Camelid management during Inca times in N.W. Argentina: models and archaeozoological indicators

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ABSTRACT

Several authors have pointed out that the development of a specialized economy is in concordance with a state policy that favours the increase of control over the production, distribution and consumption of resources and goods. In agreement with these ideas a series of coordinated strategies has been proposed for the Inca occupation of north-west Argentina (NOA), including the intensification of the pastoral system. In this paper I will explore how local variations deviated from the general model originally proposed. This is essential for understanding the diversity of animal products — wild and domesticated — produced locally in comparison to other close or more distant areas, their circulation and use in different contexts. Based on the information coming from several sites located in the Quebrada de Humahuaca (Jujuy province) and the Yocavil valley (Salta province) we test the aforementioned model by using some zooarchaeological markers, basically size variation and stable isotopes in camelids.

KEY WORDS
Animal products,
camelids,
archaeozoology,
Inca times,
north-west Argentina.

RÉSUMÉ

Gestion des camélidés pendant la période Inca au nord-ouest de l'Argentine : modèles et indicateurs archéozoologiques.
Plusieurs auteurs ont montré que l'évolution d'une économie spécialisée coïncide avec une politique d'état qui privilégie un accroissement de contrôle sur la production, la répartition et la consommation des ressources et des biens. Conformément à ces idées, une série de stratégies coordonnées a été proposée pour l'occupation inca dans le nord-ouest de l'Argentine (NOA), y compris l'intensification du système pastoral. Dans cet article, l'auteur montre comment les variations locales s'écartent du modèle général initialement proposé. Cet élément est essentiel pour la compréhension de la diversité des productions animales (sauvages et domestiquées) réalisées localement par rapport à des zones géographiques plus ou moins distantes,

leur circulation et leur utilisation dans des contextes différents. S'appuyant sur des données provenant de plusieurs sites situés dans la vallée de Yocavil (province de Salta) et dans le Quebrada de Humahuaca (province de Jujuy), le modèle précité est testé en utilisant quelques marqueurs archéozoologiques, essentiellement la variation de taille et les isotopes stables chez les camélidés.

RESUMEN

Manejo de camélidos durante los tiempos Inka en el Noroeste Argentino: modelos e indicadores zooarqueológicos.

Algunos autores han señalado que el desarrollo de una economía especializada coincide con una política estatal que favorece el incremento del control sobre la producción, distribución y consumo de recursos y bienes. De acuerdo con estas ideas una serie de estrategias coordinadas fueron propuestas para la ocupación Inka del Noroeste Argentino (NOA), incluyendo la intensificación del sistema pastoril. En este trabajo voy a explorar cómo las variaciones locales se desviaron del modelo general originalmente propuesto. Esto es esencial para entender la diversidad de productos animales (silvestres y domesticados) producidos localmente en comparación con otras áreas cercanas o más distantes y su circulación y uso en diferentes contextos. Basados en información proveniente de algunos sitios localizados en el valle de Yocavil (Provincia de Salta) y en la Quebrada de Humahuaca (Provincia de Jujuy) contrastamos el modelo mencionado utilizando algunos marcadores zooarqueológicos, básicamente la variación de tamaño y los isótopos estables en camélidos.

INTRODUCTION

A series of coordinated strategies were instrumented by the Incas during their occupation of Northwest Argentina (NOA) during the first half of the XV century or even earlier. They involved the construction of a great number of forts and state installations along the road network, the placing of several shrines in high elevation peaks, and the development of several state farms. Other state policies included the intensification of the craft, mine, agricultural, and the pastoral production (*e.g.*, D'Altroy *et al.* 2000, D'Altroy 2002).

In this presentation, I will explore some aspects of this general model and its variations (local or regional) in relation to camelid management. This is essential for understanding the diversity of animal products (wild and domesticated) that were produced locally in comparison to other close or more distant areas, and their circulation and use in different contexts.

A GENERAL MODEL

Several authors have pointed out that the development of a specialized economy is coincident with a state policy that favors the increase of control over the productive system (*e.g.*, Earle & D'Altroy 1989, Zeder 1991, D'Altroy & Hastorf 2001).

The general model that can be derived from this assumption is that the intensification of the economy usually implies an increase in the control of several aspects of the production, distribution and consumption of products and their goods. As a result, several are the expectations for each of the components of the productive system.

In an agropastoral economy an intensification of the animal production may lead to the specialization of the herds exploited, either domesticated or wild. This means keeping the domestic animals segregated due to the specificity of their products: primary (meat) or secondary (*e.g.*, fiber or transportation). In the case of wild animals this segregation may imply restrictions for their slaughtering which can be limited for ceremonial purposes or other special occasions.

It is also expected that the access and, therefore, the redistribution of some products (*e.g.*, meat for cooking and fiber for crafts) may be regulated or even centralized. An outcome of this increase in control would be a relative standardization in the production of primary products (meat) and goods (fiber) and the regulation of their circulation.

