Social dimensions of camelid domestication in the southern Andes

Hugo D. YACOBACCIO
Sección Arqueología,
Universidad de Buenos Aires,
25 de Mayo 217 (C1002ABE), Buenos Aires (Argentina)
Yacobaccio@aol.com

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ABSTRACT
Complex hunter-gatherers are distinguished from those called egalitarian or generalized, because they do not have equal access to resources. They are characterized by reduced residential mobility, social inequality, economic and craft specialization, and widespread exchange networks. These are discussed in the context of Holocene hunter-gatherers of the southern Andes, especially those aspects related to reduced residential mobility, mortuary practices, and prestige technology. In this perspective, the goal of this paper is to propose the idea that certain elements of social complexity developed in the region within the hunting-gathering society, and that camelid domestication is the outcome of this development.

KEY WORDS
Complex hunter-gatherers,
Camelid domestication,
Southern Andes

RÉSUMÉ
Dimensions sociales de la domestication des camélidés dans les Andes du Sud.
Les chasseurs-cueilleurs hiérarchisés se distinguent des chasseurs égalitaires ou généralistes par un accès non égalitaire aux ressources. Ils se caractérisent par une mobilité résidentielle réduite, par l'inégalité sociale, une spécialisation économique et artisanale, et par l'amplitude de leurs réseaux d'échange. Dans cette optique, l'objectif de ce travail est de soutenir l'idée que certains éléments de la complexité sociale se sont développés dans cette région au sein de la société de chasseurs-cueilleurs et que la domestication des camélidés a été le résultat de ce développement.

MOTS CLÉS
Chasseurs-cueilleurs hiérarchisés,
domestication des camélidés,
Andes du Sud.

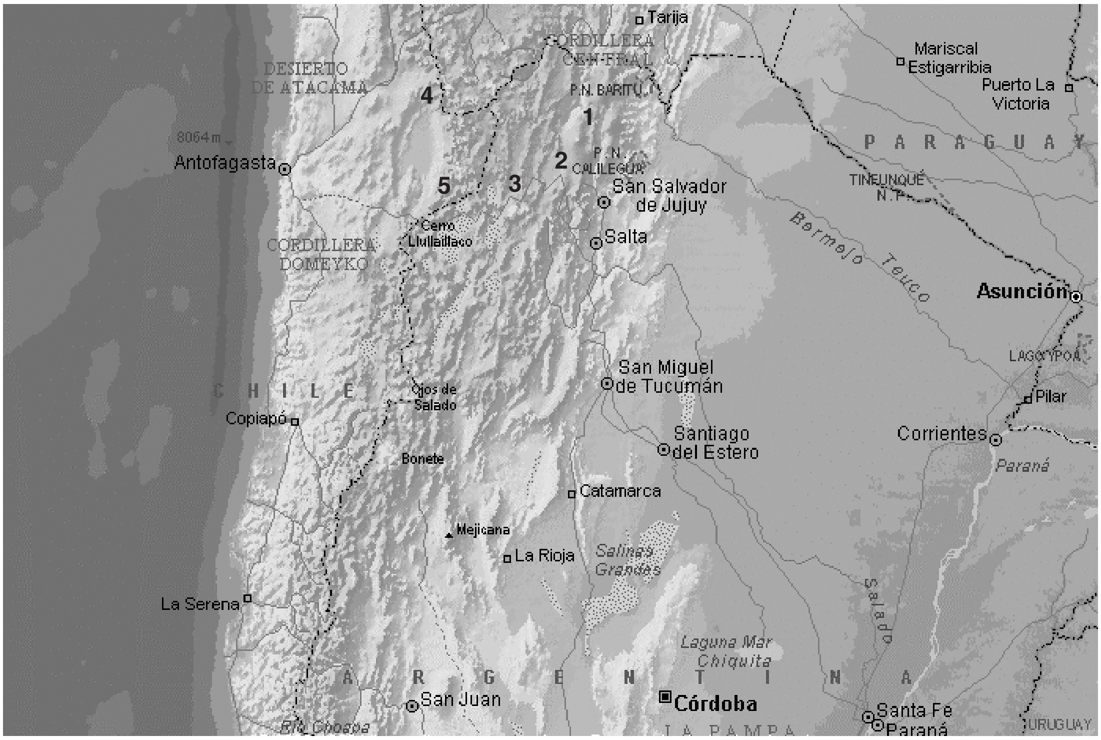

FIG. 1. – Sites with evidence of domestication and/or complexity discussed in the text.
References : 1. Inca Cueva 4 and Inca Cueva 7 ; 2. Huachi- chocana III ; 3. Alero Unquillar ; 4. Puripica 1 ; 5. Tulán 52.

