IN THE SHADOW OF THE PEÑON:
A ZOOARCHAEOLOGICAL STUDY OF FORMATIVE DIET, ECONOMY, AND SOCIOPOLITICS IN THE RÍO PUKARA VALLEY, PERU

by

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ABSTRACT

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In the Lake Titicaca Basin, the Formative period saw extensive changes in the scale and nature of sociopolitical complexity, ritual practice and economic organization associated with the transition from small villages to the rise of regional Late Formative polities. These changes were partially fueled by the development and intensification of agro-pastoral economies. Consequently, it is essential to compare and contrast subsistence and herding practices associated with the domestic and political economies, given that these forces supported life at the village- as well as the polity-level. A growing database exists for animal exploitation associated with Formative through Tiwanaku Periods in the South Titicaca Basin. This dissertation aims to add to our understanding of the Pukara Polity and Formative Period, as seen from the Northern Titicaca Basin of Peru, specifically the Pukara River Valley.

This dissertation addresses the goal of tracking diachronic change in subsistence, herd management, and extra-domestic use of fauna (feasting and ritual) by presenting results of an analysis of large faunal assemblages from two Pukara Valley sites—Huatacoa and Pukara. These sites span the Early to Late Formative periods. Excavated contexts from the small village-ritual center, Huatacoa, and the Pukara polity center itself, at Pukara, include remains of domestic activities, public area feasting, and ritual deposits. Documentation of this range of cultural activity areas offers a good opportunity to characterize everyday meals, commensal politics, and ritual behavior. Camelid exploitation is studied to characterize site-specific contextual use, compare polity-wide herd management practices, and as a proxy for change over time in their importance. Data analyzed and discussed include taxonomic abundance; taphonomy; camelid osteometrics and mortality profiles; body part representation, and evidence for butchery and food preparation patterns.

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CHAPTER 1: INTRODUCTION

As elsewhere, archaeologists in the Andes seek to understand the processes and social changes spurring the transition from egalitarian hunting-gathering to adoption of an agrarian and pastoral lifestyle. Archaeologists also grapple with concomitant why and how questions concerning: 1) multiple, unrelated kin groups aggregating in villages, 2) nascent leadership offices paving the path to integrated state and empires, 3) the role of ritual and feasts as formal arenas for communal integration and corporate empowerment, and 4) exchange, social differentiation, and economic specialization.

The present dissertation project sought to cast light on these issues through a faunal study of two sites from the Formative Period (1500 BC – AD 300/400) of the Titicaca Basin. This millennial unit of time brackets societal revolutions occurring between Archaic hunter-gatherer-fisher lifeways to the prominence of the Tiwanaku State. To construct a diachronic, micro-regional and intrasite analytical framework, two neighboring sites, Pukara and Huatacoa were investigated. Respectively, at their prospective heights, they functioned as a North Basin polity capital and a village-ceremonial center. Studied Pukara site contexts document both open space that hosted communal gatherings and individual household activity areas, while those at Huatacoa display a long-term domestic habitation and ritual sunken court precinct (Table 1.1).

For a comprehensive perspective, these broad social transformations are best elucidated by pulling together multiple lines of evidence. Wild fauna and domesticated camelids and guinea pigs served as crucial components of prehistoric Andean subsistence, economy, ideology, and sociopolitical and ritual transactions (e.g. feasts and sacrifices). Zooarchaeological analysis yields invaluable datasets with which to test theories of social continuity and change and add depth to our reconstructions.

Table 1.1: Overview of Formative Contexts by Site

	Huatacoa	**Pukara**
Early Formative (1500-800 cal. BC)	Domestic: 2 houses, midden Ritual: plaza, sunken court	NA
Middle Formative (800-200 cal BC)	Domestic: midden Ritual: First sunken court	Ritual: Qalasaya sunken court (Wheeler and Mujica1981)
Late Formative (200 BC-500 cal AD)	Domestic: midden Ritual: Sunken court	Public: Communal feasts Domestic: Compounds Ritual: 1) Lagunita Mound 2) Domestic rites 3) Qalasaya (see above)

Before delving into data, this chapter sets the stage by defining the theoretical perspectives and models influencing this research project. Next, drawing from this framework, research questions springing from these perspectives are presented. Resultant testable archaeological expectations are laid out and the proposed analytical methodologies to test them are enumerated. The chapter ends with a chapter-by-chapter description of the volume.

Theoretical Frameworks

Archaeological Theory

Pastoralism: Meat vs. Secondary Products

In the Andes, the Terminal Archaic – Early Formative domestication of wild camelids represents a major realignment in human-camelid relations. During the Early to Late Archaic, wild camelids were a major hunting focus for foragers across the Andes (Mengoni Goñalons and Yaccobaccio 2006; Moore 1989; Wheeler 1984; Wing 1986). Meat and fat, wool, and additional body products (e.g. bone, sinew, and hide) were key resources. Several Osmore Valley sierra and puna sites indicate camelid domestication was a long-term process, beginning in the Late Archaic and continuing during the Terminal Archaic-Early Formative (Aldenderfer 2002). High-altitude acclimation and adaptation to high-sierra valleys, the Altiplano, and puna environments likely were multigenerational processes (Aldenderfer 1998, 2008).

During this extended period of adaptation, hunters became familiar with wild camelid herd behavior and herd populations likely declined following overexploitation. Early during this process the herd-herder relationship is characterized as carnivorous pastoralism (*sensu* Ingold 1980), whereby herd animals served as manageable risk buffers (i.e., a readily available source of meat-on-the hoof and hides) (Browman 1974)[1]. Yet, risk buffering as a short-term adaptation – to maintain viable prey populations as both human populations and demand for camelids increased – is debated, due to the low reproductive rate of camelids (Aldenderfer 2008:140). Recently, a costly-signaling and behavioral ecology-based model of herding's development was proposed (Aldenderfer 2006). It suggests men engaged in wild camelid hunting as a means of status competition through meat provisioning. As wild camelid prey became scarce, a prey conservation and herd accumulation strategy became favorable. Herd size then became an observable signal of prestige, while herds (and their meat, wool, and future reproductive potential) became deferred-use private property (Aldenderfer 2006:193).

Continued management and breeding by Formative Period pastoralists and an expanding political economy increased the importance of secondary products and

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[1] Active management encouraging herd growth remains key to this day, given mortality rates of young, low fertility, and loss of animals to raiding, frost, disease, and predators (Browman 1974; Flannery et al. 1989).

suprahousehold and ritual use of herd animals. Chief among these are wool production (by alpaca and llama) and local and long-distance exchange of goods (by pack llamas). As we will discuss in Chapter 3, long-distance trade operated by the Early Formative, before intensifying in the Middle and Formative. Similarly, weaving – documented by the presence of bone weaving tools and spindle whorls and some preserved textiles – grew in importance (Conklin 1983; Moore 1999; Mujica 1987).

Another notable trend amongst Andean cultures and pastoral and domesticated animals worldwide is the consumption of herd animals in feasting and their use in ritual performance and associated deposits (deFrance 2009b; Gladwell 2010; Guaman Poma 1992; Jing and Flad 2005; Keswani 1994; Kuznar 2001; Russell 2012; Warwick 2010, 2012; Webster and Janusek 2003). For example, in terms of ritual sacrifice, broad cross-cultural similiarites can be identified between Andean and Ancient Greek animal sacrifice performances: animals are consecrated, prayers and additional offerings are made (e.g. plants, alcohol and blood), the sacrificed is consumed in a communal feast, and the supernatural is receives a burnt offering of a share of the meal (Burkert 1983:1-7). Burkert describes the sharing of the first offering, which consists of a “few raw pieces of flesh from every limb [and]…bones as well, indicating the entirety of the slaughtered animal. The purifying fire then consumes all” (Burkert 1983:6). This very much compares to the process described below for the practice of pago burns and wilancha sacrifice.

This new herder-herd animal relationship and recognition of new economic and extradomestic practices lead me to several expectations about Formative animal use. First, I expect the pastoral production to effectively replace or reduce the use of wild animals from the Early to Late Formative Period. Second, anticipated growth in importance of pastoral secondary goods increasingly engaged pastoral production into an emerging political econonomy. Over time wool production and caravanning should become a more significant focus of herd management over base meat contribution. This should be perceived in species ratios (wild vs. domesticated camelids), average age at cull, and bone pathologies associated with burden carrying. At both the village and polity-level, greater emphasis on meat production – for feasts – and herd animals in ritual is expected.

Corporate Culture: Factions, Elite Power, Commensal Politics and Surplus Consumption

Across the Lake Titicaca Basin, the Formative Period is marked by major social, political, and economic changes (Hastorf 2005). During the Early Formative, the first small villages developed alongside single-household sites. By the Middle and Late Formative, multi-settlement polities emerged, based on growing sociopolitical inequalities, expanded economic relations, and shared ritual ideologies (Bandy 2004; Stanish 2003; Stanish and Plourde 2006). Attendant with these changes are archeological signatures of increasing social differentiation and multi-household social cohesion: rank-size site hierarchies; growing corporate identity evident in ceramic styles, stelae, ritual paraphernalia; public architecture; long-distance exchange and interaction; and the fluorescence of the Northern Basin polity of Pukara (Burger et al. 2000; Klarich 2005a; Stanish 2003). Agro-pastoral household production underwrote this settlement aggregation, economic and ritual elaboration, and adapted in response to the shifting social landscape. What conditions encouraged the transfer of household herd animal surplus into the extra-domestic political economies of the village and regional polity?

Intermediate-level societies worldwide depend upon the household as the basic unit of economic production and consumption and as the foundation of the political economy (D'Altroy and Hastorf 2001; Feinman and Nicholas 2004; Muller 1997; Stanish 1992, 2003). Historically, the Andean household, in concert with village-centered kin groups (*ayllu*), was the focus of socioeconomic (e.g. reciprocal, redistributive ties), ritual, and political relationships and obligations (Stanish 1992:27). As such, households ceded some of their socioeconomic autonomy to undertake cooperative labor projects and consumption of surplus in communal feasts and rites.

Elite factions, by necessity, compete with each other to persuade households to contribute surpluses or labor to pursue their agendas. Generosity (e.g. in gifts or feasts) can foster a cycles of interaction and indebtedness that can be drawn upon in the future (Dietler 1996; Clark and Blake 1994:21). Periodic feasts encourage the gathering, redistribution, and consumption of food surplus that led to the "creation and maintenance of identity and social relations" (Logan et al. 2012:235). They also provide favorable settings for economic and ritual transactions (Hayden 2001). In the prehistoric Andes, feasts cemented factional membership and commemorated ancestor-descendant relationships (Hastorf 2003a, 2003b; Lau 1993). Additional feast types known from ethnographic contexts are discussed below.

Dietler (2000:77) notes a very important point about feasts purport to serve a benign role of maintaining corporate identity: they are "simultaneously arenas for manipulation and the acquisition of prestige, social credit, and the various forms of influence, or informal power, that symbolic capital entails". When formalized status and power are temporary, hosting a feast demonstrates managerial skill as labor and resources are marshaled. It also becomes an arena to garner prestige necessary to exert persuasive influence and temporary leadership (Dietler 2000:78). Over successive repetition, power and social differentiation might become more formalized.

Elite control of religious belief systems can also encourage community integration and cooperative behavior. Ritual forms serve as glue to ensure reciprocal relations. Specialized multi-household production and labor in ranked societies "is based on notions of reciprocity and ritually sanctioned redistribution" of food surplus and manufactured prestige-goods (Stanish 2004:17; Haley and Stanish 2004). Ideology and power are presented in material form, in the form of monuments, iconography, feasting, and prestige items, and enacted, through ritual events (DeMarrais et al. 1996). These varied media serve as concrete, repetitive referents of group membership and factional power.

The above theories describe feasts and rites as loci: 1) where corporate factions form and interact, 2) where reciprocity and group ideology are reinforced, and 3) that demand and consume surpluses. These facts have implications for our understanding of Formative society. Domesticated, and to a lesser extent wild, fauna become increasingly important elements of the greater political economy. For camelids, there is rational economic and subsistence sense for husbandry and improvements to their productivity – as sources of meat, wool, dung for fertilizer and renewable fuel, and good transport. Ritual and social (and of course, economic) interactions also interlink society, camelids, and the supernatural (see Nielsen 2000). They become the focus of and means to reproduce subsistence, economic, social and human-supernatural relationships.

I therefore anticipate pastoral household by the Late Formative might utilize their animals in strategic new ways to acquire prestige. First, pastoralists will become less focused on household subsistence and self-sufficiency, but more about tapping into ever-widening circles of sociopolitical allegiance, reciprocity, and prestige-gathering strategies. Over time I expect to see larger examples of suprahousehold-feasting hosted in public locales and manipulation of kin or corporate relationships to marshal surplus. Incremental additions of animals from multiple herds would not burden household herds, but additively generate surplus.

By the Late Formative, settlements like Pukara will have achieved a level of success. Nonetheless, smaller village settlements like Huatacoa might pursue alternate feast or prestige strategies. For instance, feast may be more humble and potluck in format and caravan exchange of prestige and subsistence goods may serve as an alternate pathway to influence and surplus. At the Pukara Polity capital, larger public feasts and rituals would draw upon greater surpluses from larger factions. This surplus might also support provisioning of meals for elites or retainers.

These changes will have measurable impacts on faunal exploitation[2]. First, the ratio of camelid to wild animal consumption will increase. Public and ritual context culling strategies would favor slaughter of younger animals for readily accessible meat (~3 years of age). A mortality second spike at old age would correlate with wool producers and caravan animals that age out of their productive years (between 8-10 years old). At the household-level, culling of prime age animals would prove more costly because smaller herds are being managed. Wool production and caravanning could

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[2] The following trends are expected to be exaggerated in scale at Pukara capital versus the smaller village.

become two economic strategies. If wool production is the selected economic focus, I anticipate a higher ratio of alpacas, breeding to favor wool production, and lower evidence for caravan animals (e.g. pathologies, body-size). A caravan emphasis should present the opposite pattern, larger herd animals complemented by higher frequency of caravan bone pathologies.

Associated trends in carcass butchery and food should characterize contexts in at the two sites. Butchery contrasts between domestic and extra-domestic contexts should scale up in relative differentiation over time, and consequently, between the two sites. High food utility biases, which demonstrate provisioning of carcass parts, should be associated with Late Formative domestic contexts rather than earlier village domestic contexts. Alternatively, high utility may occur within ritual contexts, rather than domestic context – provided their suprahousehold nature. Carcass processing should display contrasts between the two sites and particularly between domestic and extra-domestic contexts. Feasting butchery should utilize whole carcass use, while domestic contexts should emphasize soups (highly fractured bone) and *ch'arki* consumption. The described predictions about the impact of corporate power consolidation and extra-domestic competitive events will be tested below.

Ethnographic Analogies for Prehistoric Herd Management and Use

Herd Size / Composition

Historic and ethnoarchaeological studies provide useful baselines to begin to model prehistoric herd management, butchery, and culling practices. What might a typical family herd be like? For management purposes, household herds are often separated into two herds: a family herd (of mixed sex, age ranges) and a male herd (of castrate / non-dominant reproductive males). Separation reduces aggression that the dominant male directs towards other reproductive males and facilitates control of herd breeding stock (Bonavia 2008:422-423; Tomka 1992). Castration further reduces antagonism (Nikolman et al. 2000), allowing adult castrates to remain part of family herds. Traditional herd sex ratios can include a relatively high percentage of adult males and castrates, though adult females predominate (Moore 1989:108-109; Tomka 1992:416-417)[3].

Herds of the post-Spanish Conquest Aymara Lupaqa polity of the Titicaca Basin were the communal property of *allyus*, which Moseley (1992:53-54) defined as multi-household, consanguine kin units that exchange labor and manage corporate pasture and farmland (Graffam 1992; Murra 1965). In practice, however, households managed and owned segments of the communal herd (Flannery et al. 1989). In contrast, a modern household herd's initial form derives from kin social relations: 1) childhood gifts, 2) wedding gifts (dowry), 3) a married couple's joint holdings, and 4) family herd inheritance (Browman 1974:193; Palacios Ríos 1988; West 1983). Gifts (of livestock and land) and lineal transmission of *bofedal* usufruct rights create reciprocal bonds, between parent and children, assuring a social net of labor for aging parents and inherited livestock for the young (Bolin 1998; Palacios Ríos 1988).

If properly managed, herds can transform from humble beginnings to larger holdings. Post-Conquest Lupaqa family herds are estimated at 50 – 70 head (Graffam 1992, see Flannery et al. 1989:110-111 for lower estimates). Within the west Titicaca

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[3] Male and castrate frequency may correlate with secondary products yield, as male / castrate are considered the strongest pack animals and male alpacas produce high wool yields (Browman 1990:335).

Province of Puno, 20th Century average household herds ranged between 90 – 250 head (Browman 1990:328). The largest household holdings range between 500 – 600 head, while small family herds consist of 20 – 40 head or less. Herds wax and wane in response to natural mortality, household culling, and culling in response to social demands and ritual consumption.

Caravanning

Llama pack animals are one link between the domestic and greater economic and social aspect of the political economy. Historic accounts of Lupaqa caravans, which linked the Titicaca Basin to far-flung colonies or trade partners in the Moquegua Valley, Cusco area, and *selva*, formed the basis for the vertical complementarity model (see Murra 1968:121-125; Masuda et al. 1985). Altiplano agropastoral households exchanged pastoral goods and agricultural goods (e.g. *ch'arki*, tubers, fat, salt, wool, textiles) for minerals, obsidian, coastal products (fruits, dried fish, *ají* peppers), and *selva* goods (ceramics, coca, hallucinogens, maize, cotton) (Browman 1974:339-344). Among modern traders, trade items also include old castrate llamas (8 or more years of age) as meat-on-the-hoof, and three ritual items – camelid fetuses, llama fat, and ritual herbs (Nielsen 2000:413).

In his dissertation, *Andean Caravans: An Ethnoarchaeology,* Nielsen (2000:520) sets the typical caravan-elite relationship on its head: "… most pre-Inka traffic in this area [South-Central Andes] must have been in the hands of independent pastoral households". Given their procurement of long-distance goods necessary to the emerging prestige-goods economy, he argues caravanners shared a more equal social position vis-à-vis elites. They were well-positioned to pursue status themselves, given greater autonomy, control of access, and cultivation of relations with distant trade partners. For the prehistoric Titicaca Basin, by the Late Formative, large-scale, llama caravan trade was well-established, given the widespread distribution of long-distance trade goods such obsidian and olivine basalt hoes (Bandy 2004; Tripevich 2007). However, the smaller-scale origins of caravan trade may stretch back to the Early and Middle Formative Periods.

Castration: A Digression

Significant to this study are two additional consequences of castration. First, meat from castrated individuals is judged to be more tender than from reproductive males (Tomka 1994:118). Meat tenderness might reach its apex with the culling of young castrates. Second, castrate adult llamas are larger, stronger, and taller than adult females and sexually intact males – making them preferred pack animals (Bonavia 2008; Fowler 2011:136; Tomka 1992:427).

Since generational studies of castrate and adult camelid growth were found, I use modern studies of sheep as taxonomic analogy. Castrate sheep display greater total long bone length and later epiphyseal fusion than intact male sheep (Davis et al. 2000). With energy redirected from reproductive development to body growth, a longer period of bone growth results in later epiphyseal fusion. Consequently, castrate alpacas and llama should cluster at the large end of their respective species' body-size ranges. If true, castrates might account for some archaeological specimens that osteometric study describes as intermediate- and very large size (see Chapters 5 and 7).

Carcass Processing

Based on ethnographic observations in Peru, Bolivia, and Argentina, butchery divides camelids into similar units (Table 1.2). Ethnographic accounts also describe describe secondary processing and food preparation (Miller 1979:48-68; Olivera and Nasti 2001:300)[4]. Boiled head, vertebrae, sternebrae, scapula, and the radio-ulna, metapodia, and phalanges often flavor soups. Ribs, and sometimes the sternum's brisket cut, are roasted. Meat is filleted from limbs, scapula, and pelvis, for roasting, stews, or *ch'arki*; while defleshed, smashed limb bones and marrow also flavor soups. At the end of the rainy season, camelids are slaughtered to harvest fat stores at their peak (Tomka 1994:242). Fat cakes are rendered from the cooked bone and marrow for later use. From a zooarchaeological perspective, I would expect meatier limb bones to be associated with roasting. Axial elements (and a lower limb bones) wil be more associated with soups and ch'arki production.

