



Late Holocene camelid use tendencies in two different ecological zones of Northwestern Argentina

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Abstract

The human–camelid relation can be traced from the end of the Pleistocene to the present time. During that time span that relations changed transforming from merely extractive techniques to productive ones (e.g. herding). In order to recognize the camelid use tendencies within the late productive economies, archaeofaunal assemblages from southern Calchaquíes valleys are compared with other collections from the higher Argentinean Puna (Northwestern Argentina). Some possible signs of distinctive economical use of camelids between these two zones are discussed, as expressed in the archaeofaunal record of the Late Holocene. Three periods were observed. The earliest period shows for both zones the use of three camelid species (*Lama glama*, *Lama guanicoe* and *Vicugna vicugna*) with the presence of more adult remains than subadults. The second period (Middle) shows more variability with less biodiversity in Puna and some regions of lower valleys while proportions of adults and subadults for Puna are the inverse of those during the earliest period. For the Late period the economy shows for Puna the presence of adult camelids while the subadults still are predominant in certain localities. Valley records do not register major changes during the three periods in age classes and species occurrence. The presence of two camelid use models in the region is established.

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1. Introduction

The relation of the ancient inhabitants of South America with the Neotropical fauna has been variable through time. Many of the faunal species that humans knew upon arriving at the South American subcontinent became extinct, being replaced in their ecological niches by other animals. The South American camelids were one of the replacement families in diverse geographic areas, even though some camelid taxa also become extinct (Cardich and Izeta, 1999–2000). For that reason the relation between humans and the camelids can be tracked from the end of the Pleistocene to the present time. During most of that time span the relationship was based on the hunting of wild animals. Therefore the humans used extractive techniques in their subsistence economy. That situation changed in the Late Holocene where diversified types of human–camelid relations expressed in economic terms began. Moreover, a productive strategy started to emerge based on the use of

domesticated camelids such as the llama (*Lama glama*) and the alpaca (*Lama (V.) pacos*). In Northwestern Argentina two forms of productive techniques were adopted: a herding economy and a mixed economy (agriculture and herding). Both were associated with two different ecological areas: the Puna highlands and the valleys. For that reason and with the purpose of advancing the knowledge of the past relations between humans and camelids, the objective of this work is to determine the use tendencies of these animals at a time when productive economies were established to a great extent in Northwestern Argentina.

This objective will be achieved through evaluation of differences and similarities in the archaeofaunal patterns, considering quantitative results on camelid record analysis, their assignment to age categories and their interspecific identification. The sample is composed of 14 archaeofaunal assemblages from the southern Calchaquíes valleys and another 13 from the higher Argentinean Puna. As a result, comparative analysis allows discussion of the possible signs of differential economic practices between these two distinct ecological zones as expressed in the archaeofaunal record of the Late Holocene.

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2. Camelids in Andean economies

Analysis based on the archaeofaunal record allows the researcher to gather data on animal appropriation, use and consumption patterns. However, those patterns often must be related to past human behavior. Therefore a *middle range theory* can be used to link the acquired data with an interpretation of human–camelid relationship. Subsequently, as today, camelids were a very important economic factor for many Andean populations. Current ethnoarchaeological data can be used in order to compare modern and past behavior. Moreover, ethnoarchaeological research has given abundant information on how humans have related with camelids in various ways. Information on several topics is available, such as butchery patterns (e.g. Miller, 1977; Haber et al., 1991; Yacobaccio et al., 1998) and young camelid mortality within corrals (Wing, 1972; Wheeler Pires-Ferreira et al., 1976). More general studies focus on the use of camelids in various types of Andean economic systems (Tomka, 1993, 2001; Kuznar, 1995, 2001; Nielsen, 1997–1998, 2001; Yacobaccio et al., 1998).

Based on this available information, what can be expected for different archaeological contexts? Aldenderfer (2001) summarizes various ethnoarchaeological models based on economic characteristics of modern Andean populations. Basically they can be referred to as the “pastoralist” versus “agriculturalist” models. The agriculturalist model can consider other models, including those represented by mixed economies that rely both in agriculture and herding (and hunting as well). Major differences between the two models rely on seasonal movements which are more restricted for agriculturalists (Rabey, 1989; Nielsen, 1997–1998), the need for long distance trading circuits for herders and pastoralists (Nielsen, 2001) and differential herding management strategies (Flannery et al., 1989; Olivera, 1997, 1998; Izeta, 2007b). The modern models involve the analysis of several characteristics that can be tracked on the archaeological record of the Puna and valleys such as location of the settlements, type of associated structures (e.g. corrals, agricultural fields), the presence of foreign goods, and skeletal part representation, among others.

Some generalizations can be made. For instance modern Puna settlements are more prone to show herding contexts (Yacobaccio et al., 1997–1998, 1998), although in some archaeological cases as Antofagasta de la Sierra basin and Antofalla some ancient agriculture related structures were found. On the other hand, archaeological sites in valleys show settlement patterns that include households surrounded by agricultural fields. Hence, expectations when comparing the archaeological with the ethnoarchaeological record for the Puna and valleys will differ according to the association of the archaeofaunal assemblages to either of the two economic models. For that reason, ethnoarchaeological generated Andean economic models can help understand how the ancient population related with camelids through time.