Another set of expectations can be drawn for consumption based on different aspects of the products involved, the techniques employed for food preparation, and their social context of use, either private or public. Different segments of the society (elite vs. commoner) may have preferential access to certain products. Also, some products (or goods) can be considered a luxury and be used by elite members or on special occasions. Additionally, the context of use (daily meals or feasting) may determine the kinds and amounts of products that are going to be used or consumed.

In this particular paper I will focus on some zooarchaeological markers for discussing some of these aspects, particularly those that concern with production and complementarily with distribution management. The zooarchaeological indicators here considered are the size variation observed in the camelids identified at some sites located in North Western Argentina (NOA) and their associated dietary information derived from stable isotope data.

CAMELIDS AND THE ANDEAN SOCIETY

South American Camelids (SAC) have occupied a central role in the evolution of Andean socie-ties, for ancient hunter-gatherers, pastoralists and also farmers. Camelids were the only large herd mammal that was domesticated in all the Americas. In pre-colonial times domesticated camelids were widely distributed from the highlands to the valleys, lowlands and coast. They were of primary importance in Andean economic, social and ritual life, and — for example — were a key instrument for the expansion of the Incas (D'Altroy 2002). As we will see wild camelids were also used and exploited regularly although several restrictions operated on their management during Inca times (Dedenbach-Salazar Sáenz 1990).

At present, SAC are represented by two genera (*Vicugna* and *Lama*) and four species: two wild, the vicuña (*V. vicugna*) and guanaco (*L. guanicoe*), and two domesticated, the alpaca (*L. pacos*) and the llama (*L. glama*). Under human control they interbreed giving birth to hybrids, generally called *huarizos*.

The guanaco has the widest geographical distribution, from Peru to Tierra del Fuego and from the highlands of the Andes to the Pacific coast in Chile and the Atlantic coast of Patagonia in Argentina. The vicuña lives nowadays in the highlands of the Andes from Peru to Argentina at altitudes that range between 4300-3000 m. Comparatively, the alpaca has at present a more restricted distribution to the high Andean pastures. The llama has a wider geographical distribution than the alpaca and is the most versatile form, as it has been used as a source of food, hide, fiber, but also as pack animal.

When the SAC are compared, besides the several external characteristics that differentiate them, one aspect that highlights is the significant difference they have in their live weight, which can be ordered according to a gradient. Vicuñas being the smallest, followed by the alpaca, and then by both the guanaco and llama as the largest forms. This size differentiation allows us to group these animals in two size categories: small and large. The small group includes the vicuña and the alpaca (the latter has not yet been identified in Inca time deposits of NOA) and the large group constituted by the guanaco and the llama. This approach and

classification procedure has been traditionally used for identifying and grouping individual bone specimens in the Central Andes and South-Central Andes (*e.g.*, Wing 1972, Hesse 1982, Moore 1989, Miller & Burger 1995, Cartajena *et al.* 2006, Mengoni Goñalons & Yacobaccio 2006).

However, the difference between the four species is not clear-cut because they partially overlap, specifically the largest vicuñas and the smallest alpacas and also the Andean guanaco and the smallest llamas (*e.g.*, Moore 1989). In addition, some authors have recently highlighted the existence of intermediate size cases (*e.g.*, Miller 2003) turning the classification of fragmentary bone material especially difficult. The overlap that exists between the guanaco and the llama, related to the wide geographical distribution of the first and the different size variants of the second, deserves special attention. This overlap is more notorious if the whole size range of the present guanaco is considered. Those guanaco populations living at low latitudes are the smallest, while those at the higher latitudes (Patagonia and Tierra del Fuego) are by far the largest (*e.g.*, Mengoni & Yacobaccio 2006, Mengoni Goñalons 2007).

As a consequence, not recognizing this variation has proven to be a limiting factor for detecting initial camelid domestication in the Andes (Mengoni Goñalons & Yacobaccio 2006). Therefore, in this study we have used the guanaco that lives in the North Andean area of Argentina (NOA) as standard, contrary to other previous studies that have used the guanaco of Tierra del Fuego or Patagonia, a much larger geographic form that apparently has no genetic relationship to the proposed wild ancestor of the domesticated llamas (Marín *et al.* 2006). The guanaco from the NOA is probably akin in size to the guanaco that lives in the Central Andes and, therefore, is a much better osteometrical standard, as it has been recently proposed (Mengoni Goñalons & Yacobaccio 2006).