INTRODUCTION

Llamas and alpacas are the only domesticated ungulates in all the Americas. The origins of domestication and the development of native camelid herding is restricted to the central and southern portion of the Andes, particularly Peru, Bolivia, northern Chile, and northwestern Argentina. Domestication took place in a high-altitude region, called Puna, between 3 400 and 4 200 m (Wing 1986; Browman 1989; Wheeler 1998; Stahl 2003). In pre-European times domesticated camelids were widely distributed from the highlands to the valleys, lowlands and coast. They were the main resource for Andean economies and social life, and held a key role in the expansion of early states starting with Tiwanaku and then the Incas.

The Spanish conquistadors who arrived in the Andes in the 16th century realized the importance of the camelids to the Andean civilizations. They recorded the huge quantity of domestic llamas and alpacas, describing in detail the organization of camelid pastoralism under Incan rule. They also mentioned the use of wild vicuñas and guanacos as sources of fine fiber and meat respectively (Murra 1978; Dedenbach Salazar 1990).

The goal of this paper is to show the relationship between the early development of camelid domestication and emerging complexity in hunting-gathering society. Camelids were important for the economy, the social relationships and the symbolism of these ancient hunter-gatherers. Living animals incorporated into a cultural milieu could have economic, social, and symbolical value simultaneously, thus becoming an integral part of society, influencing public and private behaviors (Hayden 1995). This analysis

will be focused on evidence mainly from northwestern Argentina and northern Chile (Fig. 1).
"Complex" has been defined as opposite to "generalized" hunter-gatherers. While the latter are often characterized by high mobility, flexible social groups, and low density populations, complex hunter-gatherers have social hierarchies (some with permanent leadership positions), delayed-return economic systems, prestige technology, and reduced residential mobility or even sedentarism (some with defended territories) (Barnard 1983; Hayden 1993; Kelly 1995; Ames & Maschner 1999). Although there is no single progressive trend toward complexity, there is evidence of local historical trajectories producing a high degree of variation in the social and economic configuration of complex hunting-gathering from different parts of the world (Rowly-Conwy 2001).

THE SOUTH AMERICAN CAMELIDS

The South American camelids are classified in two genera, *Lama* and *Vicugna*, based on their physical appearance and DNA data. At present four existing species are recognized : two are wild, the vicuña *(V. vicugna)* and the guanaco *(L. guanicoe)*, and two domesticated, the llama *(L. glama)* and the alpaca *(L. pacos)*. Current information suggests that the llama is the domesticated form of the guanaco, and the the alpaca possibly derived from the vicuña or from a hybridisation between the llama or guanaco and the vicuña (Vidal Rioja *et al.* 1994; Merabachvili *et al.* 2000; Wheeler *et al.* 2001; Vilá 2002). The evidence shows that domestication of the llama took place in several Andean locations, while evidence for the domestication of the alpaca comes only from the Puna de Junín (Perú) (Lavallée *et al.* 1985; Lavallée 1990; Stahl 2003; Yacobaccio 2001a).
Today camelids play a key role in Andean pastoral society, being a source of meat, hide, fibre, and dung; in particular, llamas are used as pack-animals. In the present and in the past both wild and domestic camelids have importance in rituals, ceremonies, and mythology.