Much of the camelid meat consumed by modern herding households between culls is in the form of *ch'arki* (meat dried by frost and sun exposure, also spelled *charqui*). The makeup of *ch'arki* units contrasts across the Andes, sometimes described as boneless filets or filets with attached podial and cranial bones (aka *chalona*) (Miller and Burger 2000; Stahl 1999: 1359-1369). Kept dry it stores for up to two years (Tomka 1994:241). Processing juvenile and older animals into *ch'arki* also improves meat palatability – by muting its bitter, grass-fed flavor (Miller and Burger 2000:574).

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[4] Miller describes extensive post-butchery bone fracture for stew and soup additions. Huatacoa and Pukara bone display similar fractures in all behavioral contexts. Burning on bone suggesting roastingwas also practiced (see Chapter 6).

Table 1.2: Butchery Units (Miller 1979; Olivera and Nasti 2001; Tomka 1994)

Miller (S. Peru)	**Tomka (S. Bolivia)**	**Olivera and Nasti (NW. Argentina)**	**Yacobaccio (NW. Argentina)**
Head: (Mandible / skull)	Head: (Mandible / skull)	Head: (Mandible / skull	Head: (Mandible / skull)
Sternum	Sternum	Sternum	Ribs
Neck: Atlas - thoracic 1, first rib	Neck: Atlas - thoracic 1, first rib	Neck: Atlas - cervical 7	Neck: Atlas - cervical 7
Axial column [1]: Thoracic 2 - lumbar, sacrum	Axial column: Thoracic 2 - sacrum, caudal	Axial column: Thoracic - sacrum, pelvis	Axial column: Thoracic - sacrum
Forelimb: Rib 2 - 11, scapula, humerus, radio-ulna, carpals	Forelimb: Ribs (minus 1, 11-12), scapula, humerus, radio-ulna	Forelimb: Ribs, scapula, humerus, radio-ulna, carpals	Forelimb: Scapula, humerus, radio-ulna
Hindlimb: Pelvis, femur, patella, tibia, tarsals	Hindlimb: Pelvis, femur, patella tibia, astragalus, calcaneus	Hindlimb: Femur, patella, tibia, tarsals	Hindlimb: Femur, patella, tibia, tarsals
Metapodia, phalanges	Carpals, tarsals, metapodia, phalanges	Metapodia, phalanges	Metapodia, phalanges

[1] **Or two segments: a) Thoracic 2 – 11 and b) Thoracic 12 – sacrum, rib 12**

Overall, *ch'arki* is a compact, readily available, and highly storable protein source. Its production remains important as a way to store surplus household meat (from a slaughtered animal) and as an exchange good transported by llama caravans (Dransart 2002; Flores Ochoa 1977; Nielsen 2000; Tomka 1994). *Ch'arki* production and consumption is expected to be primariliy associated with Formative households.

Culling: For Hearth, the Political Arena, or the Altar?

Households, of course, draw upon herd animals for subsistence. Historic estimates suggest households could annually cull at most 8-15% of their herd before creating a herd growth deficit (Browman 1974; Miller and Burger 2000). This rate encompasses culls for subsistence, *ch'arki* exchanges, and ritual obligations. For modern herders focused on secondary products, most llamas and alpacas are left to thrive into adulthood to take advantage of their value as burden-carriers, wool-producers, and (female) reproductive breeding stock (Moore 1989:275). When meat is not the goal, culling can be used to eliminate unwanted genetic traits (Moore 2008), encourage docile behavior (Flannery et al. 157) or target animals declining in health or productivity.

As secondary products garner increasing importance in prehistory, fewer younger animals are expected to be culled relative to adult and very old animals. A high mortality spike should correlate with males and female animals of an adult age when their productive use is exhausted. A rough relationship exists between alpaca and llama culling age and the age for which wool quality and production, female reproduction potential, and caravan llama ability are at their maximum level – between eight and 10 years of age (Nielsen 2000:171-172; Tomka 1994:115-119). In contrast, late juvenile / young adult age correlates maturate to maximum body-size, and thus meat quality, is reached – roughly 3 years of age (Tomka 1994:117; Webster 1993). Yet, to maximize herd size, females are often culled at advanced ages relative to males. In sum, late culling maximizes secondary product production, while balancing competing household goals.

What do mortality profiles for modern Andean herds employed for mixed fiber/meat/caravan production look like? The annual mortality profiles for studied alpaca (Moore 1989:274-279) and llama herds (Yaccobacio 2007:150-152) are examined for insight. Adults (60%) dominate the alpaca age-profile, followed by the newborn / yearling age-class (about 30%). Similarly, Yacobaccio reports 43% of culled llamas were old adults (8+ years old), 29% adult (3.5-8 years old), 14% subadults (1-3.5 years old), and 14% yearlings (0-1 year old). Both examples demonstrate the very high percentage of adults that is characteristic of a secondary products economy focus.

Just as significant is the role of culling to satisfy suprahousehold consumption and ritual accounts. Multi-household labor is necessary to complete some modern agro-pastoral tasks, including the planting and harvest processing of *quinoa* and construction of terraces, raised fields, canals, and *qochas* (Erickson 1993, 2000; Graffam 1992; Tomka 1994). Erickson and Tomka describe these events as possible *minka* reciprocal labor by *ayllu* members, whereby short-term suprahousehold labor is sponsored and rewarded by household generosity in food and drink. Sponsors provide one to two camelids for culling to provide meat (Tomka 1994:313-314). Today and in the past, *watiya* earth ovens, constructed of heated stones and mounded dirt, slow roast meat and tubers for such work-party feasts (Klarich 2005a:82; personal observation).

Ritual culling appears in several forms for Aymara and Quechua society. Herd fertility rites often include the sacrifice and consumption of llama and alpaca. The *wilancha* sacrifice, a ritual sacrifice of camelid(s) that features a blood offering to *Pachamama* and other spirits are one example. The offering invokes reciprocal relations with the supernatural, requesting herd and pasture fertility and luck in the upcoming year (Dransart 2002; Janusek 2008:39-40; Tschopik 1951:279). A proper sacrifice, within the Altiplano community of Paratia, involves a juvenile or young adult male llama or alpaca; cremation and burial of the skeletal remains follows within a ceremonial corral – to foster future rebirth (Flores Ochoa 1977:153)[5]. Natchigall (1975:195) describes a slight variant of the practice for the Puna of Moquegua. Intact, de-fleshed bones are interred in the corral. In both cases, attendees of the rite feasted upon roast camelid sacrifice, while the skeletal remains satiated the spirits.

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[5] Quechua informants note sacrifice of both sexes, mainly animals of old, declining health (Bolin 1998:56).

Tschopik (1951:249) describes the *wilancha* ritual feasts as part of funerary and house dedications[6]. The Chirabaya Alta site presents probable evidence of prehistoric practice of funerary *wilancha*. Located near the Moquegua Valley coastline, occupation of this Late Intermediate Period site (AD 950-1350) overlapped with in time and eventually outlasted neighboring sierra colonies settled by Tiwanaku State colonists (Lozada et al. 2009). Excavated elite cist burials had mummified hides and partial skeletal remains of 140 fine-fleece alpaca and llama (mainly head and lower limbs) (Lozada et al. 2009:358-361; Wheeler et al. 1995:839). Wheeler reports that the modal cull age, representing roughly 55% of the sample, falls below the first breeding season (less than 2 years old). Older juveniles, adults, and very old adults are present in smaller proportions. Sacrifices in this case, while serving management and breeding function (i.e. eliminating undesirable traits and infertile animals), clearly generated food surpluses available for ritual funerary feasts.

Additional ritual uses of camelids include *mesas* / *pagos* and *pachamanca* and dedicatory offerings. The *mesas* and *pagos* can be made as requests for good fortune, agricultural or herd productivity, the potato harvest, or success in caravan trade or fishing (Kuznar 2001; Tschopik 1951). *Mesas* and *pagos* are shaman-directed rites that involve ritual paraphernalia spread on a textile. Tschopik describes historic mesa incorporating wild and exotic resources (taruca, vicuña, feline pelts, sea shells), domesticated taxa (camelid fetus, llama fat), coca, minerals, and figurine amulets. The rite concludes when the textile and offering are burned. *Pachamanca* are burnt, often calcined animal sacrifices deposited in sacred locations. Dedicatory offerings, often fetuses or older

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[6] Sacrificed camelids were roasted and consumed by attendees. Guinea pig were also viable sacrifices.

camelids interred below house structures, may represent deposited remains of *wilancha* offerings (see above).

Conclusion

My discussion of ethnographic accounts of herding ends by considering a model of management decisions made by alpaca herders of the South Peru Aymara community of Chinchillapi (Kuznar 1991). Informants were questioned about the relative utility of llamas (as a meat and transport source) and alpacas (wool). Kuznar constructed a linear programming equation whose express goal was to maximize herd animal utility. Variables considered pasture area (pampa and *bofedal* access), herding labor, animal products (meat and wool), transport, and dung collection (for fuel). The model solution suggested an ideal household herd should consist of 195 alpaca and 37 llamas (232 head total). Kuznar described surplus of "nearly *three times* the amount of animal products were produced than was necessary for a family's carbohydrate consumption" (1990:382, my emphasis)[7]. These herds are smaller than described for many modern groups.

Thus, a family managing a herd of this size would not only be self-sufficient, but capable of periodically supplying small surpluses. Individual families conceivably could call upon extended kin-groups to yield surplus animals to meet reciprocal obligations. As corporate factions, multi-household kin groups could further pool animals to create larger-scale food surpluses – to meet food outlays associated with suprahousehold labor projects, weddings and funerals, or commemorate community-wide religious events.

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[7] Estimates of prehistoric herd size and the relative economic focus on llama and/or alpaca are possible. Yet, more accurate impressions of both depend upon taking into account the skewing influence of taphonomy, butchery, site formation processes, and archaeological recovery methods.

Research Questions

As we have seen above, demands for surplus production could create conflicting obligations, between the Formative domestic household and the political economy. Analysis of Pukara and Huatacoa faunal bone from domestic, public feasting, and ritual proveniences allow me to evaluate the significance of domesticated and wild game by context. Furthermore, we can begin to contrast diachronic differences provided the analysis of Early through Late Formative samples.

First, on a basic level, I investigate the impact of the growing role of the agropastoral economy on subsistence. What kinds of wild game were exploited? Does the importance of wild game display a diachronic change by the Late Formative? Does the significance of wild game versus domesticated animals show intersite or intra-site (contextual) variation? How might we best explain such differences?

Second, I consider evidence for herd management practices. What characteristics define the culling profiles at each site (i.e. age, sex, use of wild versus domesticated camelids, and alpaca versus llama ratios)? Did management practices differ by site or demonstrate diachronic change? Do metric and bone data demonstrate the presence of caravan llamas? In what context and frequency are caravan animals found? How were animals butchered and processed with different contexts? Does ethnographic analogy provide adequate models for herding practices to explain the archaeological findings?

Third, I examine the sociopolitical use of animals in ritual and feasting contexts. Can we discern context-specific differences in taxonomic abundance, butchery, and age profiles for these contexts? What if any wild game appears within non-domestic contexts? Can we discern skeletal frequency differences by context? Are trends comparable between the Pukara polity capital and the smaller Early to Late Formative village-center?

Finally, it is essential to grapple with taphonomic questions. How do the samples compare in the frequency of destruction from post-use hearth disposal, canine and rodent gnawing, and bone tool production? What degree of bone fragmentation and weathering characterizes each strata and context? Do ritual contexts display unique taphonomic patterns (e.g. cremation, skeletal completeness, taxonomic diversity)? To what degree does bone destruction preclude robust arguments about herd and wild game use?

Domestic and Political Economic Use of Animals: Expectations

How can we test the recovered fauna against the proposed theoretical proposals? Each behavioral context (domestic, public feasting, and ritual) is predicted to be associated with specific behaviors and archaeological correlates (Table 1.3). Proposed faunal analysis methods are enumerated to provide a metric for each correlate. This chain of logic provides independent tests, using multiple data lines, of whether the inferred suite of behaviors occurred in or shaped the recovered assemblages.

In the household economy, hunting of wild taxa is expected to decline from the Early to Late Formative, as schedule conflicts – between sedentary village life, herd monitoring, agriculture, and domestic productive activities (lithic and ceramic production) – mount. Camelid and cuy are expected to be present. Wild taxa may prove

Table 1.3. Material Correlates: Domestic, Feasting, and Ritual Contexts

Context	Behavior	Archaeological Correlate	Zooarchaeology Method
Domestic	--Hunting and herding --Time: Wild taxa use decreases over time --Intersite: taxa-use contrast	1. Taxonomic abundance 2. Reduced use of wild camelids 3. Multi-stage processing (Meat, *ch'arki*, marrow) 4. Varied taphonomy?	1. NISP, MNI, weight (camelid, cuy) 2. Metrics, incisor morphology 3 Body-part distribution (MNE) a) Meat (FUI), c*h'arki* production (DUI) b) Butchery, cultural fracture 4) Weathering, gnawing, fragmentation
	Long-distance caravan trade increases	1. High llamas / alpaca ratio 2. Caravan animal bone pathologies	1. Metrics, dental morphology 2a) Pathology (activity-related) b) Caravan markers (metrics, features) c) Age/ sex profiles
	Large-scale wool production	1. High alpaca / llama ratio	1. Metrics, dental morphology, age/ sex ratio
Feasting	1. Greater scale than domestic use 2. Husbandry stresses surplus 3. Public space, architecture 4. Serving/ storage vessels	1. Abundant food (camelid MNI / context) 2. Food Quality (cull younger males) 3. Supra-household food preparation (butchery, hearths, ash layer, discard) 4. Event-specific discard	1.a) Camelids abundant (NISP, MNI, MNE) b) High densityof bone (MNI/NISP, $NISP/m^3$) 2. **Meat emphasis**: a) High utility or full carcass (FUI) b) Age data c) Sex profile 3. Standardized butchery and cooking a) Lower fragmentation level (NISP/g)? b) Cut marks c) Age / sex profile, bone pathology d) Boiled, roasted (low burning, etc.) 4. **Taphonomy:** short-term exposure (low weathering, canid ravaging)
Ritual	1. Dedicatory offering 2. Public/ ritual space, structure	1. Animal offering linked with building events 2. Ritual deposit (exotics, ceramics) 3. Animals selected for slaughter	1.a) Skeletal completeness, articulation b) Few butchery, cut marks ? c) Fetal/ adult camelid (age profile) d) Age / sex profile, bone pathology d) Cuy or rare taxa
	1.Burned sacrifice 2. Public/ ritual space, structure	1. Ash deposits 2. Ashy pit hearths	1) Camelids, cuy, rare taxa 2) Skeletally complete or calcined bone
	1. Ancestral meal 2. Burial context	1. Morturary, court bin context (see Chapter 3)	1. Greater skeletal completeness 2. Butchery, use by ancestors, mourners

more common due to opportunistic hunting (of fields, river, and wetlands).

Households accrued reciprocal obligations to supply the political economy. Domestic contexts are expected to show lower taxonomic abundance; greater diversity in bone processing, modification, and preservation; and the presence of small-scale cooking and midden features.

Feasting contexts are predicted to differ qualitatively and in scale from household consumption (Hayden 2001: Table 2.1). I expect public contexts to display larger serving and storage ceramics. Bone is abundant and cooking hearths and disposal middens are large. Domesticated taxa, mainly camelids because of the large meat-fat package, dominate. Butchery and cooking stress bulk meat cooking. As discrete events, feasting refuse represents a rapid accumulation of bone debris and possibly hearth disposal. Feasting events associated with ritual contexts may be deposited and quickly sealed – thereby augmenting preservation (Kelly 2001; Lau 2002). However, methods of butchery, food preparation, and disposal location shape overall bone preservation.

Signatures documenting different forms of ritual faunal deposit are tested. Careful attention is paid to provenience information (e.g. association with pit hearths, burials, or monumental architecture). Deposits are frequently associated with prepared spaces and associated with ceramics and exotics. Historic accounts emphasize camelid (fetuses and adults) and cuy as common sacrifice and dedicatory offerings, though wild taxa may also be present (Gladwell 2004; Rofes 2000; Sandweiss and Wing 1997; Webster and Janusek 1993). Skeletal representation could vary – from relatively intact in-situ deposits to butchered, incomplete skeletons and calcined bone deposits (Kuznar 2001).

Volume Organization

The present volume is divided into nine chapters. Chapter 1 has provided a foundation for the study ahead, by outlining the research questions. The theoretical underpinnings guiding my research on the impacts of Formative socioeconomic change on wild and domesticated animal use – within domestic, ritual, political social settings – were also presented. Notable traits of camelid herd management practices described in historic and ethnoarchaeological accounts provide a baseline to model prehistoric herding practices. Finally, I have presented a set of expected prehistoric behaviors, archeological correlates, and zooarchaeological methods to measure them.

Chapter 2 provides an overview of the climate and paleoclimate, natural and culturally-modified ecological zones, vegetation, and animal taxa characterizing the Lake Titicaca Basin. A list of expected fauna associated with each ecological zone is compiled. Abbreviated species accounts are elaborated. Details include taxa traits that could make taxa attractive for exploitation.

Chapter 3 is an account of the Lake Titicaca Basin’s cultural chronology and development of a range of sociopolitical, ritual, and economic practices. My discussion characterizes Archaic, Terminal Archaic, and Formative lifeways, with a primary emphasis on the northern half of the Basin. Second, I consider past and current research conducted in the Pukara Valley, at Huatacoa and Pukara. To provide background for faunal and contextual analyses, the layout and archaeological contexts for each site are described.

Chapter 4 describes the methods applied in the dissertation study. The chapter begins with a brief discussion of sampling strategies and taxonomic identification. Methods used to quantify taxonomic abundance are described. Camelid exploitation is investigated via several methods: osteometrics, incisor morphology, body part representation and bone density, carcass butchery, bone pathology, sexing, and mortality patterns. Finally, taphonomic signatures impacting the two site collections are considered. To this end, incidence of bone weathering, burning, and animal gnawing are tallied and discussed.

Chapter 5 begins with an overview of prior faunal analysis studies conducted within the Pukara River Valley: at Q'Ellokaka Cave, Qaluyu, and the Qalasaya sunken court BB at Pukara. I next discuss taxonomic abundance for ¼" and flotation faunal bone samples. Identified taxa are quantified by NISP, MNI and bone weight. Camelids predominate in both collections; with the highest MNI count present within Initial Late Formative feast contexts at Pukara. Wild taxa are present at an overall higher frequency, despite extensive study of Pukara flotation samples. Wild taxa present at either site include vicuña, hog-nosed skunk, viscacha, cuy, and bird and fish taxa. Feature 3, a Huatacoa Pukara-Period ritual pit, contains a remarkable MNI frequency of small toads and a carefully structured deposit of camelid bone, bone tools, and diagnostic ceramics.

Chapter 6 summarizes results from taphonomic assessments of the collections. Data discussed include frequency by taxa of burning, canine and rodent gnawing, bone fragmentation, and bone work and tools within the collection. A comprehensive description of the bone tool industry will be completed in a subsequent publication.

Chapter 7 discusses a range of datasets that enable us to broadly reconstruct Formative herd management practices. Postcranial bone metrics provide us a variation in camelid body size for exploited specimens. Metrics are compared against published comparative taxa metrics and analyzed via a multivariate classificatory equation. Incisor morphology provides a less robust picture of wild and domesticated camelid use. Age profiles are constructed using epiphyseal fusion data and a mandibular dentition sequence of tooth eruption and wear. Results indicate culling age differed somewhat by context, with prime age animals culled in feast contexts. A small sample of camelid pelvises is used to comment on culling trends by sex. Finally, pathologies noted on specimens are described. Combined metric and bone pathology data indicate a small subset of caravan llamas was culled.

