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Hunting and Faunal Consumption Among Herders of Northwestern Patagonia: A Zooarchaeological Perspective

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Abstract

This article examines the dietary patterns of herders in central-western Argentina, known as puesteros (local herders). We investigate how changes in land use, urbanization, and hunting restrictions have affected traditional puestero herding practices and the contributions of wild and domesticated animals to their diets. The study focuses on two research questions: (1) Has the growth of urban economies and transportation infrastructure in central-western Argentina during the past several decades influenced puestero domesticate and wild animal meat consumption? (2) Does the consumption of large domesticates (e.g., beef from cattle) today decrease when the distance to cities increases and connectivity with markets decreases? We examine the differences in faunal assemblages between high-elevation summer puestos and low-elevation permanent puestos. We expected that puesteros in more remote areas would rely more on wild animals as a food source. However, the results showed that wild faunas were more common in permanent puestos compared to comparatively remote, summer puestos. This can be explained by the different activities carried out in each puesto and the animal biodiversity of each ecoregion. The study also highlights the impact of land use changes and conservation policies on puesteros. New employment opportunities, rural–urban migration, and changes in land ownership have influenced ranching and pastoralism practices as well. We emphasize the need to understand the puestero lifestyle in a broader framework that considers economic, social, and political processes and the importance of zooarchaeology in this study, which provides a valuable tool for documenting and preserving aspects of puestero culture.

Keywords

puesteros, diet, domestic fauna, wild fauna, zooarchaeology

Introduction

The herders of west-central Argentina (locally called *puesteros*) are traditional pastoralists who live in the Monte deserts and Patagonia grasslands and range up into the Andes (Agüero Blanch 1969–1970; Baied 1989). In western Mendoza province, puesteros live in areas that cross several cultural continua and physical environmental gradients, with diverse degrees of interaction with urban economies. Puesteros also employ diverse forms of residential mobility related to elevation and livestock range conditions. Their herding lifeways vary from seasonal transhumance, to take advantage of shifting plant phenology from low to high elevation, to fully sedentary, which relates to grazing patterns of goat and cattle herds. In recent decades, shifts in land use, land tenure, desertification, deforestation, and advances in urbanization have disrupted traditional puestero practices, not only in central-western Argentina (Goirán et al. 2013; Hevilla and Molina 2010; Llano et al. 2021; Peyré 2019), but also in other parts of South America (Farinaccio, Ceccon and Pérez 2021; Howell 2011; Mansilla-Quiñones, Jirón-Martínez and Imilan-Ojeda 2023; Sánchez Cortés 2021). Due to the joint impacts of poverty, desertification, and deforestation, in most of these communities cultural identity and forms of social reproduction are weakened, given the fragmentation of their societies and landscapes (Meli et al. 2022). In addition, hunting restrictions from federal legislation and wild game depletion add to the tension underlying rapid cultural change. In terms of subsistence, puesteros have become increasingly incorporated into the market economy, supplementing food with store-bought goods. In our visits to puestos (puestero settlements) we began to discern that contribution of wild animal and herd animal meats to diet may be changing (Otaola et al. 2016). Correspondingly, we conducted a zooarchaeological study of puestero middens to study patterns in animal contributions to diet.

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Although ethnographic data provide perspectives on wild animal and livestock use as well as consumption of store-bought foods, these variables can also be studied archaeologically. In particular, ethnoarchaeological techniques provide a means to understand the dynamics of living cultures via their material remains (Giardina, Otaola and Franchetti 2021; McGuire 1984; Otaola et al. 2016; Wolverton et al. 2015). In the case of puesteros, each puesto (household) has an associated midden (trash heap) that provides a record of decades of resource exploitation. In this study, zooarchaeological remains from middens were sampled from puestos who adopt a diverse range of sedentariness and seasonal transhumance as well as proximity and connection with cities. The goal of this article is to analyze differences in faunal consumption among different kinds of puestos (e.g., summer highland camps versus permanent lowland households) in the face of the rapid cultural and environmental change.

To address this goal, our study focused on answering two research questions: Has there been an increase in the use of livestock and store-bought meats, particularly in puestos in closer geographic proximity to cities and markets? Alternatively, does local wild animal resource use persist despite these new and growing limitations, particularly in puestos that are more distant from towns and cities? In this article, we approach these questions from a zooarchaeological and taphonomic perspective, which represents a novel approach for investigating the diets of southern Mendoza herders. We examine if there is variability in zooarchaeological remains from midden (trash) deposits at different types of puestero settlements, by analyzing the relative contribution of faunal remains (bones, teeth, and other skeletal parts) of wild animals, farm-raised fauna, and fauna obtained in urban markets. Surveys and identification of animal bones from middens provide large faunal datasets to examine the meat portion of local puestero diets. Harvest of goats from local herds represent one strategy for food (meat) acquisition, but wild animals are likely to have been as or more important at all puestos in the past. We hold that there is a positive relationship among the prevalence of hunting, diversity of wild prey types, and the degree of residential mobility. In addition, we surmise that there is a negative relationship among consumption of store-bought meat and degree of contact with urban economies. There should be a positive relationship between sedentary use of land and interaction with urban economies as sedentary puestos are prevalent in the lowlands closer to cities. In terms of zooarchaeology, these relationships should be reflected in the proportional taxonomic abundance of remains of wild and domesticate animals, as well as the prevalence of taphonomic signatures that indicate store-bought meats (e.g., skeletal parts of domesticates that indicate butchery saw marks). Although it is difficult to assess empirically, it is likely that puesteros interacted less with cities in the past because urban economies and transportation infrastructure have grown in the past four to five decades. Correspondingly, though wild animals continue to be an important part of diet today, with increased travel to cities we postulate that interaction with urban economies has driven change. Empirically, if the prevalence of store-bought meats relates to participation in urban economies, we expect that middens from puestos closer to cities should exhibit a higher proportion of remains from store-bought meats. Puestero lifestyle should be visible in the ethnoarchaeological record of faunal remains from middens.

Our findings reveal substantial differences in faunal assemblages between high-elevation summer puestos and low-elevation permanent puestos, generally aligning with our hypotheses, except for the unexpected prevalence of wild faunas in permanent puestos closer to cities. We also find that connectivity to cities significantly influences dietary practices. Social dynamics also play a role, with permanent puestos supporting year-round family aggregation and wild hunting, while summer camps are primarily occupied by young men focused on herding. In this study we highlight the complex social, political, and economic forces affecting puestero culture, with zooarchaeology providing a critical means to preserve their heritage.

