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Peopling of the high Andes of northwestern Argentina

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ABSTRACT

The goal of this presentation is to review the current evidence in order to model the early peopling of the highlands of Northwestern Argentina. Paleoenvironmental evidence of the late Pleistocene and early Holocene is thoroughly reviewed in order to set the stage of the process of human settlement of the Puna region of Argentina. I will analyze chronological evidence and the archaeological record—especially the archaeofaunas—of early hunter-gatherer occupations dated between 10,500 and 9000 BP (12,500 to 10,000 cal. BP). Finally, I discuss specific cultural and environmental aspects related to the dispersion and human colonization of the highland plateau.

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1. Introduction

The peopling of the high Andes is undeniably linked to the major process of hunter-gatherer dispersal into the Americas. Nevertheless, several questions concerning the timing and pathways of migration remain to be answered. Some time ago, M. Aldenderfer (1998) described the challenges hunter-gatherers had to face for colonizing high altitude environments, and for that reason the installations of human groups in the highlands had been later than that in lower lands. But, recently, data from the Pucuncho Basin in southern Peru would suggest that “Pleistocene humans lived successfully at extreme high altitude” (Rademaker et al., 2014:469). As the puna or altiplano is not homogeneous, the initial human settlement could have been quite complex. Regional studies could add evidence of this complexity because they allow generation of more detailed data on local and regional scales, thus giving the opportunity to view variability in hunter-gatherer displacement and colonization of new lands at the Pleistocene/Holocene boundary.

In this paper I will examine the environmental, chronological, and archaeofaunal evidence from the highlands of Northwestern Argentina in order to clarify some of the problems surrounding the initial peopling of this land. I will use two operative concepts that allow disentangling the peopling process in two steps: dispersal and colonization. Dispersal is filling up the available habitat, reaching an area not previously inhabited by the human group;

meanwhile, colonization is an extension of the habitat to include established occupation (Gamble, 1993:7). Established occupation is by no means sedentary, but a recurrent use of the same area in the long-term, beyond seasonal rounds.

2. Regional setting

The Puna region of Argentina comprises the arid highlands situated between 19° and 27° S latitude and between 3000 and 4500 m above sea level. This area is defined as a highland desert or semi-desert dissected by several mountain chains oriented NE-SW. It is characterized by high solar radiation due to its altitude, wide daily thermal amplitude (up to 30°), marked seasonality in rainfall (it rains only in summer), and low atmospheric pressure.

The Puna exhibits a latitudinal gradient in aridity that determines two sub-regions: (1) the Dry Puna located north of 24°S, with a mean annual precipitation of 340 mm/yr (reaching even 400–500 mm/yr in some localities of the northern-western corner), and (2) the Salt Puna, located south of 24°S, in which precipitation barely reaches an average of 100 mm/yr, and salt-lakes and saline soils are dominant features of the landscape (Morales, 2011). These overall conditions set a patchy distribution of vegetation and animal resources.

The wide altitudinal range produces strong variability in plant assemblages from ‘tolar’ (shrub steppe) to ‘pajonal’ communities (herbaceous grasslands), along with wetlands, locally known as ‘vegas’, situated in both of these main vegetation communities. Four main plant communities can be identified in the Puna (Cabrera, 1976; Arzamendia et al., 2006; Borgnia et al., 2006):

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1. Shrub steppe (tolar), dominated by *Parastrephia lepidophylla* and *Fabiana densa*, has a low proportion of herbs (5%) and is the most extensive pasture area of the zone, located between 3500 and 3900 m asl.
2. Herbaceous steppe (pajonal), dominated by *Festuca* spp. and other grasses like *Poa* spp. and *Stipa* spp., can be found between 4100 and 4700 m.asl. It is important to highlight that above 4300 m asl, shrub presence diminishes almost completely.
3. Wetlands (vegas) represent restricted swamp areas composed of short grasses. These dense grasslands of *Deyeuxia* spp. and *Mulebergia* spp are distributed in both altitudinal settings from 3500 to 4700 m asl (Ruthsatz and Movia, 1975).
4. Mixed steppes of Gramineae and Compositae (only eight genera are present) can be found between 3900/4100 m asl, and can be defined as a transitional zone or ecotone between the shrub steppe and the herbaceous grasslands.

