%), this provides sure evidence of its presence among the plant resources exploited by the human groups of Campo del Pucará between 1750 and 1450 B.P.

Supply areas

The archaeobotanical evidence comes from disposal contexts (see below), so the determination of the supply areas from which the wild or domestic plants came, can only be carried out indirectly by using the ecological requirements of the plants. Therefore, the wild plants identified from their archaeobotanical remains most probably came from the near surroundings of the archaeological structures because they grow there even today. Small trees and shrubs of *Prosopis nigra*, *P. alba*, *P. torquata*, *Acacia caven* and *A. aroma* can be seen on river banks in the present landscape, while the wild common bean is abundant in the wet ravines near the archaeological sites studied.

In different parts of Campo del Pucará we found agricultural structures and flat areas that could have been used for farming land without needing irrigation (Fig. 2). Since the three kinds of crops thrive in the zone today we may assume that if environmental conditions were similar in the period under study (Sayago et al. 1998), maize, bean and squash would have equally prospered then.

Plant uses

The possible uses of the plant resources can be reconstructed with the help of other archaeobotanical evidence from use contexts, from previous investigations in the area under study and from other archaeological sites in the northwest valley area with similar chronologies to those of Campo del Pucará.

Corn, maize

Zea mays var. *minima* cobs were found on occupation floors and in silos in two places (Núñez Regueiro 1998) at the D-1 site of Campo del Pucará. At other sites in the northwest valley area, maize was recorded in association with occupation floors, cooking places and stone grinding tools, thus proving its basic function in the diet (Balesta and Zagorodny 1999; Carrizo et al. 2003; Pochettino and Scattolin 1991; Scattolin and Gero 1999; Sempé de Gómez Llanes 1977; Tarragó 1996; Würschmidt and Korstanje 1998–1999). The evidence presented in this paper confirms its use as a principal staple food, as a possible religious offering or as raw material in the production of an alcoholic beverage due to the ceremonial character of the site sensu Núñez Regueiro (1998).

Fabaceae Mimosoideae

The remains of *Prosopis nigra* and *P. alba* (carob) are represented in larger amounts in archaeological records from use contexts at other sites in the area. As examples we can mention the finding of phytoliths in a cooking context (Würschmidt and Korstanje 1998–1999) and of endocarps and pods associated with occupation floors (Carrizo et al. 2003; Sempé de Gómez Llanes 1977). Therefore, the remains of carobs most probably have to be considered as food. The fruit, which is rich in glucose, starch and proteins, is used to prepare flour, cakes (*patay*), sweets (*añapa*), alcoholic beverages (*aloja*) and as fodder for livestock. But carob trees have even more uses: their wood is appreciated as building material, fuel and for making various objects. Although acacias do not stand out as feeding plants, livestock forage on their pods and their wood is used in building and as fuel (Burkart 1952). In nearby sites with similar chronologies, Marconetto (1999) identified *Prosopis* sp. and *Acacia* sp. among other genera in charred woody material. She interpreted this as remains of wood used originally as fuel, because both species are among the so-called "hard firewoods" and are known for their good burning qualities. In the particular case of Campo del Pucará this wood may have been also used as fuel for smelting metal (Angiorama 1997; Núñez Regueiro 1994).

Common bean

Previous research in Campo del Pucará also showed beans in food preparation and consumption areas. In a room at the H-0 site, beans were associated with a context where metallurgical activities could have taken place (Angiorama 1997). In a room at the D-1 site the remains were associated with fragmented pottery, a handstone and bone artifacts (Núñez Regueiro 1971). In the northwest valley area the common bean is recorded at different sites, but it appears in only one specific cooking context (hearths) on the Aconquija slopes where both wild and domestic forms

were associated (Pochettino and Scattolin 1991). To sum up, the beans can be interpreted as a food crop together with maize and squash. The record also shows that both farming of cultivated and gathering of wild beans took place at the same time, thus enabling a possible intercrossing between them.

Squash

Previous research refers to a record of squash in Campo del Pucará although there is no mention of its place of origin. At other sites in the northwest valleys area there are mentions of its presence in use contexts (Sempé de Gómez Llanes 1977; Carrizo et al. 2003). This information, as well as the record of squash in parts of Campo del Pucará and its occurrence together with maize and the common bean supports its function as food.

To sum up, the finds at different structures of Campo del Pucará and in activity areas of other archaeological sites of the northwest valley area show that the plants identified could have had a primary function in food, ceremonies, the production of artefacts and as forage, wood and firewood.

Possible function of the mounds based on the archaeobotanical data

The most important question to answer is how the plant remains arrived in the mound contexts and why they were charred. For this purpose, the analysis of the archaeological context where the archaeobotanical macroremains were found is essential. The main mounds are anthropogenic accumulations in which all kinds of materials were found, both fragmented and complete, charred or not, of everyday or ceremonial use. Associations with Camelidae bones, pottery fragments and stone material mixed with ashes and charcoal were recorded in some of them and were interpreted as a result of hearth cleaning events. Besides, in the B-0 main mound there were human bones with traces of red pigment, which seemed to have belonged to one or more people who could have been sacrificed *in situ* (Núñez Regueiro 1998). The record of five trophy skulls in one room of the H-0 site would support the hypothesis of sacrifices (Tartusi and Núñez Regueiro 2001). From the beginning of the research in Campo del Pucará, one of the main problems to tackle was the purpose of the main mound. This subject has been discussed in a very controversial way because it was originally called a dunghill (Núñez Regueiro 1971); later the term was replaced by "main mound", thus removing any functional connotation and stating that its function was not that of a rubbish dump, but a space where offerings or production remains of ceremonial artefacts were placed (Tartusi and Núñez Regueiro 1993).

The archaeobotanical material does not provide enough evidence to show whether the mounds were used as rubbish dumps or as ceremonial places. However, several facts suggest that the material analyzed consisted rather of different kinds of waste. The preservation of the charred and fragmented materials, and the fact that edible and non-edible parts of food plants were mixed point to kitchen waste. In addition, material of diverse nature like fragmented pottery, bone, stone, shell and metal, sometimes charred and mixed with small coal fragments and ashes was present; it can also be considered as household waste. However, as mentioned above, the possible uses of the plants include everyday functions (food, building, firewood) as well as ceremonial ones (maize offerings, alcoholic beverages made from maize and carobs). Therefore, the plant remains could have reached the mounds as waste of various everyday or of ceremonial activities. It is not possible to decide whether they represent the primary function of the mounds or material which was deposited after their abandonment. However, compared with rubbish of a farming settlement, it seems to be strange that weeds are lacking. Therefore, the origin of the finds is perhaps more probably in connection with sacrifices.

Finally, it can be stated that the plant resources used in Campo del Pucará between 1750 and 1450 B.P. were wide and varied. With a very low rate of mobility, human groups were able to exploit different ecological zones easily (Yungas and Monte provinces), making use of a great variety of plant resources that fulfilled many needs either utilitarian or otherwise.

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