CAMELID DOMESTICATION

Archaeologists and other researchers, including geographers or anthropologists, have constructed several models in order to explain the process of animal domestication, and have explored distinct primary causes that could have triggered this important change in human societies. The authors' identification of these causes relied (1) on the ecological and environmental realm, (2) as an outcome of specific social relationships of past societies, (3) or as part of ideological constructions such as "domestication metaphors" or new religions (Hodder 1990; Hayden 1995; Harris 1996; Cauvin 2000). In the Andes, some authors proposed external factors as causes for the origin of camelid domestication. They argue that the need for more meat and for transport animals, to help cope with unstable and risky environmental conditions, was the main reason (Hesse 1982). An earlier human demographic increase is assumed to be the underlying factor influencing the change in the strategies of animal use by hunter-gatherers. These explanations have a common feature related to the potential economic benefit that people could have obtained by domesticating camelids (Núñez 1989; Aschero 1994). But, whatever the primary causes for camelid domestication in the southern Andes, it was part of the context of increasing social complexity that took place in the hunter-gatherer groups. Also the social modifications that took place in hunting-gathering societies were linked to the environmental change which occurred in the Middle Holocene.
The Holocene in this region was characterized by environmental fluctuations. In the 10900-7700 cal. BC period, when human colonization occurred, the climate was cold and humid, with average precipitations of about 50% to 75% higher than today (Sylvestre *et al.* 1999). The 7700-4200 cal. BC timespan witnessed a generally dry, hot period, but better local conditions (i.e., abundance of water) were available for hunter-gatherer populations in restricted areas. More humid conditions were established as from 4200 cal. BC onwards, in a process that reached a maximum about 2000 cal. BC (Grosjean 1994; Sylvestre *et al.* 1999). Since

the Middle Holocene the environment was patchy, with plant and animal resources concentrated in favorable areas such as lake-margins, narrow gorges, and sedimentary basins.

The archaeozoological record in the southern Andes shows a long-term trend of intensification of camelid utilization. The representation of camelids in a sample of 20 sites from southern

TABLE 1. – Camelid remains from sites of the southern Andes.
Also shows taxonimic determination of camelid species when available.
Key : V= vicuña (Vicugna vicugna) ; G= guanaco (Lama guanicoe) ; Ll= llama (Lama glama) ;
(Ll= specimen of similar size than llama ; A= alpaca (Lama pacos).

Period	Site	Location	Percent of camelid bones	Number of Identified bones per taxon	Identified Species of Camelid	References
10900 to 7700 BC	Asana	S. Perú	79.7	—		Aldenderfer 1998
	Tuina 1	N. Chile	60.9	41		Núñez 1983
	San Lorenzo 1	N. Chile	7.3	68		Núñez 1983
	Pintoscayoc	NW. Arg	12	1745		Elkin & Rosenfeld 2001
	Inca Cueva 4/2	NW. Arg	10.2	1045	V, G	Yacobaccio 1994
	Huachichocana III/E3	NW. Arg	87.4	859	V, G	Yacobaccio 1994
	Quebrada Seca 3 (LL)	NW. Arg	81.2	373	V, G	Elkin 1996
	Tambillo	N. Chile	47.6	2197		Núñez 1983
7700 to 4200 BC	Puripica 13-14	N. Chile	94	238		G Núñez *et al.* 1999
	Hornillos 2/2	NW. Arg	48.9	364	V, G ?	Yacobaccio *et al.* 2000
	Quebrada Seca 3 (ML)	NW. Arg	91.8	881	V	Elkin 1996
	Puripica 33	N. Chile	99	932	V, G	Núñez *et al.* 1999
4200 to 1800 BC	Puripica 34	N. Chile Seca 3 (UL)	96	142		Núñez *et al.* 1999
	Quebrada	NW. Arg	94	1393	V, G	Elkin 1996
	Chiu Chiu Cementerio	N. Chile	98.5	5873	V, G, ≈ Ll	Cartajena Concha 1997
	Tulán 52	N. Chile	84.8	14.264	V, G, ≈ Ll	Núñez 1983
	Puripica 1	N. Chile	76.3	4490	V, G, ≈ Ll	Núñez 1983
	Tomayoc	NW. Arg	99.7	367	A ?	Lavallée *et al.* 1997
	Inca Cueva 7	NW. Arg	50	40	≈ Ll	Aschero & Yacobaccio 1998/99
	Huachichocana III/E2	NW. Arg	100	57	Ll	Yacobaccio & Madero 1992
	Alero Unquillar	NW. Arg	92	50	≈ Ll	Yacobaccio *et al.* 2000

TABLE 2. – Summary statistics about camelid remains in the Holocene.
Figures are percentages of identified bones.