3. Materials and methods

3.1. The past environment

The initial human dispersal in the highlands of northwestern Argentina and northern Chile seems to have occurred in an environmental scenario characterized by moister, but very cold conditions (Yacobaccio and Morales, 2013). These conditions fostered the downslope displacement of herbaceous steppe that currently is located above 4000 m asl (Fernández et al., 1991) and a generalized overflowing stage in the lakes of the region (Sylvestre et al., 1996, 1999; Geyh et al., 1999; Baker et al., 2001; Bradbury et al., 2001; Abbott et al., 2003). Particularly, and in terms of the classic Andean lake-level phases (Sylvestre et al., 1999), initial human dispersal seems to have occurred after the Ticaña “dry” (and probably warmer) event ca. 12,800 cal. BP.

The occupation of the area, according to radiocarbon dates, seems to have been accomplished during the Pleistocene/Holocene boundary, during the moist Coipasa event that started ca. 11,045 cal. BP (Sylvestre et al., 1999). Broadly speaking, the environmental conditions during the Early Holocene in the South Andes were moister and more homogeneous than present (Thompson et al., 1995, 1998, 2006; Bradbury et al., 2001; Ramirez et al., 2003), also showing a weaker seasonality in rainfall and a weak to moderate frequency in short term climatic variability, due to atmospheric circulation patterns less influenced by the South Atlantic Anticyclone (Villagrán, 1993) and the virtual absence or reduced intensity and frequency of short term climatic oscillations, like ENSO (El Niño-Southern Oscillation) (Villagrán, 1993; Bradley, 2000) or PDO (Pacific Decadal Oscillation) (Mantua et al., 1997; see review in Morales, 2011). The ecological impact of these changes in moisture amount and distribution –spatial and temporal– allowed herbaceous steppe to grow in lower altitudes –below 3800 m–, thus replacing current shrub steppe (Markgraf, 1985; Oxman, 2015; Tchilinguirian et al., 2013). Also, the regional abundance of pack rat middens (Latorre et al., 2003, 2006) and paleosols (Morales, 2011) clearly shows more stable and moister conditions during this period. This wet phase was recorded in a large number of records from both the Dry and Salt Puna, with a chronology between 12,600 and 7800 cal BP (Morales, 2011; Tchilinguirian and Olivera, 2014).

The end of Early Holocene characteristics has non-synchronous dates, being somewhat later (ca. 7800 cal. BP or even later) in the southern part of the Central Andean region (Northern Chile and NW Argentina). This late chronology is mainly evidenced in water bodies with broad moisture catchment areas and in those located at higher altitudes above 4000 m asl (Morales, 2011).

3.2. Chronology of human dispersal

The paleoenvironmental studies indicate areas with high productivity during the Early Holocene in the Dry Puna. These areas particularly are in the north-central region, between the hills of Rinconada and Zenta-Santa Victoria in the Dry Puna (Morales, 2011: 166) (Figs. 1 and 2). The gradient of the radiocarbon dates suggests that these sectors could have formed the paths of the first human groups into the region. The areas above 4000 m, under periglacial conditions, could only have been occupied and/or visited seasonally during the summer, suggested by the use of certain raw materials, particularly obsidians from sources like Zapaleri/Laguna Blanca or Caldera Vilama, both above 4000 masl. These obsidians have been found in Hornillos 2 and Alero Cuevas. Nevertheless, human colonization of the sectors above 4000 m should have been somewhat later, as indicated by the radiocarbon dates from sites located at that altitude (Table 1).

In the southern Salt Puna the only places with such antiquity (i.e. Pleistocene/Holocene boundary) detected so far are Quebrada Seca 3 and Peña de las Trampas. Quebrada Seca 3 has similar artifact types as those of the Dry Puna and the Salar de Atacama region of northern Chile. Thus, in this case a human dispersal from the northwest cannot be ruled out, as can be observed by the similarities in the morphology of the projectile points with the already mentioned areas, and with the upper Loa river. On the other hand, the occupation at Peña de las Trampas is spatially restricted and is composed by a few flakes and tools.