3. Camelids in the Late Holocene economy

Today, the South American Camelid family is composed of four species: *Lama guanicoe* Müller 1776 (guanaco), *Lama glama* Linnaeus 1758 (llama), *Lama pacos* or *Vicugna pacos* Linnaeus 1758 (alpaca) (Gentry et al., 2004), and *Vicugna vicugna* Molina 1782 (vicuña). Two (llama and alpaca) are domesticated forms, and the other two (guanaco and vicuña) are wild species. These can be segregated by a size gradient where llama is the largest camelid, followed by guanaco, then by alpaca and lastly by vicuña (Mengoni Goñalons and Elkin 1990; Madero, 1993–1994; Yacobaccio et al., 1997–1998; Izeta, 2007a, b). These size differences allow species identification and therefore the interpretation of their importance within ancient Andean economies in different regions. Several techniques can be used in order to achieve species identification, differentiating in the process between wild and domestic forms (e.g. Cardich and Izeta, 1999–2000; Izeta, 2004, 2007a, b; Izeta and Cortés, 2006; Mengoni Goñalons and Yacobaccio, 2006).

The segregation between domestic and wild camelids has been based on several lines of evidence. In this paper the use of osteometric data from archaeological bones is the main technique used, followed by fiber analysis and stable isotope analysis. The first uses univariate, bivariate and multivariate statistics, as for Quebrada Seca 3 Nivel 2a, Urcuro 1 and Matancillas 2 where Meadow's (1999) univariate log-ratio technique was used (Elkin, 1996; López, 2003, 2004). On the other hand, bivariate plots following the Kent (1982) technique were used on Tebenquiche Chico 1 samples (Haber, 1999). Huirunpure camelids were discriminated using multivariate statistical techniques such as multidimensional scaling (MDS) (Yacobaccio et al., 1997–1998). Other multivariate statistics were applied to Southern Calchaquies valley samples (Discriminant Hierarchical Cluster using UPGMA) (Izeta, 2004, 2007a, b). Lastly, osteometric analysis was used for Casa Chavez Montículos 1 and 4 archaeofauna data, but no published data was found concerning this technique (Olivera and Elkin, 1994). Fiber analysis on Quebrada Seca 3 Nivel 2a and Casa Chavez Montículos 1 and 4 allowed differentiation of wild from domestic camelids (Olivera and Elkin, 1994). Lastly, stable isotope analysis ($\delta^{13}\text{C}$) was used on samples from Tesoro 1, Potrero Antigal (Izeta et al., 2006) and Punta de la Peña 9 (López Campeny et al., 2005). This last technique allows differentiation of camelids by their feeding habits and deserves to be further explored.

Morphological features were also used in order to discriminate wild from domestic camelids. Dental morphology allowed identification of subadult vicuña in the Bañado Viejo site. First phalanx morphology and osteometry made possible the identification of a ca. 32 months old guanaco from Loma Alta NE (LANE).

Age classes used in this paper tend to homogenize the available data. Several authors (e.g. Yacobaccio et al., 1997–1998) uses three age classes (nonate/neonate, juvenile

and adults). Here, the non-fused bones are treated as subadults (used here as a synonym for “not adult”) grouping previously defined finer-grain age classes.

Prior work based on the above procedures and the interpretation of body part representation and age profiles indicates that Late Holocene economies generally relied on camelid consumption. Olivera’s (1997, 1998) quantification of more than 10 sites suggests that camelid remain samples in all cases have NISP values higher than 80%. A similar case occurs in archaeofaunal assemblages from the southern Calchaquíes valleys (e.g. Izeta, 2004, 2007b).

In sum, camelids were the most popular animals in the period and the region, independent of which ecological zone is analyzed. In order to proceed to an interpretation of camelid use tendency, it is necessary to make a finer analysis, taking into account species and age differences to see the importance of wild or domestic camelids in each site and to investigate the economic relations between them.

4. Faunal assemblages

The samples come from two distinctive ecological zones from Northwestern Argentina: the lower valleys and the Puna. Analysis for the first zone uses the available information for Loma Alta (Izeta, 2004, 2007b; Izeta and Scattolin, 2006), Bañado Viejo (Izeta and Scattolin, 2001; Scattolin et al., 2001), Morro de las Espinillas, Antigal de Tesoro, Tesoro1, Potrero Antigal and Yutopían (Izeta, 2004, 2007b). For the second zone the sites are Quebrada Seca 3 Nivel 2a (Elkin, 1996), Casa Chávez Montículos 1, Casa Chávez Montículos 4, Real Grande NI and NII (Olivera and Elkin, 1994; Olivera, 1997, 1998), Tebenquiche Chico 1 (Haber, 1999), Matancillas 2 (López, 2003), Punta de la Peña 9 — PP9 (López Campeny et al., 2005), Urcuro 1 (López, 2004), Huirunpure and Puesto Demetria (Yacobaccio et al., 1997–1998) (Fig. 1). The ¹⁴C dates corresponds to the time span from 2480 to 700 BP (Table 1). These 17 sites have in total 27 different occupations. The results from these different bone assemblages are discussed.