Stable isotope analysis is an important source of information for studying the variability in diet in human and other animals (*e.g.*, Schoeninger & DeNiro 1983, Schwarz & Schoeninger 1991, Norr 1995, Ambrose & Krigbaum 2003,

Tykot 2006). However, in the Andean region carbon isotope research on present and ancient camelids whether wild or domesticated is — with some exceptions — rather recent both in the ecological and archaeological literature (*e.g.*, Schoeninger & DeNiro 1983, DeNiro 1988, Burger & Van Der Merwe 1990, Fernández *et al.* 1991, Fernández & Panarello 1994, Yacobaccio *et al.* 1997, Olivera & Yacobaccio 1998, Cerling & Harris 1999, Fernández & Panarello 1999-2001a; 1999-2001b, Panarello & Fernández 2002, Funicane *et al.* 2006).

In most of the cases camelid stable isotope data has been basically used to discuss human diet. It has hardly been employed to discuss management practices in prehispanic contexts with only a few examples. First, we have the pioneering research initiated by DeNiro (1988) on prehispanic camelid bones coming from several Peruvian archaeological sites and from different periods located in diverse geographical settings, such as Pucara (n=18) at the altiplano, Upper Mantaro valley sites (n=3), and Chilca (n=5), and La Paloma (n=3) at the coast. More recently we have the innovative research developed by Funicane *et al.* (2006) on camelids (n=16) from Conchopata site in the sierra of central Peru.

Therefore, the data here presented on carbon isotopes of archaeological camelid bone samples is new and original. It has allowed us to discuss some significant cultural aspects related to the exploitation of camelids from different depositional contexts. Our main research goal is to contribute to the understanding of camelid management practices through time. In the next section I will present some data recently produced by other researchers on the isotopic ecology of the region (N.W. Argentina) that was used as a frame of reference for discussing the variabilitiy of the archaeological isotopic data.

SITES AND THEIR NATURAL ENVIRONMENT

The materials studied come from three sites located in North Western Argentina (NOA). The

general natural setting where these localities are placed is characterized by desert vegetation that covers highlands and flood plains formed along main and secondary quebradas and valleys. Several major environmental units can be identified in the area, each with its particular relief, water supply and vegetation (Cabrera 1976). First, we have the bolsones and valleys that drain below 2000 m and present tree and shrub vegetation. Second, the prepuna, a transitional environment (2000-3400 m) that connects the valleys with the high grasslands, is distinguished by the presence of a shrub steppe with very large cacti or native trees along the quebradas. Finally, the puna (above 3400 m) is characterized by mountain slopes, high quebradas, and plateaux covered by different kinds of herbaceous and shrub steppes.

The first two zones are heavily transformed by artificial irrigation and other agriculture installations that in many cases can be traced back to prehispanic times. The nearby puna provides the necessary pastures for the development of camelids and other herbivores.

The grasses that grow in the puna include native plants that follow C3 and C4 pathways. Some of these plants (herbs and grasses) are of great importance as natural pastures and therefore, can be used as fodder. Some C3 plants that are used by camelids are the following: *Ephedra breana* (-21.6‰), *Trifolium amabile* (-25.5‰), *Tagetes multiflora* (-27.3‰), *Poa annua* (-25.9‰), *Poa lilloi* (-25.0‰), *Cotula mexicana* (-27.8‰), *Poa jujuyensis* (-26.7‰), *Festuca orthophylla* (-27.5‰) (Fernández & Panarello 1999-2001a, Panarello & Fernández 2002). Camelids also feed on grasses that follow a C4 pathway such as *Muhlenbergia fastigiata* (-13.3‰) y *M. atacamensis* (-12.2‰), *Sporobolus rigens* var. *atacamensis* (-12.1‰), *Pennisetum chilense* (-10.6‰) and *Eragrostris nigricans* (-13.8‰) (Fernández & Panarello 1999-2001b).

A recent study shows that modern vicuñas, guanacos and llamas living in Argentina at high altitude (above 4000 m) consume C3 plants (δ^{13}C -29.1 to -24‰) and, therefore, have carbon isotope signatures that are very negative, below -19.0‰ (vicuña: -19.6‰; guanaco: -19.4‰;

llama: -20,5‰). On the contrary, camelids that feed at lower altitudes (below 4000 m) include in their diet (vicuña: -16.8‰ and llama: -17.3‰) a significant proportion (ca. 30 %) of C4 plants (δ^{13}C -13.8 to -10.6 ‰) according to Fernández and Panarello (1999-2001b; Panarello & Fernández 2002). This proportion was estimated by Fernández and Panarello (1999-2001b) based on laboratory results showing that animals that have a diet exclusively centered on C3 plants transfer to collagen a δ^{13}C of -22‰ and that a diet constituted by a mixture of 50% of C3 and 50% of C4 plants produces a δ^{13}C value of -14.4‰. It has been considered that the fractionation factor between diet and collagen is a little above 5‰ as indicated by Panarello and Fernández (2002). For these comparisons it has been taken into account the discussion around the fossil fuel effect (Cerling & Harris 1999). Although this actualistic information needs to be expanded it currently provides an important reference tool to discuss some aspects of our results.