Chapter 8 presents results from camelid body part representation data compiled from Hautacoa and Pukara. Observed skeletal frequency is correlation tested against utility values and bone density using Spearman’s rho statistics. In addition, cut mark frequency by element is reported as evidence of butchery practices.

Chapter 9 draws together the varied lines of evidence presented in Chapters 5 through 8 to address the research questions. A more cohesive outline of how Formative agro-pastoralists used fauna and managed domesticated camelids within the Pukara River Valley is brought to light. We revisit trends distinguishing faunal use in the domestic, political, and ritual economies. Final thoughts and recommendations for future research are presented.

CHAPTER 2: LAKE TITICACA BASIN: NATURAL BACKDROP

Andes: An Overview

The complex climate and ecology of the South Central Andes are shaped by several factors: the sheer size and height of the Cordillera Occidental and Cordillera Oriental ranges; the interaction of seasonally-migrating latitudinal air masses, temperature, and altitude; and the Pacific Ocean's Humboldt Current (Gomez and Little 1981:123-125; Winterhalder and Thomas 1978:12). Both mountain ranges function as rain shadows. Temperature drops 6°C for every elevation increase of 1,000 m, thereby rapidly augmenting humidity (Brush 1982:20). As a result, moist Pacific Ocean air becomes rain upon crossing the Cordillera Occidental, while westward-moving moisture is largely spent before reaching the Altiplano. Along the coast the Humboldt Current further intensifies aridity by cooling and drying air masses moving off the Pacific.

Seasonal rainfall patterns correlate with the movement of a low-pressure air trough known as the intertropical convergence zone (ITCZ), high- and low-pressure air masses, and the trade winds (Gomez and Little 1981:123-124). The summer months, from November to March, constitute the highland rainy season, when moist, low-pressure air is pushed south from the equatorial latitudes. Periodic El Niño / Southern Oscillation (ENSO) events further complicate seasonal climate and rainfall patterns. Warm tropical currents displace the Humboldt Current, producing heavy coastal rains and flooding.

These factors separate the Andes into several ecological zones. Pulgar Vidal (1987) developed an Andean ecological zone schema that draws upon Quechua terminology. Table 2.1 summarizes relevant characteristics associated with each zone.

The west Andean slope features low water availability. The the coast and low sierras depend upon mountain-fed rivers, while the high sierras are fed by rivers, springs and seasonal rain. Water is more abundant in the Altiplano and *puna*, where seasonal rainfall is supplemented by lakes, rivers, and springs.

Table 2.1: Andean Ecological Zones (compiled from Pulgar Vidal 1987)

Quechua terminology	**Elevation (meters above sea level)**	**Characteristics**
Chala	0-500	Desert, *lomas* plants, irrigation farming
Yunga (Andes slopes)	West: 500-2300 East: 1000-2300	W Andes: dry, l*omas* vegetation, irrigation farming, herding E Andes: moist forest, farming, maize, coca
Quechua (sierras)	2300-3500	Rain, irrigation farming of multiple crops Upper limit of maize cultivation Nightly frost (upper elevation extent)
Suni (low puna)	3500-4000	Seasonal rains Rain, terrace, raised field farming Tuber, starchy seed crops, herding
Puna (high puna)	4000-4800	Seasonal rains Rain and terrace field farming (up to 4200 m) Tubers, herding
Janca	4800+	Snow-capped peaks
Rupa-rupa	400-1000	High Amazon jungle Maize, coca, farming / herding, coca
Omagua	< 400	Amazon rain forest

The Lake Titicaca Basin

Sandwiched between the Cordilleras Andes, the Altiplano stretches across a broad area measuring—at its maximum—about 2000 km long (north-south) by about 200 km wide (east-west) (Lavenu 1992:3). Dating to the Quaternary Period, its geology consists of glacial and interglacial sediments combined with fluvial and lacustrine deposits. Its areal extent covers parts of Peru, Bolivia, Chile, and Argentina, and includes Lakes Titicaca and Poopo and the *Salares Coipasai* and *Uyuni* (Figure 2.1).

Lake Titicaca is a large freshwater lake found at mean elevation of 3810 m above sea level that covers much of the Altiplano of southeastern Peru and southwestern Bolivia (Figure 2.2). It is comprised of the larger, deep-water *Lago Chicuito (Lago Grande*), and the shallower, much smaller *Lago Huiñaimarca* (*Lago Menor*). While the lake's water has a total surface area of c. 8,652 km^2, its drainage basin covers a total area of 57,340 km^2 (Binford and Kolata 1996:24). The lake's drainage catchment is supplied and drained by several large rivers, including the Ramis, Huacané, Coata, Suchez, Illave, Desaguadero, Catari, and Tiwanaku. The focus of this study, the Pukara River Valley, is a braided tributary of the Ramis. This riverine ecological zone is adjacent to both sites.

Two smaller lakes provided nearby lacustrine habitat exploitable within a two day's walk from the Valley. The small Lake Quequerana is located just 12.7 km (7.9 mi) away from Pukara. Lake Arapa (or *Laguna* Arapa) is located a few kilometers north of where the Ramis and Huacané rivers drain into the northern tip of Lake Titicaca. This large lake is located approximately 45 km (27.9 mi) away from the site of Pukara. Lake Arapa was likely a departure point for watercraft or caravan access to Lake Titicaca itself (Stanish 2003:160).

Paleoclimate

The Altiplano we see today was created processes of glacial advance and retreat; the waxing and waning of several Pleistocene and Holocene paleolakes and Lake Titicaca; changes in precipitation-level and temperature, and tectonic processes (Baker et al. 2001a, 2001b; Lavenu 1992; Whitehead 2007). For the Pleistocene's Last Glacial Stage (ca. 26,000-11,500 years BP), O^{18} ratios from the Sajama Mountain, Bolivia icecap demonstrate that a cool and wet climate was prevalent (Thompson et al. 1998).

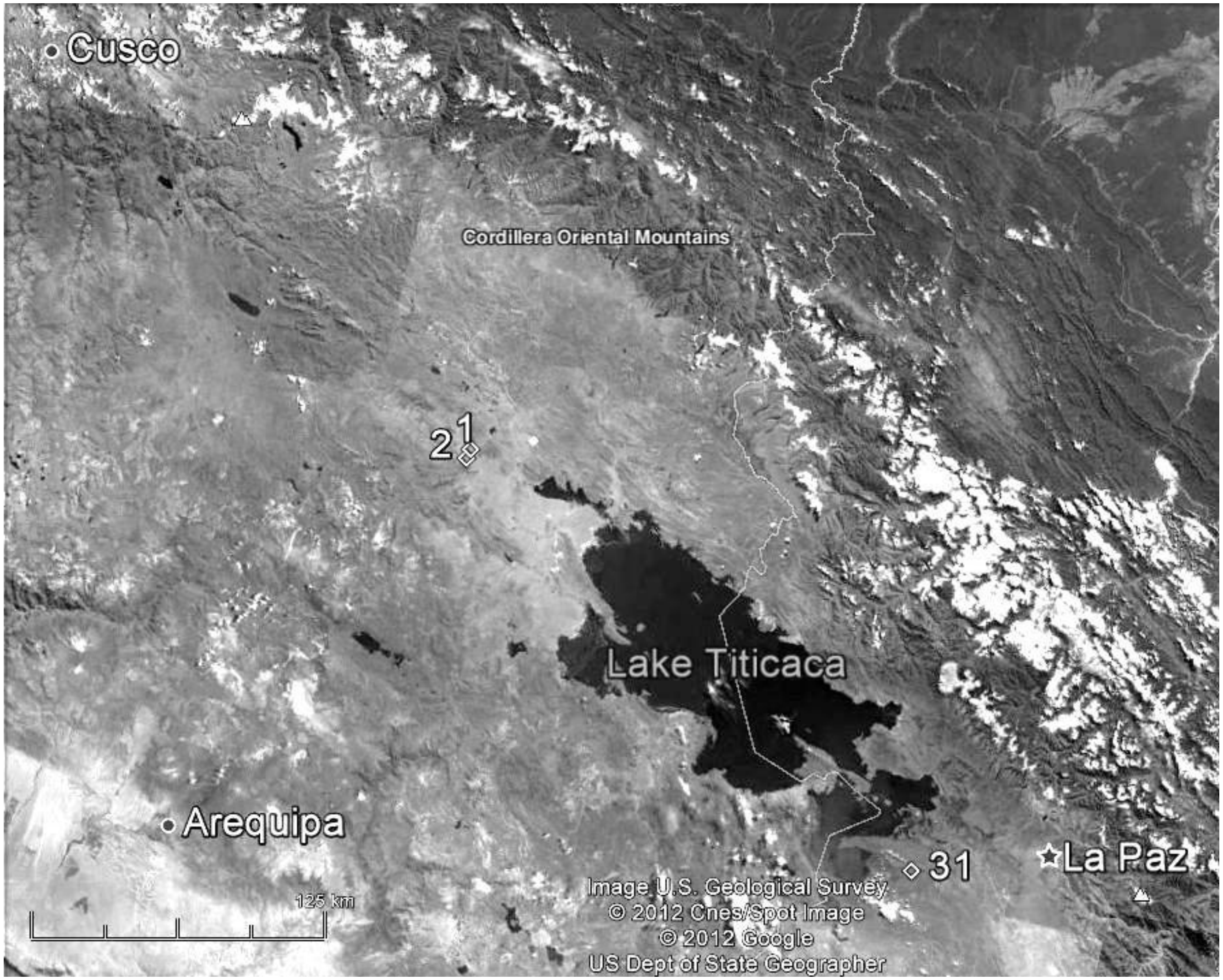

Figure 2.1: Overview of North and Central Altiplano

Note: 1. Pukara, 2: Huatacoa, 31. Tiwanaku. Thin zig-zag line marks the Peru-Bolivia border

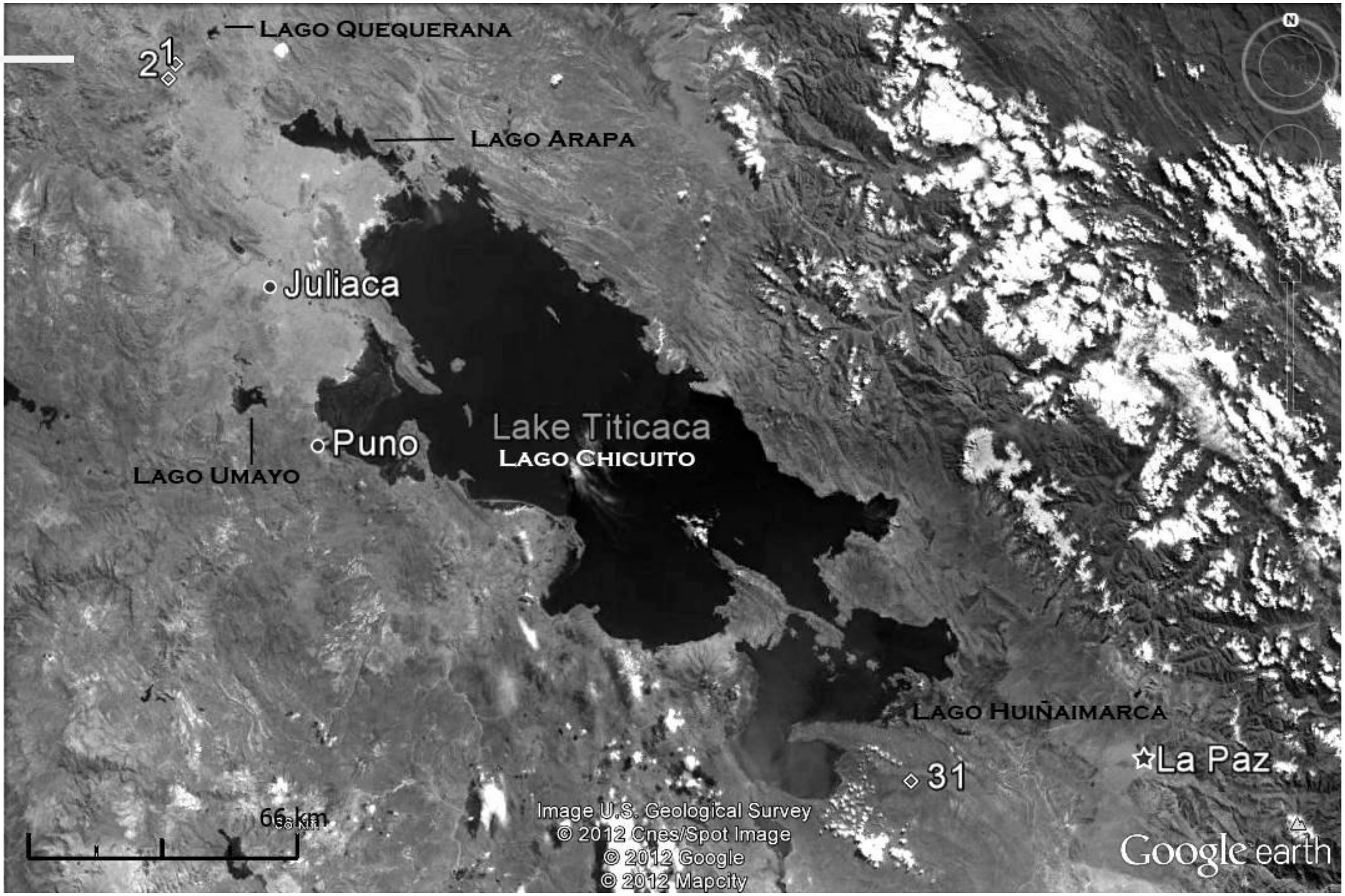

Figure 2.2: Overview: Lakes Titicaca, Arapa, and Umayo

At this time, Lake Titicaca was larger and deeper, perhaps 9,000 km^2 in area and about 5 m above modern lake-levels (3815 absl) (Baker et al 2001:641; Lavenu 1992:10). Water outflow from the Titicaca basin supplied the central Altiplano's massive paleolake Tauca (43,000 km^2) and its retreating lake-phases, the Ticaña and Coipasa, prior to the latter's Holocene desiccation (Baker et al. 2001a, b; Fornari et al. 2001:270) [8].

In contrast, the Holocene featured generally warmer temperatures and cycles of dry and moist climate. The Early Holocene alternated between a warm, dry climate (11,500-10,000 Years B.P.) and a cool, wetter climate and a temporary restoration of outflow from the basin (10,000-8500 cal. years B.P.) (Baker et al. 2001b). Mid-Holocene climate was very warm and arid, gradually shrinking Titicaca to between 80-100 m below modern lake-levels from 8,500 to as late as 3600 years B.P. (Cross et al. 2000:30; D'Agostino et al. 2002; Seltzer et al. 1998). This shift radically reshaped the landscape of the Basin: *Lago Chicuito* shrank dramatically; *Lago Huiñaimarca* shrank to a small shallow lake. The central Altiplano and west *Huiñaimarca* basin were converted into salt flats (*salares*) (see e.g. D'Agostino 2002:Figure 14; Mourguiart 2000:Figures.6-7). Now-inundated lands were inhabited by plants and animals, providing Archaic foragers with an expanded territory and resource base, which has implications for the reconstruction of settlement patterns around *Lago Chucuito*[9].

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[8] A brief warm, dry period (15,000-13,0000 cal yr B.P.) is thought to be responsible for the Lake Tauca's gradual retreat from high- (Tauca) to low-lakestands (Coispasa) (Baker et al. 2001b:641)

[9] Shoreline and lake-levels changes must be taken into account, given the likelihood that "near-shore" sites are underrepresented in the archaeological record of Lake Titicaca.

Table 2.2: Late Holocene Climate (years BP)[1]

Wet Climate, High Lake-Level	Drier Climate, Low-Lake-Level
3500-3200	3200-2800
2800-2500	2500-2200
2200-2000	2000-1600
1600-900[1]	900-500
500-0	

[1] **Data compiled from (Abbot et al. 1997; Baker et al. 2001:642)**

The Late Holocene has a much more nuanced climate reconstruction as result of thorough study of lake-core sediments from *Lago Huiñaimarca*. Rainfall steadily increased, while temperature and lake water-levels approached modern conditions. Baucom and Rigsby (1999) note a small paleolake inhabited the mid-valley Río Desaguadero held from 4600-4000 years B.P, prior to the formation of its present-day channel route. By or just after 3500 years BP, Lake Titicaca's two sub-basins were reunited via overflow through the Straits of Tiquina. Lake sediments demonstrate the Basin's climate swung between wet climate periods, with near-modern lake-levels, and fairly arid ones, with lower lake-levels (Table 2.2). Modern day lake-levels occur by 2100 years BP (Cross et al. 2000). Overall, Late Holocene climate is characterized by see-sawing, as seen in the lake-level range (>22 m) relative to the six meter deviation recorded for the 20th-century (Abbott et al. 1997:179; Roche et al. 1992:64).

Under debate also is the timing of the earliest onset of the El Niño Southern Oscillation phenomenon (ENSO). Overall, the ferocity of El Niño's impacts decrease along a west-to-east gradient across the Andes (Sandweiss and Richardson III 2008:100). Yet, historical ENSO events have correlated with drought, fluctuating annual rainfall, and Lake Titicaca lake-level changes (Binford and Kolata 1996:33, 38; Roche et al. 1992:75).

Such events could reduce crop yields by disrupting the certainty of the rainy season's pattern of rainfall and temperature change along with the length of the growing season (Whitehead 2007:19). Therefore, it is important to document El Niño's onset to better comprehend climate change as part of Altiplano prehistory.

Middle Holocene (5000 yr B.P.) El Niño events are documented by extensive radiocarbon dating and analysis of fauna from several Archaic coastal sites (Sandweiss et al. 1996). El Niño's influence may date to the Late Pleistocene (to 38,000 yr B.P. or earlier), based on C^{14} dating of landslide debris at Quebrada Tachahuay (Keefer et al. 2003). This early date means highland societies, from the first settlement by Archaic foragers to modern agropastoral production, adapted to climatic fluctuation on a multi-generational scale.

Climatic cycles of aridity and lake-level change in the Titicaca Basin are cited as stressors prompting prehistoric adaptation and disrupting cultural continuity. The collapse of both the Late Formative Pukara Polity and Tiwanaku State were perhaps precipitated by long-term climatic aridity, which undercut the productivity and reliability of intensive agricultural systems (Stanish 2003:157; Binford et al. 1997). The cultural florescence of Chiripa and other Taraco Peninsula (South Basin) sites may correlate to lower lake-stands that characterized the Middle Formative Period (Bandy 2004:101-108). Elite control of caravan trade routes, which traversed the Peninsula, and prestige good exchange underwrote a boom in public ceremonial architecture construction, a growing political economy, and population aggregation (i.e. site-size increases). Without a reliable subsistence base, both dense population aggregations and expanding political economies were unsustainable.

Modern Climate

Today, the Basin's climate is characterized by both seasonal variation and moderation (Roche et al. 1992:66-70). Precipitation, as noted above, is largely restricted to the rains of the summer months. Yet, hail and snow can occur throughout the year. Hailstorms are frequent during the warms months bracketing the summer solstice (Winterhalder and Thomas 1978).

Mean rainfall total is greatest at *Lago Chucuito*'s center (1000-1500 mm). The North basin receives more rain on average (700-1000 mm) than the South (600-800 mm). Annual rainfall, however, differs from year-to-year and droughts periodically occur. On the microlevel, Winterhalder and Thomas (1978:17) note,"…precipitation in one valley can be quite different from that of a neighboring valley, and both may vary independently from year to year".

Temperature, in contrast, remains fairly constant, due to the moderating influence of the Lake's proximity. Mean annual temperature ranges from 7 to 10°C (44.6-50°F) (Roche et al. 1992). At the same time, temperature cycles dramatically in the course of a day. The mean range between maximum and minimum daily temperature is as much as 20°C in the dry season (68° F) (Brush 1982:29). Night and early morning frosts are common, especially during the dry, winter season of April to October. Instability, in the form of periodic drought, hailstorms, and frosts – during the spring to summer transition – poses a major threat to the growth of young crops (Wintheralder and Thomas 1978:23).