Taphonomic information for the assemblages (when available) shows that most have been accumulated by humans. Although fragmentation is high in several assemblages such as those from the southern Calchaquíes valleys (Izeta, 2004, 2005, 2007b) and Punta de la Peña 9 (López Campeny et al., 2005) they can be associated to human activity rather than the product of sub-aerial agents. In sum, no taphonomic factors largely affect the assemblages treated in this paper (Izeta, 2007b).

4.1. Bañado Viejo

This is a multicomponent site located in the Santa María Valley bottom, 5 km north of the modern town of El Bañado (Tucumán Province). The sample allows the calculation of a MNI of 9 adult camelids and 3 subadults (less than 36 months old). Taxonomic determination using

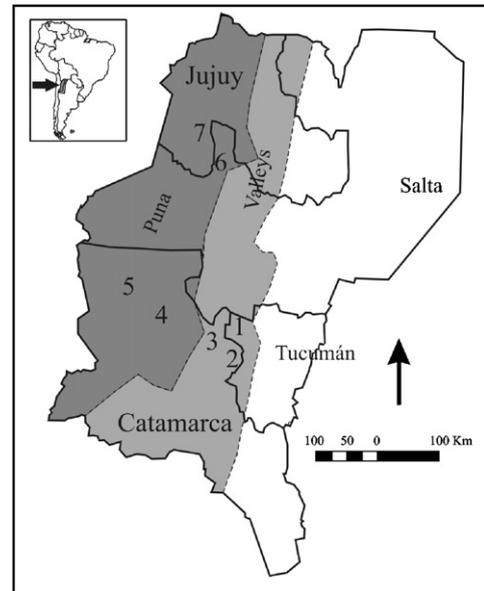


Fig. 1. Selected Sites. 1: Bañado Viejo; 2: Morro de las Espinillas, Tesoro 1, Antigal de Tesoro, Potrero Antigal, Loma Alta; 3: Yutopían; 4: Montículos Casa Chávez, Real Grande, Quebrada Seca 3, Punta de la Peña 9; 5: Tebenquiche Chico 1; 6: Matancillas 2, Urcuro 1; 7: Huirunpure, Puesto Demetria. Dark grey: Puna highland, light grey: valleys.

osteometric data suggests the presence of two llamas, two vicuñas and one guanaco. Deposits 1–2 contain one llama, one vicuña and a guanaco. Deposit 3 contains the other two camelids (one llama and one vicuña). No specific camelid identification was made on Deposit 6 archaeofauna.

4.2. Morro de las Espinillas

This site is situated near the modern village of Pajanguillo, in the southernmost part of the Santa María valley. It is a village composed of various rectangular stone structures within another stone enclosure that makes this site architecturally different from the others of the region. Although the faunal sample is scarce (NSP = 18) an adult and a subadult camelid were identified.

4.3. Tesoro 1

Located south of Morro de las Espinillas, this is the first of a group of sites located on the western slope of the Aconquija Range. In contrast to Morro de las Espinillas, the architecture of the village has semicircular stone structures with households located between agricultural fields, a pattern typical of other Formative villages from southern Calchaquíes valleys. The faunal sample is also scarce (NSP = 14), allowing the identification of one adult camelid. In 1986, University of La Plata (Argentina) researchers analyzed a bone sample totaling 3.2 kg. Much was used to make a radiocarbon date and stable isotopes analysis. The last analysis allowed interpretation of the

Table 1
Archaeofaunal data from Northwestern Argentina lower valleys and Puna (Late Holocene)