The localities studied were essentially occupied during the Regional Developments (or Late Intermediate Period) and Inca Periods. All these occupations are bracketed between 1290 – 1620 cal AD. In all these assemblages camelid bones are abundant and, particularly, dominant.

The locality of Tolombón is situated at the north of the valley of Yocavil (Valles Calchaquíes, Salta province), at ca. 1700 m (Fig. 1). This site includes several architectural sectors (*e.g.*, residential areas, public spaces, burial grounds, defense and agricultural structures). It was occupied during the XIIIe to early XVIIe century, based on a series of calibrated dates that bracket the occupation between 1291-1628 cal AD. The materials analyzed here come from the excavations of a residential space (Structure 6, Architectural Division A) where several layers were excavated containing ceramics, stone artifacts, shell ornaments, among other elements, and also plant and animal bone remains. This is the only residential structure from which clear Inca pottery was retrieved. This site had a very important role during the native Indian resistance against the Spaniards (Williams 2003, 2002-2005).
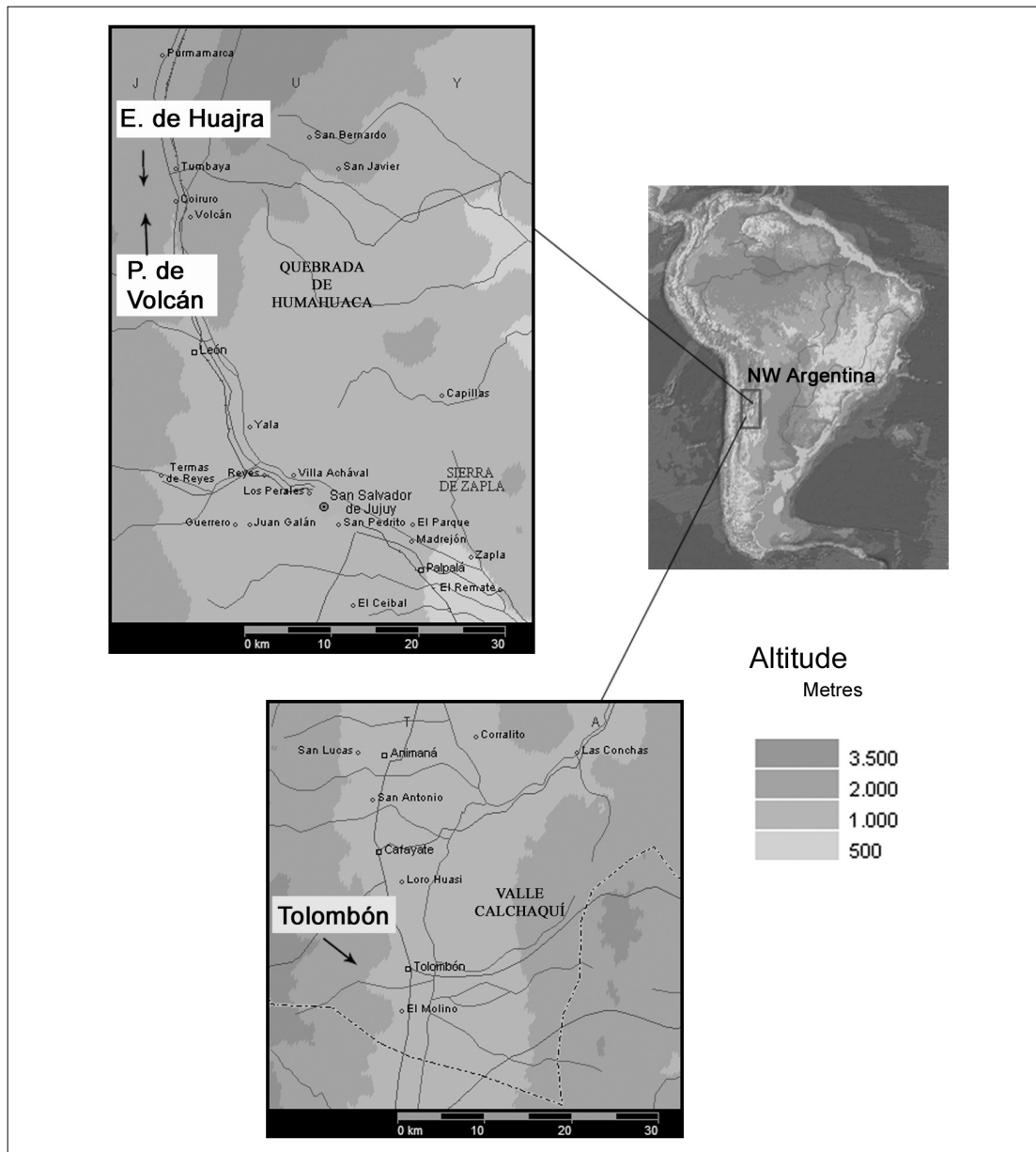
Fɪɢ. 1. – Site location. Design G. L. Mengoni Goñalons.