Period	N (sites)	Average	Standard Deviation	Range	Min/Max
10.900-7700 BC	8	48,28	34,24	80,1	7,3/87,4
7700-4200 BC	4	83,42	23,21	50,1	48,9/99
4200-1800 BC	8	86,91	17	50	50/100

Peru, northern Chile, and northwestern Argentina, ranging in age from 10800 to 1800 cal. BC, shows this pattern. Table 1 lists the localities, the percentage of camelids in each one, and the total bone remains identified per taxon. Camelids average 48.2% of the identifiable remains from sites of the Early Holocene (10800 to 7700 cal. BC), with a great deal of variability at each locality, perhaps showing a generalized, opportunistic strategy in obtaining animal resources. By the Middle Holocene (7700-4200 cal. BC), camelids increase to 83.4%, its variation diminishing between localities. Camelids almost always make up more than 86.9% of the assemblages from the Late Holocene (4200 to 1800 cal. BC), and reach 100% of the archaeofauna on some sites, with little variability in the profile of exploited species from site to site across this broad region (Table 2). On the other hand, exploitation of other animal resources declines dramatically (Yacobaccio 2001b). Thus, over several millennia of intensive interactions, especially from the Middle Holocene onwards, camelids become the overwhelmingly dominant animal resource in the southern Andes.

This rise is associated from 4200 cal. BC onward with several indicators showing that a new kind of relationship between people and camelids beyond hunting was developing at this time. This evidence includes captivity of animals inferred from the presence of corrals, and dung-layers and an increase in animal size is noted from osteometric analysis.

Evidence of corrals and the penning of camelids can be found at two sites in the south-central Andes. In the first occupation of Inca Cueva 7, a small cave located in the Argentine puna, dated to 2590-2518 cal BC, dung pellets cover the surface of the cave floor and a stone wall enclosed the mouth of the cave (Aschero & Yacobaccio 1998-99). At Asana, an open-air site located in southern Peru, dung-derived soil deposits are outlined by a series of post-molds that have been interpreted as a corral and dated to 2025 cal BC (Aldenderfer 1998). These two cases are the oldest evidence of enclosures for the entire high Andes.

As mentioned already, at 1720 cal. years BC a camelid the size of a pack-llama appears in the archaeological record as shown by allometric analysis on a camelid head found as an offering in an inhumation of an adult man at the site of Huachichocana III, layer E2 (Yacobaccio & Madero 1992). Also the existence of a statistically significant size increase in bones of the lower hind limb, especially in the distal depth of the metacarpal is recorded. This can be seen in Figure 2 in which evidence from Alero Unquillar, Inca

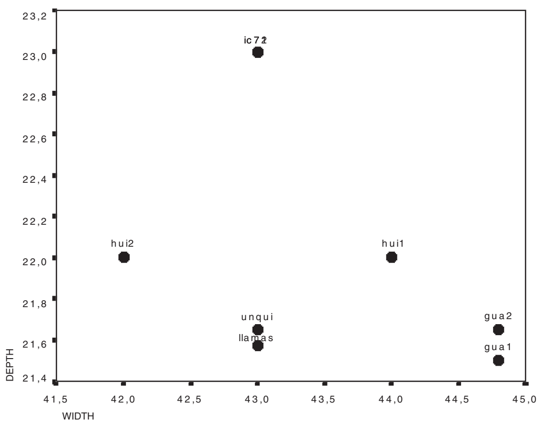

FIG. 2. – Measurements of the lower hind limb (von der Driesh) Bones from alero Unquillar, Inca Cueva 7, and Huirunpure are compared with those of modern north Andean guanacos and with the average of four modern llamas.