The earliest radiocarbon dates from human occupation sites are from the end of the Pleistocene, about 13,000 cal BP. This evidence is still scarce but allows some inferences. If we arrange the oldest dates according to the altitude above sea level a gradient can be observed in which the earliest dates are below 3800 m. These dates have a range between 12,958 and 12,363 cal. BP, whereas the sites located above 4000 masl have a range of 11,279 to 11,124 cal BP. The difference between these dates is about 1450 years and is statistically significant ($t = 34.5$, $p = 0.05$). The implication of this analysis is that the peopling of the Puna proceeds from lower environments. Also, we can see that the sites that have these early occupations are located on the periphery of the Puna, close to the mesothermal valleys and the mountain forest, locally known as yungas (Fig. 2).

There is a high quantity of plant species coming from the lowlands recovered from these early sites, and it is worth noting the lack of obsidian in Inca Cueva 4, Huachochocana III, and Pintoscayoc 1 (Yacobaccio, 1994; Yacobaccio et al., 2008).

From 10,682–10,566 cal BP all the areas of the Puna have evidence of human occupation; this is coincident with the appearance of the first open-air sites located on the margin of ancient wetlands, like Lapao 5 and 11 near Hornillos 2, dated between 10,871–10,275 cal. BP (Table 1).

3.3. Utilization of animal resources

The Puna is an environment with low ungulate diversity. Only three species are found: two wild camelids (guanaco and vicuña) and taruca deer (*Hippocamelus antisensis*). Guanacos (*Lama guanicoe*) are spread throughout the Andean range from Peru to Tierra del Fuego. Their social structure in the breeding season comprises three basic social units: territorial family groups; male groups (non territorial), and solitary males (Franklin, 1982). Family groups' territoriality is directly correlated with stable food supply. When a severe drop in food availability occurs, usually in winter, guanaco populations displace, losing territory and forming mixed herds, breaking apart family groups (Cajal, 1985). According to the archaeological record, in the past, guanacos inhabited the Puna in montane grasslands and also in the meso- and micro-thermic