Puestero Lifestyle

Puestero culture has been shaped by the high deserts and mountain environments of the Andes for much of the past two centuries. In the study region, pastoralism is conceived as a traditional production system based on the exploitation of herding animals (Baied 1989; Grünwaldt, Pedrani and Vich 1994). Puestero herds comprise a high proportion of goats (*Capra* spp.), moderate numbers of sheep (*Ovis aries*), and a smaller proportion of horses (*Equus caballus*) and cattle (*Bos taurus*). Herd composition varies geographically and by household wealth. Herd size depends on the amount of available range, which is commonly rented from large, corporate land holders at very low cost. Alternatively, some puesteros have grazing access on government lands (Bocco deAbeyá 1988; Giardina, Otaola and Franchetti 2021; Otaola et al. 2016). They also raise chickens which they move to the summer puestos, generally keeping them for eggs but also for meat consumption. In some cases, they raise turkeys for meat. In areas with abundant water, they also have geese.

Puestero settlement patterns are highly variable and are, in general, linked to the characteristics of environments surrounding family residences. Social organization is based on family relationships and is important for structuring work roles of herding and natural resource exploitation (Bocco deAbeyá 1988; Grünwaldt, Pesalaccia and Pedone 1995). Puestero homes are usually near a water sources, such as streams and seeps, are equipped with livestock corrals, and are surrounded by shade trees, such as cottonwoods (*Populus* sp.), willows (*Salix* sp.), or eucalyptus (*Eucalyptus globulus labill*). Puestos are geographically isolated and are occupied by small family groups (Figure 1).

Depending on the extent of available range for grazing, puestos may consist of small habitation units with one



Figure 1. Summer (left) and permanent (right) puestos.

nuclear family, or bigger units with multiple nuclear families (Figure 2). In some cases, up to three generations can live in a sedentary puesto or in a winter puesto when seasonal transhumance is practiced. Kinship is patrilineal and when the sons reach adulthood they may build a home and settle near their parents' puesto. This kinship arrangement supports the cooperative activities of herding and other responsibilities related to field maintenance in larger puestos (Soto and Martínez-Navarrete 2020).

Puesteros raise herds for subsistence but also for income through the sale of livestock. They have a deep local ecological knowledge of grazing areas, including an awareness of range damage caused by overexploitation. In southern Mendoza, puesteros manage their herds in two ways. One is a sedentary lifestyle in the lowlands between roughly 1000 and 1700 masl, where herds are rotated among nearby pastures on an annual cycle. The second lifeway is seasonal transhumance between the piedmont and highland valleys of the Andes. In this second system, winter puestos are at roughly 1400 to 1900 masl, and summer camps extend into areas between 1900 and 2500 masl. The highlands provide productive grassland for livestock during the summer (October to March), with cattle being moved to upland pastures first, followed later by goats and sheep. Goats are moved to upland pastures after young-of-the-year have been birthed, but the timing also depends on the condition of winter range. If pastures in the piedmont are overgrazed, goats may be moved to the highland river valleys earlier in the year. Transhumant and nontranshumant strategies require large tracts of rangeland to convert the productivity of the high Andean deserts into animal biomass. When adopted, the pattern of transhumance has the effect of fattening cattle, taking advantage of high-productivity pulses in mountain pastures during the summer (Agüero Blanch 1971; Baied 1989).

Traditionally, hunting of wild animals has been a viable source for animal protein in puestero diet. Hunting is also a community-building activity incorporated in social activities and festivities (Agüero Blanch 2014; Giardina, Otaola and Franchetti 2021). During fieldwork among puesteros, we identified situations in which wild game hunting takes place, which we divide into (1) individual opportunistic or (2) collective programmed hunting. In the first type, puesteros encounter prey during their herding activities and decide to hunt using a firearm, a bola or by hand, depending on which weapon they are carrying and the type of prey. We observed hunting of pumas, armadillos, and hares, which were field processed, cooked, and shared with the people present in the herding/hunting party. The other type of hunting occurs as a planned activity involving several people (see Giardina, Otaola and Franchetti 2021). Many hunting parties are organized around key celebrations; for instance, puesteros meet to celebrate Easter, weddings, and birthdays. They also meet when a project or task requires the help of large teams beyond the size of a family, such as gathering and branding cattle and castrating calves. During these social events, activities such as dancing, playing music, and storytelling take place and might last multiple days. In addition, communal hunting of large, wild animals such as choique (rhea) takes place. Dogs are often used to chase down choique and to prevent their escape to inaccessible areas of the desert and piedmont landscape. Such planned hunts represent a recreational pursuit that is not linked to food acquisition, but instead to having fun and displaying one's ability as a hunter (Agüero Blanch 1969–1970; Agüero Blanch 2014; Giardina, Otaola and Franchetti 2021). Another type of communal hunting takes place when there are puma attacks on livestock herds. Puesteros form a hunting party and track puma with dogs, harvesting them with firearms. Even though the purpose of such hunts is to protect livestock, puesteros eat the meat of the puma.

In contrast to hunting large game such as pumas or rhea, harvesting armadillos or rhea eggs does not require collective labor



Figure 2. A google earth image where several households and corrals can be observed in a permanent puesto.

and almost always occurs opportunistically. Every time puesteros encounter such prey, which move slowly, they catch it by hand (Figure 3).

Hunting activities have declined in frequency in recent years due to legal prohibitions and monitoring by government officials (wild life rangers) related to compliance with national and provincial laws that protect wildlife in Argentina. In recent decades, the laws that forbid the capture of native animals (National Law N° 22,421 and Provincial Law N° 4602), have led to the imposition of expensive fines on people who hunt its, limiting subsistence hunting by puesteros, who generally do not hold large sums of money.

The level of exchange with urban economies is variable among puesteros and is conditioned mainly by distance as well as the existence and maintenance of improved and two-track roads. Puesteros in southern Mendoza regularly visit nearby urban centers, such as San Rafael, Malargüe, or Alvear, to stock up on merchandise. They also rely on itinerant merchants who visit their puestos to sell goods from cities or on goat buyers who may acquire animals for merchandise, especially for the Christmas and New Year festivities. Access to the road network plays an important role concerning access to markets, health services, education, and urban centers. Low accessibility, due to either lack of roads or bad road conditions, is an important limitation to the possibilities of diversifying local production and to people's living standards (Rubio, Rubio and Abraham 2018). In this regard, and related to our research questions, it is pertinent to analyze access to the road network by puesteros in the study area.