Ecology

Suni (low pampas)

As discussed above, the Lake Titicaca basin is broadly divisible into two ecological zones, the *suni* and the *puna*. The *suni*, located between 3,800 and 4,000 m in altitude, consist largely of expansive pampa grassland vegetation. It covers additional microclimates, such as Lake Titicaca and the Altiplano lakes, rivers, and various wetlands. Bunch grasses (mainly of the tribes *Pooidae*, *Arundinoideae*, *Chloridoideae* and the *Panicoideae*) dominate the landscape, growing denser and taller in wetter and warmer areas (Whitehead 2007:36). Small native trees, mainly queñua *(Polylepis)*, *Buddleia*, and *Cantua*, and tola bushes (*Compositae* genera.) are found in protected or non-cultivated areas, like along boulder-strewn slopes, and ravines (Binford and Kolata 1996; Brush 1982; Craig et al. 2010:37; see below for argument about their present distribution). Indigenous highland crops cultivated in the *suni* include potato (*Solanum* spp.), oca (*Oxalis tuberosum*), ullucu (*Ullucus tuberosus*), quinoa (*Chenopodium quinoua*), kichwa (*Amaranthus caudatus*), canihua (*Chenopodium palicule*), and tarwi (*Lupinus mutabilis*). Camelid pastoralism, widely practiced in prehistoric and modern times, depends on pampa grasses for primary fodder.

Recent studies (Craig et al. 2010; Paduanao 2003) assign an anthropogenic origin for the modern landscape, mainly the exhaustion of forestland and land clearance associated with the emergence of agropastoral production. Within palynological cores, fine-particulate charcoal abundance demonstrates overexploitation of firewood. Charcoal declines from high abundance, from 2050-650 cal. B.C. (4000-2600 cal. B.P.), disappears around 50 cal. B.C. (2000 cal. B.P.) (Craig et al. 2010:47). By 1150 cal. B.C. (3100 cal.

B.P.), tree pollen (*Polylepis*) greatly declines, while grassland and chenopod pollen simultaneously increase in relative abundance (Paduanao 2003:274). Grazing and agriculture best explain the growth in “disturbed ground” vegetation. Significantly, this anthropogenic transformation securely brackets the dates of the Terminal Archaic / Early Formative to Late Formative Periods, the main temporal foci of this present research.

Lakes and Rivers

Pampa grasses and cultivated crops grow up to the edge of lakes and rivers. Agriculture is very productive adjacent to Lake Titicaca in particular due to high annual rainfall, the temperature-moderating effect of the lake, longer growing season, and fertile soils (Erickson 2000:318). Furrows, called *suka colla* by Aymara informants from the Juli area, are carved out of lakeshore soil to create rich pasturage (Stanish 2003:63).

Marshy and shore portions of Lake Titicaca are a prime focus for tortora reed bed management and cultivation. This aquatic plant serves as food (its starchy roots) and the raw material for roofing, mats, and reed boats. The surface and littoral zone of lakes and rivers, prehistorically accessible by reed boat and foot, were important resource patches for waterfowl capture and fishing.

Managed Landscapes (Raised Fields, Bofedales and Qochas)

Raised fields (*waru waru* in Quechua) are Prehispanic elevated planting platforms, constructed in areas where soils are saturated or subject to seasonal floods. Field-associated furrows and canals also provided habitats for fish, waterfowl, and tortora reed (*Schoenoplectus tatora*) (Erickson 2000).

Bofedales are spongy, marshy areas overgrown with *Distichia* cushion plants and grasses, where groundwater is close to the surface (e.g. adjacent to rivers or springs) (Aldenderfer 1998:33-35). These wetlands are prized as excellent grazing grounds for camelids. They are the preferred feeding grounds of alpacas and vicuña; they depend on more succulent grass forage than the other camelids, especially during the dry season (Koford 1957; Erickson 2006:341). As such, bofedales were also probable important hunting patches for Archaic foragers and pasturage for later pastoralists. *Bofedales* are found proximate to Late Archaic sites in the Río Moquegua (Asana, El Panteón) and the Rio Huenque Valleys (Aldenderfer 1998; Klink 2005).

Natural bofedales, some very large, exist around the *suni* and *puna*. However, to maintain large alpaca herds, modern pastoral communities augment the size of natural bofedales and create artificial ones. Palacios Ríos (1977:157) recounts the Aymara of *Chichillapi* (Departmento of Puno) state, “las alpacas cuidadas en ‘bofedales’ tienen más peso...y dar en dos años, de diez a doce libras de lana, mientras que en sitios secos dan de tres a cuatro libras de lana”[10]. Management requires canal building – to channel water from nearby sources and flood areas; seasonal cleaning and repair; and periodic burning to renew growth (see Lane 2005; Dransart 2002: 36-39).

Qochas (or cochas) are a third form of managed wetland. Appearing as ponds in the rainy season, they consist of round- or ovoid excavations, composed of cross-cutting furrows, cut to the water table in poorly drained soils. This design collects and allocates rainwater to crops, while stored water protects against frost damage (Flores Ochoa and

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[10] Translation: “Those alpacas raised on bodefales weigh more… and yield in two years between ten to twelve pounds of wool, while those raised on dry vegetation sites yield only four pounds”.

Paz 1983:7). They are the focus of multi-year crop rotation systems, fallow-year pasturage for camelids, water-storage, and a convenient settings to freeze-dry potatoes (*chuño*) (Flores Ochoa 1987). For the Huatta region, north of Puno, Erickson (2000:341) describes their fallow-season significance as habitat for fish and aquatic vegetation.

A precise date for the origin of raised field and qocha construction remains controversial, but may date as early as the Early to Middle Formative period (1800-900 B.C.) (Erickson 1993:389). The pampas and river valleys in the circum-Titicaca Basin include several areas of remnant raised fields, some of which have been subject to archaeological study (see Erickson [1993] and Stanish [2003:63-64] for distribution of raised fields). Likewise, large concentrations of qochas are found within the heartlands of the Formative Pukara and Tiwanaku cultures (Binford and Kolata 1996; Flores Ochoa 1983). Mujica (1997) argues that the rise and expansion of Late Formative Pukara polity across the North Titicaca Basin owes much to the development of all three technologies as a means to combat risk and augment agropastoral production. Pukara's Lagunita mound (Figure 2.3) exemplifies a prehistoric anthropogenic landscape: a mound built from soil borrowed associated with qocha construction (Klarich 2010:59, Stanish 2005).

Cerros

Hillsides are widely distributed across the Basin's pampas at altitudes mostly below 4100 meters above sea level (Stanish 2003). Adjacent to the Lake and in major river valleys, hills and slopes are often terraced with stone walls, providing additional land for farming and near-field habitations. Yet, many are less suitable, often very steep or with poor soils, and remain non-terraced. Terracing, as a technological innovation, has its probable origins in the Formative Period (1800 B.C.) (Erickson 2000:333).

Figure 2.3: Pukara: Culturally Modified Landscape
Note: The Lagunita Mound is located in the center of the photo. A seasonally verdant bofedfal and man-made lagoon (*qocha*) encircle the mound. (Photo courtesy of Elizabeth Klarich).

Puna (high pampas)

The high *puna* shares many characteristics with the nearby *suni* zone. Cultivation of hardy, bitter, frost-resistant potatoes extends into the lower extent of the high puna (up to c. 4200 m) (Brush 1982:33). The aforesaid pampa grasses, tola bushes, and tree taxa cover the landscape, though in short, less verdant forms – due to the high altitude, colder temperatures, and high solar radiation. Given its relative unsuitability for farming, this expansive vegetation provides exceptional fodder for both wild and domesticated camelids. Yet, bofedales provide the richest pasturage within this zone. In the Altiplano and highlands, herders often move animals into the puna during the dry season, to prevent overgrazing, improve herd nutrition and wool, and likely to avoid disputes with neighboring herders (Flores Ochoa 1979; Tomka 2001).

Fauna

The Altiplano and Lake Titicaca Basin are home to a broad range of animals that have adapted to conditions and thrive in the *suni* and high *puna*. Many have distinct microhabitats, behavior, or cultural significance to native Andean peoples. These and other details are discussed below. Each class is described in a table that compiles a concise list of taxonomic names, habitat, and significance for prehistoric and modern Andean groups. This list of fauna is by no means exhaustive, but meant as an outline and descriptive reference.

Mammals

Description of mammal taxa is divided into three categories based on body size. Table 2.3 compiles all three categoriesher. Six members of the Order *Artiodactyla* make up the large mammalian taxa. The resident deer species, taruca (*Hippocamelus antisensis*) and white-tailed deer (*Odocoileus virginianus*), are browser / grazers. Body size is roughly equivalent for both cervids at about 45 to 65 kg (Walker 1999). Pre-herding hunter-gatherers extensively hunted deer and wild camelids. Herders of the Osmore drainage are reported to use dogs to hunt taruca (Kuznar 1990:136).

Both inhabit rocky outcrops, hillsides, and queñua groves with nearby water sources; their truncated distribution is likely the result of hunting and pastoral expansion (Barrio 2010:81). In general, taruca exploit higher elevation territories and are more frequent in archaeological sites than *Odocoileus* (Moore 1989; Wheeler 1984). Taruca are also distinct in other ways: 1) a bifurcated adult male antler pattern and 2) year-round congregation in mixed sex groups of up to 30 or more individuals (Merkt 1985).

Table 2.3: Fauna of the Altiplano, Lake Titicaca Basin

Common Name	Scientific Name	Habitat	Cultural Value
Mammals			
Llama	*Lama glama*	Pampas, bodefal	Meat, wool, dung, transport, ritual
Alpaca	*Vicugna pacos*	Pampas, bodefal	Meat, fine wool, dung, ritual
Guanaco	*Lama guanicoe*	Pampas, queña grove bodefal	Meat, wool
Vicuña	*Vicugna vicugna*	Pampas, bodefal	Meat, fine wool
Taruca	*Hippocamelus. antisensis*	Pampas, queña grove, bodefal	Meat, antler tool
White-tailed deer	*Odocoileus virginianus*	Pampas, queña grove, bodefal	Meat, antler tool
Puma	*Felis concolor*	All	Pelt, ritual
Andean Mountain Cat	*Leopardus jacobita*	Pampas, rock outcrops	Pelt, ritual
Pampa Cat	*Leopardus concolo*	Pampas, rock outcrops	Pelt, ritual
Dog	*Canis familiaris*	All	Hunting partner, ritual?
Andean fox	*Lycalopex culpaeus*	All	Pelt?
Hog-nosed skunk	*Conepatus chinga*	Pampas, rock outcrops, burrows, queña grove	Meat, pelt
Viscacha	*Ladigdium* spp.	Pampas, rock outcrops	Meat, pelt
Chinchilla	*Chinchilla chinchilla*	Pampas, rock outcrops	Meat, pelt
Guinea Pig	*Cavia porcellus*	Pampas, pens	Meat, ritual, medicine
Tuco-tuco	*Ctenomys* spp.	Pampas, rock outcrops	N/A
Mice	*Akodon* spp.	Pampas	N/A

The New-World camelids include two wild species, the guanaco (*Lama guanicoe*) and vicuña (*Vicugna vicugna*), and two domesticated forms, the llama (*Lama glama*) and alpaca (*Vicugna pacos*). A major theme of Andean archaeology is the investigation of hunting, domestication, and subsequent herding of camelids (see Flores Ochoa 1977;

Kadwell et al. 2001; Kent 1982; Mengoni Goñalons and Yaccobacio 2006; Moore 1989; Tomka 1992; Webster 1993).

All four species are generalized grass grazers, though guanaco and llama are capable of eating drier, low quality grasses and browse when necessary (Bonavia 2008:407; Franklin 1982). Body size varies by species: llama (130-155 kg), guanaco (100-120 kg), alpaca (55-65 kg), vicuña (45-55 kg).

Following domestication, the economic role of camelids expanded. They went from prey to reliable, culturally-managed sources of fresh meat, *ch'arki*, bone and hide, wool, and dung (a valuable fuel / fertilizer) (Bonavia 2008; Browman 1974; Winterhalder et al. 1974). They also became tools of a growing political economy. In this capacity, camelids functioned as pack animals (moving food and goods) (Mujica 1985, 1997); dedicatory offerings (Webster and Janusek 2003); and as components of herd fertility rites and feasts (Dransart 2002:86-88; Janusek 2008:39-40; Lau 2003; Natchigall 1975).

Medium-sized mammals include taxa belonging to the Families *Felidae*, *Canidae*, and *Mephitidae*. Several predators are members of this category. The puma (*Felis concolor*) is a large, solitary hunter that maintains large territories. Today, they are very rare in highland Peru as result of continuous hunting, given their capacity to kill young and adult camelid herd animals (Flannery et al. 1989:; Moore 1989:32). Its prey also includes guanaco and vicuña, deer, and smaller game. Members of a second cat genera, the elusive, house-cat-sized Andean Mountain and Pampas Cats (*Leopardus* spp.), both hunt rodents, viscacha and chinchilla, and tuco-tuco and scavenge carrion (Walker et al. 2007). Their observed habitats are pampa grassland and rock outcrops (Yensen and Seymour 2000). Stuffed mountain cat pelts and puma paws are elements of the historic herd "increase" blood sacrifices (*wilancha*) and subsequent *misa* rites practiced by the Chucuito Aymara. Both receive offerings (llama fat, libations, coca, and flowers) (Tschopik 1951:243,276). Yet, neither taxon is abundant within archaeological sites.

Canidae and *Mephitidae* are respectively represented by the domestic dog (*Canis familiaris*) and Andean fox (*Lycalopex culpaeus*) and the hog-nosed skunk (*Conepatus chinga*). Foxes practice a generalized prey diet of insects, rodents, tuco-tucos, chinchillas, birds, and scavenged camelid carcasses (Walker et al. 2007). Herders remain vigilant during the birthing season as foxes often target the young members of wild and domesticate camelid herds (see Dransart 2002:29, 165; Novaro et al. 2009). Hog-nosed skunks are nocturnal omnivores that live in pampa burrows and rock outcrops. Historic hunting relies on dogs and the use of snare traps (Moore 1989). Their fur is valued, but their meat is rarely consumed.

Small mammals include several types of rodents. Viscachas (*Ladigdium peruanum*, *L. viscacia*), small rat-rabbit-like rodents, are an important secondary taxa in the prehistoric Andean highland and Altiplano diet and economy (Mengoni Goñalons and Yaccobacio 2006; Moore 1989; Webster 1993). These diurnal herbivores congregate in dispersed colonies of up to 20 or more individuals; their preferred habitat is outcrops and rock piles in close proximity to water (Pearson 1949). The fine pelts of the viscacha, and its relative the chinchilla (*Chinchilla chinchilla*), are prized. Their capture likely involved use of dogs, to flush hiding animals from burrows, or snaring. Other small rodents, for example tuco-tucos (*Ctenomys* spp.) and mice (*Akodon* spp.), could be taken as possible prey. It is unclear to what dietary importance they could have had.

The guinea pig (*Cavia porcellus*) is the Andes second major domesticate (Wing 1986). Wild guinea pigs (*Cavia* spp.) live in pampa grasses, rock piles, and brush, while their domesticated brethren are kept in household pens. As readily available sources of fat, they may serve as crucial dietary supplements to the carbohydrate rich highland diet (Rosenfeld 2008). Guinea pigs were consumed as feast foods, offered as sacrifices, and served as elements of folk medicine and divination rites (Gade 1967, Morales 1994, 1995; Sandweiss and Wing 1997; Weismantel 1988:130-131). Despite their recorded historic and prehistoric importance, guinea pigs appear in low frequencies in Altiplano sites relative to camelids[11].

Birds

The Altiplano and Titicaca Basin support a great diversity of avifauna (Table 2.5). As such, it is unfeasible to list and describe each one in great detail. I have focused on bird taxa of potential cultural value. The compiled taxonomic list and species accounts derive to Dejoux (1992), Fjeldså and Krabbe (1990), and Kent et al. (1999).

Aquatic and shorebird taxa include members of the Orders Anseriformes (ducks and geese), Ciconiiformes (herons and flamingoes), Gruiformes (Rails), Podicipediformes (grebes), Charadriiformes (lapwings, waders, stilts, and gulls), and Pelecaniformes (cormorants). Undoubtedly, the greatest populations of many of these taxa are near the large lakes and Titicaca itself, which contain great concentrations of food (macrophyte vegetation, invertebrates) and habitat (Dejoux and Ilitis 1992). However, most of the taxa listed, e.g. ducks, flamingoes, grebes, herons, lapwing, and stilts, were conceivably

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[11] This imbalance may accuratelyeither: 1) reflect a camelid emphasis or 2) be an artifact of excavation methodology (limited flotation), or 3) reflect the greater vulnerability of small bones to taphonomic destruction (Valdez and Valdez 1997).

attracted – albeit in lower numbers – to the Basin's ponds, rivers, and managed wetlands (*bofedales*, *qochas*, and raised field canals)[12].

Table 2.4: Birds of the Titicaca Basin and Altiplano

Common Name	Scientific Name	Habitat
Birds		
Ducks	*Anatidae* spp.	Lakes, rivers, ponds, wetlands, shore
Andean Goose	*Cloephaga melanoptera*	Lakes and lagoon shores, rivers, ponds, wetlands
Flamingo	*Phoenicopterus* sp.	Rivers, shallows, lakes
Black-crowned Night Heron	*Nycticorax nycticorax*	Shores: lakes, rivers, streams, reeds, wetlands,
Common Moorhen	*Gallinula chloropus*	Reeds, shore, shallows, wetlands, lakes
Andean coot	*Fulica ardesiaca*	Reeds, lakeshore, shallows, wetlands, lake
Rails	*Rallidae*	Reeds, shore, shallows, lakes, wetlands
Large Grebes	*Podiceps* spp.	Shallows, reeds, shore
Grebes	*Rollandia* spp.	Shallows, reeds, shore
Small Grebe	*Rollandia micropterum*	Flightless; shore, reeds
Lapwings, plovers	*Charadriidae* spp.	Ground, wetland, lakeshores
Black-necked stilt	*Himanthopus mexicanus*	Mudflat, wetland, lakes
Andean gull	*Larus serranus*	Shoreline, reeds, wetland, rivers, ponds, pampa
Cormorant	*Phalacrocorax* spp.	Diving waterbird, river, lake, marsh, shore, shallows, wetlands
Tinamou	*Nothura darwinii*	Shore, pampa, uplands, fields
Doves	*Columbidae* spp.	Lakeside, pampas, upland, fields
Aplomado falcon American kestrel	*Falco femoralis* *Falco sparverius*	Lakeshore, upland, pampas, wetlands
Mountain caracara	*Phalcoboenus megalopterus*	Lakeshore, pampas, fields, wetlands, hills
Aguila	*Circus cinereus*	Lakeshore, reeds, wetlands, pampas
Hawk	*Buteo* spp.	Pampas, upland
Turkey vulture	*Cathartes aura*	Lakeshore, wetland, pamapas, upland, hills, near settlements
Andean condor	*Vultur gyryphus*	Flight over pampa, carrion

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[12] The author observed flamingos drinking from the Río Pukara, South of the town of Pucará during a summer 2008 visit. On a subsequent visit to the town's *feria* in 2009, I found dried flamingos were being sold.

Tinamous (*Tinimidae* spp.) and doves (*Columbidae* spp.) are the main terrestrial bird found across the Titicaca Basin and Atliplano. They are small quail-like birds that rarely fly. Four documented species inhabit lakeshore, pampa grassland and tola brush habitats. Several species of dove are present in the Basin and were common game birds (Kent et al. 1999)

Observed predatory birds belong to the Families *Falconidae*, *Accipitridae* and *Cathartidae*. The *Falconidae* and *Accipitridae* forms observed are small raptors that hunt small prey, mainly insects, lizards, amphibians, lizards and rodents (Fjeldså and Krabbe 1990; Jaksić et al. 1991). The turkey vulture (*Cathares aura*) is a medium-sized vulture that feeds primarily on carrion and hunts small game (Ferguson-Lees and Christie 2001). In comparison, the enormous Andean condor (*Vultur gryphus*) is a low frequency visitor to the Altiplano (Fjeldså and Krabbe 1990:90). While they are consummate scavengers, condors are observed on occasion to pester newborn camelids (Koford 1951:186). Condors appear as a motif depicted on Tiwanaku pottery (Janusek 2004a).

