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ORIGINAL ARTICLE

From weeds to wheat: a diachronic approach to ancient biocultural diversity in the Santa María valley, northwest Argentina

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Abstract
The aim of this paper is to analyse continuities and changes in plant diversity and use in the southern part of the Santa María valley in northwest Argentina, from the 1st millennium AD up to the Spanish Conquest in the 16th century. Variable degrees of association between people and plants (wild, weedy and domesticated), as well as various management practices (gathering, cultivation, tolerance, eradication, protection and encouragement) were studied to investigate the biocultural history of this region through the analysis of plant macroremains from archaeological sites. Samples were obtained from four archaeological sites located in the valley, Rincón Chico 1, Rincón Chico 15, Soria 2 and El Colorado. As a result, we identified 628 macroremains belonging to 20 taxa and determined whether they were either wild plants, weeds or crops, related to strategies of gathering and cultivation. The results suggest that there were changes through time, with a dominance of ruderal weeds in the earliest of the archaeological sites along with a diversity of association degrees, while a division was found between wild and domesticated plants, represented by maize and *Prosopis* (*algarrobo*), in the sites of the Late period. This last scenario suggests that the growing of trees and shrubs together with crops and pasture (agroforestry), or woodland management together with grazing (silvopasture), could have been part of the past land management practices in the area. *Chenopodium* remains indicate past complexes of wild plants, weeds and crops growing together in the cultivated plots; the newly introduced crops brought from Spain, such as wheat and barley, did not replace the local plants, mainly *Prosopis* (*algarrobo*) and *Zea mays* (maize), which were still grown during early colonial times. This paper offers a diachronic perspective on plant management in a particular region, considering a plant record that is still limited, but which allows us to get a first glimpse of how plant management strategies may have changed in this part of South America.

Keywords Argentinian Northwest · Weeds · Crops · Biocultural diversity

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Introduction

The Santa María or Yocavil valley is a region of importance in the history of the Argentinian northwest (ANW) as well as in the southern Andes region in general because of its economic and demographic development and also its complex political organisations and symbolic significance through time (Fig. 1; Tarragó 2003). The valley played a fundamental role in the Calchaquí wars against the Spanish invaders, developing novel organisational and defensive strategies against the European attack. Although this area has been subject to archaeological investigations for several decades, archaeobotanical remains have been analysed from only a few sites; no study of changes with time in plant use and management has previously been made for this valley. The aim of this paper is to analyse continuities and changes

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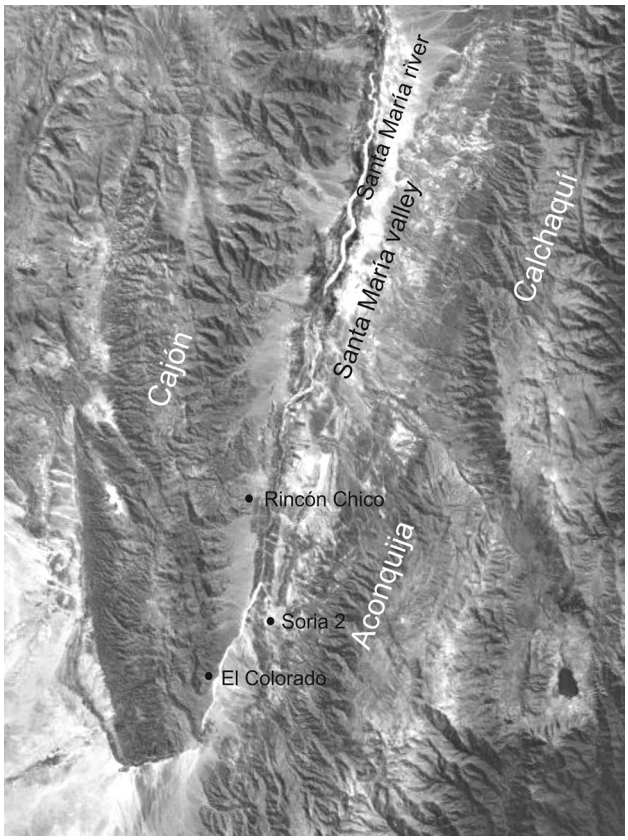

Fig. 1 Location of the archaeological sites in the Santa María and Yocavil valleys

in the interactions between human societies and plant diversity in the southern part of the Santa María valley during a time span ranging from the 1st millennium AD, when the first agropastoralist societies appeared in this region, until the 1st centuries after the Spanish Conquest in the 16th century. The analysis was based on carbonised seed and fruit remains recovered from four archaeological settlements corresponding to three different periods: Soria 2 (Formative period ca. 2,000 BP), Rincón Chico 1 (RCh1) and Rincón Chico 15 (RCh 15) (Late period, ca. 1,000–1,400 BP) and El Colorado (Early Colonial period, ca. 16th century AD) (Fig. 1).

Association degrees, management practices and biocultural diversity

By "biocultural diversity" we mean the interlinked diversity of the natural environment and human culture; these diversities do not exist in separate and parallel realms, but rather are different manifestations of a single, complex whole, encompassing how people interact with nature within a complex socio-ecological system which has developed over time (Maffi and Dilts 2014). This interwoven diversity comprises plants, spaces, agricultural systems and landscapes which have been created, maintained and used by social groups with various management strategies, such as growing crops and managing woodlands, sometimes together with growing crops and pasturing ("agroforestry" and "silvopastoralism") (Moreno-Calles et al. 2014). Several management practices are linked to plants with different degrees of dependence on humans, either wild, weeds or domesticated ones (de Wet and Harlan 1975; Casas 2001). Therefore, the recognition of these three categories of plants in the archaeobotanical record is an analytical pathway to help to interpret various management practices in the past. The understanding of connections, coexistence and replacements of taxa through time with different degrees of dependence on humans and the associated management practices can thus provide us with clues to help us understand past biocultural diversity.