Puestos do not have basic services such as running water, and they are not connected to the power grid, thus puesteros use solar panels (mostly in the permanent puestos) that provide a small amount of energy for one or two lights in the house. As with many pastoralist cultures (Dong et al. 2011), the puestero lifestyle of herding goats, sheep, horses, and cattle in the Andean steppes and highlands is undergoing rapid change. Most puestero families do not own the rangelands they exploit (Agüero Blanch 2014; Álvarez 2010; Montaña et al. 2005), and already low-productivity range is worsening due to increased desertification (Rubio, Rubio and Abraham 2018). These impacts contribute to depletion of local natural resources as well as out-migration processes of recent generations of puesteros (Peyré 2019), which has led to disruption of social and family structures and economic instability.

The primary causes of desertification in Mendoza are overgrazing, deforestation, and nonsustainable agricultural practices (Abraham 2002). In addition, the expansion of viticulture is restructuring provincial spaces into cultural irrigated oases, leaving arid places marginalized from these processes of economic and social development. This explains the current state of sociospatial marginalization of peasant populations (Bocco deAbeyá 1988; Cepparo 2014). Along with these factors, the development of mining, hydroelectric, and urbanization activities continue to lead to the deterioration of traditional transhumance practices in western Argentina (Llano et al. 2021). Zooarchaeological remains from puestero middens provide a source of information with which to study these changes.



Figure 3. A puestero preparing an armadillo with an ember cooking technique. In the photo of the bottom, he is putting a hot stone in the interior to help heat the inner part of the prey.

Study Area

Western Argentina comprises two large geomorphological zones with different climates, flora, and fauna—the Andean massif and the central plains. Climate in the area ranges from South American subtropical to warm temperate desert and semidesert located with strong climatic gradients and seasonality due to the combined effects of latitude, continentality, wind from Atlantic and Pacific anticyclone rain shadow, and cold oceanic upwelling (Stalder et al. 2020). The interference of the Andes with prevailing wind systems creates the "Arid Diagonal" (Bruniard 1982). The climate is semiarid to arid and rainfall is scarce in the eastern lee of the Andes. Annual precipitation ranges between 100 and 450 mm varying by relief, and mean annual temperature varies between <10°C and 18°C. Correspondingly, agriculture is confined to irrigated valleys, with intensive cultivation of fruits and vegetables (Abraham et al. 2009).

The distribution of phytogeographic provinces in southern Mendoza varies mainly with elevation, which increases from east to west; the diversity of flora and fauna decreases with elevation (Roig, Carretero and Méndez 2000; Roig 1972). Lower-elevation areas are dominated by Monte deserts, Patagonia grasslands are abundant at intermediate elevations, and the Andina and Altoandina vegetation communities occur at high elevations (Cabrera 1976). The Neotropic fauna of the region corresponds to the Andean-Patagonian zoogeographical subregion and the Andean, Patagonia, and Central domains (Ringuelet 1961). The main species represented are those from the "Fauna de la Estepa Patagónica," and the "Fauna de montaña," which includes Guanacos (*Lama guanicoe*), chinchilla (*Lagidium viscaccia*), red fox *(Lycalopex culpaeus*), puma (*Puma concolor*), mara (*Dolichotis patagonum*), small armadillo (*Zaedyus pichiy*), armadillo peludo (*Chaetophractus villosus*), and many bird species, such as Choique (*Rhea pennata)*, Andean goose (*Chloephaga melanoptera*), and numerous duck species such as red shoveler (*Anas platalea*) (Roig 1972).

Materials and Methods

Puestos were selected for study based on location and previous contact with the investigators. Zooarchaeological remains were sampled from middens of 11 puestos, 5 of which are permanent-sedentary households located below 1,500 masl; 6 are seasonal summer puestos (*veranada*) indicative of puestero seasonal transhumance, located above 2,000 masl (Figure 4). Some puestero families have been using the same camps for over a century, so trash middens represent a palimpsest of faunal consumption of multiple decades.

Connectivity with cities is not simply a product of distance but also relates to quality of roads. In the study area, roads comprise national routes and provincial routes. Some of them are paved and interconnect provinces and some of them are gravel and dirt roads that connect localities (Figure 4). At local scales, puestos are often connected to improved roads by two-track trails. Travel by such roads and trails is very slow, and depending on weather conditions, such routes can be impassible. Dirt and gravel roads are better maintained but can also require slow travel depending on maintenance and conditions. In Figure 5 connectivity between puestos and the most proximate city (San Rafael, Malargüe, and Alvear) is weighted. For each puesto, we sum the km puesteros need to drive on two track, dirt and/or pavement roads to reach the most proximate city (Figure 5; left) and San Rafael (Figure 5; right). It can be seen that there is better connectivity between puestos and San Rafael (right graph) than other smaller cities (left graph) in southern Mendoza, and we expect more interaction with San Rafael than with other cities because of improved transportation structure in and around the city.

Seasonal, high-elevation summer camps are farther from national, paved routes and are more isolated than lowland, permanent puestos; some summer puestos are only reachable by horse. Activities at summer camps are limited to the family's daily living, herding, and protection of livestock from pumas and foxes. The summer camps are commonly occupied by