Site	Ecological zone	Radiocarbon dates BP	Period	Age (1)		Taxon (2)			Identification method	NSP	Excavated surface (ES) (4)	NSP/ES	MNI	References
				Subadult	Adult	Llama (%)	Guanaco (%)	Vicuña (%)						
Quebrada Seca 3 Nivel 2a	Puna	2480±60	Early	2	6	X	X	X	Osteometry/fibers	834	20	41.70	8	Elkin (1996) and Olivera and Elkin (1994)
Huirunpure c1	Puna	2040±70	Early	24.50	75.50	50.0	50.0	–	Osteometry	505	?	?	2	Yacobaccio et al. (1997–1998)
Urcuro 1	Puna	ca. 2000 (3)	Early	–	–	33.3	33.3	33.3	Osteometry	197	2	98.50	3	López (2004)
Matancillas 2 B2	Puna	1925±80	Early	–	–	33.3	33.3	33.3	Osteometry	501	?	?	3	López (2003)
Matancillas 2 R1	Puna	1925±80	Early	–	–	33.3	33.3	33.3	Osteometry	157	?	?	3	López (2003)
Matancillas 2 C2	Puna	1925±80	Early	–	–	100.0	–	–	Osteometry	72	?	?	1	López (2003)
Yutopíán Str11	Valley	1940±90	Early	10.10	87.90	33.3	33.3	33.3	Osteometry	2573	16	160.81	5	Izeta (2004, 2007b)
Yutopíán Str3	Valley	1830±60	Early	14.39	85.61	100.0	–	–	Osteometry	3436	20	171.80	5	Izeta (2004, 2007b)
Casa Chávez Montículos 1	Puna	1670±60	Middle	83.60	16.40	X	–	X	Osteometry/fibers	10998	32	343.69	?	Olivera and Elkin (1994)
Casa Chávez Montículos 4	Puna	1660±60	Middle	82.50	7.50	X	–	X	Osteometry/fibers	4421	32	138.16	?	Olivera and Elkin (1994)
Tebenquiche Chico 1	Puna	1610±70	Middle	69.00 (L) 8.00 (Vi)	31.00 (L) 92.00 (Vi)	30.0	–	70.0	Osteometry	3809	24	158.70	?	Haber (1999)
Yutopíán Str4	Valley	1630±60	Middle	12.00	88.00	–	–	–	–	1897	26	72.96	5	Izeta (2004, 2007b)
Bañado Viejo D6	Valley	1760±100	Middle	28.50	71.50	–	–	–	–	137	2	68.50	–	Izeta (2004, 2007b)
Yutopíán Str1	Valley	ca. 1600 (3)	Middle	16.66	83.34	–	100.00	–	Osteometry	2241	21	106.71	5	Izeta (2004, 2007b)
Loma Alta NE	Valley	1560±130	Middle	23.60	76.40	50.0	25.0	25.0	Osteometry	2933	70	41.90	8	Izeta (2004, 2007b)
Antigal de Tesoro R19	Valley	1536±25	Middle	30.00	70.00	100.0	–	–	–	456	1.5	304.00	2	–
Bañado Viejo D3	Valley	1400±40	Middle	21.50	78.50	50.0	–	50.0	Osteometry	282	2	141.00	3	Izeta (2004, 2007b)
Loma Alta NG	Valley	1360±60	Middle	23.50	76.50	100.0	–	–	Osteometry	451	6	75.17	2	Izeta (2004, 2007b)
Punta de la Peña 9	Puna	1150±50	Late	41.25	58.75	X	–	X	Stable isotopes/fibers	369	17.64	20.92	?	López Campeny et al. (2005)
Real Grande (N II)	Puna	1110±100	Late	78.30	21.60	X	–	X (95% MNE)	Osteometry	278	7	39.71	?	Olivera and Elkin (1994)
Real Grande (N I)	Puna	980±70	Late	85.10	14.90	X	–	X (95% MNE)	Osteometry	423	7	60.43	?	Olivera and Elkin (1994)
Puesto Demetria c2c2	Puna	820±90	Late	17.50	82.50	–	–	–	–	71	?	?	?	Yacobaccio et al. (1997–1998)
Bañado Viejo D1–2	Valley	1170±40	Late	25.20	74.80	33.3	33.3	33.3	Osteometry	568	2	284.00	3	Izeta (2004, 2007b)
Morro de las Espinillas	Valley	1160±40	Late	50.00	50.00	–	–	–	–	18	6.78	2.65	2	Izeta (2004, 2007b)
Tesoro 1	Valley	1090±115	Late	0.00	100.0	–	100.0	–	Stable isotopes	14	1	14.00	1	Izeta (2004, 2007b) and Izeta et al. (2006)
Potrero Antigal	Valley	735±115	Late	10.00	90.00	–	100.0	–	Stable isotopes	136	1	136.00	2	Izeta (2004, 2007b) and Izeta et al. (2006)
Loma Alta NF	Valley	700±50	Late	22.00	88.00	50.0	50.0	–	Osteometry	506	15	33.73	2	Izeta (2004, 2007b)

(1) Quebrada Seca 3 expressed as MNI, rest of the sites as %NISP. (2) X means presence, frequencies expressed as %MNI. (3) Estimated dates based on contextual archaeological record. (4) Expressed in m².

paleodiet of the camelid, suggesting a major intake of C3 photosynthetic path plants similar to those of modern free range feeding habit camelids. Therefore, this camelid can be interpreted as a “wild camelid” feeding type (Izeta et al., 2006).

4.4. Antigal de Tesoro

This site is 3 km westward of Tesoro 1, in the Aconquija Range at 3200 m above sea level. Similarly to the two sites discussed above, it shows one adult camelid (llama) and one subadult.

4.5. Loma Alta

Located at 3000 m above sea level and 5 km south of Tesoro 1 in Cerrillos, it shows the same architectural pattern as Tesoro 1. In Loma Alta three households were completely excavated: LANE, LANF and LANG.

LANE: Camelids for this household are represented by NISP = 445. Of these, 386 are Camelidae, 34 *Lama glama*, 13 *Lama guanicoe* and 12 *V. vicugna* (Izeta, 2004, Table 7.7). The adult NISP is 340 while the subadult NISP is 105. The MNI indicates eight adults and six subadults. The adult category is composed of four llamas, two guanacos and two vicuñas. Two elements of the llama group had palaeopathological features resembling osteoarthritis, suggesting some stress in the limbs that was interpreted as a result of cargo related activities.

LANF: Camelidae presents a NISP = 52 (45 Camelidae, 2 *Lama guanicoe* and 5 *Lama glama*). Adults are more represented than subadults (NISP = 46 for adults and NISP = 6 for subadults). That difference, when converted in MNI values for both categories, becomes equal to one.