In this paper we follow the writings of de Wet and Harlan (1975), Harlan (1992) and Zohary (in Hartmann-Shenkman et al. 2015) in order to establish a classification of wild, weedy (ruderal, crop weeds, facultative or obligatory weeds) and domesticated plants (crops) from an ecological point of view, taking into account landscape disturbances of either human or natural origin, cycles of succession and the variable reliance of plant communities on human societies for their reproduction. In addition, we consider the classification of management practices (tolerance, eradication, protection and encouragement) understood as representing cultivation in the broad sense, as opposed to cultivation in a limited sense that refers only to sowing or planting crops (Casas 2001; Lema 2009). The cited literature leads us to consider that only one human/plant association is clear-cut, that is domesticated plants and full cultivation. In contrast, the status of wild plants and weeds is more ambiguous, as they can be both gathered and cultivated. Furthermore, weeds and domesticated plants can share the same spaces in fields, such as those classified as crop weeds. For that reason, their remains have been used in extra-American archaeobotanical research as indicators of past farming systems, taking into consideration that the interaction between crops and weeds is associated with particular types of agricultural management. To do this, it is important to be able to distinguish between obligatory versus facultative weeds, as the first ones grow only in agricultural fields and are associated in some cases with certain domesticated taxa ("crop weeds"), whilst the second can occur both in fields and in primary natural habitats (Hartmann-Shenkman et al. 2015).

The sites and their environment

Environmental context

The Santa María valley is part of the Calchaquí valley system that lies between the El Cajón mountainous chain to

the west and the Calchaquí and Aconquija ranges to the east (Fig. 1; Ruiz Huidobro 1972). The Santa María river runs along the valley and on each riverbank there are numerous alluvial fans from tributary streams that flow into the main drainage system (Lantos et al. 2017). From a phytogeographical point of view, the area belongs to the Monte and Prepuna vegetational provinces, according to the altitude (Cabrera 1976). The general environment is that of a high scrub desert with an average annual rainfall of 300–350 mm, concentrated in torrential summer rains. There are narrow flood plains along the longitudinal drainage basins as well as lateral valleys. The latter are more protected and relatively moister and thus allow the existence of micro-environments that are more favourable to the development of flora and fauna. The native flora is dominated by cacti, Zygophyllaceae and wild legumes on the slopes, while flatter valley bottoms display shrubby woodland zones and plant communities that include *Prosopis flexuosa/nigra/alba/chilensis* (*algarrobo*) woods. Pasturelands for grazing are available in the nearby *puna* (high grassland) region (D'Altroy et al. 2000).

Brief history of the Santa María valley

According to previous archaeological research, village-based communities have been present in the Santa María valley since the Formative period (ca. 2,000 BP), with households surrounded by crop fields, corrals for livestock and irrigation systems for farming and grazing. Although mostly self-sufficient, these communities were organized around the management of irrigation channels and participated in regional exchange networks involving various products (Korstanje and Quesada 2010; Korstanje et al. 2015). In the southern part of the valley the site of Soria 2 probably corresponded to a family household structure next to cultivated fields, which formed an early village (Fig. 1; Álvarez Larrain 2009).

In several of the ANW valleys, the Late period (ca. 1,000–1,400 BP) was characterised by an increasingly complex social organisation characterised by the growth and concentration of populations, more farming, settlement diversification and the emergence of hierarchical political systems in a general context of inherent social conflict and an overall change in the way of living as shown, for example in architectural patterns, technologies and agricultural features (D'Altroy et al. 2000; Tarragó 2000; Lantos et al. 2017). The inhabitants of the main valleys lived in *pukara*, grouped fortified hilltop settlements with surrounding farmlands. As part of the archaeological locality of Rincón Chico consisting of 37 sites in the Santa María valley, the RCh1 site represents such a settlement (see below).

Even though the Inca occupation (ca. AD 1480) expressed itself differently according to the region concerned, the administration of agricultural land and crop growing have often been mentioned as central concerns during the Inca rule and this was also the case in the Santa María valley (González and Tarragó 2005). The Inca presence in the area seems, for example, to have been associated with the introduction of new maize varieties (Petrucci 2017). The European colonization of the ANW from ca. AD 1536 resulted, among other things, in the appearance of new plants and animals of Eurasian origin at previously occupied sites (Capparelli et al. 2005). This last situation is represented by El Colorado in the southern part of the valley (Fig. 1). This site comprises a minimum of 163 structures for residential, farming and grazing, and funerary or religious uses. The occupation, by a small population, lasted from Formative to contemporary times, including an occupation phase during the Early Colonial period from which plant remains are analysed in this paper.

Description of the sites

The site of Soria 2 (Fig. 2) is dated to 1,940 + 80 BP, 103 cal BC–AD 310. Excavations took place in two attached subquadrangular enclosures, R1 and R2 that correspond to the yard and a room respectively of a house or residential unit (Spano et al. 2014). Practices related to the processing and consumption of food, the making of stone tools and the discarding of refuse took place in the yard (Palamarczuk et al. 2007).