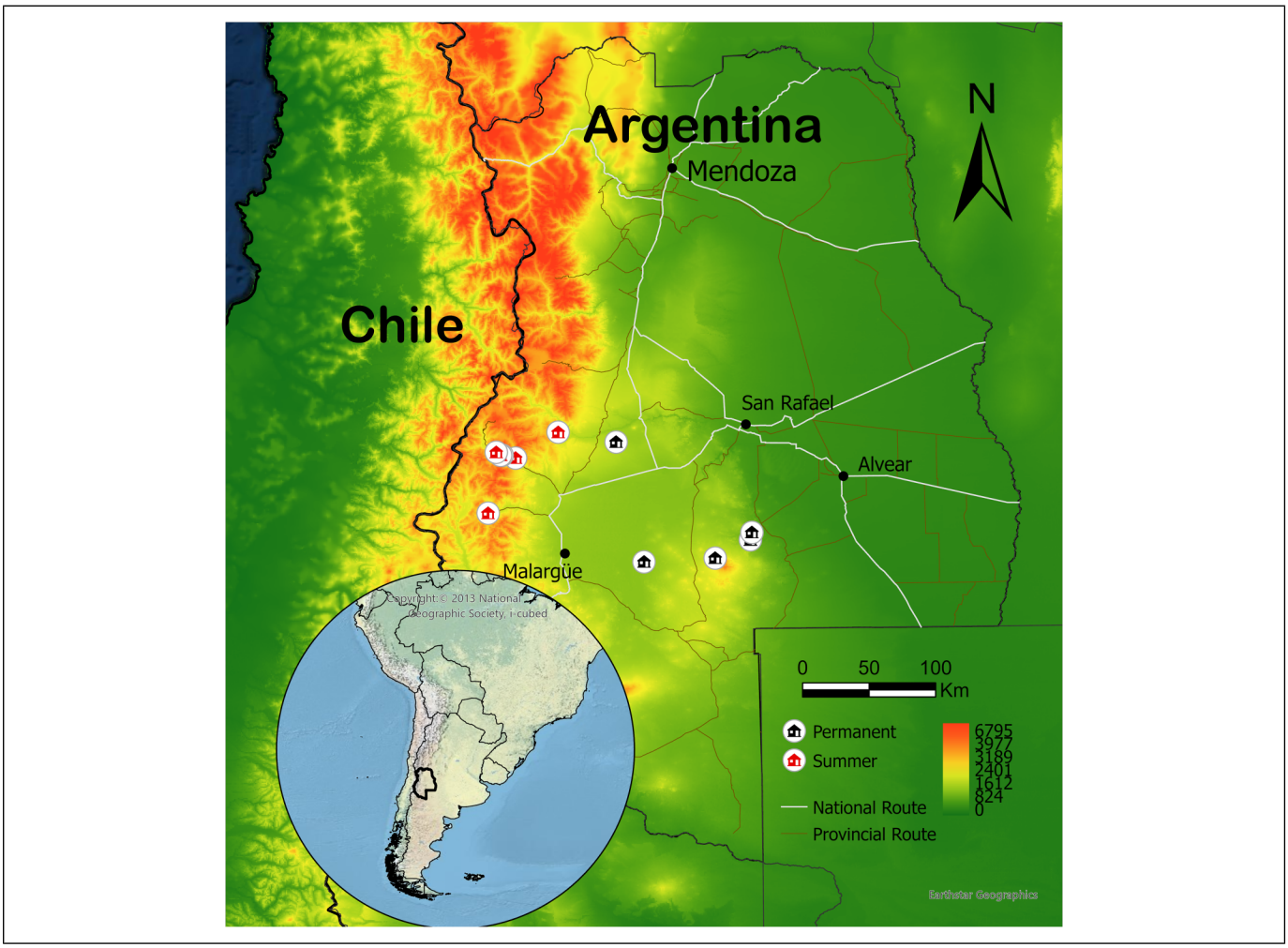


Figure 4. Location of the puestos studied in this article. National routes have pavement and Provincial routes are gravel and dirt roads.

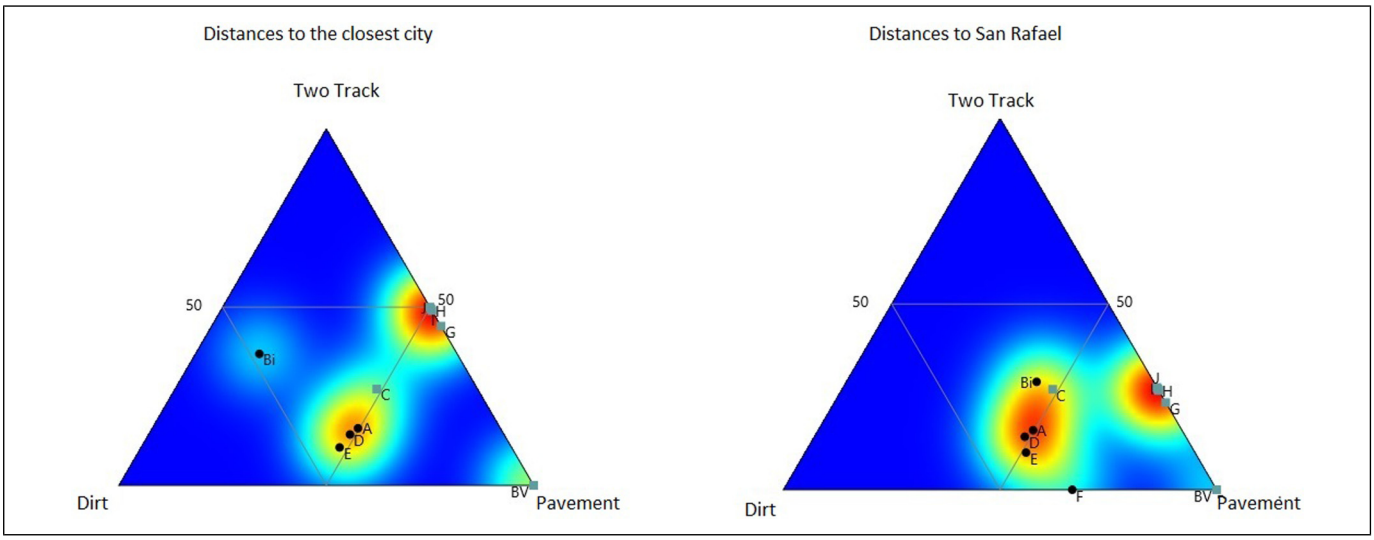


Figure 5. Ternary graphs showing the relation between distances between puestos considering the road type and distance from cities. Each dot represents a puesto, the letters refers to the name of the puesto we give in this article to preserve the identity of the families. A, BI, D, E, and F are permanent puestos; BV, C, G, H, I, and J are summer puestos.

men and are only visited sporadically by puestero women. In contrast, permanent Puestos are closer to national and provincial routes and cities. In all permanent puestos, communal, social activities are common, such as family gatherings and birthday feasts.

We hypothesize that these differences in connectivity to cities and in lifeways has an impact on wild and domesticate animal consumption. Thus, our expectations are:

1. The consumption of wild fauna will increase when the distance to cities increases and connectivity with markets decreases.
2. The consumption of large domesticates (e.g., beef from cattle) will decrease when the distance to cities increases and connectivity with markets decreases. This includes the consumption of asado meat (typically large cuts of beef) bought in town or city markets.

We also expect to observe the inverse of the conditions stated above with a decrease in consumption of wild animals and an increase in consumption of large domesticates with closer distance to and connectivity with cities and markets.