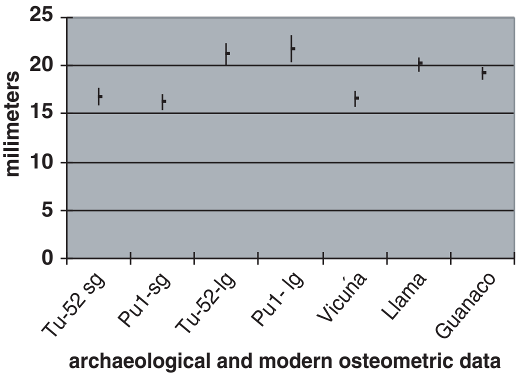

FIG. 3. – Measurements of the proximal latero-medial width of the first phalange from Tulán 52 and Puripica 1 sites compared with that of modern camelid species.

Cueva 7, and Huirunpure is compared with that of modern north Andean guanacos and the average of four modern llamas. Although a high variability in the data is observed, they are grouped near llama figures. The same trend is also recorded in other bones, such as the proximal latero-medial width of the first phalange that is thicker than those of modern guanacos in specimens of Tulán 52 and Puripica 1 sites, approaching the llama figures (Fig. 3). I suggest that these large camelids are a transitional form between wild guanacos and herded llamas. Also Figure 3 shows a small camelid group in these assemblages, which can be taxonomically assessed as vicuñas.

The development of a relationship of protecting-herding (Harris 1996), in which local groups of hunter-gatherers with reduced residential mobility were managing segments of large camelid populations, affording them protection from natural predators and access to forage and water, could explain the appearance of large camelids in the archaeozoological record. Meanwhile, the hunting of vicuñas continued. The archaeological record between 4200 and 1720 cal. years BC shows several sizes in the camelid populations : one large, with high size variation (the protected one, most probably large guanacos that were the origin of the llamas), and one small (vicuñas that were heavily hunted), and finally, the appearance of domestic llamas (Table 1).

SOCIAL CONTEXT OF CAMELID DOMESTICATION

I will present some evidence that shows the changing patterns between 4100 and 1720 cal. BC, associated with emerging features of complexity. These changing patterns can be better discerned in historical perspective, as a result of several millennia of human occupation in the area. I will concentrate on three elements, namely, reduced residential mobility, burial patterns, and prestige technology.

EVIDENCE FOR REDUCED MOBILITY

From 4100 cal. BC onwards (date of Isla Grande site, Núñez 1981), substantial sites with stone-made habitation structures appear in the region. These have been interpreted as evidence of reduced residential mobility or even sedentism (Núñez 1981). Some of them, like Tulán 52 and Puripica 1, have 20 to 40 circular structures interspersed with courtyards and cover a surface of about 400 m^2 to 540 m^2. The habitations gave evidence of domestic activities and, in one case, storage-pits. Outside the dwellings, especially in the courtyards, mortars and pestles were found in high quantities. Also, evidence of long distance exchanges can be seen in the occurrence of Pacific Ocean shells and, possibly, obsidian from the high Puna (Yacobaccio *et al.* 2002). In Puripica 1, inside one habitation structure a sandstone with depictions of camelids was found interpreted as domesticated camelids (Berenguer 1996; Klarich & Aldenderfer 2001), (Fig 4). Both sites show an intensive use of camelids (Table 1), whilst osteometric data shows the presence of a camelid that fit the size of actual llamas.

Also ceremonial structures appear from levels IX to VIII (4000 cal BC) at the Asana site in the highlands of southern Peru. Aldenderfer (1998) characterized these structures by the presence of prepared clay floors, altars, stone circles and ovals, trenches, clay-surfaced basins, surface hearths, miniature ovals and circles of posts. These structures showed changes through time, suggesting that "[...] the ceremony and the ritual that took place within them moving across a continuum from open and public in the earliest