Rincón Chico is an archaeological locality situated on various parts of a hill (top, slope and alluvial fans) and comprises domestic and public spaces, production and transit areas. The locality is divided into different parts: a grouped village, RCh1, with a minimum of 365 structures, located on the top and slopes of a rocky spur; 34 minor sites along the alluvial fan including RCh15, two burial zones, one footway and specific activity areas comprising those dedicated to agricultural production and quarrying, located between the occupation sites (Tarragó 2011). RCh1 was an important administrative centre with political and ceremonial pre-eminence in the valley and it was in contact with minor settlements like RCh15, where pottery and metals were mainly produced. It was of central importance on a local and a regional scale (Tarragó 1999, 2011).

RCh1 was a clustering village covering an area of 40 ha (Fig. 3). Sectors (see Fig. 3) were identified delimiting, on the highest part of the hill, residential areas of the elite, public congregation and ceremonial activities; sectors corresponding to domestic areas linked to productive activities are situated lower down.

The site of RCh 15 (Fig. 4) is located at a distance of 1 km from RCh1, at the edge of an alluvial fan and close to the Santa María river (Fig. 1). The site comprises rectangular structures associated with two mounds, one southern (MM, 70 m^2),

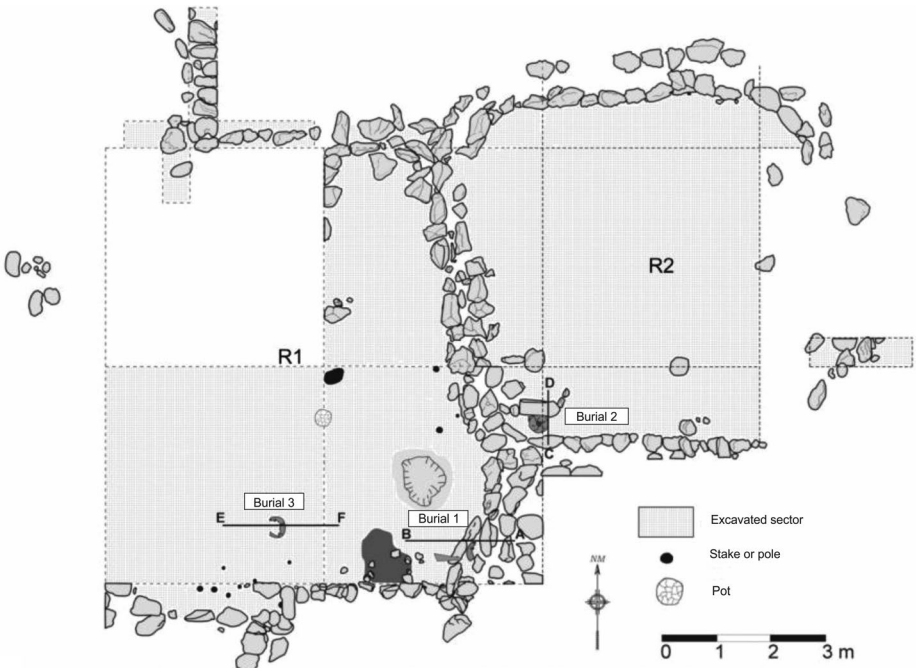

Fig. 2 Excavated areas in Soria 2 (from Spano et al. 2014, Fig. 2)

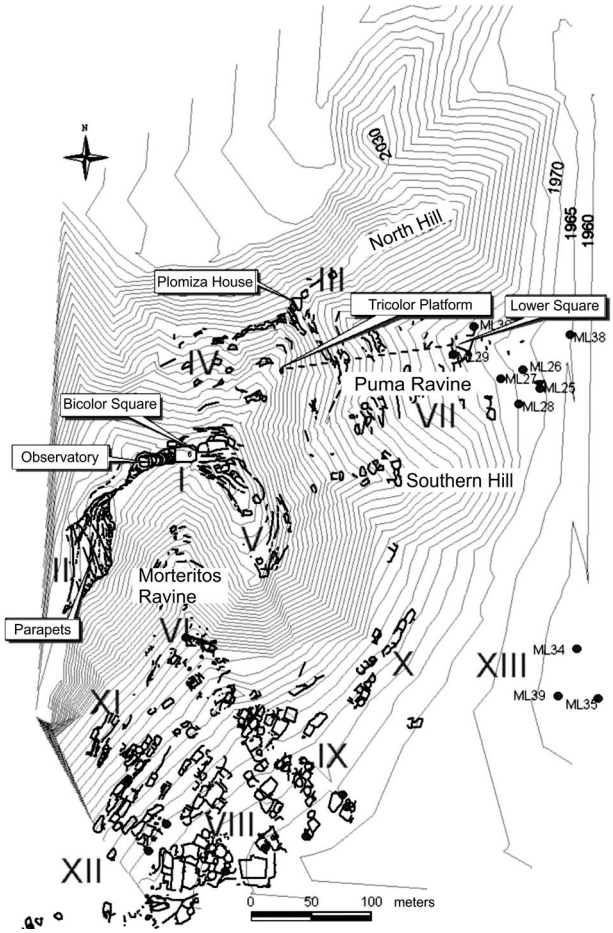

Fig. 3 Rincón Chico 1. Sectors are numbered with Roman numerals, flotation samples were taken from sectors I, II, IV, V, VII, IX, XI and XII (from Tarragó 2011)

and one eastern (MO, 400 m^2) (Tarragó 2007). Artefacts and biological remains linked to production activities were found at the site, as well as areas of domestic activity and burial structures (Piñeiro 1997; Tarragó 2007; Marchegiani 2011). In MO, material and remains associated with metalworking and pottery were recognized, and these were interspersed in the stratigraphy with successive deposits of a large amount of secondary residues, such as food waste and fragments of pots (Piñeiro 1997). According to radiocarbon evidence, the site was continuously occupied throughout the Late period until post-conquest times, ca. 10th–17th centuries AD (Greco 2014). Flotation samples obtained from MO, corresponding to the Late period, were analysed.