To examine these hypotheses, we analyze the abundance of remains of wild and domestic animals, and those of domesticates with clear taphonomic evidence of being obtained in butcher shops (e.g., bones that were cut with a bandsaw in a butcher shop, see below) from puestero middens. We make comparisons among puestos using three faunal abundance indices (*sensu* Szuter and Bayham 1989; Broughton 1994): the wild game index (WGI), the large domesticated fauna index (LDI), and the asado costilla index (ACI) (Otaola et al. 2016). The indices are calculated using the following formulas:

WGI

$$\frac{\Sigma \text{ NISP wild game}}{\Sigma(\text{NISP large} + \text{small domestic fauna})}$$

LDI

$$\frac{\Sigma \text{ NISP large domestic fauna}}{\Sigma(\text{NISP large} + \text{small domestic fauna})}$$

ACI

$$\frac{\Sigma \text{ NISP Costillas de Asado}}{\Sigma(\text{NISP Costillas de asado} + \text{NISP domestic fauna})}$$

Wild game includes remains guanaco, piche, rhea, and rodents (chinchilla), but may include various small mammals and birds. Small domesticates include sheep and goats, and large domesticates include remains of pigs and cattle and rarely horse. The ribs (costillas) of cattle butchered in city and town butcher shops have ends that are completely sawed using a bandsaw. Correspondingly, the ACI contrasts the abundance of such rib remains as a proportion of the total remains of domesticates, providing an indicator of the prevalence of remains from urban/suburban butcher shops.

A detailed description of fauna in the study area can be found in Roig (1972) and Videla et al. (1997). In this article, we designate small-size wild animals as all nondomesticated fauna with a body weight of less than 15 kg (e.g., armadillos, rodents of different sizes such as mara, vizcacha, and chinchilla, and wild canids such as the gray fox [*Lycalopex griseus*] and the red fox among others). Foxes are not known to be part of puestero diet, but their remains occur in faunal assemblages, in some cases they use their pelts. Large wild animals include those with body weight exceeding 15 kg, including rheas, guanacos, and pumas. Regarding domestic fauna, the taxa framed within the category of "small size" include members of the subfamily Carpininae, including goats (*Capra* sp.) and sheep (*Ovis* sp.); dogs (*Canis familiaris*); and chickens (*Gallus gallus*). Domestic "large fauna" include pigs (*Sus scrofa*), cattle (*Bos taurus*), and horses (*Equus caballus*). As with the foxes, dogs are not part of the puesteros diet, but their bone remains are present in the middens, which may be because of the great amount of dogs living within the puestos.

Waste from butchery, cooking, and consumption of animals is always discarded near puestero homes, eventually forming midden deposits where bones occur in high abundance on or near the surface. During fieldwork at each puesto, middens were located and surface samples of faunal remains were collected in 10 1×1 m units (Figure 6).

Taxonomic and skeletal part identifications were made at Los Reyunos Regional Center, UTN-IDEVEA-CONICET, using the zooarchaeological comparative collection locate there. Taphonomic variables were analyzed to consider if there are differences in the accumulation, depositional, and postdepositional histories of faunas from different types of puestos (summer versus permanent puestos). Taphonomic processes that impacted faunal remains include extent and intensity of fragmentation, weathering, and identifiability of remains. The analysis included designation of weathering stage (Behrensmeyer 1978), identification of carnivore marks and cut marks, as well as examination of %whole to assess extent of fragmentation and NSP/NISP (number of unidentifiable and identifiable specimens [NSP] divided by number of identifiable specimens [NISP]) to examine the intensity of fragmentation among assemblages (after Lyman 1994). The logic underlying %whole is that for faunal assemblages with lower fragmentation rates, the proportion of whole skeletal elements should be higher. The logic underlying NSP/NISP is that in comparatively intensely fragmented faunas the number of bone specimens that are not identifiable to taxon will be higher (Nagaoka, Wolverton and Fullerton 2008; Wolverton et al. 2008).

The identities of puesteros are protected because hunting and consumption of wild animals is prohibited by Argentine federal law. For purposes of mapping, we do not use family or puesto names and provide only general locations. Results of analysis of faunal data from puestos A, BI, BV, and C is published in a preliminary report by Otaola et al. (2016). A and BI are year-round puestos and BV and C are summer puestos. In this article, we add information from the seven additional puestos: D, E,



Figure 6. The 1x 1 m collecting samples from four different puestos.

and F, which are occupied year-round and summer puestos G, H, I, and J.

Results

A total of 2,686 bone specimens were analyzed, of which 2,077 (77%) could be identified at some taxonomic level (Table 1). Faunal analysis reveals a high diversity of animals consumed in southern Mendoza by puesteros. In lowlands permanent puestos, wild fauna includes guanacos, chinchillas, vizcachas, armadillos, gray fox, puma, and choique. In addition, the full suite of domesticates—goats, sheep, cattle, horses, pigs, and chickens—were recovered and identified from lowland puestos. The only wild animal remains identified from summer puestos are those of armadillo. Domesticate remains from summer puestos are dominated by goats and sheep, with a small fraction of cattle remains (Table 1).

In summer puestos, people focus the animal portion of their diet on goats and sheep they are herding. In permanent puestos, in contrast, large domesticates are more commonly consumed with a smaller reliance on goats. Summer puesto faunal samples exhibit very small proportions of wild animal remains and a large proportion of remains of small domesticates. In permanent puestos, six taxa of wild animals were consumed (Table 1), with higher proportional representation of wild and large domesticate animal remains (Figure 7).

Figure 8, portrays the patterns in faunal abundance evident in Figure 7 across geographic space using values of the three faunal abundance indices. For each map, we use equal interval classification, use three intervals within the range of index values. Larger circles represent higher values of each index in permanent puestos. There is one summer puesto that has a relatively large ACI value; however, the maximum of this index is 0.11, which means that only a few sawed rib bones were recovered there. In general, the ACI is higher closer to cities, but because all value are relatively low, outliers (such as the one summer puesto with a high value) have a large effect. In contrast to our expectations, the WGI is higher in the lowlands at permanent puestos, which likely has to do with the paucity of seasonally available wild game near summer puestos at high elevations (see below). The LDI, as hypothesized, is highest in closer proximity to cities. These patterns are also clear in the difference in average index values for the ACI, WGI, and LDI for summer and permanent puesto faunal assemblages (Figure 9).

Index values are analyzed by distance of puestos from cities using Spearman's rho (Figure 10). There is a significant negative correlation between the WGI and distance from cities, which holds for all puestos and for the permanent puestos

Table 1. Taxonomic Abundance of Faunal Remains From Each Puesto.