LANG: With a NISP = 17, an adult llama and a juvenile camelid were identified.

4.6. Potrero Antigal

Potrero Antigal is located, as is Loma Alta, in the Cerrillos locality. It had a NISP = 136 with an adult camelid and a juvenile. Similarly to Tesoro 1, this site shows the presence of a “wild type” feeding habit adult camelid (Izeta et al., 2006).

4.7. Yutopián

Yutopián is a village with several households excavated, located in the Cajón valley westward of the Santa María Valley and east of the Puna. The selected households for this analysis are Structure 1 (YU STR1), Structure 3 (YU STR3), Structure 4 — upper occupation (YU STR4) and Structure 11 (YU STR11).

YU STR1: With a NISP = 2241, only 120 correspond to Camelidae. An MNI of three adults (one guanaco) and two subadults was calculated.

YU STR3: While the total NISP = 3436, the NISP for camelids is 139. As for Structure 1, three adults (one llama) and two subadults were calculated.

YU STR4 (upper occupation): Following the same pattern than the other structures of the site the NISP = 1897, corresponding 126 to camelids. Again, three adults and two subadults were calculated (MNI).

YU STR11: With a NISP = 2573 only 153 corresponds to Camelidae. Three adults (one llama, one guanaco and one not identified at the specific level) and two subadults were identified (one vicuña based on teeth morphology).

4.8. Quebrada Seca 3 N2a (Elkin, 1996)

This site shows the presence of six adults and two subadults. The specific differentiation with osteometric data has allowed the identification of guanaco and vicuña while fiber analysis permits recognition of llama, guanaco and vicuña. The proportion of wild camelids is higher than domestic forms.

4.9. Real Grande NI and NII, Casa Chávez Montículos 1 and 4 (Olivera and Elkin, 1994; Olivera, 1998)

The data published for the different occupations of the sites shows that subadults are the most represented in every sample with frequencies near 78% (%NISP). Within the adult assemblage the presence of domestic and wild forms (llama and vicuña, Table 1) was identified.

4.10. Punta de la Peña 9 — PP9 (López Campeny et al., 2005)

For PP9, adults are slightly more frequent than the subadults. Species (llama and vicuña) were determined by isotopic analysis and wool fabrics supported by macroscopic size differences.

4.11. Tebenquiche Chico 1 (Haber, 1999)

Osteometric data obtained from camelid bones allowed Haber (1999) to identify 30% llama and 70% vicuña. The age profile of the sample suggests that the domestic animals are represented mainly by juveniles or subadults while the wild camelids are represented mostly by adults. This means that the relations differ in both categories.

4.12. Matancillas 2 and Urcuro 1 (López, 2003, 2004)

The first sample comes from Matancillas 2, where three distinct units were excavated. The NISP specifically determined allows recognition of seven animals (three llamas, two guanacos and two vicuñas). For Urcuro, three animals were calculated, representing the same species as at Matancillas 2 (llama, guanaco and vicuña).

4.13. *Huirunpure and Puesto Demetria (Yacobaccio et al., 1997–1998)*

For these sites, the proportions of adult camelids are higher than the subadults. For the first, a llama and a guanaco were determined by statistical analysis from osteometric data.

In sum, the 27 assemblages allow consideration of different data and on different scales. Problems like sample sizes (Table 1) cannot be ignored in several of the sites if economic human–camelid relations are to be proposed. Furthermore, several assemblages, despite their time period assignment, correspond to partial excavations of the total site. However, as can be seen in Table 1, when the excavated surface is taken as a comparative measure some small samples become significant because of their archaeological contexts. Morro de las Espinillas has one of the smallest samples, but the archaeological context is similar to Late period (~1000–1450 AD) villages where discard patterns seems to be different to those of Formative (~450 BC–1000 AD) villages and occupations. Generally Northwestern Argentina formative households' floors present similar patterns as those noticed by Stahl and Zeidler (1990) in early formative contexts and ethnoarchaeological records from Ecuador: highly fragmented specimens associated with restricted activity areas or features, mainly combustion areas related with cooking activities. On the other hand, Late period contexts show “cleaner” floors and specific discard areas.

Having these potential problems in mind, and in order to normalize the amount of specimens recovered in each case, an index was used. This takes into account the total amount of recovered specimens (NSP) and the excavated area. Normalization allows comparison of large with small assemblages and determining when a small sample can be the result of a sampling effect or of human discard behavior. Differences in the NSP/Excavated area index were noticed in the assemblages (Table 1). However, when results are grouped by period (Early, Middle and Late), the descriptive statistics of the NSP/Excavated surface index shows for the Early moment a Mean 118.20, Typical error 30.17 and Median 129.65; for the Middle moment a Mean 145.07, typical error 32.14 and Median 122.43 and lastly for the Late moment a Mean 73.93, Typical error 33.38 and Median 36.72. Thus, formative assemblages (Early and Middle periods) can be segregated by sample sizes from the Late period, which shows a general tendency towards less specimens per excavated area than do the previous periods.