Pucará de Volcán is placed at the southern portion of the Quebrada de Humahuaca (Jujuy province), at ca. 2100 m (Fig. 1). It is large and complex site with a main residential sector, a cemetery, agropastoral structures and other ins-

tallations. The materials studied here were retrieved from a trash area (identified as B2) associated with a series of habitation structures and open spaces that surround an artificial mound located at the west of the main residential area. Based on

the ceramics the deposit was considered homogenous and has a date of 1533 cal AD. The site occupied a strategic position within the cultural landscape by interconnecting different localities placed to the east and west of the Quebrada de Humahuaca (Cremonte & Garay de Fumagalli 1997, Garay de Fumagalli 1998).

Esquina de Huajra is also located at the Quebrada de Humahuaca, a few km north of Pucará de Volcán at ca. 2000 (Fig. 1). It is characterized by a series of architectural installations, mainly residential structures, burial features and terracing structures. It was also occupied during the Late Intermediate Period (or Desarrollos Regionales) of NOA chronology and probably had an important strategic role as connects the quebrada with the oriental valleys. The materials studied come from a domestic context, probably deposited in a patio adjacent to a residence where several elements of material culture were retrieved. This deposit has a calibrated date that range between 1520 – 1620 cal AD (Cremonte & Peralta 2005).

SOME METHODOLOGICAL ASPECTS

As previously stated the goal of this paper was to test the aforementioned general management model combining the information of two zooarchaeological indicators: camelid size variation and stable isotope composition. The osteometric and the isotope data were used as a baseline for discussing dietary similarities and differences within the members of the different camelid size groups.

After identifying anatomically the osteological material available, we sorted out which camelid specimens were suitable for osteometric analysis (N=118). This not only allowed us to classify the specimens within each main size category (small and large) but also to recognize the existence of three subgroups: one that overlaps in size with the present vicuñas, another which probably corresponds to large llamas and a third one that falls around the standard of the guanaco (Fig. 2). This last subgroup could be formed by small llamas, guanacos or some kind of domestic (?) hybrid.
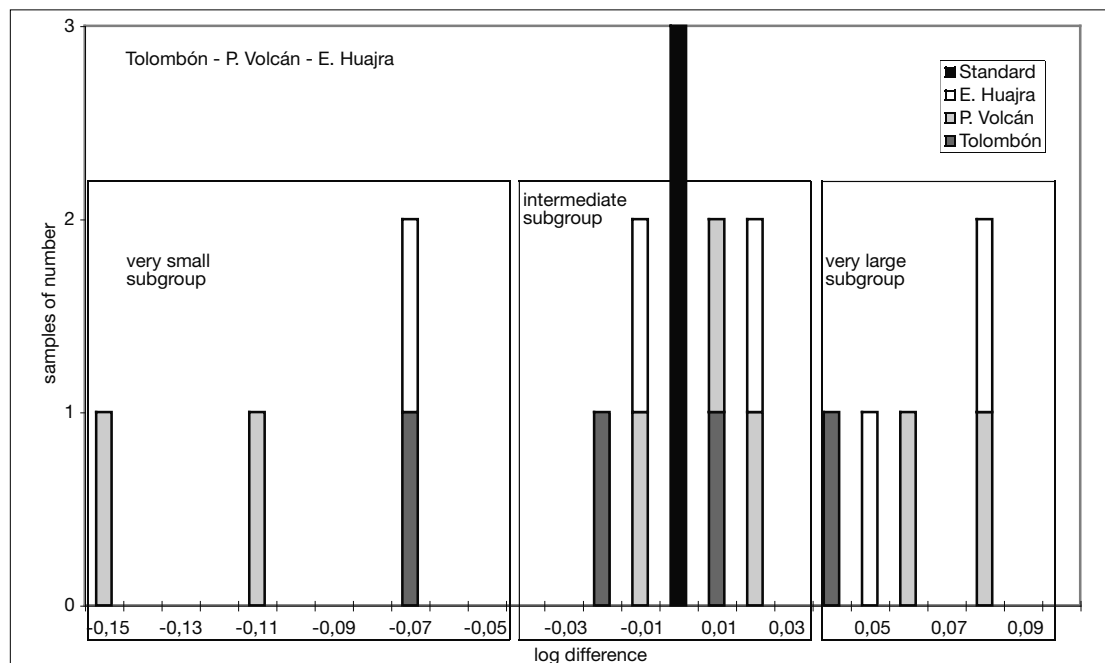

FIG. 2. – Log difference between the archaeological bone samples (hatched bars) analyzed and the modern guanaco standard (solid bar).