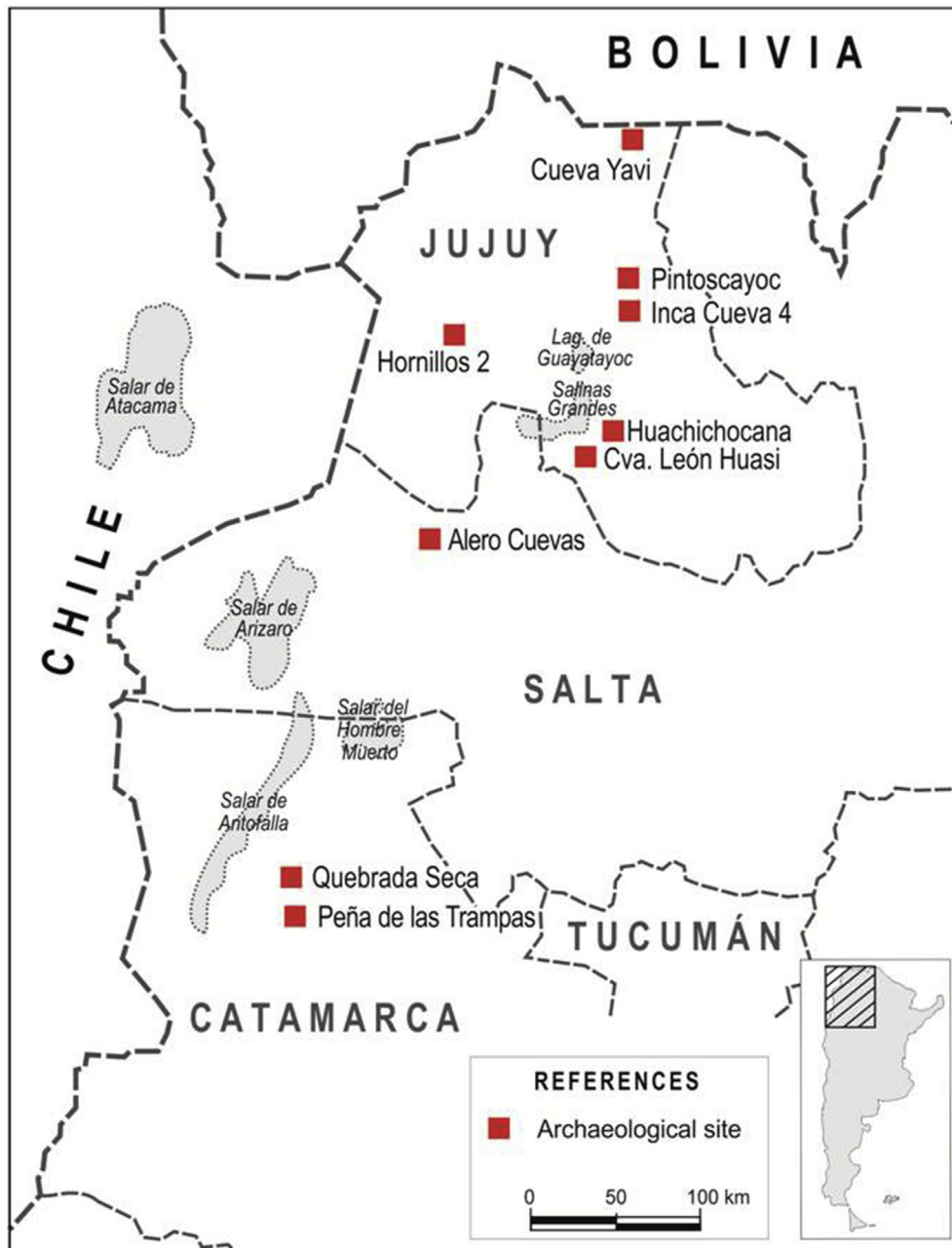


Fig. 1. Map of late Pleistocene/Early Holocene sites in Northwestern Argentina discussed in the text.

valleys of lower altitude. Today the northern subspecies *Lama guanicoe cacsilensis* is restricted to small populations (only hundreds of individuals) in high altitude environments (Censo, 2010).

The vicuña (*Vicugna vicugna*) lives only in high altitude Puna environments above 3400 m, from Peru to Argentina and Chile. The southern subspecies *Vicugna vicugna vicugna* inhabits the Puna of Argentina. The vicuña lives in family groups, whose composition is one male, three-four females and two offspring. These groups are stable and territorial all year round. The mating system has mixed components of polygynous, resource defense, and harem (females + calves) defense because the alpha male limits and defends an area, but he also conducts the females to the territory when they move far away. Contrary to guanacos, the vicuñas are obligate drinkers, thus they must drink water every day; therefore location of water is a limiting factor concerning the distribution of

vicuña populations (Vilá, 1999, 2000).

The taruca deer (*Hippocamelus antisensis*), is distributed from the Ecuadorian Andes to Argentina and Chile, although today the species is extinct in the Puna areas of these two countries. Small populations remain in the highland grasslands (1800–5500 m) of the Mountain Forest (Yungas), and also in the high ranges of mountain chains in the southern section of northwestern Argentina (Regidor and Rosati, 2001). Taruca groups, as a cryptic species, are highly variable throughout the year. “Group size and structure [...] changed seasonally and these changes were highly correlated with the reproductive cycle of the deer. [...] The breeding cycle is strongly seasonal and is determined by precipitation and temperature patterns” (Merkt, 1987: 397). Presence of taruca in the archaeological record is highly variable but mostly very low, and only in a few sites.