	Permanent puestos					Summer puestos					
	A	BI	D	E	F	BV	C	G	H	I	J
Caprinae	70	8	22	61	53	15	7	33	32	45	151
Bos taurus.	22		1	30	8	2		1	1		1
Equus caballus				16	2						
Sus scrofa	4										
Lama guanicoe	15	1		1							
Lagostomus maximus	9										
Lagidium viscacia	1										
Chaetophractus sp./*Zaedyus p.*	88	7		32	4	1	2	5	9		
Pseudalopex griseus	1										
Puma concolor	1										
Canis sp.	1			1							
Rheidae	7		2		4						
Gallus gallus	1			1	3						
Iguanidae			1								
Medium size bird	3										
Medium carnivore	1										
Large size mammal	59	8	18	80	74	9	3	13	19	11	3
Medium size mammal	214	23	34	29	170	190	75	41	77	55	74
Small mammal	9								1	1	
Unidentified	118	11	3	141	39	68	8	71	45	96	9
Totals	624	58	81	392	357	285	95	164	184	208	238

A, BI, D, E, F are Permanent Puestos and BV, C, G, H, I and J are Summer Puestos.

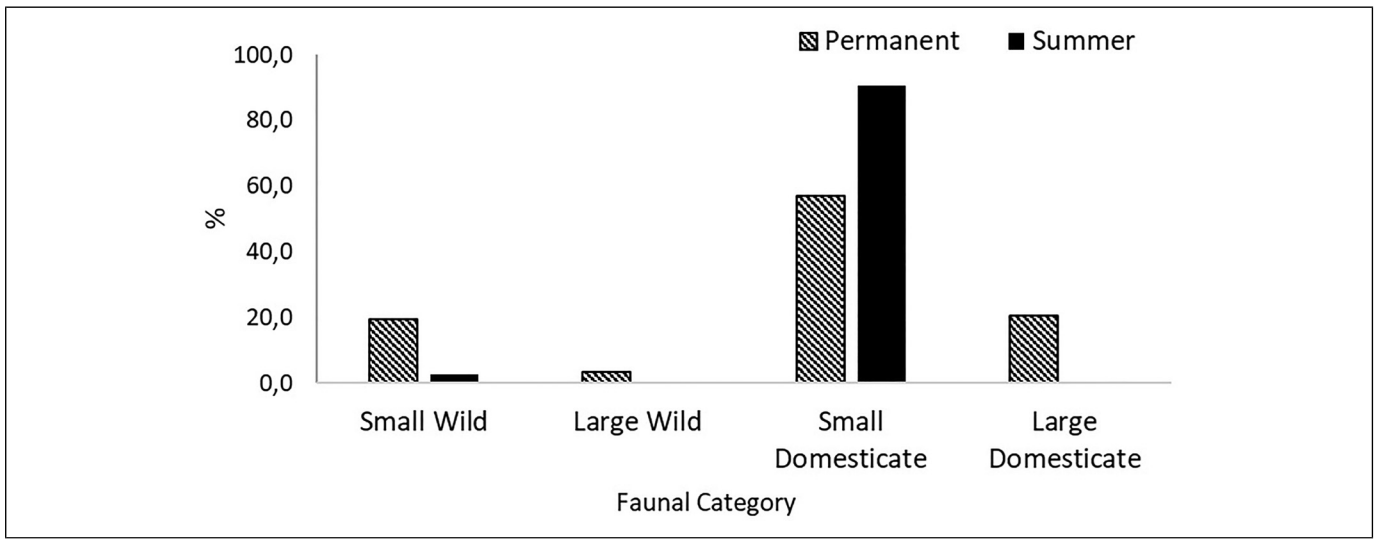


Figure 7. Comparison of faunal remain abundance by animal and puesto category.

(Table 2). This is contrary to our expectations; we hypothesized that wild animal consumption would increase with distance from main cities. There is also a significant negative correlation between the LDI and distance from cities, which hold for all puestos and the summer puestos. There is no significant relationship between the ACI and distance to cities, which is contrary to our hypothesis (Table 2); however, we did not encounter high abundance of bandsaw-cut rib fragments in any of the assemblages, and a small number of remains in one upland puesto midden may drive the relationship.

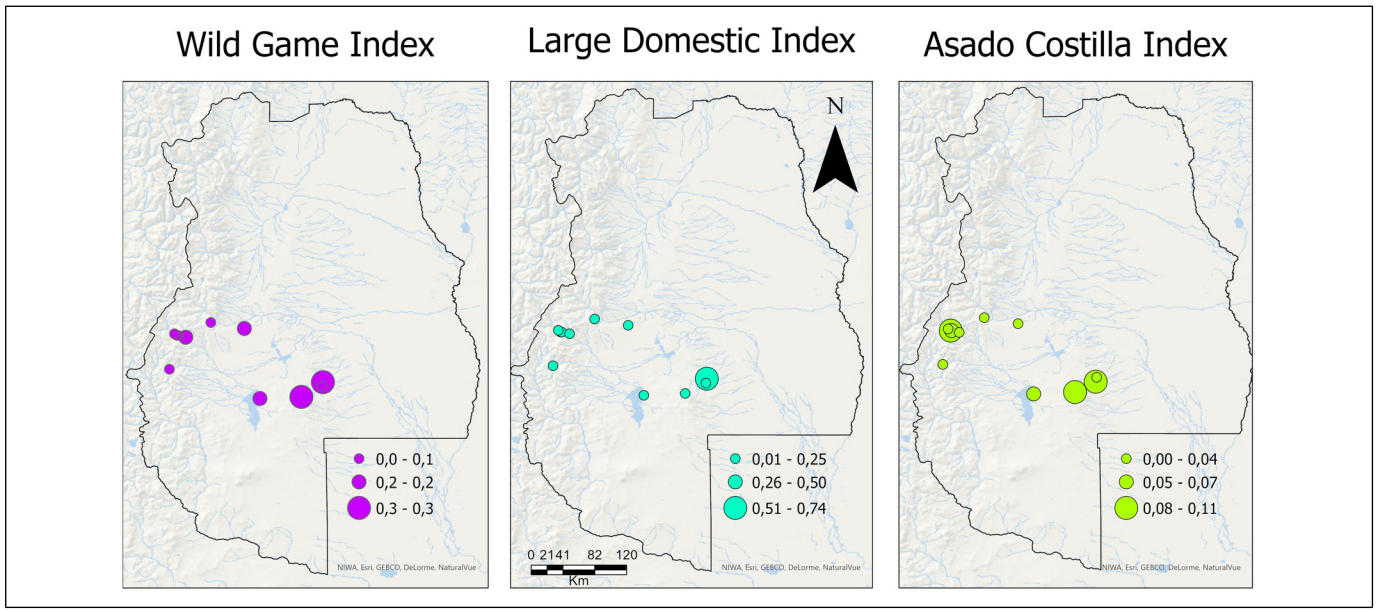


Figure 8. The geographic distribution of faunal abundance index values.