5. Discussion

The aim of this work was to establish if the archaeological camelid samples from the lower valleys and the puna allows the identification of different human–camelid relations and temporal use tendencies. Therefore, the frequency of each of the camelid species in every site from

the lower valleys and Puna for the Late Holocene can be discussed.

However, it is of fundamental importance to make a previous comparative analysis of the current location of the different camelids species in the Andean area and specifically in Northwestern Argentina. Beginning with the wild camelids, the guanaco is distributed along most of the Neotropical region, extending from the Central Andes to the Argentinean Pampas and extra-Andean Patagonia, Tierra del Fuego and Navarino Island. It is found at altitudes that range from sea level to 4250 masl (Franklin, 1982) although its presence at such high altitudes is not very frequent due to the high energetic requirements needed to maintain their large body size (Lucherini, 1995). Within the Andean area, their presence is associated with desert grassland and bush lands. At the present time they can be found in the Cumbres Calchaquies summits, Nevados del Aconquija and Chaschuil puna region in Catamarca Province (Lucherini 1995; Izeta, 2007b), and Valle Grande and Volcán in Jujuy Province (Yacobaccio, personal communication August 22nd, 2006).

Vicuñas show a more restricted distribution. They are found in the Andean area, in Ecuador, Peru, western Bolivia, northern Chile and Northwestern Argentina. Vicuña only inhabits areas of great altitude. The geographical and ecological differences among these two species have been proposed to be related to the vicuña's particular adaptation to high-altitude environments (Franklin, 1982). However, in some specific locations and due to special geographical conditions, these species can be found living in the same environment (Lucherini, 1995). In all the cases, the vicuña inhabits the puna ecological region. The distribution of llama species is confined to the Andean area, and it is one of the most frequent species of the region (Franklin, 1982).

Summarizing, modern camelid distribution can be considered to be differential in space, at least in the vast regions of the Argentinean Northwest. This situation is regulated nowadays by processes related to different ways of land use and occupation than were those of past populations. However, the data show some overlapping among camelid species, especially between llama and guanaco and llama and vicuña, while it is rare to see guanacos with vicuñas.

Was this the same situation in the past? The answer to this question can be interpreted from the analysis and comparison of the archaeological samples. Figs. 2a–c show the presence of camelid species in the archaeological sites in three arbitrary periods. These were used in order to look for patterns in the archaeological record. The first one includes the sites with dates around 2000 BP (Early period: 2480–1830 BP), the second with dates near 1600 BP (Middle period: 1760–1360 BP) and the third with sites dated around 1000 BP (Late period: 1170–700 BP) (Table 1). The periods do not correlate with any Northwestern Argentina “cultural” sequences. Instead, they are only “operational” and do not necessarily relate to