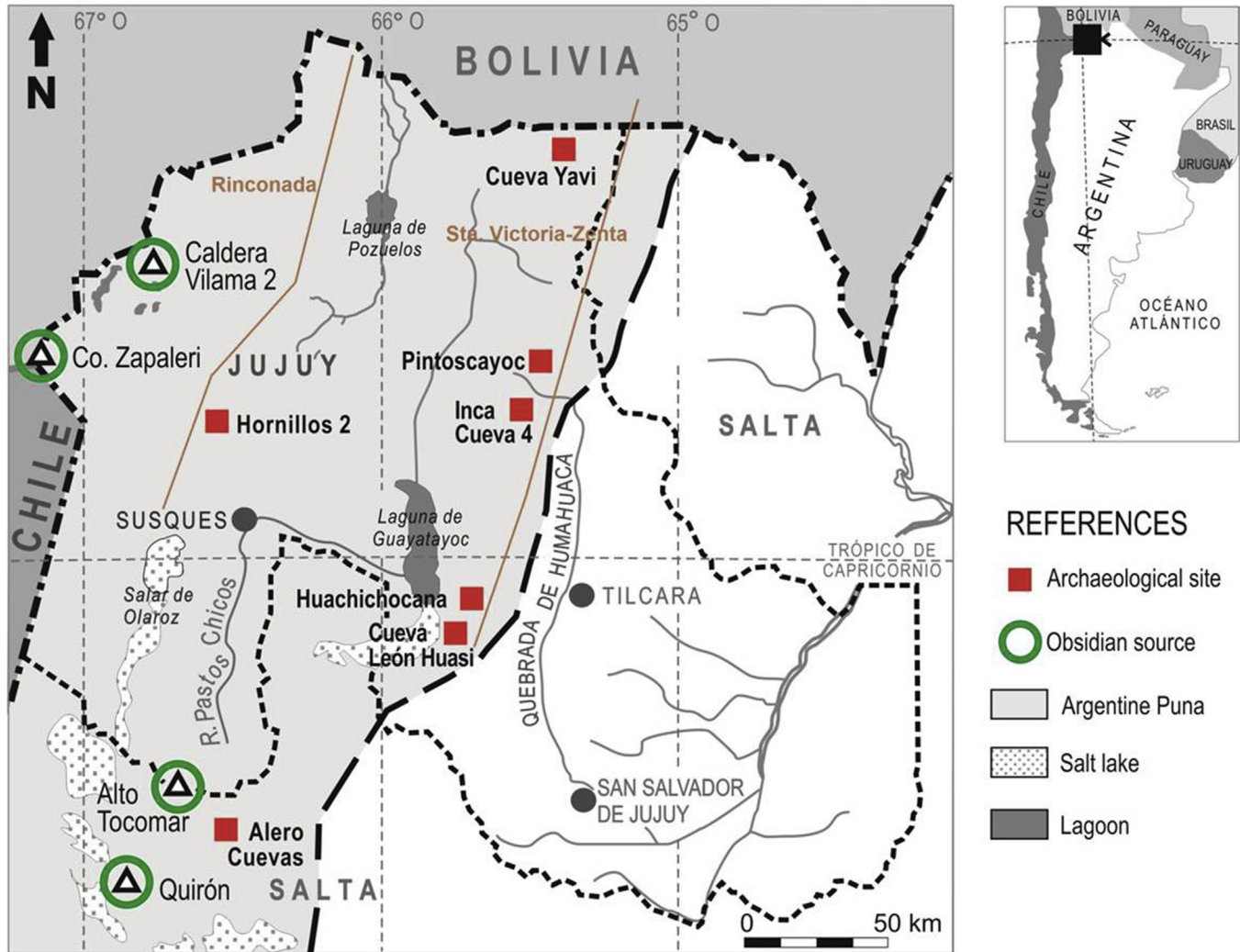


Fig. 2. Map of the Dry Puna showing the earliest archaeological sites and the possible dispersal patterns. Brown lines show the central basin of the puna between the Santa Victoria-Zenta and Rinconada mountain ranges. Dashed line indicates the eastern border of the Puna. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

It is important to mention that hunter-gatherers also consumed an important range of small mammals, such as rodents (*Ctenomys*, *Caviidae*), *Xenarthra* (*Chaephractus* spp), and birds (*Metriopelia* sp, *Anas puna*, *Anas cyanoptera*) that lived in a wide range of local environments. As suggested by Grosjean et al. (2003), rodents are strongly dependent on moisture, and consequently their populations are usually well correlated to regional moisture, as well as birds.