Subsequently, we selected a set of individual bones from each main size category and from the three size subgroups that could be distinguished based on the log-ratio technique — as described and discussed by Meadow (1999). This technique allows visualizing the size difference between the archaeological specimens and the modern standard used, in our case the guanaco from NOA (Fig. 2). All the bones chosen are from osteologically mature individuals, older than 12-18 months or more, according to what we now about the timing of fusion stages (Kent 1982, Wheeler 1999, Miller 2003, Kaufmann 2004). This last selected batch of specimens was used for running staple isotope analysis ($\delta^{13}C$ and $\delta^{15}N$) on which the following discussion is basically centered (Table 1).

The isotope analyses were conducted at the Center for Applied Isotope Studies (CAIS) of the University of Georgia. The values for $\delta^{13}C$ ($^{13}C/^{12}C$) are expressed as parts per mil (‰) relative to the international standard PDB with an error of less than 0.1 ‰ and the $\delta^{15}N$ ($^{15}N/^{14}N$) as parts per mil (‰) relative to the international standard Air with an error less than 0.2‰. All stable isotope ratio analyses were conducted on Finnigan MAT252 mass spectrometer.

At the laboratory the bone samples were cleaned by brush and washed, using ultrasonic bath. Then they were crushed and treated with 1N acetic acid to remove any secondary carbonates at room temperature with periodic evacuation of CO_2 for 24 hours. The residue was filtered, rinsed with deionized water to remove any residue of acetic acid. Then the sample was dried overnight 60°C. The dried sample was evacuated in the flask and treated with diluted HCl at 4°C to recover CO_2 from bioapatite. The carbon dioxide was cryogenically purified and collected for stable isotope ratio analysis.

The acid solution was collected and left overnight at 4°C. Then the solution was filtered on fiberglass filter and precipitate was rinsed with deionized water. The precipitate was boiled in deionized water (pH=3) for 6 hours to dissolve collagen and leave humic substances in the precipitate. The collagen solution was then filtered to isolate pure collagen and dried out. The dried collagen was combusted at 575°C in evacuated/sealed Pyrex ampoule in the present CuO. The carbon dioxide and nitrogen have been cryogenically separated and purified and collected in the flasks for analyses.

Carbon and nitrogen concentrations were measured and C/N ratios were also calculated to

TABLE 1. – Bone samples analyzed. Abbreviations: px, proximal; ds, distal.

Sample	Bone	Portion	log (x/g)	Size Group	δ13C	δ15N	%C	%N	C/N
T-123	metapodial	ds	-0,02	small	−12,7	6,6	29,2	10,4	2,8
T-199	scapula	ds	-0,07	small	−19,0	2,5	33,9	11,8	2,9
T-629	radioulna	px	0,04	large	−12,8	6,8	27,0	9,4	2,9
T-574	metapodial	ds	0,01	large	−13,7	5,3	34,9	12,3	2,8
V-42B	humerus	ds	-0,01	small	−14,0	2,9	35,2	12,2	2,9
V-72A	radioulna	ds	-0,11	small	−15,9	8,5	34,3	11,9	2,9
V-82A	metapodial	ds	-0,15	small	−17,9	5,3	36,7	12,8	2,9
V-32B	tibia	ds	0,08	large	−13,1	4,5	33,9	11,9	2,8
V-32A	metatarsal	px	0,06	large	−9,0	11,8	28,9	9,7	3,0
V-82B	metatarsal	px	0,02	large	−17,2	6,1	36,7	12,6	2,9
V-62A	metatarsal	px	0,01	large	−13,1	3,5	39,0	13,7	2,9
H-26C	metapodial	ds	-0,01	small	−15,7	8,3	26,4	9,1	2,9
H-26A	tibia	px	-0,07	small	−14,2	2,8	22,5	7,9	2,9
H-26D	scapula	px	0,08	large	−13,9	6,4	25,1	8,6	2,9
H-25A	metapodial	ds	0,05	large	−15,2	8,1	21,8	7,6	2,9
H-26B	radioulna	ds	0,02	large	−16,3	8,0	32,2	11,3	2,9

measure the impact of diagenetic processes that can potentially deplete collagen content from bones.

All the samples have bone collagen carbon and nitrogen concentrations that have acceptable values according to the reference literature (*e.g.*, Ambrose 1990). Most of the samples have C/N ratios that fall within the accepted range of 2.9 –3.6 (*e.g.*, DeNiro 1985), with the exception of a few samples that have a C/N ratio of 2.8 (Table 1). Anyhow, these last samples have acceptable %C and %N collagen concentrations and, therefore, there carbon and nitrogen isotopic values are considered reliable (Randy Culp, CAIS-UGA, pers. com.). Furthermore, the isotopic values of those individuals that do not precisely match the aforementioned standard do not appear as outliers (Fig. 3). Besides, all their isotopic values do not differ significantly from those observed in modern counterparts and fall within the expected range.

It is also important to highlight here the potential that all these results have, specially within the context of camelid zooarchaeological studies, for which scarce isotope information is available and only a few systematic studies of their diet variability have been produced.