In all likelihood, birds primarily served as food. Netting may have been a favored capture strategy for shore and aquatic birds (Kent et al. 1999; Moore et al. 1999). Gilmore (1950) suggests use of snares, ambush, and use of decoys and calls as other potential means of capture. Slings and clubs may also have been key hunting weapons. Eggs could be collected from ground-nesting birds. Raptors and the turkey vulture might have been subject to ambush while feeding.

However, other products extracted from birds include bone and feathers. Moore (1999:87) notes the use of bird long bone shafts, which have thin cortical bone and are largely hollow, as raw material for tubular bead-making at Chiripa. Bird bones were also made into tubes for consumption of snuff and hallucinogenic substances in the Andes (Torres 1995). Second, feathers may have served roles in ritual and decoration. In Altiplano pastoral *misa* rites in Bolivia and Northern Chile, flamingo feathers figure as offerings and components (Nielsen 2000, 2001; Dransart 2002:84). Furthermore, depictions of potential elites on Pukara and Tiwanaku ceramics are interpreted as feather headdresses (Chávez 1992:43; Plourde 2006:405). Plourde (2006:396) proposes Formative elites may have incorporated exotic bird feathers as prestige markers procured via long-distance trade with the nearby selva. This suggests feathers' potential importance as aspects of personal adornment. Unfortunately, such remains are unlikely to preserve.

Fish

Native fish taxa include two genera: pupfish (*Orestias*) and catfish (*Trichomycterus*) (Table 2.6). Today, due to predation pressure by humans and introduced fish taxa, both fish taxa grow only to a small size[13]. The genus *Trichomycterus*, mud dwelling, burrowing catfish, are represented by two species in the Lake Titicaca Basin: *suche* (*T. rivulatus*) and *mauri* (*T. dispar*) (Figure 2.4). The two species' distribution differs. The former inhabits both the bottoms of rivers that feed into the lake and the shallow lakeshore and littoral zones, while the latter occupies the lake bottom itself (Capriles 2006). Catfish are depicted on Formative Yaya-Mama stelae as a symbol of water and/or fertility (Chávez and Mohr Chávez 1970:27; Hastorf 2005:80).

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[13] Several fish elements observed within the archaeological assemblages from both Huatacoa and Pukara are larger than modern fish. This produced an unenviable challenge for taxonomic identifications as a much larger archaeological specimen was compared to a tiny modern comparative specimen.

See Capriles (2006) for discussion of evidence from Kala Uyuni demonstrating change in fishing technology and its relationship to a diachronic standardization in the size of fish captured.

Table 2.5: Fish, Amphibia, and Reptiles of the Lake Titicaca Basin

Common Name	Scientific Name	Habitat	Cultural Value
Fish			
Catfish	*Trichomycterus* spp.	Rivers, lakes	Meat
Pupfish, killfish	*Orestias* spp.	Rivers, lakes (microhabitats)	Meat
Amphibians			
Andean toad	*Bufo spinolous*	Pampas, wet areas	Medicine, ritual
Frog	*Telmatobius* spp.	Wetlands, lakes	Medicine, ritual
Frog	*Pleuroderma* spp.	Wetlands, pampa	Medicine, ritual
Marsupial frog	*Gastrotheca boliviana*	Lakes, wetlands, lakeshore	Medicine, ritual
Reptiles			
Colubrid snake	*Tachymenis peruviana*	Lakeshore burrows	?
Iguanid lizard	*Liolaemus spp.*	Pampa burrows	?
Spectacled lizard	*Proctoporus* spp.	Pampa burrows	?

Carachi or killfish species (*Orestias* spp.) inhabit Lake Titicaca and its tributaries (Table 2.5). Different species focus on lake microhabitats, such as near the lake surface, the tortora zone, the littoral zone, and deeper waters (Lauzanne 1992). Archaeological recovery of bone fishing tackle includes net gauges, shuttles, and cordage toggles imply net fishing (Moore 1999, see Vellard 1992c for images of historic net forms). Fish are harvested near shore and farther out into the lake with tortora reed boats (*balsas*).

Amphibians

Four amphibian taxa inhabit Titicaca basin wetlands, lakes, streams and rivers. Vellard (1992a) provides species accounts of the four taxa below. The Andean warty toad (*Bufo spinolous*) is the single toad taxon present. One genus of frogs (*Telmatobius* spp.) has evolved to inhabit many niches: the main bodies of Lake Titicaca and smaller lakes, rivers, streams, and marshes. Frogs of the genus *Pleuroderma* inhabit damp areas, though breed in the water. The marsupial frog (*Gastrotheca boliviana*) also prefers wet habitats, but can be found at a distance from them.

Figure 2.4: Suche (*Trichomycterus rivulatus*) [Typical size, ventral view]

Figure 2.5: Carache (*Orestias agassii*) [Typical size, ventral view]

Amphibians are used in rites and to treat diseases. Both toads and *Telmatobius* and *Pleuroderma* frogs are used in Aymara and Quechua folk medicine. Toads are applied to treat skin maladies and prepare “evil potions”, while frogs are used to make infusions to treat internal disease and female sterility (Binford and Kolata 1996). Vellard (1992a:457) cites the collection of *Telmatobius coleus,* a Lake Titicaca- frog, in bowls to commune with *Pachamama* to bring rains during droughts. Binford and Kolata (1996:45) describe use of toads, collected from rivers, ponds, and *bofedales* for the same rite. Toads ‘cry’ as they dry out, which is thought to be a pray to speed the onset of the rainy season or end droughts (see also Tschopik 1951:277-279).

Reptiles

A single species of small colubrid snake (*Tachymenis peruviana*) and iguanid (*Liolaemus* spp.) and spectacled lizards (*Proctoporus* spp.) are native to the Altiplano of Peru and Bolivia (Pearson and Bradford 1976). This nocturnal snake lives in lakeshore burrows, at 3000-4000 m altitude (Vellard 1992b) and eats local amphibians.

The iguanid lizard lives in burrows across the pampa grasslands of the *puna* and *suni,* being identified up to an altitude of 4876 m (16,000 ft) (Pearson 1954). It is diurnal and forages for vegetation and insects. Reported predator species include foxes (*Lycalopex culpaeus*), hog-nosed skunk (*Conepatus rex*), and raptors. Spectacled lizards are diurnal insectivores living from 2770 to 4080 m (Doan 2008).

Conclusion

Our understanding of shifting cycles of precipitation, lake-levels, and ecological conditions grounds our investigation of prehistory. These details augment our ability to model prehistoric ecological variables, such as an estimate of an area's agropastoral potential and determine the landscape available – for agropastoral production, foraging, non-food resource extraction, and traversable by caravan trade. Wetter climate and the cultural landscape modifications I have discussed were key pillars for the growth of the Formative political economy and social aggregation (also see Chapter 3 below).

The ecological zones and fauna described above provide a modern analog and ecological framework that past cultural groups adapted to, exploited, and modified. Camelids are expected to be major contributors to the Formative domestic (household) and political economies (e.g. llama caravans, feasting, and sacrifices). Yet, the diversity of habitats within the Pukara drainage and nearby – cerros, river and lake habitats, and wetlands – raises the likelihood that wild mammals, birds and fish were of continued importance. Furthermore, long-distance caravan trade could introduce non-local fauna to ceremonial or elite contexts. As a result, we must analyze archaeofauna from varied behavioral contexts to test hypotheses on the ecological catchment and fauna exploitation.

Clearly, ecology aided the rise of complex societies at Pukara and Tiwanaku:

> …it appears that the development of political complexity at Pucara and Tiwanaku was due in part to their favored geographical locations, relative to the competitors in the area, for optimal economic production and exchange. The northwestern and southeastern Titicaca Basin areas have several geographical and ecological features that only co-occur in these zones: **a proximity to prime raised-field agricultural land[14], location on a major river, proximity to extensive camelid grazing lands and direct access to the major lake**…. Furthermore, each area had unimpeded access to the western slopes of the Pacific watershed and the eastern lowlands. That is, people living in these two areas were able to travel directly east and west without having to cross territory controlled by contemporary complex polities (Stanish 2003:159-160, my emphasis)

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[14] Here we could also add the impact of qochas upon production of agropastoral surplus production.

This description emphasizes the role of the subsistence base and adjacent diverse ecological zones in the political, social and economic transformations that characterized the Late Formative cultural landscape. Climatic cycles changed the relative bounty of wild and domesticated resources across these zones, which would in turn make large population aggregations and conspicuous consumption riskier practices. The present study recognizes Late Holocene climatic change that at some times encouraged and other times frustrated cultural changes and adaptations.

CHAPTER 3: PUKARA VALLEY: ESTABLISHING A FOUNDATION FOR RESEARCH

Cultural Background: A Brief Prehistory of the North Titicaca Basin

An assessment of faunal remains and import of the Pukara Valley sites of Huatacoa and Pukara necessitates their grounding as components of the Titicaca Basin's cultural chronology. Here I explore the nature of Archaic hunter-gather lifeways that preceded the Formative Period village settlement. This transition resulted in several diachronic changes in subsistence and economy, sociopolitical organization, ritual, and interaction. In this chapter, where applicable, I will consider and incorporate findings from across the Titicaca Basin[15]. Yet, in most circumstances, our attention focuses on the North alone.

Early to Late Archaic Period

In the high-elevation environs of the Southern Peruvian Andes as a whole, the Archaic (or Preceramic Period) dates roughly between 11,000 to 1800 BC (Aldenderfer 2008:131). When Lake Titicaca Basin proper is considered, Aldenderfer proposes a subdivision of the Period into Early, Middle, Late, and Terminal Archaic Periods (Table 3.1). Our perception of Archaic lifeways across the Peruvian Altiplano and nearby high-sierra continue to advance thanks to the survey and excavation efforts led by *Programma Collasuyu* members (Aldenderfer 2002, 2004; Craig 2005; Craig et al. 2010; and see also several reports in Stanish, Cohen, and Aldenderfer 2005)[16]. I review our general

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[15] This remains important for tracking regional change and in light of disparate programs of survey, excavation, and application of analytical methods.

[16] Our limited understanding of the Bolivian Archaic (Early through Late Periods) remains vexing, given our growing recognition of sites around segments of Lake Titicaca (see Aldenderfer 2009:81-82; Bandy 2001:87-89).

understanding of the Archaic Period followed by a discussion of data from select excavated sites.

Archaic populations practiced a hunter-forager lifeway predicated on shifting reliance on residential and logistic mobility. In the Early Archaic Period, initial residential mobility forays across the puna and Altiplano took place. By 8900-7600 BC, high sierra sites like Asana (located in the Osmore drainage) served as temporary base camps for seasonal exploitation of guanaco, vicuña, and taruca and wild plant resources available in the sierra and Altiplano (Aldenderfer 1998; 2008) (Table 3.1). Early residential base camps in the Huenque, Ilave, and Huancané Valleys of Titicaca indicate foragers used a broad range of ecological habitats, yet had a marked preference for puna rim and upstream camp locations (Cipolla 2005; Craig 2005:453-483; Klink 2005:18-21).

Table 3.1: Lake Titicaca Chronology

	N. Basin	**N. Basin**	**S. Basin**
Period	**Stanish (2003)**	**Aldenderfer (2009) [calibrated dates]**	**Bandy (2004) [calibrated dates]**
Formative			
Late	500 BC-AD 400	200 BCE-CE 500	250 BCE-CE 475
Middle	1300–500 BC	800-200 BCE	800-250 BCE
Early[1]	2000–1300 BC	1500-800 BCE	1500-800 BCE
Archaic			
Terminal		3000-1500 BCE	
Late		4800-3000 BCE	
Middle		6800-4800 BCE	
Early		8800-6800 BCE	

[1] **Note: The timing of the Formative Period remains a point of debate. For Aldenderfer, the Terminal Archaic demarcates the initial steps towards sedentary village life; low-level food production; and flickers of prestige-building, lineage worship, and monument construction (2002, 2004:23-25). The present dissertation works within the framework of Aldenderfer's chronology.**

Widespread application of Steadman's (1995) ceramic typology continues to bring into focus the relative contemporaneity of pan-Titicaca cultural changes and ceramic technology.

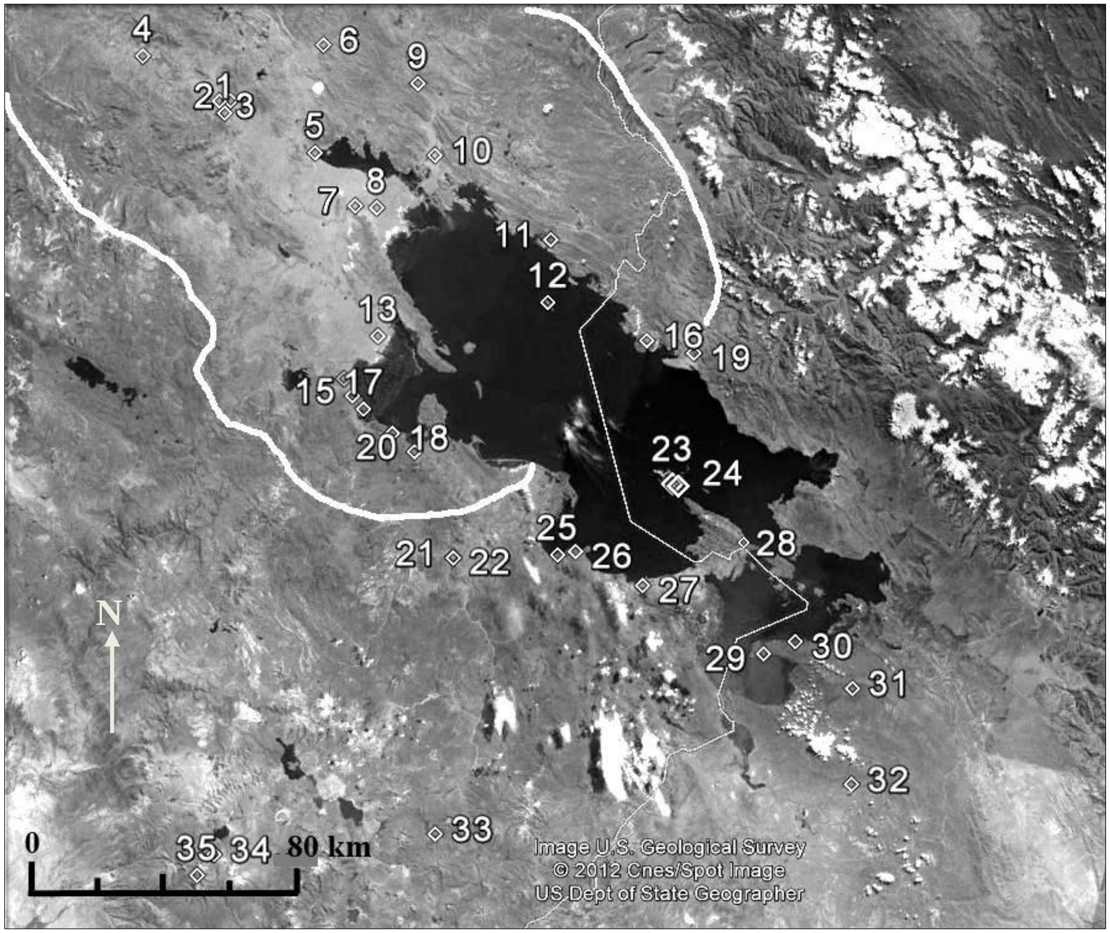

Figure 3.1: Select Archaic and Formative Sites and Proposed Extent of Pukara Polity Control (AD 100-300)

1. Pukara; 2. Huatacoa; 3. Qaluyu; 4. Balsapatas; 5. Arapa; 6. Canchacancha Asiruni; 7. Saman; 8. Taraco; 9. Capichupa; 10. Huancawichinka; 11. Moho; 12. Isla Soto; 13. Wanima; 14. Paucorolla–Santa Barbara; 15. Cerro Chincherros; 16. Lailuyu; 17. Huajje; 18. Incatunuhuiri; 19. Titimani; 20. Camata; 21. Jiskairumoko; 22. Kaillachuro; 23. Titinhuayani; 24. Ch'uxucqullu; 25. Sillumocco-Huaquina; 26. San Bartolomé-Wiscachani; 27. Ckackachipata; 28. Ch'isi; 29. Kala Uyuni; 30. Chiripa, Alto Pukara; 31. Tiwanaku; 32. Khonko Wakane; 33. Quelcatani; 34. El Panteón; 35. Asana

Note: Zig-zag line depicts the Peru-Bolivia border. Some sites depicted are not discussed in the text, while others are not depicted.

Middle and Late Archaic forager settlement systems adapted to millennial-periods of aridity, which reshaped Basin-wide hydrology and landforms (see Chapter 2). Foremost, the flow and evolution of tributary rivers dramatically changed (Farabaugh and Rigsby 2005:26; Rigsby et al. 2003). New pampa formed from ancient lake bottom as Titicaca shrank into a shallow, more saline lake. During both periods, forager camp sites occupied lower-valley river terraces, wetlands (*bofedales*), and hill and pampas habitats with greater frequency than before (Cipolla 2005; Klink 2005)[17]. Camp sites became more concentrated near permanent water sources. Foragers adjusted to changing conditions, notably the Middle Archaic's greater ecological patchiness (lower resource density), by practicing both logistical and residential moves (Klink 2005:21-24).

From the Early to Late Archaic, migrating large mammal game were high rank prey species, likely supplemented by opportunistic capture of small mammal and wetland species (e.g., waterfowl and fish) (Kuznar 1990; Klink 2005:20-21). Archaic foragers harvested plants for food, including wild quinoa and tubers, and industrial uses (e.g. totora, for baskets and roof thatch) (Craig 2005:555; Eisentraut 1998; Haas et. al. 2009).

Terminal Archaic Period

The start of the Late Holocene (3900-2400 cal years BP) coincided with a significant precipitation increase, which ameliorated climate, augmented river discharge rates, and caused the expansion of Lake Titicaca (Aldenderfer and Craig 2002:6).

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[17] Reconstructing Middle / Late Archaic settlement patterns faces a small problem:

> …[I]t is assumed that the sites located near the [Lake Titicaca] margins today would probably have not been on the lake edge during the Late Archaic period. Also, these sites are not on the modern-day river terrace but appear to be located along a relict river terrace from where the Huancané River has shifted over time. The shift in the lakeshore environment has likely affected the representation of sites found on the surface during survey (Cipolla 2005:62)

Simultaneous with this climatic shift, a process of transition from Terminal Archaic to Early Formative lifeways began.

Data from both excavations and survey demonstrate a culmination of several trends by the Terminal Archaic: reduced residential mobility, longer-term (semi-permanent) base camps, gradual population growth, and greater settlement aggregation (Aldenderfer 2002:395). Residential base camps clustered around permanent water sources (river terraces, *bofedales*), pampas, and hills. However, low-valley and near-lakeshore areas became more important also for site locations (Cipolla 2005; Klink 2005). Logistical extractive sites are expected to be scattered around base camps.

Insights about domestic and political life have been gleaned from in-depth excavations. Domestic midden deposits from the Island of the Sun sites of Ch'uxuqullu and Titihauyani yield some of the first comparative data from Bolivia (Stanish et al. 2002). An increasing number of sites reveal domestic structures with prepared foundations (Aldenderfer 1998, 2004, Craig 2005) (Figure 3.1)[18]. For example, Jiskairumoko contains six small pithouses; each is associated with individual hearths and wall storage features. These structures encircle a larger structure, which contains a bench and large, central hearth showing long-term reuse. The latter, given its size, large hearth, and the absence of storage features, may have hosted public or ritual events (Aldenderfer 2004:24, Craig 2005:718).