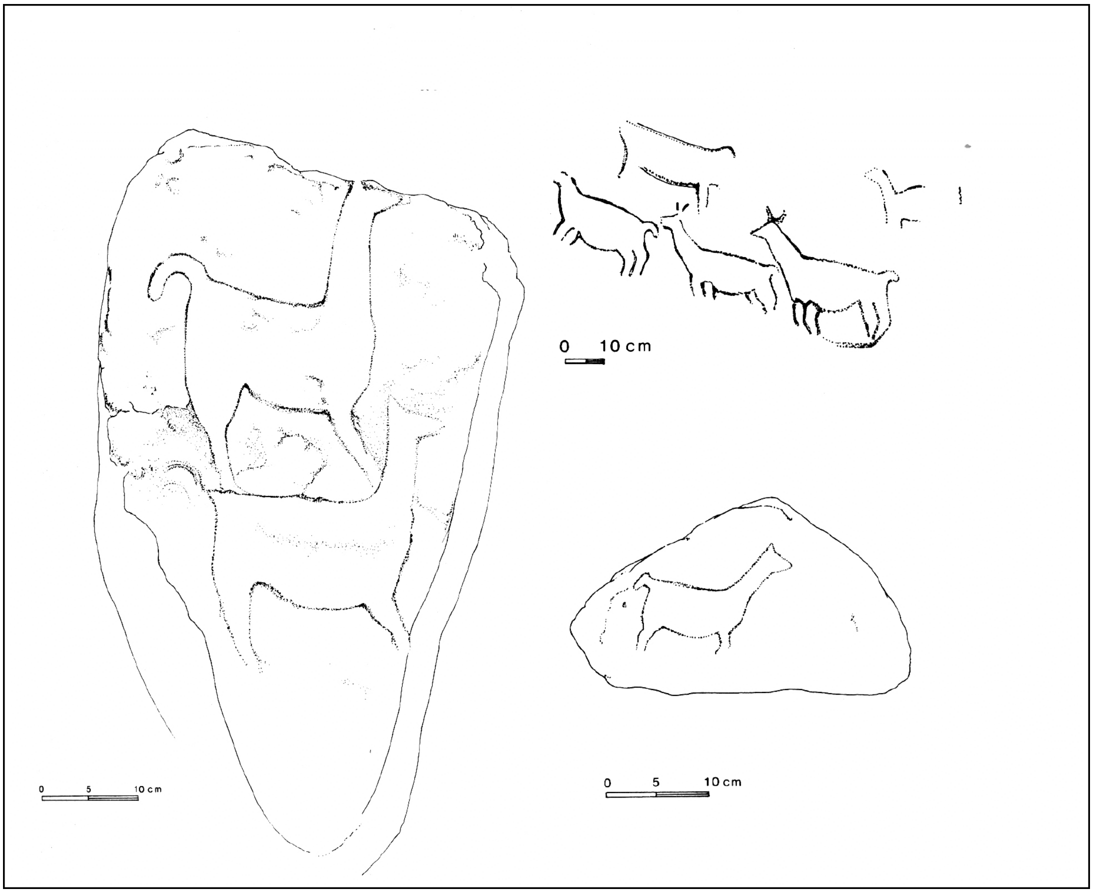

FIG. 4. – Camelid depictions : left, and bottom right engraved stones from Puripica 1 found inside habitation 1 ; top right : engraving from Tulán 64 rock shelter. This style of camelid representation is considered to depict domesticated animals. (Redrawn from Dransart 1991).

levels to close and private in level VIII times" (Aldenderfer 1998 : 256).

BURIAL PATTERNS AND PRESTIGE TECHNOLOGY

Human remains were found at Inca Cueva 4, and were dated between 4140 and 4020 cal. years BC (Aschero 1994). At least one mummified body deposited in a flexed position, possibly a female, was recovered. The corpse was wrapped with a netting textile, over which a blanket of camelid skin covered the body; on her head was a decorated basket-like hat. Moreover, with this individual there were several selected body parts from other individuals, including the skull of an adult man without its mandible, a child's skull, a mummified head with two articulated cervical vertebrae, and several mummified body parts of children (legs, feet, and skull). Among the valuable objects are beads of marine and spring-water shells, tropical bird feathers, decorated baskets, carved wooden bowls, wooden cradles, wool- and vegetal-fibre ropes, and blankets made of camelid skins.

Because of its rich offerings, it is also important to note the inhumation of layer E2 of Huachichocana III, dated around 1720 cal. BC (Fernández Distel 1986). Numerous offerings were included with the body of an 18 year old man

TABLE 3. – Types of sites, dates, and evidence of domestication and/or complexity.
Evidence discussed in the text.