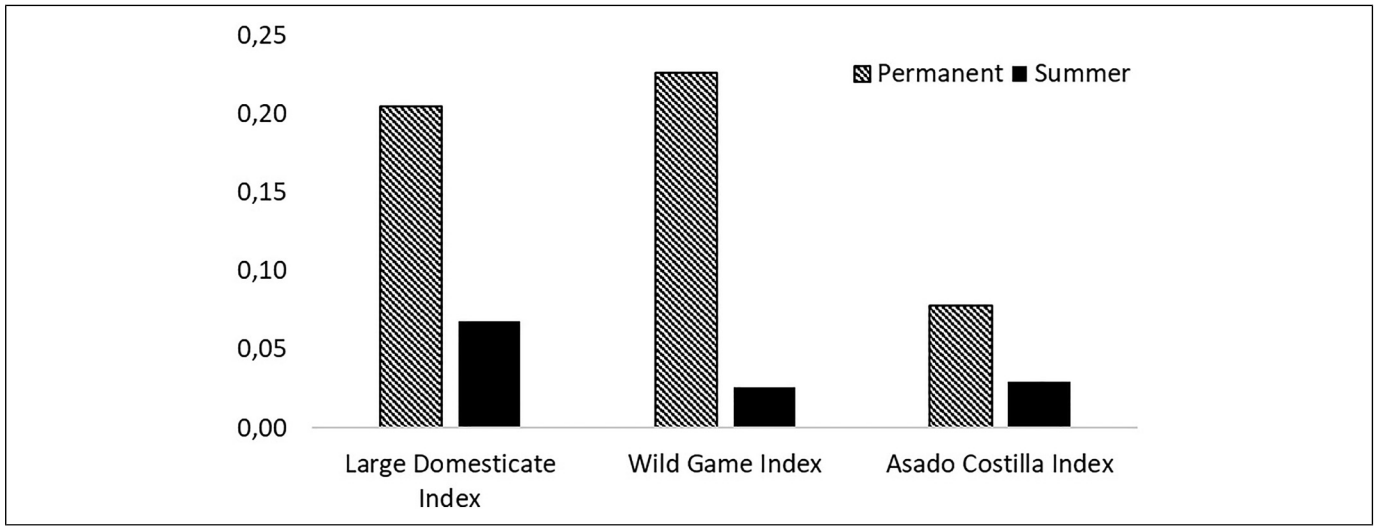


Figure 9. Faunal indices estimated for summer and permanent puestos.

Taphonomic analysis indicates that postdepositional processes had similar effects on faunal remains from both datasets. Remains from both types of puestos have a low % whole (high extent of fragmentation), and intensity of fragmentation is similar at approximately 1:1 NSP:NISP for the summer and permanent puesto assemblages (Figure 10). Remains from permanent puestos exhibited a higher prevalence of carnivore damage. Samples from permanent puestos exhibit a higher proportion of remains in the lower stages of weathering, and summer puestos show a higher proportion of remains with a high degree of weathering (Figure 11).

Discussion and Conclusions

Our findings show that substantial differences occur in faunal assemblages from high-elevation summer puestos and low-elevation permanent puestos, mostly meeting our expectations. However, one expectation was not met, specifically that with increased distance to cities, puesteros would rely more on wild animals. The results of our analyses showed that wild faunas were more common in permanent puestos (closer to the cities) than in summer puestos (farther to cities). This pattern can be explained by the activities carried out in each

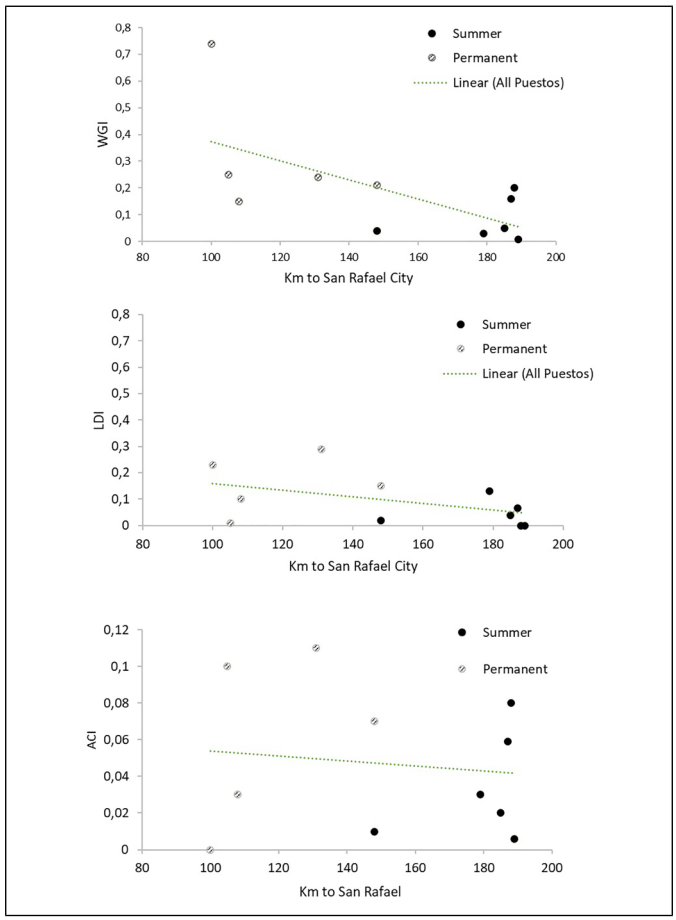


Figure 10. Scatter plots of the relation between the different indices and distance to San Rafael. (a) Wild Game Index, (b) Large Domesticate Index, and (c) Asado Costilla Index.

Table 2. Spearman Correlations Between the Value of Each Index and the Distance in Km. to San Rafael City.

	Wild Game Index	Large Domestic Index	Asado Costilla Index
All puestos	−0.66*	−0.56*	−0.07
Permanent	−0.7	0.2	0.5
Summer	0.09	−0.58	0.09

*P < 0.05.

puesto and the animal biodiversity of each ecoregion. During the summer, puesteros drive their goat herds and sheep flocks to high elevations to take advantage of seasonal pulses in primary productivity. Puesteros in summer camps likely focus on tending their herds and only take wild game opportunistically. In addition, there is low diversity of animal prey in this ecoregion (Roig 1972). Puesteros in summer camps have lower access to purchased food, such as meat from butchery shops. As a result, animal protein derives primarily from the butchery of their own goats in summer camps.