The animal remains from archaeological sites are composed of modern wildlife; there are not extinct megamammals, although these were available at the time of the first arrival of human groups to the region (Yacobaccio and Morales, 2013; Martínez, 2014). There are varying proportions of some taxa, especially camelids and chinchillids, particularly viscachas (*Lagidium viscascia*). Richness (measured as the maximum number of taxa) ranges between 5 and 10 taxa; with Pintoscayoc 1 and Inca Cueva 4 are the sites with the greatest taxonomic richness. According to the proportion of each taxon the sites can be arranged into three groups:

(1) Those with predominance of camelids (Huachichocana III, Alero Cuevas and Quebrada Seca 3);

- (2) Those in which the chinchillids, particularly *Lagidium*, are prevalent (Inca Cave 4 and Hornillos 2);
- (3) Those with a balanced representation of camelids and small fauna (Pintoscayoc 1). (Table 2).

The first group are assemblages with high dominance and less taxonomic richness. These assemblages were formed as a consequence of several hunting episodes nearby to the sites, as can be seen from the balanced presence of axial and appendicular sections of camelid skeletons. Also, there is high representation of non-fused bones (between 41% and 67%) showing a focus on the obtaining of young animals (Table 3), perhaps a product of seasonal hunting, specifically at the end of the wet season (summer-fall), when the offspring have been recently born.

In the second group *Lagidium* sp (a medium-size rodent) prevails which indicates the availability of local wet patches surrounded by rocky areas. Regarding the camelid remains, non-fused bones are also in high proportion, reaching 50% in Inca Cueva 4. Both sites of this group (Inca Cueva 4 and Hornillos 2) have a large representation of rear legs and feet bones. The bones are heavily cracked, presumably for obtaining marrow.

Table 1

Radiocarbon dates from the archaeological sites of the Puna. Calibration was made with Calib 7.0.2.

Site	Altitude	Provenience	Date RCy BP	Calibrated Age BP	Lab. Code	Source
Pintoscaycoc 1	3800	layer 6.6a	10,720 ± 150	12,363: 12,958	LP-503	Hernández Llosas, 2001
		layer 6.9a	10,340 ± 70	11,964: 12,426	Beta 79,849	
		layer 6.2a	9190 ± 110	10,180: 10,609	LP-628	
		layer 6.7a	9180 ± 230	9695: 10,898	LP-449	
Inca Cueva 4	3650	Funerary C	9080 ± 50	10,176: 10,301	CAMS 39,041	Aschero, 2014
		layer 2	10,620 ± 140	12,077: 12,793	LP-137	
		layer 2	9900 ± 200	10,738: 12,074	AC-564	
		layer 2	9650 ± 110	10,694: 11,243	LP-102	
		layer 1b	9249 ± 51	10,267: 10,561	AA 94,582	
León Huasi 1	3800	layer 2	9230 ± 70	10,246: 10,567	CSIC-498	Yacobaccio, 2013
	3400	layer 2	10,550 ± 300	11,399: 12,990	GAK-13402	Aschero, 2014
Cueva Yavi	3400		10,450 ± 55	12,123: 12,557	N/D	Fernández Distel, 1989
			9790 ± 100	11,060: 11,413	N/D	
			9760 ± 160	10,661: 11,718	AC-1093	
			9480 ± 220	10,216: 11,310	AC-1088	
Huachichocana III	3400	layer E3	10,280 ± 420	10,718: 12,956	N/D	Fernández Distel, 1986
	Hornillos 2	4020	layer 6	9710 ± 270	10,369: 11,984	
layer 6		9590 ± 50	10,741: 11,144	UGA 8724	Yacobaccio et al., 2014	
layer 6		9150 ± 50	10,226: 10,433	UGA 8723		
layer 6		9380 ± 110	10,871: 10,275	LP-980	Yacobaccio and Morales, 2013	
Lapao 5	3650		8980 ± 100	10,298: 9732	LP-1763	
Lapao 11	3650		9650 ± 100	10,718: 11,230	LP-1736	López, 2008
Alero Cuevas	4400	layer F4	10,190 ± 190	11,228: 12,427	UGA-1975	Martínez, 2014
Peña de las Trampas	3582	Layer 1(1)	10,030 ± 100	11,217: 11,829	LP-1788	
		Layer 1(4)	9790 ± 50	11,124: 11,279	UGA 9257	
Quebrada Seca 3	4050	layer 2b19	9410 ± 120	10,366: 11,091	LP-881	Martínez, 2014
		layer 2b25	9250 ± 100	10,232: 10,673	LP-895	Aschero, 2014
		layer 2b25	9050 ± 110	9886: 10,509	Beta-59930	Pintar, 2008
		layer 2b22				