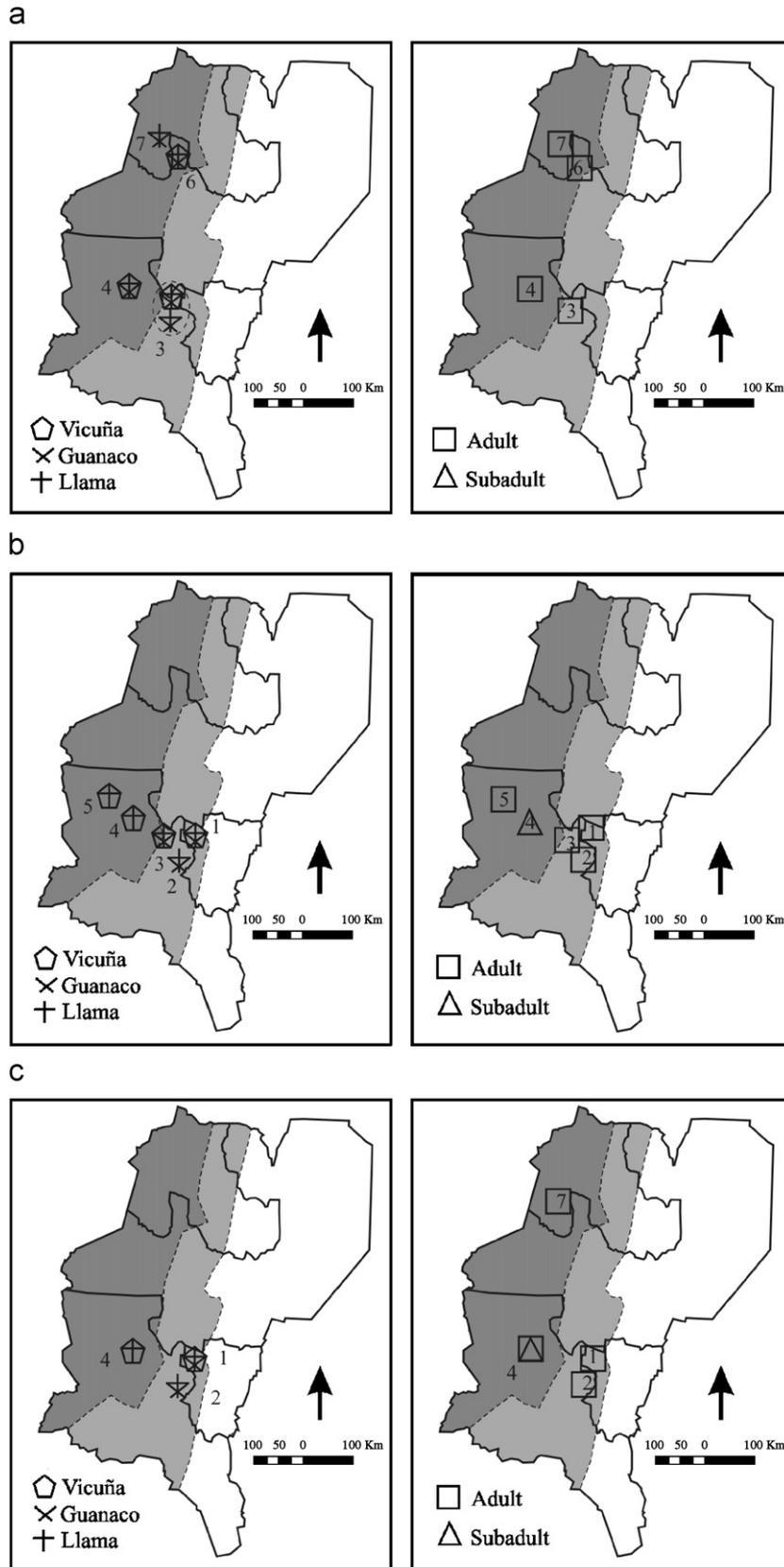


Fig. 2. Camelid distribution (species and predominant age class). (a) Early period (2480–1830 BP); (b) Middle period (1760–1360 BP); (c) Late period (1170–700 BP). 1: Bañado Viejo; 2: Morro de las Espinillas, Tesoro 1, Antigal de Tesoro, Potrero Antigal, Loma Alta; 3: Yutopián; 4: Montículos Casa Chávez, Real Grande, Quebrada Seca 3, Punta de la Peña 9; 5: Tebenquiche Chico 1; 6: Matancillas 2, Urcuro 1; 7: Huirunpure, Puesto Demetria. Dark grey: Puna highland, light grey: valleys.

technological or cultural changes for the Northwestern Argentinian Andes. Consequently what it is shown in Fig. 2 must be interpreted as a portrayal of a continuous process that operated in Northwestern Argentina during the Late Holocene.

Beginning with the Early period, in the puna of Salta the represented species correspond to llama as much as guanaco and vicuña (Urcuro and Matancillas 2). For Jujuy Puna there is record for llama and guanaco (Huirunpure). No vicuña was registered, although their presence in previous times is well documented (e.g. Yacobaccio et al., 1997–1998). For both sites of Salta's Puna, the presence of wild animals is more frequent than domestic ones. For the Antofagasta de la Sierra Puna, the represented species are llama, vicuña and guanaco. The identification was based on osteometry and through fiber analysis (Elkin, 1996). The lower valley archaeofaunas show the presence of all three camelid species. Adults are the predominant age group represented in both zones throughout this first period. Wild animals are relatively more abundant in Puna sites, as they are registered in five of eight sites with species identification data. The valleys show one occupation with more wild camelids, while the other shows more domestic forms (Tables 1 and 2).

The Middle period shows some differences. In the Puna samples, guanaco presence is not verified at all, and neither is the vicuña in some sites of the lower valleys (e.g. Yutopián). As for the frequencies of adults and subadults, the valleys have a preponderance of adults in every recorded site (Table 1). Within the Puna of Antofagasta de la Sierra the proportions are inverted, and therefore subadult remains dominate (Olivera and Elkin, 1994; Olivera, 1997, 1998). Antofalla shows a particular situation where the llamas exhibit a major frequency of subadult specimens (no methodology is presented to obtain this result) and vicuña are largely represented by adults (Haber, 1999). Because vicuña frequencies are up to 70% of the whole assemblage the site tendency is to present more adults than subadults (Table 2).

Table 2
Summary of observed patterns

	Puna	Valleys
Early (ca. 2000 BP)	More adults/more wild animals/Llama-Vicuña-Guanaco	More adults/wild and domestic animals in same proportion/Llama-Vicuña-Guanaco
Middle (ca. 1600 BP)	Variation in age classes between sites—more subadults/more wild animals/Llama-Vicuña	More adults/variation in wild and domestic animals proportion between sites/Llama-Vicuña-Guanaco
Late (ca. 1000 BP)	More adults in residential camp bases—more subadults in short term occupations/more wild animals/Llama-Vicuña	More adults/more wild animals/Llama-Vicuña-Guanaco

For the last period llama and guanaco presence has been recorded within the Aconquija Range western slope and in the bottom of the Santa María valley (Izeta, 2004, 2007b). In this last case, vicuña has also been detected (Izeta and Scattolin, 2001). For the Puna also wild and domestic camelids are noted. In Punta de la Peña 9, a residential camp base, llama and vicuña presence is interpreted through isotopic analysis of wool fabrics supported by bone macroscopic evidence of two different size groups assigned to vicuña (the smallest) and llama (the largest) (López Campeny et al., 2005). The same situation is present at Real Grande N I and N II where llama and vicuñas are present in the archaeological record. In this last site vicuña remains represent 95% of the specifically determined MNE (Olivera and Elkin, 1994).