El Colorado covers an area of 60 ha, with evidence of settlement distributed between the piedmont (at the foot of the mountains) and the alluvial plain (Fig. 5). A group of structures with Late period architecture located in the northern part consisted of a residential space composed of a minimum of seven structures. An excavation of an extended area was carried out inside one of them (E3), finding evidence of a succession of occupations ranging from the final Formative period to Early Colonial times. In our analysis, we considered the seed remains recovered from these strata that, according to stratigraphic interpretation, probably correspond to the Early Colonial period.

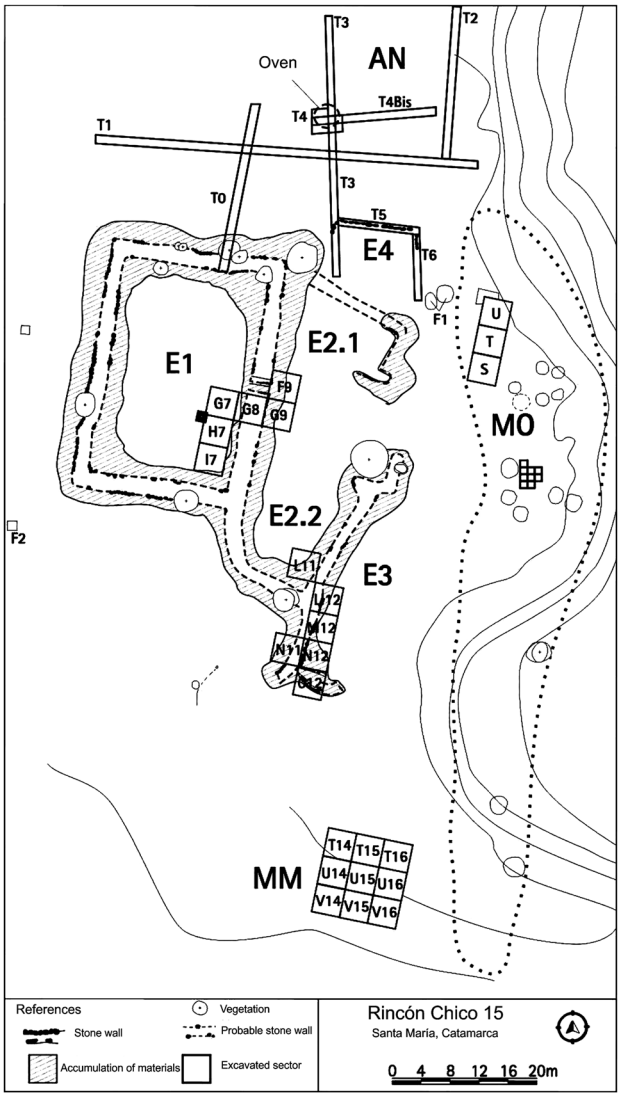

Fig. 4 Rincón Chico 15 with excavation units (from Greco 2012)

Materials and methods

At Soria 2 the excavation of an extensive area was done by following natural layers. Flotation samples were taken by random sampling from each stratigraphic unit and the total volume of samples was 10% of the total excavated sediments in both enclosures. The samples were processed by assisted machine flotation and 968 l sediment was floated.

At RCh1 34 structures in various areas of the site were excavated. From each excavated artificial level in each grid a 1 l sample was collected and was manually floated. The fixed volumes were in some cases modified by particular features discovered during excavation and a total of 147 l sediment was floated.

At RCh15 the eastern mound was excavated according to natural stratification. Four grids were arranged in order to define a combustion structure detected in previous excavations. From each grid, 1 l of sediment from each layer was sampled and manually floated, giving a total of 60 l.

El Colorado was excavated using the stratigraphic method, following natural layers. Macroremains from E3 were recovered by dry sieving, using a 2 mm mesh. Flotation samples are still being analysed.

Given the differences in the volumes of sediment sampled from each site as well as the variability of methods used for the recovery of botanical macroremains, the results presented here are preliminary ones and should be completed by the analysis of more systematically collected samples.

Although all the seed and fruits obtained from each excavation have been identified as far as possible, in this contribution only the charred remains which were recovered from occupational levels are considered, in order to be sure that they correspond to past activities at each site for the periods of interest and do not come from post-depositional processes or natural sources, in the case of desiccated remains. Taxonomic identification was made with the aid of a stereoscopic and a photo microscope with incident light, and by comparisons with the reference collections of the Laboratorio de Etnobotánica y Botánica Aplicada (FCNyM, UNLP) and with specialized literature and herbarium collections corresponding to the flora of the region.