Furthermore, at Kaillachuro and Jiskairumoko, there are more in-depth evidence of social practices. Kaillachuro contains nine burial mounds, including one with a stone-lined crypt that contained a primary burial lying on a purple ochre layer. The presence of such mounds and associated secondary burials is interpreted as evidence of early

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[18] Pithouse structures are documented at Asana, Jiskairumoko, Quelcatani (aka Quilcatani).

ancestral lineage veneration and territoriality (Aldendender 2004:24-25). Recovered artifacts provide evidence of incipient social differentiation, wool weaving, and long-distance prestige good procurement: a) a gold necklace grave good; b) wichuña and whorls; c) Chivay obsidian[19]; and d) worked bone snuff paraphernalia (Aldenderfer et al. 2008; Craig and Aldenderfer 2005; Stanish et al. 2002).

Late Terminal Archaic populations, following a millennial-long process of manipulating and managing certain plants and animal species, practiced a low-level food production subsistence economy. Such an economy is defined by a per annum caloric input of domesticate species (plants and animals) falling below 30-50% of the diet (Smith 2001:27; Aldenderfer 2004). Corrals (at Jiskairumoko and Asana) and zooarchaeological studies (for Asana and Quelcatani rockshelter) document early small-scale camelid management in the circum-Titicaca basin (Aldenderfer 2004; Kuznar 1990). Likewise, fully-domesticated chenopodium (*quinoa*) is found in Terminal Archaic contexts at Camata, Quelcatani, and Jiskairumoko (Craig 2005; Eisentraut 1998)[20]. Tuber species may also have increased in dietary importance. Nonetheless, a full-blown, agropastoral economy, predicated on domesticate dependence and intensive cultural effort (i.e. management of landscapes and large herds), did not occur until perhaps 700 years later during the Middle Formative (Craig et al. 2011; Stanish 2005).

Early Formative

The Early Formative is defined by the growth of small, undifferentiated villages, a mixed intensive horticulture, fishing, and herding economy, and the first widespread use

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[19] Its source is on the the Altiplano periphery in the Colca Valley, which is located about 140 km away from the Pukara site (Burger et al. 2002; see also Tripevich 2007:231, Figure 3-12).

[20] See Kuznar (1993) for a proposal of how camelid herd management and domesticated chenopodium emerged through a co-evolutionary process.

of ceramic technology (Stanish 2003:101). Some overlap exists between the Terminal Archaic and Early Formative in settlement patterns and cultural and subsistence practices. Terminal Archaic base camp occupations frequently underlie Early Formative hamlet / village sites (Aldenderfer and Klink 2005:25; Cohen 2010; Craig 2005; Herhann 2004; Steadman 1995; Stanish 2003:99-109) (Figure 3.1)[21].

Debate surrounds how to conceptualize the Archaic-Formative transition. Stanish (Stanish 2003; Stanish and Levine 2011) favors subsuming the Terminal Archaic into a broader-defined Early Formative Period, where villagelife gradually became widespread and early Titicaca regional centers, like Qaluyu and Chiripa, were in their infancy (Table 3.1). A compressed Early Formative Period, defined by calibrated C-14 dates, is advocated as an alternative (Aldenderfer 2008; Bandy and Hastorf 2007; Craig 2005; Hastorf 2008). The Period definition draws together a pan-Basin pattern of village settlements (and subsequent budding into daughter villages), the rise of regional centers, and the concomitant initial construction of sunken court architecture (Bandy 2004; Cohen 2010)[22]. Debate notwithstanding, the Early Formative lifeway:

> …appears to be more an elaboration of the Late [Terminal] Archaic one, with the addition of pottery, greater sedentism, heavier reliance on domesticated plants…[rather] than…any kind of qualitative break in the political organization of the region [Stanish 2004:20].

Regional surveys from the Titicaca basin suggest diversified settlement patterns, with greater emphasis on lakeshore and river-valley habitats (Bandy 2001; Cohen 2010; Klink 2005; Stanish et al. 1997). Formative regional development differs across space by

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[21] For example: Camata, Ch'uxuqullu, Huatacoa, Jiskairumoko, Kaillachuro, Quelcatani, San Bartolomé-Wiscachani, and Titinhuayani

[22] Along the Taraco Peninsula, the Early Formative includes the Early and Middle Chiripa Phases (1500-1000 BCE, 1000-800 BCE)

timing and trajectory. For instance, in the South basin, Bandy (2001:103-111) notes several magnitude differences between the average size and density of village sites for the Juli-Pomata area (Pasiri-ceramics) versus the Taraco Peninsula's Early and Middle Chiripa village (Chiripa ceramics). This same average site-size imbalance remains following calculation of rough average size of contemporaneous Ilave Valley sites (see Craig 2005, Table 5.4's summary of the survey's results). Bandy attributes the Taraco Peninsula's remarkable population growth and site density to intensive harvesting of lake fauna and agriculture, territorial circumscription, and village-budding (2001:105).

Floral and faunal subsistence remains from excavated Terminal Archaic and Early Formative-component sites demonstrate small-scale camelid herding – at Asana, El Panteón, Quelcatani, and Jiskairumoko – and domesticated *quinoa* cultivation, at Jiskairumoko and Camata (Aldenderfer 2008; Craig 2005; Craig and Aldenderfer 2002; Eisentraut 1998; Kuznar 1990; Murray 2005). In turn, early herder-cultivator exchange networks may have developed – evidenced by biased camelid body-part representation, at Asana, El Panteón, and Quelcatani, and the discovery at Quelcatani of *quinoa* above its viable habitat (Aldenderfer 2002b:393-394; Eisentraut 1998; Kuznar 1990, 1995). On the Taraco Peninsula, the Early Formative subsistence economy is focused on lakeshore resources (fish and waterfowl), *quinoa* horticulture, and camelid herding (Bandy 2001; Bruno and Whitehead 2003; Moore et al 1999).

At the same time, long-distance trade in exotics within the Titicaca basin and puna rim is relatively low-level during the Archaic, until the Late Archaic to Early Formative occupations. Chivay obsidian appears in the form of projectile points, lithic tools, and debitage at Qaluyu-Period sites, like Camata, Quelcatani, Jiskairumoko, and in limited representation at Chiripa (Aldenderfer 2002a, in press; Bandy 2001; Burger et al 2001; Craig and Aldenderfer 2002). Furthermore, Stanish et al (2002) report the long-distance import via watercraft of obsidian preforms to the Island of the Sun by 1600 BC. At Chiripa and Jiskairumoko, other decorative exotics found in burial contexts hint at incipient social differentiation and status display, including sodalite, lapis lazuli, and gold beads, and remnants of mortuary-associated ritual performance, in the case of red ochre use, camelid effigies, and possible snuff paraphernalia (Blom and Bandy 1999:118-119; Craig and Aldenderfer 2002:11). The presence of such goods suggests llama-caravans and watercraft were already in use for long-distance trade.

Middle Formative

The Middle Formative period is marked by growing social differentiation, loose political integration, and regional communication and exchange, in both material goods and ideology. As noted for the Early Formative, the temporal demarcation of this period varies by geographic region. At some sites, excavation has enabled us to construct radiocarbon chronology correlated with known Titicaca ceramic forms. Within the North basin sites, sites such as Qaluyu, Huatacoa, Cachichupa, and Camata, an early, extended chronology is defined by absolute dates and ceramic typology (ca. BC 1400/1300-500) (Cohen 2010; Chavéz 1977; Plourde 2006; Stanish 2003; Steadman 1995).

In contrast, in the South basin, the Middle Formative Period has a shorter, temporally much younger designation: for the south and southeastern region, the Late Chiripa Phase (BCE 800-250), and in the Juli-Pomata region, the Early Sillumocco Period (BC 900-200) (Hastorf 2008; Stanish et al. 1997). In terms of ubiquity and geographic distribution, however, Qaluyu and Chiripa ceramics are the most widely distributed and studied, suggesting both polities' prominence during this period[23].

Thus far, eight settlement clusters are identified for the Basin (Hastorf 2008, see Stanish 2003: Map 1.3)[24]. Sites have domestic settlements, corporate-ceremonial architecture (sunken courts and terraced pyramids), and sometimes both at large centers. Regional clusters suggest political structure akin to simple chiefdoms - with hamlets, villages without public architecture, regional center-villages, and possibly large regional centers (Plourde and Stanish 2006:251-252; Stanish 2003; Stanish et al 1997). Alternatively, loosely woven webs and alliances might have existed, uniting villages and regional centers on the basis of economic ties and shared ritual practices (Hastorf 2005, 2008). The Qaluyu settlement cluster deserves further discussion.

Qaluyu: Middle Formative in the North Basin

Qaluyu is a bisected tell-like mound site located 4 km northeast of the Pukara site on the Puno-Cuzco highway. Test excavations conducted by Chávez Ballón (1950) and Chávez Ballón and Kidder II (Kidder 1956), respectively, described the site and its material culture and collected C-14 dates. The mound's stratigraphic sequence consists of an Early - Middle Formative- occupation (Qaluyu) stratum, a 1-2 m alluvial deposit, and Late Formative (Pukara) occupation stratum (Chávez-Ballon 1950).

Mohr-Chávez dug five trenches, ranging from 1 to 1.5 meters wide by 3 to 5 meters long, to a depth of one to four meters (Mohr-Chávez 1969:50). Artifacts,

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[23] As this dissertation focuses on the North basin, Chiripa is only discussed briefly throughout. Broad similarities between Qaluyu and Chiripa provide a comparative data. For more details on Chiripa see Bennett (1936); Hastorf (1999); Mohr-Chavez (1988), and Stanish (2003).

[24] Moving clockwise (from the North Basin), these clusters are: Qaluyu; Titimani; Titinhayauna (the Isle of the Sun); Huata; Chiripa; Ckackcipata; Sillumoco; and Huajje.

ceramics and faunal remains (see Chapter 5) were collected. The ceramic and stratigraphic sequences document a Middle Formative occupation (Qaluyu) and a Late Formative occupation (Pukara). Mohr-Chavéz (1977) proposed a ceramic typology, which distinguishes an Early Qaluyu sub-phase (1400-1100 BC) from a Late Qaluyu one (1000-600 BC). Radiocarbon dates corroborate the broad outline of the typological and occupational sequence: the Qaluyu occupation (1427-971 BC) preceded a later Pukara one (54-179 AD) (Table 3.2)[25]

Table 3.2: Selected Qaluyu Radiocarbon Dates (basis for combined date range)

C-14 Lab ID	Age	Context	14C± σ Years BP	Calibrated Years +2σ
P-1585	Q	Lot 16, Trench 1 (2B/16)	3239±52	1628-1415 cal. BC
P-1584	Q	Lot 9, Trench 1 (2B/9)	3045±56	1427-1152 Cal. BC (97.2%) 1148-1129 Cal. B.C. (2.8%)
P-1582	Q	Lot 4, Trench 1 (2B/4)	2925±61	1313-971 Cal. BC (97.5%) 1367-1363 Cal B.C. (2.5%)
P-1581	P	Lot 3, Trench 5 (2F/3)	1949±52	54-179 Cal AD (97.7%) 83-80 Cal B.C. (2.3%)
P-156	Q	KTE	2962±120	1450-895 Cal. BC (99.4%) 869-854 Cal B.C. (0.6%)
P-155	Q / P	KTE	2522±114	851-393 Cal BC (98.6%) 895-868 Cal B.C. (1.4%)

Note: Raw C-14 dates from charcoal (Mohr-Chávez 1977:1144-1145; Ralph 1959:57); dates calibrated using CALIB 6.0 (Stuiver and Reimer 1993; Reimer et al. 2009); KTE corresponds to dates from Kidder's test excavation (Ralph 1959:57). Q = Qaluyu, P = Pukara

At the Camata site radiocarbon-bracketed strata and refined, ceramic typology augments our understanding of the two Qaluyu phases. Criteria like vessel form, decoration, surface treatment, and paste types helped re-define the Early Qaluyu (1200-850 BCE) and Late Qaluyu (850-400 BCE) phases (Steadman 1995). Camata's Early Qaluyu assemblage was dominated by mineral tempered, large utilitarian bowls and

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[25] Both occupations' C-14 date assignments are based on maximum range recorded from Qaluyu. Excluded are two outlier dates (see Table 3.1). However, Mohr-Chavéz proposes a "younger" termination of Qaluyu occupation at the site than is reflected by the C-14 date — based on regional ceramic typological comparisons with Marcavalle, a site near Cuzco.

undecorated neckless ollas. The Late Qaluyu phase was dominated by fiber-tempered vessels, showed greater variation in vessel forms (e.g. ceramic trumpets, bottles, and rectangular vessels), and had more decorated vessels (about 5% of the assemblage). Decorative methods include punctates, incised lines and geometric shapes, and surface painting (in red, black, and cream colors). Nonetheless, shortcomings in the typology's application for the North Basin and Pukara drainage include: 1) a need to define an Initial Qaluyu phase (1500-1200 BCE) to encompass earlier ceramics types and 2) regional variation in vessel form frequency and decoration (Cohen 2010:57-58).

Further work conducted in the North Basin by the Programma Collasuyu has expanded our understanding of Qaluyu culture. Recent reconnaissance and mapping of the Qaluyu site identifies it as the largest Qaluyu-period center within the Pukara Valley (Plourde and Stanish 2006). Roughly seven to ten hectares are covered by dense habitation refuse and at least five sunken courts (based on scattered cut stone blocks and depressions). Survey of the Pukara drainage noted 13 new Qaluyu villages – staggered every 2-3 kilometers along the floodplain all north of Pukara (Cohen 2010:65-67).

Meanwhile, excavations at the nearby Pukara site's Qalasaya terrace architecture discovered Qaluyu-period habitation debris, ceramics, five-level step terrace pyramid, and early temple complex (Lynch 1981:204; Wheeler and Mujica 1981:26-29). Extensive Late Formative remodeling and site use limit further reconstruction of Middle Formative contexts at Pukara (Plourde and Stanish 2006:246).

Survey of the Huacané River drainage and around Lake Arapa led to the discovery of many additional sites bearing Qaluyu and Late Formative ceramics (Figure

3.1). Patterns of site size distribution indicate economic and political integration between settlements (Stanish 2003:110-111). Twenty-four of these discovered sites compare to Qaluyu itself in size and several exceed 20 ha in size within the Arapa-Taraco area (Plourde and Stanish 2006:249). Two other sizeable Qaluyu regional centers, Balsaspata and Canchacancha-Asiruni, are located along the upstream portions of the Pukara and Ramís Rivers (Chavéz and Mohr-Chavéz 1970; Kidder 1943; Stanish 2003:111-112; Tantaleán 2005, 2008). Large terraces and compounds at Cachichupa demonstrate a western extension of Qaluyu culture by 1400 BC (Plourde and Stanish 2006:249-251).

Recent excavations at the Taraco site require a reevaluation of the traditional treatment of Qaluyu ceramics as a strictly Pre-Pukara culture phenomenon. A long stratigraphic profile excavated in 2007 reveals the following ceramic-seriated, radiocarbon sequence in descending order: a Pukara stratum, a Pukara/Qaluyu stratum, and a Qaluyu stratum (Oshige 2011:145; Stanish and Levine 2011).

This invalidates the notion that Qaluyu- and Pukara-style ceramics define rigid, categorical Middle versus Late Formative occupations. This notion is not totally foreign, given the Qalasaya excavation chronology for the Pukara site and Aldenderfer’s recent chronology (see Table 3.1 and 3.3; Wheeler and Mujica 1981). Instead, Late Qaluyu (Final Middle Formative) and Initial Pukara (Early Late Formative) cultures overlap.

In sum, Qaluyu stands out as an early recorded Middle Formative center in the Titicaca basin and an eponymous ceramic type collection. What remains to be firmly established is whether sites operated as an integrated regional polity or as loosely associated settlement clusters.

Table 3.3: Qaluyu/Pukara Chronology (Adapted from Klarich 2005a:Table 1)

Formative Period	Craig et al. (2011)	Mujica (1988)	Steadman (1995)
Late Qaluyu	800 – 500 cal. BC		
Qaluyu – Pukara	750 – 200 cal. BC		
Pukara	800 BC – 200 A.D.		
Pukara Site			
Initial Pukara		500 – 200 BC	400 – 300 BC
Middle / Classic Pukara		200 BC – AD 100	300 BC – AD 100[1]
Late Pukara		AD 100 - 300	AD 100 – 350

1 Combines Pukara 1 and 2 Phases

Subsistence and Economic Interaction

The economy and diet practiced represent an elaboration and intensification of the Early Formative pattern. Site locations demonstrate a lake and riverside resource emphasis. Domesticated crops, mainly quinoa and tubers, took on greater importance in domestic and ritual meals (Bruno 2008; Bruno and Whitehead 2003; Whitehead 2007)[26]. Maize, whether as exchanged lowland food or a near-lake cultigen, first appears in small quantities. These remains were processed into probable *chicha* beer, found in Middle to Late Formative ritual and burial contexts (Logan et al. 2012).

In Chapter 2, I noted construction of terraces, raised fields, and qochas as evidence of Formative agricultural intensification practices. Early terraces, at Pukara and Cachichupa, and raised fields, in the North basin regions of Huatta, Arapa, Azánagro and Huacané, lend credence to their Middle Formative innovation by Qaluyu populations (Erickson 2000; Plourde 2006; Stanish 2003:64, 2006; Wheeler and Mujica 1981). Instructive also is a recent study of qocha distribution within the Pukara-Azánagro interfluvial region, located south of Pukara proper. Survey and analysis of satellite data were used to locate and count qocha distribution; limited test excavations provided relative chronology of site occupation and qocha use. This study finds qochas had a

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[26] Huatacoa and Pukara floral datasets have yet to be analyzed.

Qaluyu-Pukara transitional period origin, but extensive and intensive use by the Pukara polity (Craig et al. 2011:2900). Taken together, an active effort was underway to intensify agricultural productivity.

Animal proteins remained an important food source. Camelids are well-documented as major dietary components in North and South basin zooarchaeological studies from the Middle Formative onward (see Moore 2008; Moore et al. 1999; Wing 1986). Wild mammals, fish, and several bird taxa served supplementary food and non-subsistence uses. Camelid wool grew increasingly important for textile and clothing production. Most recovered bone tools from the Huatacoa, Pukara, and Taraco Peninsula collections served weaving functions (Moore 1999; 2008).

A more pronounced political economy existed by Middle Formative times, with goods transported llama caravan, reed boat, or by foot. Burger et al (2000) and Chavez (1977, 1988) demonstrated exchange and extraction of Chivay and distant Alca obsidian[27] (seen at Qaluyu, Canchacancha-Asiruni, and Taraco) and inter-regional ceramic exchange with the Cuzco region. Non-local ceramic vessels (undoubtedly transporting goods) served to "initiate and lubricate the exchange of accompanying goods, services or obligations and/or belonged to a prestige, as opposed to a domestic, sphere of interaction" (Burger et al 2000:302) between elites in both regions. Recent work also suggests the South Puno Bay area was a probable production center for olivine-basalt hoes found at North and South basin sites (Bandy 2004; Steadman 1995).

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[27] The Alca obsidian source was found at in the considerably more distant Cotahuasi Valley, located in the west end of the Department of Cuzco (see Tripevich 2007:Figure 3-12).

Altiplano-selva interaction is also posited as the extraction of exotic lowland plants (coca, *ají*, and hallucinogens), feline pelts, and bird plumage may have taken on greater importance as prestige markers or ritual components (Bandy 2004:97; Plourde 2006). Cachichupa, for instance, appears strategically located to control passage from the lake edge across the Cordillea Real into the Amazon[28].

Though notably more difficult to identify, a brisk exchange in "domestic" perishables (crops, *ch'arki*, textiles) presumably existed beside the prestige goods political economy discussed – further integrating neighboring communities. Control over prestige good production and the flow of exchange of goods was one factor contributing to the social differentiation and greater ritual, political and economic integration of communities to each other (Bandy 2004; Plourde 2006).