The results here presented and discussed need to be considered as the first step in a research programme that has as its basic goal the understanding of the interaction between humans and camelids over time and the identification of domestication practices by considering different but complementary zooarchaeological markers.

As a general framework for discussing the variability of the results obtained on the archaeological specimens I used the data of a recently published staple isotope (δ^{13}C) study conducted on
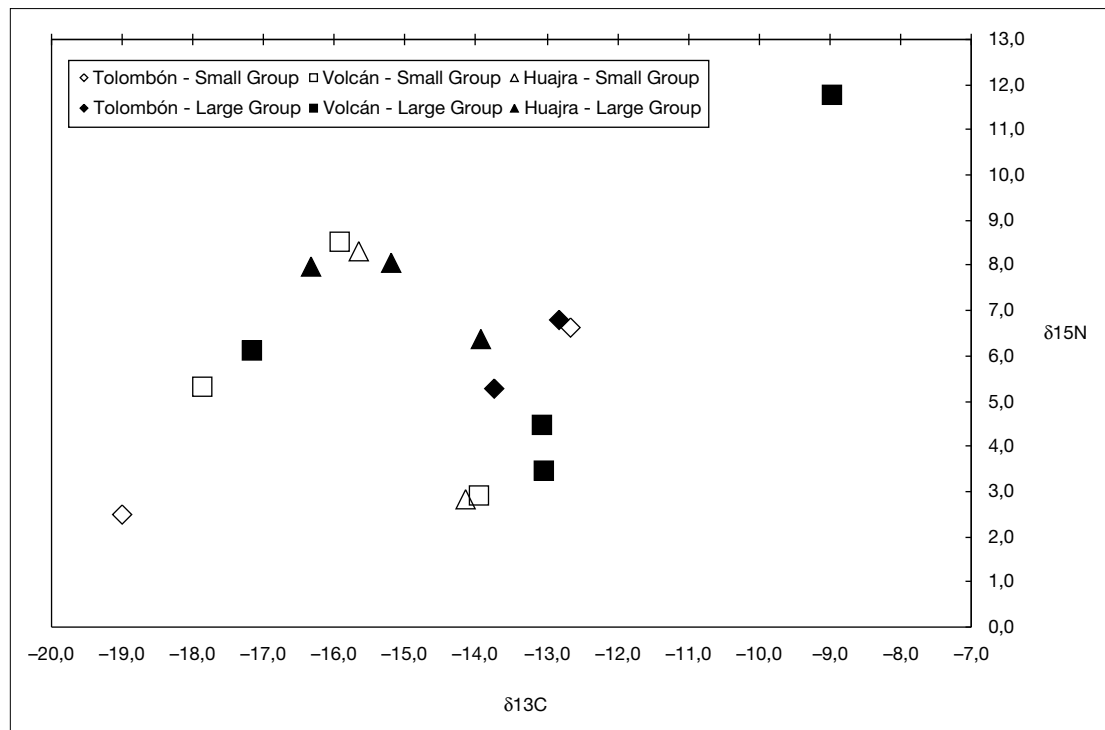

Fig. 3. – Carbon and nitrogen isotope values for all samples. Main size groups are differentiated: small group (open symbols) and large group (closed symbols).

modern vicuñas, guanacos and llamas from the same broad region, NOA (Fernández & Panarello 1999-2001a, b; Panarello & Fernández 2002).

SOME PRELIMINARY RESULTS

The overall variability of the carbon isotope is high (CV: 16.6%) when all the samples are taken together. They also show to be highly variable within each main size group: small and large (Table 1; Fig. 3: open symbols and closed symbols, respectively). This suggests that no all camelids had the same diet, and that their diet may have differed depending not only on the ecological zone where they lived but also on the type of fodder it was used for breeding them in the case of the domesticates.

Results at Tolombón (n=4) show a great variability suggesting different plant consumption among individuals of this particular batch. The overall coefficient of variation is high (CV = 20.6%).

The individuals from the large size category and an individual of the small one show similar carbon isotope values (Table 1: cases T-629, T-574, T-123; Fig. 3) suggesting they all had a relative uniform diet centered on a mixture of C3 and C4 plants. This interpretation is based on the present data available for contemporary camelids (vicuñas and llamas) that live in the same broad region below 4000 m (Fernández & Panarello 1999-2001b; Panarello & Fernández 2002).

On the contrary another individual (Table 1: case T-199) has a carbon (δ^{13}C) signature that is very negative (-19.00‰). Osteometrically it falls within the size range of the vicuña, therefore, suggesting these wild animals were brought from a different ecological zone, probably more distant or from a higher elevation where C3 plants constituted their diet (Fernández & Panarello 1999-2001b).

At Pucará de Volcán (n=7) the situation is more complex. Both size groups show variability (CV general = 21.2%) showing the animals consumed different plants (Table 1).