Results

With the exception of the El Colorado site where the recovery of plant remains was done by sieving, a total of 835 l of sediment from occupational levels allowed the recovery of a total of 628 seed and fruit items, resulting in 20 identified taxa (Table 1). Among these we have recognised three crops that have been domesticated in the Americas (maize, quinoa and beans), two from the Old World (wheat and barley), two crop weeds, *Chenopodium quinoa* var *melanospermum* and *C.* cf. *carnosulum* and four local wild taxa, *Prosopis flexuosa/nigra/alba/chilensis, P. torquata, Geoffroea decorticans* and *Celtis* sp.; all the members of this last genus present in the area are considered to be wild according to *Flora del Conosur* (the flora of Argentina, Chile and Uruguay) (IBODA 2016).

The comparison of the numbers of different plant taxa (N) as well as plant densities (N/l) between the sites shows clear differences (Table 1; Fig. 6). Thus five taxa disappear from the archaeobotanical record between the Formative and Late periods, while an equal number of new taxa appear. The Early Colonial period is characterised by the introduction of *Triticum* (wheat) and *Hordeum* (barley) as well as the first appearance of two other taxa not previously recorded, *Prosopis torquata* and maybe *Phaseolus vulgaris*

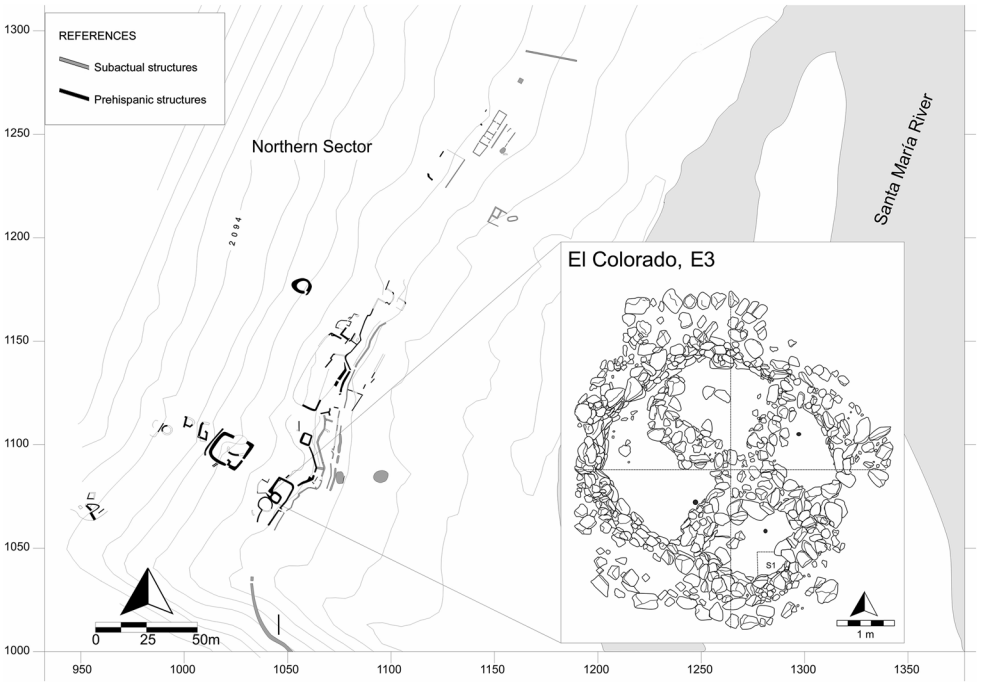

Fig. 5 El Colorado (northern sector) with detail of Structure 3 (E3) (modified from Palamarczuk 2016)

Table 1 Results of the analyses of charred macroremains from the archaeological sites in the Santa María valley

Association	Taxa	Vernacular names	Soria 2	RCh 1	RCh 15	El Colorado
Domesticated plants	*Chenopodium quinoa* var. *quinoa*	Quínoa	5		1	
	Hordeum vulgare	Cebada				42
	Phaseolus vulgaris var. *vulgaris*	Poroto			1	1
	Triticum spp.	Trigo				39
	Zea mays	Maíz	9	70	57	14
Wild plants	*Celtis* sp.				1	
	Geoffroea decorticans	Chañar	23			1
	Prosopis flexuosa/nigra/alba/chilensis	Algarrobo	3	39	45	31
	Prosopis torquata					7
Crop weeds	*Chenopodium* cf. *carnosulum*		10			
	Chenopodium quinoa var. *melanospermum*	Ajara			1	
Ruderal weeds	*Opuntia* sp.	Penca	4	21	19	
	Trichocereus sp.	Cardón	127	10	4	
Non domesticated plants (wild or weedy)	*Chenopodium* sp.		10		17	
	Fabaceae undetermined 1 and 2		4			
	Malvaceae				2	
	Polygonum sp.			2		
	Solanaceae		8			
Quantity of carbonized remains associated with occupancy levels			203	142	148	135
Quantity of taxa			11	5	10	7
Total of floated litres in occupancy levels of the site			728	86	21	

var. *vulgaris* (bean), while *Zea mays* (maize) and *Prosopis flexuosa/nigra/alba/chilensis* (*algarrobo*) are continuously present.