Table 2Faunal remains (NISP), Richness, Dominance and Diversity indices by site. References: ¹Elkin and Rosenfeld 2001, ²Yacobaccio and Madero 1992; ³Yacobaccio and Madero 1992, ⁴Mondini 2008; ⁵Mondini and Elkin 2006; ⁶Yacobaccio et al., 2014, ⁷López 2009.

Taxa	Pintoscaycoc 1 layer 6 ¹	Huachichocana layer E3 ²	Inca Cueva 4 layers 2 y 1b ³	Quebrada Seca 3 lower levels ⁴	Hornillos 2 levels 6-6d ⁵	Alero Cuevas level F4 ⁶
Artiodactyla	998	5	200		765	532
Camelidae		751	223	687	357	575
Cervidae	25	2	32		19	1
Chinchillidae	39	98	994	74	1549	55
<i>Lagidium</i> sp.	234				206	
<i>Chinchilla</i> sp.	70					
Caviidae	1382					
<i>Ctenomys</i> sp.	602		5	1		
<i>Cavia</i> sp.						
Rodentia indet.	81		55	38	35	50
Avis	64		11	16	10	
Carnivora	5	3	2	1	1	
Dasipodidae			14			
Total	3500	859	1536	817	2878	1203
Richness	10	5	9	6	6	5
Dominance (D)	0,27	0,77	0,45	0,71	0,5	0,83
Diversity (H')	1,54	0,42	1,13	0,59	0,91	0,36

Table 3

Non-fused camelid bones (total and percent) by layer and site (Yacobaccio, 2013: Tables 1–3, and references therein; also references of Table 2, this work).

Site	Nisp	%NF	Layers	¹⁴ C Dates (cal BP)
Pintoscaycoc 1	998	33	6.2–6.3	12.958–9695
Inca Cueva 4	163	50	2-1b	12.793–10.738
CH III E3	410	67	E3	12.956–10.718
Hornillos 2	257	31	6-6d	11.144–10.226
QS3 HT	631	41	2b25–2b12	12.279–9886
Alero Cuevas	575	41	F4	11.230–10718

The third group is only composed by one site: Pintoscaycoc 1, which has a balanced proportion of camelids and small fauna. The

rodent remains are mainly *Caviidae*; this family of rodents prefers moist (riparian) habitats in which they are in dense populations. The relatively high proportion of camelids situates the site in an intermediate position between the former groups.

A common feature of all these sites is the high index of cracking of the camelid bones. As has been highlighted for Inca Cueva 4 and Hornillos 2, this can be explained by two factors: the fracturing of large bones for obtaining marrow and bone-grease, and the preparing of anatomical units for transport outside the sites, which seems the case for Huachichocana III, Alero Cuevas, and Inca Cueva 4, shown by the near-absence of high-utility skeletal parts (Yacobaccio, 1994; López, 2008). Both wild camelids (guanacos and vicuñas) have been identified in all the sites.