Regarding age groups, the lower valleys region presents the same proportion for the three periods where adult is the most frequent age class (Table 2), while in Puna this proportion is more variable. In some sites, the subadult presence is higher, as in Real Grande, a short term occupation site. In others, the registered predominance is of mature animals (Punta de la Peña 9 and Puesto Demetria, both residential camp bases). Summarizing, the tendencies of camelid use shows that the Middle and Late periods seem to be more complex than the Early period (Table 2).

The same tendency can be appreciated through camelid paleodiet isotopic analysis (information that is available only for the lower valleys: Santa María, Ambato and La Candelaria region). Camelids from ceremonial contexts from Ambato valley and La Candelaria region are not considered extensively in this paper. However, the analysis of this data demonstrated that remains from ceremonial contexts showed more enriched values of $\delta^{13}\text{C}$ (mean $\delta^{13}\text{C}$ –10.70‰) than those from domestic contexts (mean $\delta^{13}\text{C}$ –17.43‰). This was interpreted as the result of differential handling or control of the food for camelid individuals or herds, segregating the domestic animals from the wild camelids that feed freely (Izeta et al., 2006). Those ceremonial contexts correspond to occupations dated between 1600 and 1260 BP (Middle and Late periods in this paper).

Also, there are camelid elements from the Middle period site Loma Alta (LANE) that present pathologies probably caused by overloading of the limbs of the animals related to transport activities and (possibly) caravan traffic (Izeta and Cortés, 2006). Those signs have not yet been registered in the Early period assemblages.

In Puna, most of the groups are represented by wild animals, mainly vicuña, which is reasonable as it is a typical resource of the area. Seven of the 13 Puna occupations show more wild animals. Within this category, vicuña is always represented in the three periods while guanaco is only registered in Early moments. The other five Puna occupations from the Middle and Late periods show the presence of llamas and vicuñas. In the cases when quantification was made, vicuña represents the most

frequent species (e.g. Real Grande where vicuña MNE represent 95% of the assemblage). On the contrary, in valley sites the most represented wild species is guanaco. It was registered in eight of the 14 occupations while vicuña is present only in four.

A greater variability exists in age classes for that area compared to the valleys. The valleys continue to present a similar pattern throughout the three periods, although wider variability in the economic practices is shown by other indicators (palaeopathologies and paleodiet).

6. Conclusion

The increase of complexity in the relationships among humans and camelids can be analyzed through archaeofaunal remains. Although at first sight the compositions of the samples seem to be similar, subtle differences reveal distinct tendencies in the camelid use throughout North-western Argentina. This is more evident in the Middle and Late periods, where palaeopathological and isotopic information demonstrates by independent lines of investigation that the use of camelids is more complex than for the Early period. Even more, the high frequency of subadults in the puna starting in the Middle period could indicate different relationships between humans and camelids as a result either of local generation or introduction of determined economic practices which could include breeding intensification, or adverse paleoenvironmental conditions such as animal food shortage (Olivera, 1997). On the other hand, the presence of adults in the valleys may be an indicator of animals being used mainly for transport or wool acquisition (Izeta and Cortés, 2006; Izeta, 2007b).

An interesting conclusion of this analysis is that in the Early period no major differences can be noticed for the Puna and valleys' species representation. Domestic and wild camelids are noticed in both zones. While domestic animals provide food, wool and transport, the presence of wild animals shows an inclination to minimize the risk associated with herding practices (risk management *sensu* Browman, 1997). Guanacos are lacking in Puna sites since the end of the Early period (~1830 BP). Therefore, this can be interpreted as a decrease of the wild camelid biodiversity in that region as a product of environmental conditions, hunting pressure or even the occupation of their niche by domestic herds. This idea needs further investigation and the analysis of more Early period camelid samples.

Thus, in light of the existing data, two general tendencies are distinguished: one that privileges the maintenance of mature age animals; and another that privileges the use of subadult domestic and adult wild animals (although some variation can be observed). The first tendency corresponds to the valleys throughout the three periods and the second for the Puna for the Middle and Late Periods. Integrating these two variables indicates that during the Late Holocene in the south of the Calchaquíes valleys, the conservation of the domestic livestock would be privileged until mature age

(possibly for the use of secondary products as wool or transport). This tendency was possible because agriculture generated the staple food for those ancient villagers. On the other hand, the strategy of the puna would be more diverse, as the use of adult wild animals and subadults domestic ones was recorded.

Subsequently, this evidence can be associated with the two ethnoarchaeological economic models presented by Aldenderfer (2001), where Puna short term occupations and some residential camp bases can be related very well to the pastoralist models while the lower valleys seem to be more likely related to the agriculturalist one.

In sum, a simple model of the use of South American camelids can show complexity concerning the region and period studied. Therefore, subtle changes in camelid use as noticed in the Middle and Late periods can lead to a better understanding of the Late Holocene local economies. This can reveal differences in human–camelid relations between the different regions and through time.

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