The possible cultivation of *algarrobo* in northern Chile as well as its integration into managed woodland systems in central Peru during pre-Hispanic times have been suggested

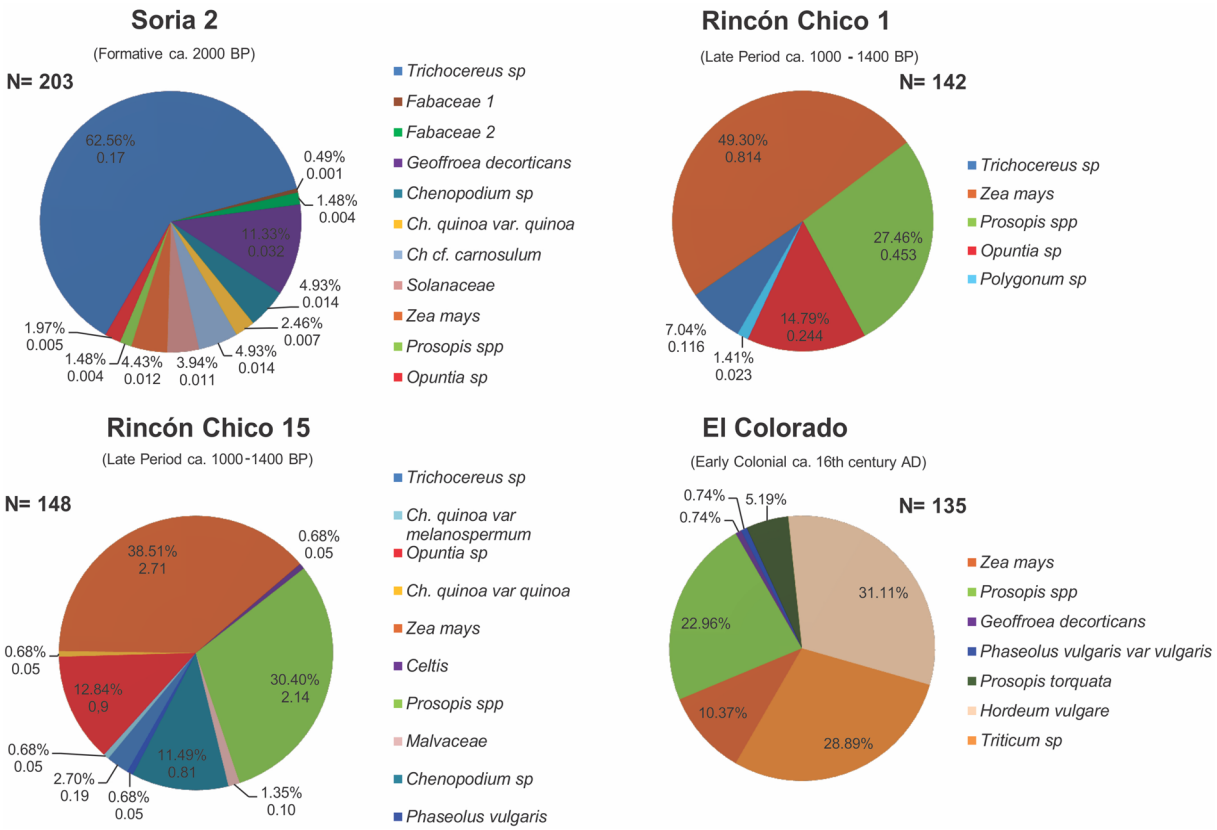

Fig. 6 Relative percentages and densities/l of identified taxa at the four studied sites. N = total number of remains

(Beresford-Jones 2004; McRostie 2016). Within these types of management systems the *algarrobo* might have been treated in several different ways, by being either tolerated, protected or encouraged; even if the trees were usually not planted and their fruits were gathered from wild trees, they acquired a specific status different to that of truly wild plants and they can be considered not just subject to simple gathering practices from the wild (Moreno-Calles et al. 2014). Archaeobotanical analyses of the material from the sites studied here has shown that the *algarrobo* fruits (*algarroba*) were processed in various ways in order to obtain flour and drinks from them during the Formative and Late periods (Petrucci 2017).

All the members of the genus *Opuntia* (prickly pear genus) that grow in the area are usually considered as wild in *Flora del Conosur* (IBODA 2016). However, several studies carried out, mainly in Mexico, show that *Opuntia* can also grow as a weed (Nobel 2002) and this situation has also been noticed in several modern contexts in the ANW (Petrucci 2017). On the basis of these observations we have interpreted the *Opuntia* remains as corresponding rather to a ruderal weed and its seeds as the result of gathering practices.

Concerning the seed remains of *Trichocereus* sp., the study of columnar cacti in Mexico made by Rodríguez-Arévalo et al. (2006) shows that the greatest abundance of these plants is found in places where the environment has been disturbed by human activities. This has also been noticed for members of the genus *Trichocereus* associated with archaeological sites (Halloy 2008). The common association between *Trichocereus* sp. and disturbed environments makes us interpret the archaeobotanical remains from this taxon as those belonging to a ruderal weed.

The unique and fragmented seed identified as *Phaseolus vulgaris* from RCh15 is not conclusive regarding its belonging to a wild (var. *aborigineus*) or domesticated (var. *vulgaris*) taxon.

The remains determined as *Chenopodium* do not correspond either to *C. quinoa* var. *quinoa* (quinoa) or to C. *quinoa* var. *melanospermum* (*ajara*) or to *C.* cf. *carnosulum*. Although we can assert they do not belong to a domesticated form, they could correspond to either weedy or wild forms and thus their presence might reflect either gathering or cultivation.

The *Polygonum* sp. remains are similar to *P. hispidum*, a species that grows near water and is not considered as a weed, although other members of the genus are (IBODA 2016).