4. Discussion

A long time ago E.P. Lanning –the advocate of the model of transhumance– stated that the Lauricocha caves at the Puna de Junín (Perú) were probably occupied only during the summertime because the land could have been extremely rigorous for “man and beast” during the winter (Lanning, 1967:47). D. Lavallée also thought that the first occupations in the Puna de Junín were seasonal. Based on Telarmachay data she proposed that the inhabitants of the site made movements between different winter and summer habitats located at a slightly distinct altitudes within the annual cycle (Lavallée, 2000:93). Also, T.F. Lynch favoured the transhumance model, which he considered “a reasonable and likely adaptation for mobile hunting and gathering people in montane environments” (Lynch, 1980:311). Although he disregarded the coast as an ecozone to be employed by high-Andean hunters, recent research in southern Peru provides evidence about coastal-sierra movement as one possible strategy as early as the Terminal Pleistocene (Sandweiss and Rademaker, 2011).

So in order to tackle the problem of the colonization of the high Andes, mobility is a central keyword. Mobility is an essential concept in the study of hunter-gatherer adaptations (Binford, 2001). Dispersal to new habitats implies the amplification of the logistical radius in a constant way, thus promoting high residential mobility. When local habitats (i.e. patches) have been incorporated into the circuit of movements, recurrent utilization begins and persistent places are constructed.

The structure of the faunal remains helps us to understand this initial mobility. Archaeofaunas show that the hunter-gatherers had a mostly generalized subsistence base on a regional scale, and the different patches in which the sites are located were used according to the gross species abundance, except those patches that offered few resources in great abundance, like Pintoscayoc 1 (*Caviidae*) or Hornillos 2 and Inca Cueva 4 (*Lagidium* in both cases). This subsistence strategy is in accordance with the dispersal of human groups to new habitats. Other characteristics can be cited here in order to sustain this argument: 1) the small size and thin occupation layers in the caves and rockshelters (between 8 and 37 square meters); 2) a probably seasonal occupation of the sites, as can be seen from the quantity of non-fused bones, and the flowers of plant remains (Yacobaccio, 1994). High mobility of these human groups is also suggested by the findings in the Puna archaeological sites of long-distance raw material, such as obsidians, lowlands plants and canes (*Chusquea lorentziana*), and Pacific Ocean mollusks' shells (*Oliva* sp).

Notwithstanding this high residential mobility, the use of the local space (i.e. patches) was made in a redundant way. Also, three of the sites (Inca Cueva 4, Hornillos 2, and Quebrada Seca 3) have rock art, giving them a special meaning. These representations could have been associated with landscape marking or could have served as emblems of local populations of hunter-gatherers (Aschero, 2014). Also the presence of inhumations of selected human bones, in some cases intentionally burned (Fernández Distel, 1986), support the idea of these sites as persistent places.

At this point it is difficult to disentangle the earliest human dispersion from later occupation, because the stratigraphic units in the archaeological sites have a low resolution. However, the ordering of radiocarbon dates can help to clarify this problem. The earliest dates ca. 12,900 cal. BP, which can be associated with hunter-gatherer group dispersal, come from sites located below 3800 m. The evidence of the first occupation of sites above that altitude is dated around 11,279–11,124 cal. BP. By 10,682–10,566 cal. BP all the Puna landscapes have evidence human occupation. This pattern suggests human advance from lower lands to higher ones.

5. Concluding remarks

Although human dispersal in the Puna highlands started about 12,900 cal. BP, the ultimate occupation of the area seems to have been established during the Early Holocene (Yacobaccio and Morales, 2013), during the moist Coipasa event that started around 11,045 cal. BP. Moreover, the evidence shows that by 10,550 cal. BP the colonization of the Puna environments was widespread and since then, density dependent mechanisms started to operate, such as marking of particular places, standardization in the use of lithic resources, etc. This was intensified by 9500 cal. BP with the appearance of a marked cultural diversity and the construction of widespread human networks throughout the Southern Andes. So, we conclude that the harsh conditions that altitude and climatic conditions of the pre-Coipasa phase imposed on hunter-gatherer populations demanded a long time span for establishing permanent occupation of this region.

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