Iconography, Ritual Architecture and Stelae

Spanning the Middle to Late Formative, the Yaya-Mama Religious Tradition (ca. 800 BC – 200/300 AD) consists of emblematic iconography – including animals (snakes, birds, fish), male-female duality, plants and geometric shapes – decorating stelae and ceramics, ritual ceramic forms (trumpets and *incensaríos*), and sunken court architecture (Kidder 1943; Chávez 2002, 2004; Chávez and Mohr-Chávez 1975; Mohr-Chávez 1988; Mohr-Chávez and Chávez 1997:5-7).

Sunken courts, semi-subterranean prepared-clay plazas with cut-stone block structures, are found at regional centers across the Titicaca basin (cf. Cohen 2010:77-91)

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[28] Discarded within the construction fill of one terrace was a probable snuff kit spoon, which displayed an elaborately carved handle. Similar handles were recovered at Huatacoa.

(Figure 3.1)[29]. Many courts are encircled by small niche rooms. One explanation holds these niches were food storage locations for court-associated ritual consumption. During Bennett's excavation of Chiripa's Upper House court and its niches, excavators found *quinoa* and carbonized *quinoa*, *chuño*, and reed basketry fragments (Mohr-Chavéz 1988:19). At the Bolivian site of Ch'isi, food-cache pits were associated with a sunken court. Burnt *oca*, *chuño*, fish, deer, camelids, *cuy*, and birds were recovered from the pits (Chavéz 2004:74). Presumably, the remains represent two steps (storage and burnt offering) in a multi-step process associated with preparation and performance of ritual offerings and feasting events.

A second interpretation of the niches use is presented by Christine Hastorf (2003b). Human burials are often found adjacent to or present within courts. Cyst burials and formal burial crypts occur in courts at Huatacoa, Chiripa, and elsewhere (Cohen 2010; Hastorf 2003b). Starting in the Middle Chiripa (1000-800 BC), Hastorf maintains that court niches became loci for ancestor veneration, wherein each niche stored mummies of a particular community lineage. Mummies were stored and periodically disinterred so ancestors could interact with the larger community and participate in rites reinforcing lineage affiliation and community[30]. Chiripa's Late Formative *Montículo*, reminiscent of Pukara's Qalsasaya sunken courts, materialize the emergence of an early *ayllu* – a multi-household, kin-based landholding unit whose members trace themselves back to a common ancestor (Hastorf 2003b:327). Pukara's Middle Formative ritual chamber represents an interesting iteration. Two of its niches

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[29] *In-situ* Yaya-Mama stelae are occasionally found on sunken court floors.

[30] Hastorf (2003:324) suggests charred floral remains, from the House Five niche on Chiripa's Montículo, represent burnt offerings to feed the ancestors.

contained an interred, painted stone figurine and a stone head (Lynch 1981; Wheeler and Mujica 1981)[31]. Thus, niches would be elaborate crypts and courts themselves venues to invoke ancestor-descendant relations and reciprocity.

Several theories have been advanced to decipher the iconographic messages depicted on Yaya-Mama stelae. Stelae are seen to reinforce ancestor-descendant relations – through depiction of male-female panels – and materialize agropastoral productivity and natural bounty (Hastorf 2005, 2008; Janusek 2008:82-87). Human society, past and present, is thereby symbolically intertwined with nature and agriculture. Pan-Basin repetition of common motifs suggests adherence to an overarching, Middle Formative regional ideology. At the same time, anthropomorphic stelae, ritual ceramics, and sunken courts may communicate local political messages. Stanish argues Yaya-Mama anthropomorphic stelae juxtapose site-specific (or regional) motifs next to standardized motifs (Stanish 2003: Figure 6.13). Closer inspection reveals hints of improvisation both in ceramic iconography and sunken courts (e.g. their size, design and process of renovation over time) (Cohen 2010: 72-87; Janusek 2004:136). Such local variation advertises emerging local elite corporate groups participating in the larger regional political and ideological system (Stanish 2004:311-312).

How can we interpret this widespread sharing of architectural forms, artifacts, and symbolic content? Chávez and Chávez proposed a Titicaca Basin syncretism in belief and ritual practice facilitated economic interaction, the integration of multiple households into communities, and social differentiation (Burger et al 2000:311; Chávez 1997 [cited by Janusek 2004:136-137]). Ideology was made material and reinforced through varied

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[31] It remains possible that lineage ancestors were removed to curate elsewhere prior to abandonment of this chamber. The stone sculptures conceivably then served as permanent substitutes for the physical remains.

media: stelae iconography, ceremonial ceramic forms, ritual practice, and corporate architecture (sensu DeMarrais et al. 1996).

Communal, shared ritual and ideology helped to facilitate sociopolitical and economic integration. Ritual counteracts and mitigates endemic scalar stresses experienced within Formative villages as population aggregated (Bandy 2004; 2007). Ritual also served to "encode proper behavior and provide the means to sanction people who do not cooperate" (Stanish and Haley 2004:61). Reciprocal relations and cooperative work by a multi-household group became codified (Stanish 2003, 2004). The on-going shift was a subtle tweak of egalitarian notions of work and property and the metamorphosis of socioeconomic relations. These changes made construction and curation of courts possible, underwrote manufacturing (of stele and ceramics), facilitated creation of food surpluses, and motivated long-distance trade excursions (Stanish 2004:23). Feasts and other rites were occasions for periodic redistribution of food surplus, goods, and ritual goods. These events perpetuated cycles of cooperative labor, status differentiation, and a robust political economy. In reality, increasing ritual, economic, and social integration may have resulted in polity crystallization.

Late Formative

This period marks the outward expansion of Pukara as a North Basin regional power and polity and Tiwanaku as its equivalent in the South Basin. Following Aldenderfer (Table 3.1 above), the Late (or Upper) Formative corresponds to 200 BC-AD 500, roughly bracketing the polity's apex and decline. Stanish (2003) proposes that the Pukara and Tiwanaku polities coexisted and competed with twelve or more smaller sovereign or semiautonomous polities around the Basin[32]. They interacted and controlled territories:

> The relationship between these polities was competitive, and alliance-formation was one means of competition. The archaeological data from the Upper Formative sites conform well with our understanding of complex chiefly societies and incipient state societies, particularly in regard to the development of elite alliances, conflict between polities, absorption of neighbors, peer-polity interactions and control of exchange (Stanish 2003:137-138).

Pukara and Tiwanaku are conceptualized as primate nonurban regional centers, which had resident elite and retainer (possibly craft specialist) subpopulations. These sites held sway over a multi-level site hierarchy of primary and secondary centers, villages and hamlets (Hastorf 2005:83; Stanish 2003:140-141).

Primary centers are characterized by the *Qalasasaya Complex:* multiple stone-lined sunken courts, a *Qalasasaya* dressed stone (terraced) enclosure, pyramidal mounds, and elaborated cut-stone stelae. Both authors contend such complexes were the setting of ancestor veneration, communal competitive feasting, and human sacrifice (see below). A further hypothesis holds that Pukara’s ten probable sunken court complexes represent ranked “offices” for North Basin elite corporate groups. Elites resided, at least part-time, and conducted business away from their home regional center (Stanish 2003:284)[33]. Domestic occupation by elites and non-elites was somewhat segregated. If Pukara’s layout is representative, elite households bunched near a ceremonial core, while nonelites settled the center’s periphery and countryside.

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[32] Clockwise around the Basin from the Pukara site: Several strong candidates for autonomous or semiautonomous polities include Taraco / Saman, Huancahuichinka (Arapa area), Lailuyu, Titimani, Titinhayani, Santiago de Huata, Copacabana, Pajchiri, Ckackachipata, and Sillumocco (Stanish 2003).

[33] Radiocarbon cross-dating of secure contexts from each court offers hope for testing this hypothesis. Mainly we could then answer when courts were constructed, how long they were used, and which were contemporaneously used.

The Pukara polity's spheres of direct control and exchange are definable after a long history of survey and excavations in the North Basin and nearby regions. Direct political control extends outward: north to the La Raya pass, east to Lailuyu, and west to Incatunuhuiri and Camata [Figure 3.1] (Kidder 1943; Stanish 2003:145-147)[34].

Subsistence and Economic Interaction

Agropastoral practices continued as the bedrock for subsistence. As noted above, extensive use of qochas, near the Pukara heartland, and terrace and raised field agriculture enabled the surplus creation. Quinoa, various tubers, other cultigens, and perhaps increasingly maize (see Logan et al. 2012), were important crops (Bruno 2008; Whitehead 2007). These qochas also encouraged wetland vegetation, which would help augment forage for alpaca and llama herds. Despite increasing emphasis on domesticated camelids, and cuy, wild game continued to be exploited in the North and South Basins (Moore et al. 1999, 2007; Wing 1986; Wheeler and Mujica 1981).

Increased sociopolitical integration over the Titicaca Basin meant numerous goods moved back and forth within the Pukara polity and between it and its neighbors. A brisk caravan exchange in obsidian continued. Obsidian sourcing analyses of artifacts from Pukara, Taraco and Qaluyu were conducted (Burger et al. 2000:315-317), indicating that Pukara itself demonstrated a high frequency (20-30%) of the distant Alca source obsidian, retrieved from 258 km away in Arequipa. Meanwhile, nearby Qaluyu and Taraco[35] (on the Arapa lakeshore) almost exclusively had Chivay obsidian. Nonetheless,

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[34] A dense presence of Pukara ceramics and stelae form the basis of this definition.

[35] Strikingly this proportion is a reversal of Alca obsidian representation at Taraco, during its pre-Pukara occupation (16%) (Burger et al. 2000:311-312).

a predominance of Alca obsidian demonstrates a stronger link between the polity and the nearby Cuzco region.

Late Formative mortuary contexts at Chiripa contained exotic burial goods, including marine shell, lapis, copper objects, gold plaques (Bennett 1936). At the Huajje site (near Puno Bay), Qaluyu and Pukara-period occupants practiced small-scale silver smelting, likely for status item manufacture (Schultze et al. 2009). Presumably, items of personal adornment also served owners in life as status items. Trade of organic items (e.g., textiles, coca, hallucinogens, and foodstuffs) remained significant[36].

A trickle of Pukara ceramics, textiles, iconography, and stelae define more distant exchange links with foreign elites. Stelae bearing Pukara iconography are recorded within the Cuzco-adjacent Chumbivilcas Province (Chávez 1988). Pukara motifs also occur at some Northern Chile sites. Pukara ritual incised, polychrome ceramics occur as exotics within sites of the Apurimac and Vilaconota Valleys (near Cuzco) and the Arequipa Valley (Klarich 2005a:69-71). They occur as rare imports along with Nasca ceramics in Moquegua Valley elite cemetery contexts (Goldstein 2000). Pukara motifs are present on a wool bag and hat recovered as grave goods at Azapa 70; at Patillos they appear on a wool bag and a hallucinogen snuff tablet (Mujica 1987:289). Overall, their recovery as burial goods indicates their prestige good role marking local elite status.

In contrast, non-local ceramics at Pukara were recovered from suprahousehold food consumption contexts. Caravan exchange relations linked Pukara elites with Cuzco, the Bolivian lowlands and other Titicaca Basin polities (Klarich 2005a:253-255). As

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[36] Plourde (2006:394) notes the prominence of feline imagery on Pukara ritual ceramics, textiles, and sculptures. Such depictions indicate the ideological and status value of lowland cats and their pelts (e.g., Feline Man, described in Chávez 1992).

probable serving vessels, these prestige items would signal to host participants the hosting corporate group's access to distant resources and extra-group social networks.

Conflict

Political and economic integration came with an attendant increase in violence. Direct evidence exists in the form of localized destruction events and sacrificial offerings. A recent study contends that Pukara raided the Taraco site, destroying an elite domestic compound in a site-wide burning event (AD 50 – 240 cal. AD) (Stanish and Levine 2011). Household activities were radically transformed by the event. Relative to its predecessor, the post-burn household shows a marked status decrease (based on frequency of decorated ceramics and obsidian) and coincident greater emphasis on agricultural work[37]. In effect, the rise of the Pukara Polity corresponds with the subjugation and absorption of the rival center. Warfare serves as one means to resolve factional competition amongst ranked societies (Milner 1999; Brumfiel and Fox 1994).

Sacrificial offerings appear both in Pukara iconography and archaeological deposits. Late Formative Pukara ceramics, stelae, and textiles often depict decapitation and trophy head-taking (Chávez 1988; Conklin 1986; Stanish 2003:161-162, 282). We previously noted Kidder's discovery of a vast cache of human crania fragments and mandibles at Pukara. On a smaller scale, sacrificial offerings are often found incorporated into sunken court and ritual contexts from the Middle Formative onward (Carbajal Salazar 2010; Cohen 2010). Andean ethnographic accounts describe possible goals of trophy head-taking and curation: 1) to transform the embodied spirit into fertility

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[37] This raid may explain the aforementioned Late Formative reversal in control of caravan trade routes between the North Basin and distant Arequipa (for Alca obsidian) – with Pukara becoming the beneficiary.

for the taker's lineage and 2) a desire to control vital rainfall (Arnold and Hastorf 2008:220-224). Both intergroup aggressive transformations of the "foreign" dead (trophy head-taking) and intragroup ancestor veneration coexist as Late Formative ideology and practice. One thing is clear, however: violent conflict was a component of Late Formative ideology and everyday life.

Collapse

Sometime around 300 AD, the Pukara polity – with its expansive territorial control and integrated subsistence and political economies – disintegrated. A substantial drought, beginning around AD 100, is thought to have undercut the feasibility of raised field agriculture in the North (Stanish 2003:157). Populations dispersed to fall back on camelid pastoralism as Pukara elite political economy became unsustainable. In the South, Tiwananku subsequently developed into an archaic state between AD 400 and 1100 (Stanish 2003). It later incorporated the entire Lake Titicaca Basin and established enclaves outside the Basin in the Moquegua Valley (Goldstein 1989; Kolata 1993). Nonetheless, a Pukara-derived, North Basin polity known as Huaña (AD 600-1000) coexisted and interacted with nearby Tiwanaku enclaves.

Research in the Pukara River Valley

The present study investigates fauna from two Pukara Valley Formative sites, Pukara and Huatacoa. Below I present an overview of each site's overall layout, while highlighting the location of prior excavation work. I then return to specific provenience units, stratigraphy, and features to provide supplementary details regarding their contextual interpretation.

Pukara

The Pukara archaeological complex, situated at an elevation of 3900 meters (roughly 12800 feet), is located about 80 km northwest of Lake Titicaca along the Puno-La Raya Pass-Cusco highway and Río Pukara. The Colonial and modern town of Pucará is built over part of the site, though a majority of the ceremonial core falls within land serving as agricultural fields and grazing pasture. Occupational debris also spread across a town-adjacent river meander. Present conservative estimates have the Late Formative site area at two square kilometers (200 hectares) (Klarich 2005a: Figure 8; Stanish 2003).

Alfred Kidder II undertook the earliest, largest-scale archaeological excavations at Pukara in 1939 (Kidder 1939). Investigation focused on six locations, labeled Areas I-VI (Figure 3.2). The riverbank periphery had four pit features (Area I) and large, dense riverbank midden deposits of ash, animal bone, and ceramic sherds (Areas I-II) (Chávez 1992:51-58). Area III revealed a small rectangular, adobe house with associated domestic midden and raised hearth. Kidder discontinued study of the riverbank following a wall collapse that injured three excavators.

Area IV is situated within the ceremonial core below the Peñon, a striking pinkish-red sandstone outcrop, and the Qalasaya terrace architecture (Figure 3.2). The Area IV excavation revealed a large, square enclosure. It surrounded a rectangular platform; situated at the platform's south end was a low mound (Chavez 1992:63)[38]. Other discovered features include a three-meter-long baked clay hearth, a cist burial (of a male adult and infant), drainage canals, and domestic refuse. The complexity of the

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[38] About 75 cm below the mound's surface, a fallen, uncarved monolith (*huanca*) was found along the northeast corner interior wall. A cache of 100 human mandibles and crania fragments underlay the slab (Chávez 1992:64; Kidder 1940:343). This dedicatory offering compares to one from Akapana East residential area at Tiwanaku, associated with a ritual enclosure (2010: 291-292).

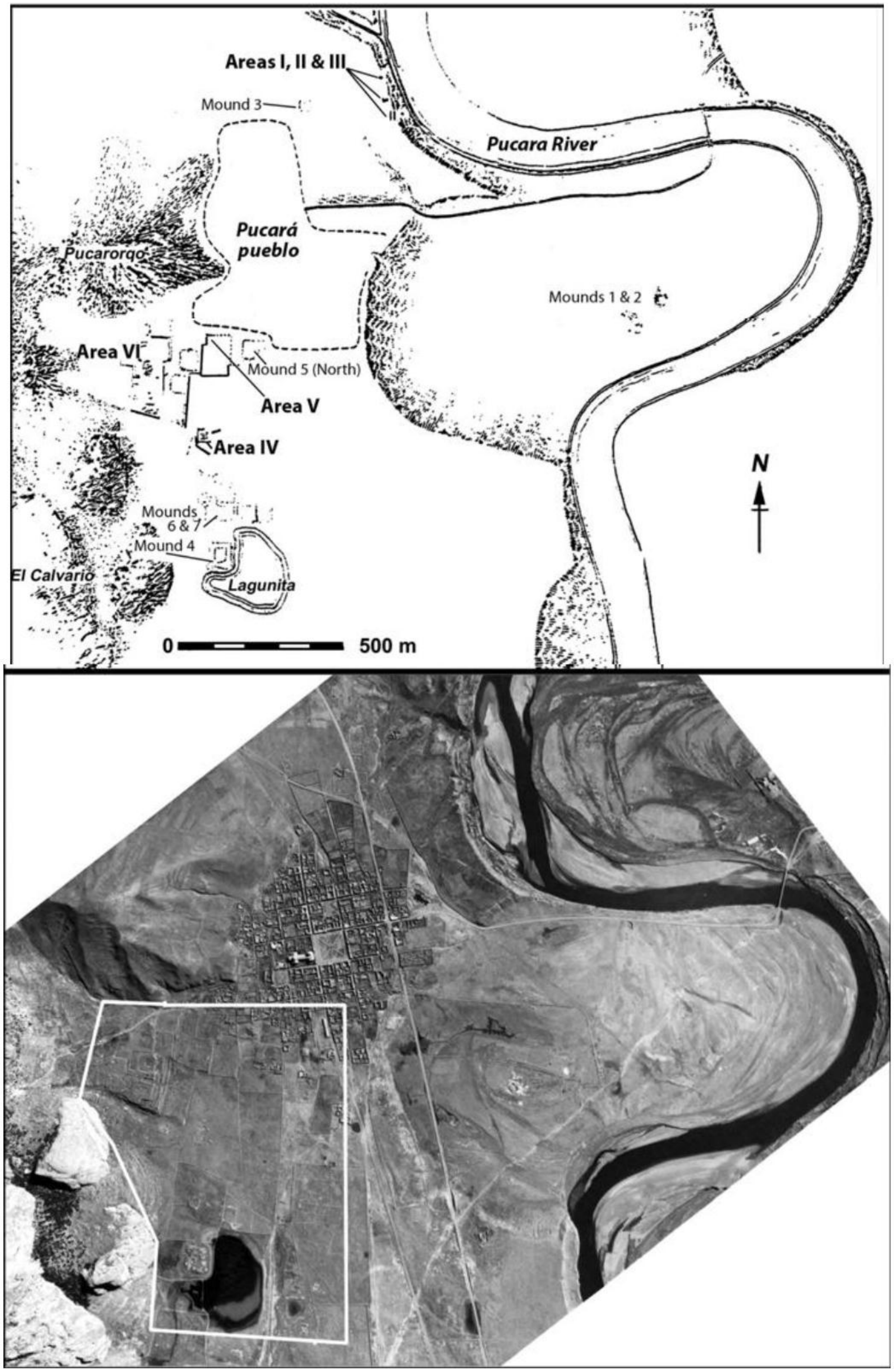

Figure 3.2: Kidder's Pukara Sketch Map and Aerial Photo (adapted from Klarich 2005a: Figure 4)

Note: The white outline demarcates the approximate boundaries of the site's ceremonial core

enclosure, its features, and stratigraphy foreshadow the multifaceted nature of contexts discovered in recent excavations across the pampa grassland (Klarich 2005a).