As for the seed remains determined only to family level, two have been classified as undetermined Fabaceae. They do not belong to the category of domesticated pulses and they do not correspond either with the Mimosoideae section or to other leguminous taxa in the herbarium collections from the area. Still, both wild and weedy legumes are present in the local flora (Burkart 1952; Rapoport et al. 2009), but the morphology of the archaeobotanical remains did not allow us to take the identification further.

In the case of the Malvaceae family, the descriptions and identification keys for the genera *Sida, Pavonia* and *Sphaeralcea* which were established on the basis of archaeobotanical remains from other ANW sites (Carrizo et al. 2003; Giovanetti 2009; Rapoport et al. 2009; Herbario 2011; Carreras et al. 2012; Capparelli 2016, personal communication) did not allow us to attribute our remains to any of these. Several local Malvaceae species are reported as weeds or medicinal plants (Rapoport et al. 2009; Carreras et al. 2012). For these reasons we consider that the seed remains identified as Malvaceae could correspond to either wild or weedy taxa even though the only certainty is that they do not belong to a domesticated one.

A similar situation occurs with seed remains from the Solanaceae family. These have been compared to various species without obtaining a convincing match. Thus our seeds do not correspond to *Lycium chilense* Miers or *Solanum sisymbriifolium* Lam., the latter a weed of maize, consulted in herbarium collections. They cannot be associated either with, for example, *S. eleagnifolium* or Solanaceae recovered from other Formative and Late sites in the area (Capparelli 2009; Lema 2009; Calo 2010). It is likely that the remains from Santa María valley correspond to either wild or weedy forms, even though a more precise identification would be necessary in order to decide on their status.

Based on the groupings presented in Table 1, the representation of each group in each site was calculated (Fig. 7), showing a reduction through time of taxonomic diversity considering categories of association with people.

Discussion

Even though the present study is based on a limited number of remains and the analysis of the flotation samples from El Colorado is still ongoing, the first results obtained from the four Santa María valley sites discussed here reveal some interesting patterns of change through time (Table 1; Fig. 7). In the Formative settlement there is a

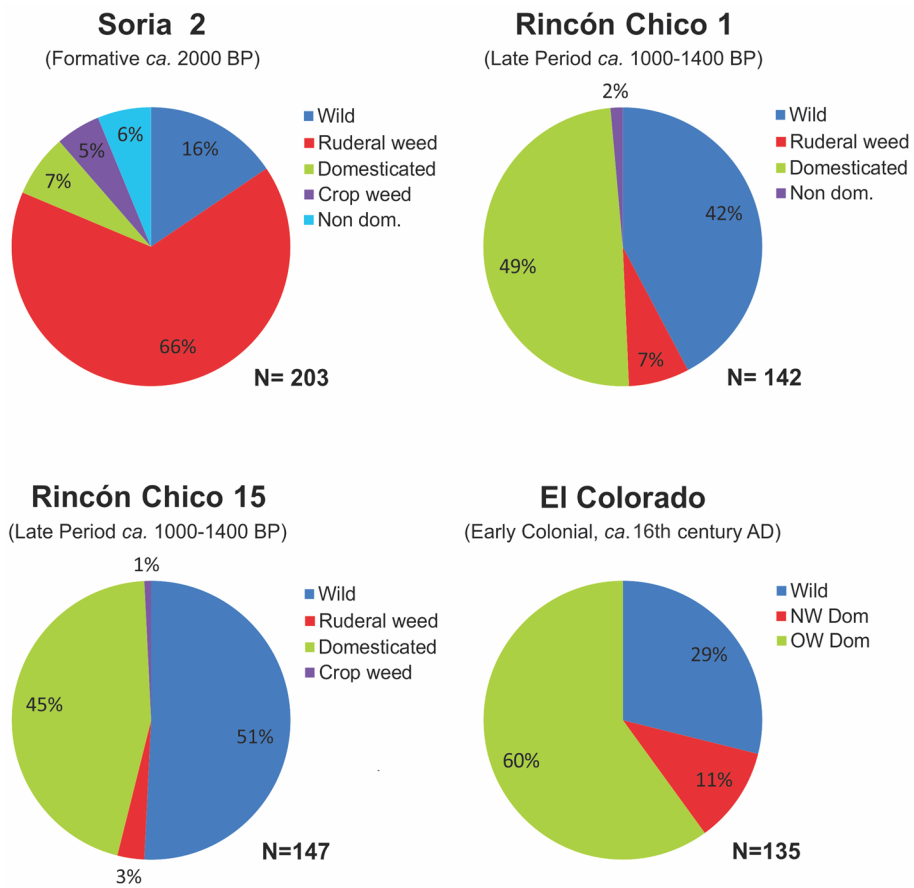

Fig. 7 Relative proportions of taxa in the various categories of association with people. *Non dom* non-domesticated, *NWDom* new world domesticated, *OWDom* old world domesticated, *N* number of remains