Site	Level	Type of site	Altitude (masl)	Date cal. BC	Evidence of Complexity	Evidence of Domestication
Inca Cueva 4	1a	cave	3 650	4140	Elaborated burial patterns/long-distance exchange network	
Tulán 52	II-IV	village	3 200	3350/2650	Reduced residential mobility or sedentarism	Osteometry : camelids having the size of modern llamas
Puripica 1	II-IV	village	3 250	3100/2300	Reduced residential mobility or sedentarism	Osteometry : camelids having the size of modern llamas. Age-classe profiles. Camelid engravings
Inca Cueva 7	II-III	cave	3 600	2590	Prestige technology/ long-distance exchange network	Dung layer. Osteometry : camelids having the size of modern llamas
Huachicho-cana III	E2	cave	3 400	1720	Elaborated burial patterns/ long-distance exchange network/prestige technology	Allometry : Camelid with weight equal to modern llamas
Alero Unquillar	2	Rock shelter	3 750	3780		Osteometry : camelids having the size of modern llamas

lying in a flexed position. These objects were manufactured with local raw materials, but others were possibly obtained from lowland or mountain forest peoples through exchange. Examples of these are carved wooden parrot heads with incised decoration, a stick with geometric designs, necklaces made with shells-beads from the Pacific Ocean and others made from newborn camelid scapulae, baskets, twinned textiles and polished stone pipes (for a detailed description see Fernandez Distel 1986). Placed behind the body was a camelid head with the two first cervical vertebrae attached. Allometric studies allowed us to infer that this specimen was of equal weight and size as modern pack-llamas (Yacobaccio & Madero 1992). This context may be indicative of individual access to prestige goods (local and foreign), including domesticated camelids, which could have played an important role as prestige animals. More evidence of prestige objects has also been recovered from Inca Cueva 7 (Aguerre *et al.* 1973; Aschero & Yacobaccio 1998-1999). This small cave was first used as a place to keep camelids in captivity as revealed by a dung-layer located at the bottom of the sequence. Over this a huge quantity of remarkable artefacts were disposed. These two episodes were dated to 2590 and 2518 cal. BC, being synchronous, radiometrically speaking. Some of these objects are pyro-engraved flutes, bone flutes, decorated bone spatulae, sticks decorated with geometric designs made of hard wood, pipes made of puma *(Felis concolor)* long-bones, baskets, pyro-engraved gourds *(Lagenaria siceraria)*, and many textiles (see Aguerre *et al.* 1973). This assemblage has been interpreted as belonging to an individual (or individuals) of high status (Aschero & Yacobaccio 1998-1999). As seen in Fig. 2, several camelid metapodials were measured, indicating the presence of an animal of equal size to large modern llamas. The same kind of bone data was obtained from the nearby Alero Unquillar, although in this case they were not associated with prestige technology, but with an occupation of domestic character (Yacobaccio *et al.* 2000).

CONCLUSION

The review of evidence in this paper shows that certain traits of complexity appear after 4100 cal. BC coupled with data that reveal camelid domestication (Table 3). This kind of evidence seem to increase with time, challenging the view of a unique center of camelid domestication in the Andes, formerly thought to be in the central Andes, particularly the Puna of Junin.

Evidence of captivity in caves serving as corrals are dated to 2590 cal. BC (the oldest in the Andean region), and camelids equal in size to large modern llamas were present in different locations at roughly the same date. The archaeological record shows that bones of domesticated camelids appear in different contexts : (1) food debris in trash-heaps; (2) associated with prestige technologies, bones or hides, as a raw material for manufacturing special artifacts, and (3) as offerings in human inhumations. For the first time domesticated camelids also appear depicted in rock and mobile art, being formally different from that of wild camelid depictions (Gallardo 2001) (Fig. 4).
Living animals were integrated into the human community intersecting the economic, social, and symbolic spheres of society. Hunter-gatherers domesticated the camelids, but at the same time, and from the very beginning, the domestic camelids changed the structural basis of hunting society.

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