Animal biodiversity is higher in the lowland environments of permanent puestos, which increases the richness of terrestrial animal prey species. In addition, lowland puesteros, are in proximity to large tracts of range with high microhabitat variability as well as closer, more efficient access to villages and cities with butcher shops. As a result, permanent puesto midden deposits are abundant in faunal remains that are taxonomically rich. The broad taxonomic richness may also reflect more intensive and longer duration occupations of permanent puestos, larger sample sizes, and time averaging of those deposits. It is worth noting that the lower abundance of wild game at one of the permanent puestos (BV) may reflect the intentional burning of bones before disposal, since this puesto is close to a natural reserve and receives visits from the park rangers. Puesteros there confided that they are concerned about attention from game wardens because hunting of wild game is illegal. The importance of wild animal hunting in permanent puestos is related to social aggregation, not only during festivities but during the year because the entire family resides there (young, adult, and elderly), whereas seasonal transhumance to summer camps is done primarily by young adult men. These results suggest that wild animal hunting may be more influenced by social practices and free time than by subsistence needs.

In terms of connectivity to and distance from cities, puesteros who are geographically isolated from towns and roads (generally in summer camps) rely heavily on their livestock—mainly goats and sheep. Sedentary and winter camps that are geographically closer to roads and towns, exhibit a higher abundance of store-bought beef (indicated by the abundance of saw cuts on ribs from a butcher bandsaw in the ACI). Lowland puesteros relied on a broad array of wild and domesticate resources.

Important land use changes influence puesteros differentially across the physical environments they occupy. Changes in conservation policy at provincial and federal scales and shifts in land tenure practices that relate to neoliberal economic policies and development have influenced ranching and pastoralism practices. The degree of impact varies with proximity to urban economies. In the context of new employment opportunities, young members of some families are leaving the puestos, perhaps ensuring the slow decline of this traditional ranching lifeway. Changes in diet at the puesto include increased emphasis on domesticated versus wild animal dietary resources, changes in goat herd sizes and structures, as well as encapsulation (fencing) of large tracts of land under new ownership.

Even though wild hunting is a social practice, in the past puesteros hunted wild game as a sustainable means to supplement their diet with animal resources. Contemporary environmental law in Argentina in response to intense sport harvesting has compromised the ability of herders to hunt wild game without fear of legal consequences, even though they are allowed to hunt for personal consumption.

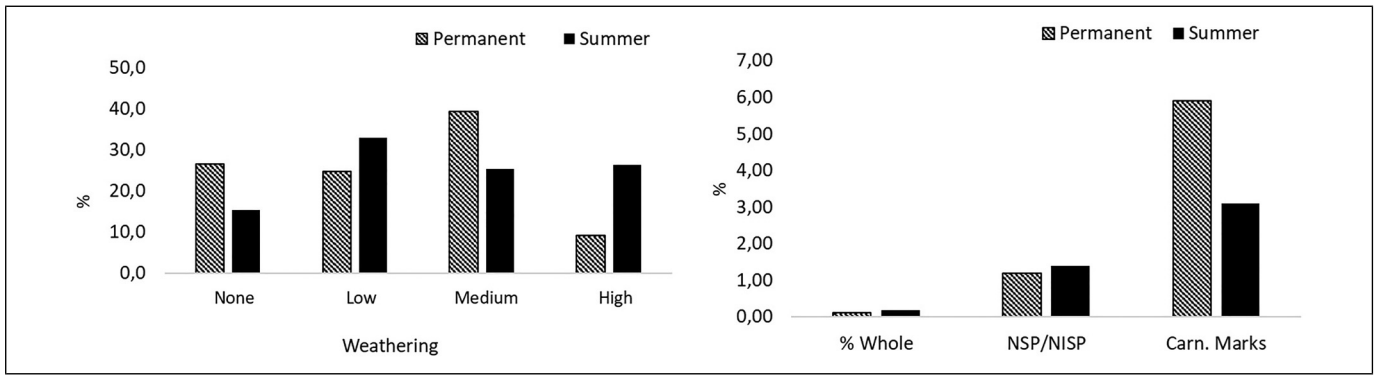


Figure 11. Taphonomic variables for each subsample of the puestos. Left: level of weathering considering Behrensmeyer stages (none = stage 0; low = stages 1 and 2; medium = stages 3 and 4; high = stage 5).

In addition, southern Mendoza puestero populations suffer the negative impact of the boom in public policies aimed at mining and tourism promotion, giving rise to a new scenario that, at the beginning of the twenty-first century, has been characterized by rural–urban migration, the ageing of the puestero population, and the resultant rearrangement of peasant and livestock infrastructure (Cepparo 2014; Reboratti 2006). In the face of considerable cultural, political, and environmental change, the traditional lifeway and local knowledge of puesteros are in danger of being lost, not only regarding faunal consumption but also wild plant use (Llano and Durán 2014; Llano et al. 2021).

In sum, this study of faunal remains from puestero middens provides a means to address research questions about this pastoral lifeway. The patterns we observe, however, point toward broader social, political, and economic forces of great complexity that are influencing puestero culture and ecological knowledge. Such processes are macroeconomic forces that have local impacts for puesteros (Accorinti et al. 2016; Soto and Martínez-Navarrete 2020). Zooarchaeology offers a lens through which to record and preserve aspects of puestero culture (*sensu* Soto and Martínez-Navarrete 2020).

Our findings highlight significant impacts on fauna, revealing that faunal assemblages differ substantially between high-elevation summer puestos and low-elevation permanent puestos. Contrary to our expectations, wild faunas were more common in permanent puestos closer to cities, attributed to higher biodiversity and proximity to diverse microhabitats and that wild prey are a traditional food item and people closer to urban areas or with greater connectivity might have a greater desire for these kinds of foods. It is important to mention that hunting wild faunas has not been recorded as a commercial activity. Permanent puesto midden deposits show greater taxonomic richness due to these factors, along with more intensive and longer occupations. Conversely, summer camps, located in regions with lower prey diversity, focus on herding, resulting in less reliance on wild game and higher dependence on livestock. Conservation policies further complicate traditional hunting practices, leading to rural–urban migration and an aging puestero population, which threaten the sustainability of their lifeways and ecological knowledge. The study underscores how broader sociopolitical and economic forces impact traditional hunting practices and faunal preservation, with zooarchaeology offering crucial insights into these dynamics.

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