In both size categories — small and large — there are individuals that on a relative scale have very negative values (below -17‰) compared to others that have a more positive signature above -14‰ (Table 1; Fig. 3). It is reasonable to assume that within each size category we are dealing with herds of probably different forms, based both on osteometric criteria and the significant differences in their diet values. One set of individuals — independently of their size category membership — had a diet mostly based on C3 plants (V-82B; V-72A; V-82A) while another set (V-32B; V-62A; V-42B) combined C3 and C4 plants.

There is even one isolated case in which the carbon isotopic signature is extremely positive (Table 1: case V-32A) suggesting a C4 based diet. If its isotopic information is correct it could be interpreted that this individual probably was fed either on a special kind of pastures or on maize. It is interesting to note that this particular animal is larger than the wild standard (guanaco), probably corresponding to a very large llama.

The batch from Esquina de Huajra (n=5) is the less diverse (CV = 6.7%) showing more isotopic uniformity and a more similar diet among individuals that probably represent different species, as small and large size animals are represented (see log difference values in Table 1; Fig. 3). For both size groups the mean values (small group = -14.9‰ and large group = -15.2‰) are slightly higher (more positive) than the average values for the present vicuñas (-16.8 ‰) and llamas (-17.3‰) following Fernández and Panarello (1999-2001b). There are no evident differences in the diet of the archaeological individuals assigned to these particular species based on osteometry, revealing that all the animals — wild and domesticated — grazed on similar pastures and were probably bred locally. In all cases δ^{15}N values fall within the expected values for herbivores. The variability observed is currently under analysis. Based of the recent studies published by Sponheimer and colleagues (*e.g.*, Sponheimer *et al.* 2003a, Sponheimer *et al.* 2003b) one aspect that needs to be considered is the physiological conditions of the individuals that were originally slaughtered and later found in these site deposits.

DISCUSSION

At Tolombón we have two scenarios suggesting dissimilar primary provisioning grounds, probably implying different distribution mechanisms. Llamas produced locally were possibly obtained directly. Vicuñas (or their body parts) which were bred in more distant areas were acquired indirectly. This is something that needs to be more thoroughly investigated and it is part of our future agenda.

It is interesting to note that the bones analyzed from this site come from a domestic space and that most of the trash is derived from food preparation and post-consumption disposal. This less inclusive and discrete deposit, though accretional in nature, indicates that the people who lived there had access to meat from domesticates and also from wild species. It is of great interest to contrast this data with that of the historic chronicles when they describe the restrictions associated with royal chaku hunts (Dedenbach-Salazar Sáenz 1990). Probably, in this particular region, far from the central core area, regulations were looser and people had greater access to wild animals. This is not an isolated case as other Inca sites from NOA also show the presence of vicuña size individuals (*e.g.*, Madero 2004, Mengoni Goñalons in prep.). At Esquina de Huajra wild and domesticated camelids appear to have had similar diets, based on local plants and, therefore, their acquisition was possibly by a more direct system with herds of animals bred locally for provisioning this particular site. This finding needs to be studied more thoroughly using other zooarchaeological markers (*e.g.*, slaughtering patterns). The use context from which these bones were obtained suggests we are dealing with domestic trash associated with daily activities.

Instead, at Pucará de Volcán we are dealing with a more complex situation, a compound deposit that probably collected the trash from a sector of the site. This explains the variability observed indicating the presence of different camelid species, and consequently the existence of segregated herds among those animals that fall within the same size category. This would also indicate the partitioning of the landscape in different patches, each with its own distinctive pastures for raising special kinds of animals.

These results may reflect the role of some sites as redistributive nodes. This is possibly revealing that some sites had an important position within the redistributive system as a source of animal products. It is also probable that they had a significative role for the breeding of certain animals for particular uses, such as public ceremonies, and not only as suppliers of food for domestic consumption.

CONCLUSIONS

At this point it is important to ask what about the general management model and its implications? It seems that the evidence provided here fulfills to some extent the expectations of the general model by suggesting herd specialization and in some cases a more indirect system of redistribution. What we are still unsure of is if all or some of these aspects were already in operation locally before the Incas. This is something that needs to be further explored in the future. More samples need to be analyzed in order to test if these patterns can be strengthened or if more variability needs to be taken into account.

We have also seen that comparing different sites and their bone deposits can be informative of distinct aspects of the management system. Different kind of deposits also (either domestic trash or compound trash) can be informative because they illustrate different scales of resolution. This change of scale is necessary if we want to increase our knowledge of complex productive and redistributive systems that operated regionally or even wider. Body part representation for each size category and death age profiles might be helpful as a measure of what parts were presumably transported from a long distance and which were not. Finally, this information could be used as a baseline for discussing whether we are dealing with a direct or an indirect distribution system, perhaps operating in a distinct way for wild and domesticated forms.

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