greater presence of ruderal weeds such as *Trichocereus* sp., followed by wild plants and rather similar proportions of domesticated plants, crop weeds and other non-domesticated taxa. In the Late period, contrary to what might have been expected, domesticated taxa are not predominant, as the proportion of fruits from wild taxa, in particular *algarroba*, is important. Regarding domesticated plants, maize is more important than quinoa and this may be correlated to the increase in productivity of maize ears and the diversification of grain types detected in the Late period sites (Raffaele 2006; Petrucci 2017). Therefore, considering the association of plants with people, we can note that the major pair wild-domesticated plants represented by maize-*algarroba* is not present in the Formative period, as would be expected for the first villages with farming and grazing, but it is present during the Late period. These results suggest that cultivation in the strict sense (of maize) and also the gathering (of *algarroba*) were both practised for a long time in the area, such as in other sites of the ANW valley area (Capparelli 2015). The increasing importance with time of cultivation areas, possibly of increasing size (Tarragó 2000), with mainly maize being grown, together with the presence of ancient *algarrobo* woods in the valley (Tarragó 2007), leads us to think that the expansion of cultivated land in later times probably happened together with the maintenance of tree stands of various *Prosopis* species. The management practice with both cultivation and also gathering shown by the maize-*algarroba* association may thus not be simply interpreted as two different activities, but as part of an integrated system of crop growing and woodland management which included llama herding and the hunting of other camelids and rodents. These kinds of systems have been studied in modern human communities to assess their contribution to biocultural diversity (Moreno-Calles et al. 2013, 2014) and lead us to consider the possibility that *algarrobo* trees could have been subject to cultivation in a broad sense. More evidence of connections between people and plants may be that *Trichocereus* sp. seeds are less abundant in the latest sites, so a possible interpretation, to be confirmed by further research in field areas, is that the expansion of cultivated areas maintained the *algarrobo* woods in a management system that included them as well, but led to the reduction of columnar cactus populations. Systems for managing vegetation including columnar cacti could also have been present in the earliest times, such as those studied in modern Mexican communities (Nobel 2002; Moreno-Calles et al. 2013). To these changes through time, variations detected in assemblages of non-domesticated taxa can be added. During the Formative period, taxa from both the Solanaceae and Fabaceae are present, while in the Late period they are absent and remains of the Malvaceae appear, maybe in accordance with changes in management systems and landscape modifications. Further analysis is needed in order to give support or not to these first observations.

Despite the fact that the flotation samples from El Colorado have not yet been analysed and the picture of taxa present at this site is probably incomplete, we can state that the incorporation of Eurasian cereals, even though numerically important, does not seem to have replaced maize and *algarroba*, as shown by the importance of *algarroba* for the inhabitants of ANW from the first occupations until the present day (Giovannetti et al. 2008). In addition to archaeobotanical assemblages recovered from non-domestic spaces corresponding to Early Colonial times in the ANW valley area (Capparelli et al. 2005), the El Colorado assemblage, recovered from a domestic context, enables us to produce a more complete understanding of plant management, access to cultivated land and places for gathering plant products from the wild at this crucial moment in local history, when resistance and battles traversed the Santa María and other valleys.

In this sense, the genus *Chenopodium* is a very interesting case to analyse, showing that cultivated land was not only dedicated to crop plants. In Soria 2 domesticated *C. quinoa* var. *quinoa* (quinoa) is present together with a crop weed (*C.* cf. *carnosulum*) and remains of wild or weedy forms of *Chenopodium*. In RCh1 remains of this genus were not recovered, but in RCh15 quinoa was present with another weed, *ajara* (*C. quinoa* var. *melanospermum*) and also with wild or weedy taxa within the genus. This recurrence in the associations is possibly the expression of wild-weedy-crop complexes of *Chenopodium* through time, with varying accompanying weeds, and maybe obligatory weeds of quinoa. Studies of *Chenopodium* in Soria 2 (Petrucci 2017) detected signs of processing for de-saponification of quinoa grains and also in those of *C.* cf. *carnosulum*. As at the Rch15 site, *C. quinoa* var. *melanospermum* has been recovered from other sites of the Late period, also with evidence of processing methods including soaking, from funerary contexts (Ratto et al. 2014). These situations suggest that weeds were not completely eradicated through time, but were tolerated or even encouraged and used, reinforcing the idea of wild-weedy-crop associations having been present in both Early and Late periods in ANW (Lema 2014; Korstanje et al. 2015). In the case of *ajara*, its domestic and sacred consumption has been ethnographically recorded in the ANW and the southern Andes, where it was used in the worship of hills and ancestors (Villagran and Castro 2003; Lema 2006; López and Nielsen 2013).

Conclusions

This contribution presents evidence of past plant use in the Santa María valley and, although it needs a larger number of samples to be studied from more sites so as to be thoroughly confirmed, it suggests several possible scenarios of changes and continuities in biocultural diversity, to be further explored. First of all, the pre-eminence of ruderal weeds during the Formative period stands out with a great diversity in association degrees between plants and humans, instead of a strong division between wild plants and domesticated crops, a division that is present in the Late period, mainly because of the predominance of two taxa, maize and *algarroba*. The classification of a taxon as wild and gathered does not mean that it may not possibly have been intensively managed and selected in the past. In this sense, the division previously mentioned could be reconsidered as part of an agroforestry system in which *algarroba* could have been subject to more than simple gathering. Secondly, Eurasian crops did not replace maize and *algarroba* consumption by local people during Early Colonial times in the southern part of the Santa María valley. Third, weeds of the *Chenopodium* genus, even though they involved different taxa through time, did not lose their importance. They were part of a management system of cultivated fields that allowed the presence of wild-weedy-crop complexes, which were also processed and probably consumed. We hope that future research will allow us to increase our understanding of the history of biocultural diversity in the southern part of the Santa María valley.

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