Areas V and VI are respectively found on the lower and final terrace of the Qalasaya complex. Area V was a large enclosure (73 x 65 m) (Chávez 1992). Kidder argued it held the largest sunken court at Pukara, yet limited excavation failed to truly confirm this hypothesis (Klarich 2005a). Excavation of the central of three sunken courts (Area VI, Court BB) documented a square, semi-subterranean temple, whose walls are constructed of worked sandstone slabs (Mohr-Chávez 1988; Figure 3.4). Nine rooms (labeled A to I) surround the sunken court itself in a U-shaped configuration; each room contained intricate subdivisions and niches. Each sunken court wall had slab-covered burial chambers: 1) north: probable male adult; 2) east: one adult; 3) south: two male adults and 4) west wall: two adults (one male, one probable male) (Chávez 1992).

Figure 3.3: Peñon and Qalasaya (July 2008)

<u>Note</u>: Southwest view from Pampa grassland near Kidder's Area V (Photo by author)

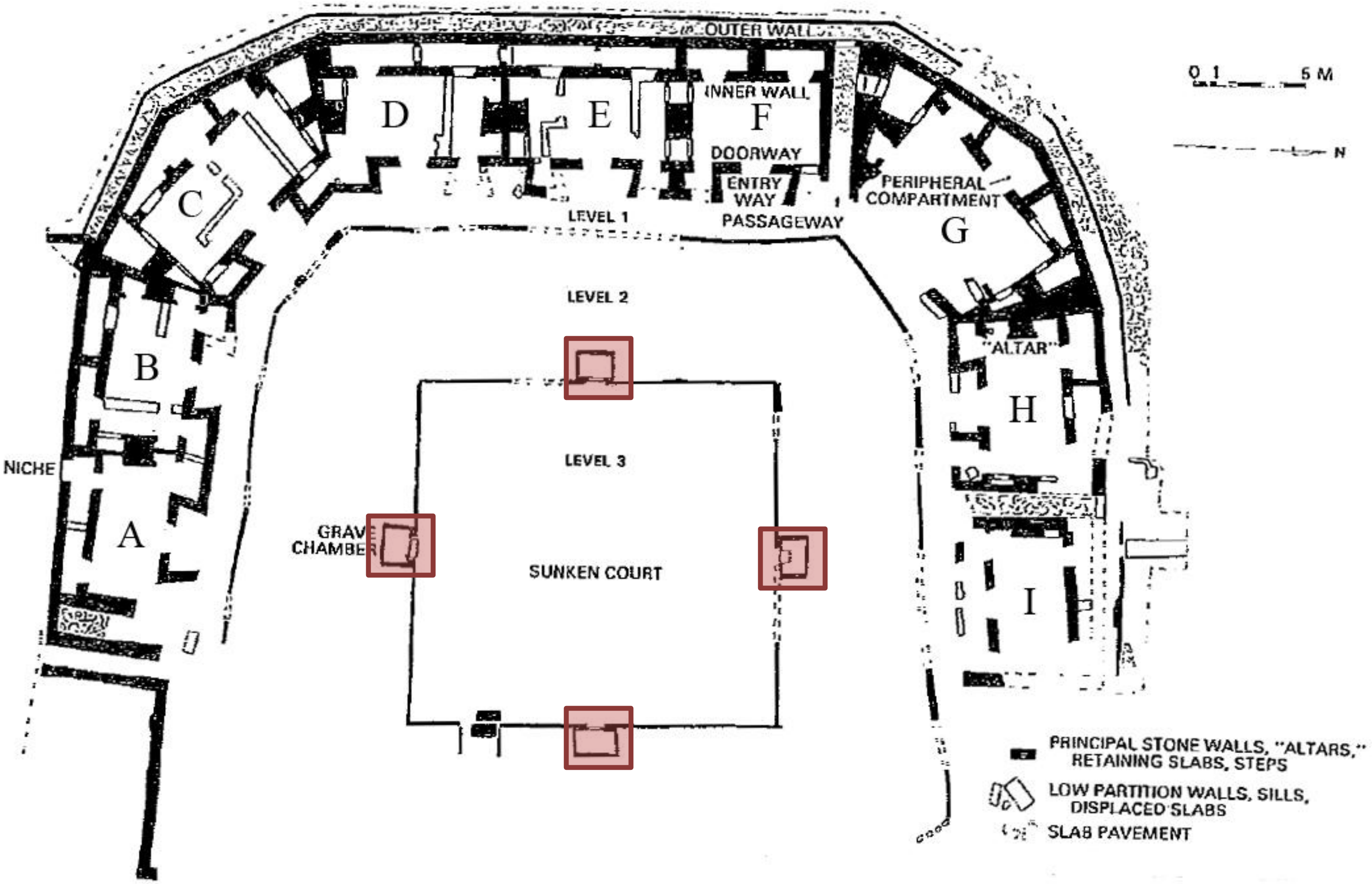

Figure 3.4: Kidder's Map of the Central Sunken Court at Pukara (Court BB) (adapted from Mohr-Chávez 1988:Figure 9).
Note Several patio niches(A-I) each display different interior layout and subdivisions. Red squared mark location of probable elite burials.

Kidder identified seven additional mounds on the pampa around the site core and the modern town (Chávez 1992:49). Kidder cut a trench into the Lagunita Mound (Mound 4), though he never published this excavation (Klarich 2005a). Later looting and gathering of cut stones modified the trench and mound (Flores Blanco 2009).

The Plan Copesco project conducted excavations from 1975-1980, with support from UNESCO (the United Nations Educational, Scientific, and Cultural Organization), the Peruvian *Instituto Nacional de Cultura* (INC), and Organization of American States (OAS). These excavations documented the Qalasaya construction, have refined our understanding of the site's occupational sequence and ceramic chronology, and have reconstructed portions of the Qalasaya itself.

Test excavations of the Qalasaya terraces and central sunken court documented Middle Formative (Qaluyu) occupation, a five-level, stepped pyramid (terrace architecture) that predates construction of the Late Formative Qalasaya, and construction of the Qalasaya terraces[39]. A rectangular structure was found adjacent to the first step of this early pyramid. Two anthropomorphic sculptures – a standing man and a decapitated trophy head decorated with red, black, yellow and white paint – were sealed into wall niches filled with clay and accompanied by burnt offerings (cf. Lynch 1981:204; Wheeler and Mujica 1981:26-29, 40). This structure and the stepped pyramid foreshadow the successive, Late Formative Qalasaya terrace and sunken court complex.

In 2000, Elizabeth Klarich began the Pukara Archaeological Project, focusing on the pampa near Kidder's Area IV (2005). Systematic surface and geophysical survey (via

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[39] Chapter 5 presents results of Wheeler's faunal analysis of the central sunken court (Court BB).

ground-penetrating radar and magnetometer) were conducted. Three geophysical anomalies were selected for investigation via excavation (Figure 3.5)[40]. Initial Late Formative occupations indicate large-scale food production present in open, undifferentiated space. Later occupations show architectural division of space for specialized ritual, ceramic production and domestic activities. Appendix A.1 provides a list of analyzed proveniences from the 2001 Pukara excavations.

Block 1

Block 1 excavations to expose Formative deposits consisted of a 5 by 5 m unit and one 1 by 2 m eastern unit extension. Occupations are split into Initial, Middle, and Final Late Formative strata based on radiocarbon dates and fill episode breaks. A Middle Late Formative wall (ASD6) divided the block into West and East halves.

The Initial occupation of Block 1 East included six superimposed midden deposits, containing dense ash, animal bone, and ceramics, laid onto sterile ground (Features 16, 22-25, and 27), spread across an eastward slope surface (Figure 3.6). Rapid accumulation of bone and ceramics, through nearby food preparation and kitchen waste disposal, is indicated. Meanwhile, the relative cleanliness (i.e. lower bone and artifact density) of the corresponding Block 1 West (B1W) contexts – occupation zone 5, a small hearth, and shallow midden – stands out in comparison. Periodic sweeping of trash onto the eastern slope might account for this difference.

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[40] Hereafter these excavations are referred to as Block 1, 2, and 3. Descriptions of excavation blocks derive from Klarich (2005). Soil was coarse-mesh screened and feature soil samples were collected for flotation.

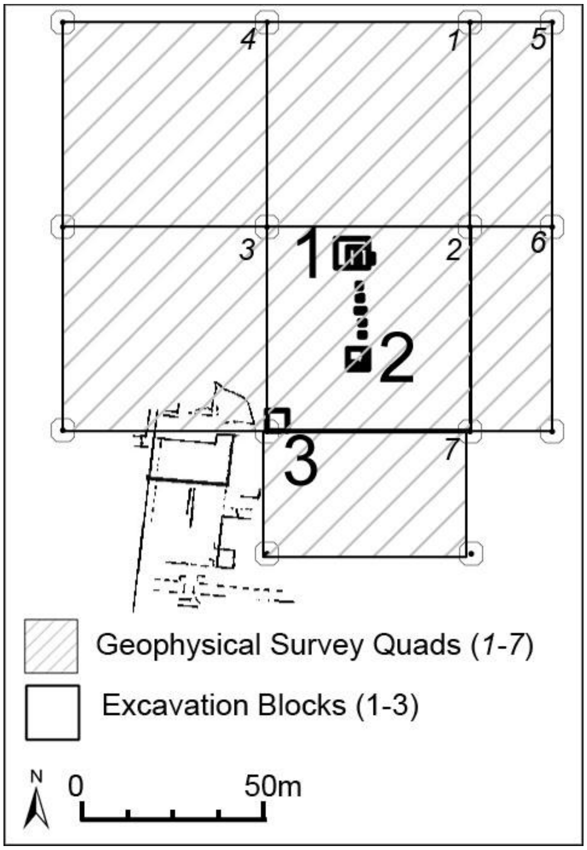

Figure 3.5: Location of Klarich 2001 Excavation and Geophysical Survey Units

Note: Kidder's Area IV architecture is directly southwest of Block 3.

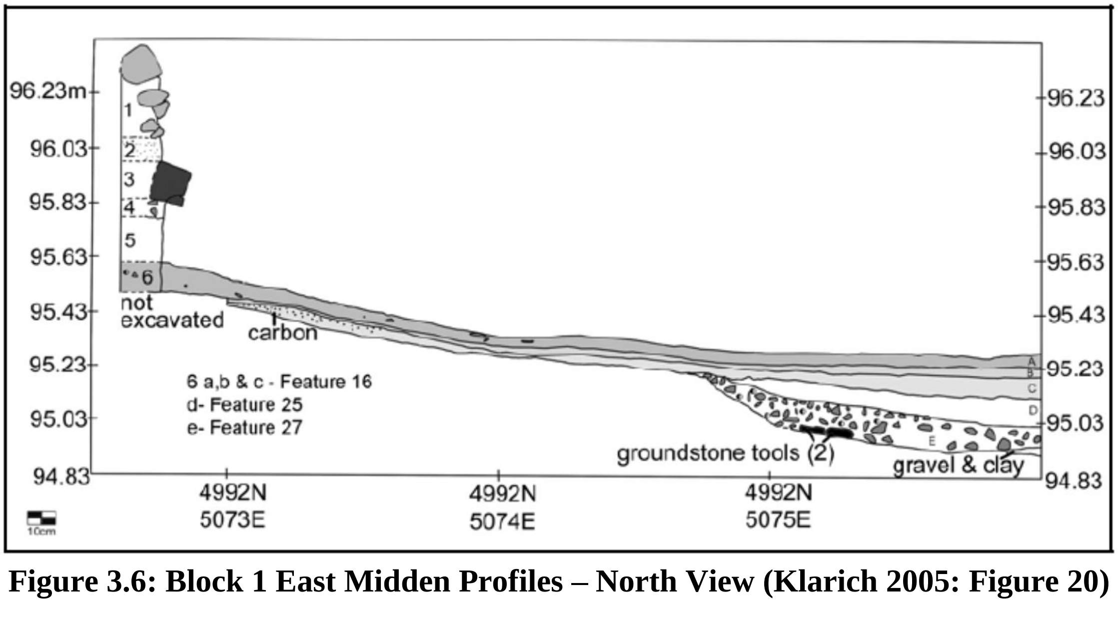

Figure 3.6: Block 1 East Midden Profiles – North View (Klarich 2005: Figure 20)

The Middle B1W occupation consisted primarily of Occupation Zone 4. Cut downward into this zone were two probable hearth features, Feature 26 and 21. Lithic processing is suggested by a single cluster of white chert and obsidian flakes adjacent to these features.

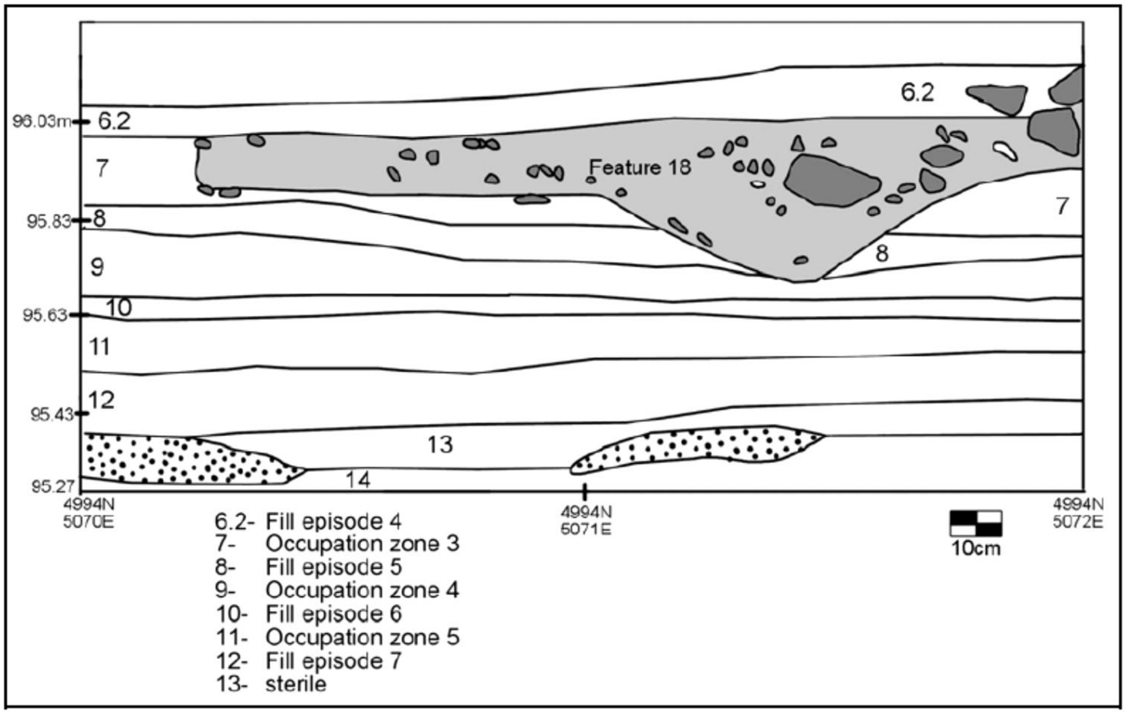

Figure 3.7: Block 1 West – North Profile Segment (Klarich 2005a: Figure 21)

The Final B1W stratum consisted of occupation zone 3, which had bone and ceramic scatters present throughout. Feature 18 was a large, dense primary bone midden deposit notable in profile (Figure 3.7). Feature 19 contained two groundstone handstones and a broken half of a stone bowl. The final Feature 20 had a deposit of burnt bone and ceramics. Yet, unlike the Initial stratum, bone was relatively less common.

Block 2

The Block 2 excavation consisted of a single 5 by 5 m test unit. Work exposed Initial, Middle and Final Late Formative strata and features[41].

The excavated Initial Late Formative stratum consisted of Occupation Zone 2 (OZ2). Klarich (2005:150-159) characterizes it as a series of superimposed use surfaces, some defined by association with features, *in-situ* artifact clusters, and a wall segment (ASD12). Further excavation exposed a use surface below OZ2 with intact features, in-situ artifacts, and activity areas, Occupation Surface 2 (Figure 3.8). Two ashy hearths, Features 29 and 30, were found along with the Southwest Corner midden, a concentration of dense animal bone (burnt and unburned bone) and unslipped ceramics.

The Middle Formative occupation consisted solely of Occupation Zone 1. Precise interpretation of this occupation is difficult. Klarich noted both areas of horizontally-oriented artifacts and lenses of jumbled midden deposits. She speculated that clay concentrations may indicate remnants of successive use surfaces.

The Final Late Formative occupation had an occupation surface, wall segments, and several features. Occupation Surface 1 (OS1) was reddish clay, pebbly floor (Figure 3.9). Wall segments (ASD13, ASD14, ASD15, and the aforementioned ASD12) demarcated two distinct spaces: a periodically cleaned interior space (the southwest corner) relative to an exterior activity- and refuse-rich space (Figure 3.9). Several features were present near a doorway along ASD12. Features 7 and 9 were small pit

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[41] Time restraints prevented excavation of the entirety of the unit to sterile soil. Accordingly, additional dense deposits of animal bone and artifacts and features likely remain preserved in-situ for the Initial Late Formative stratum.

features, while Feature 28 was a small adjacent hearth. The exterior area appears to have hosted ritual practices given recovery of fragments of at least four feline-form ritual *incensarios*. In sum, the Final occupation stratum presents more formal, spatially differentiated space and activities than Initial Late Formative one in Block 2.

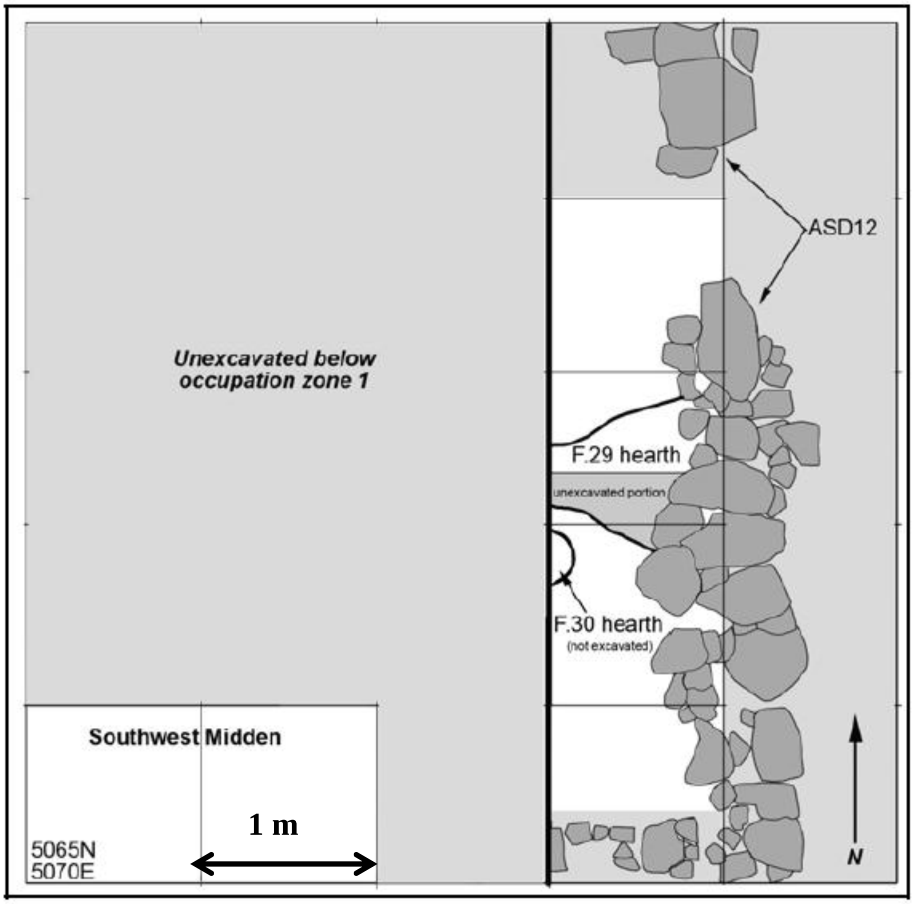

Figure 3.8: Block 2: Initial Formative Plan (Klarich 2005: Figure 33)

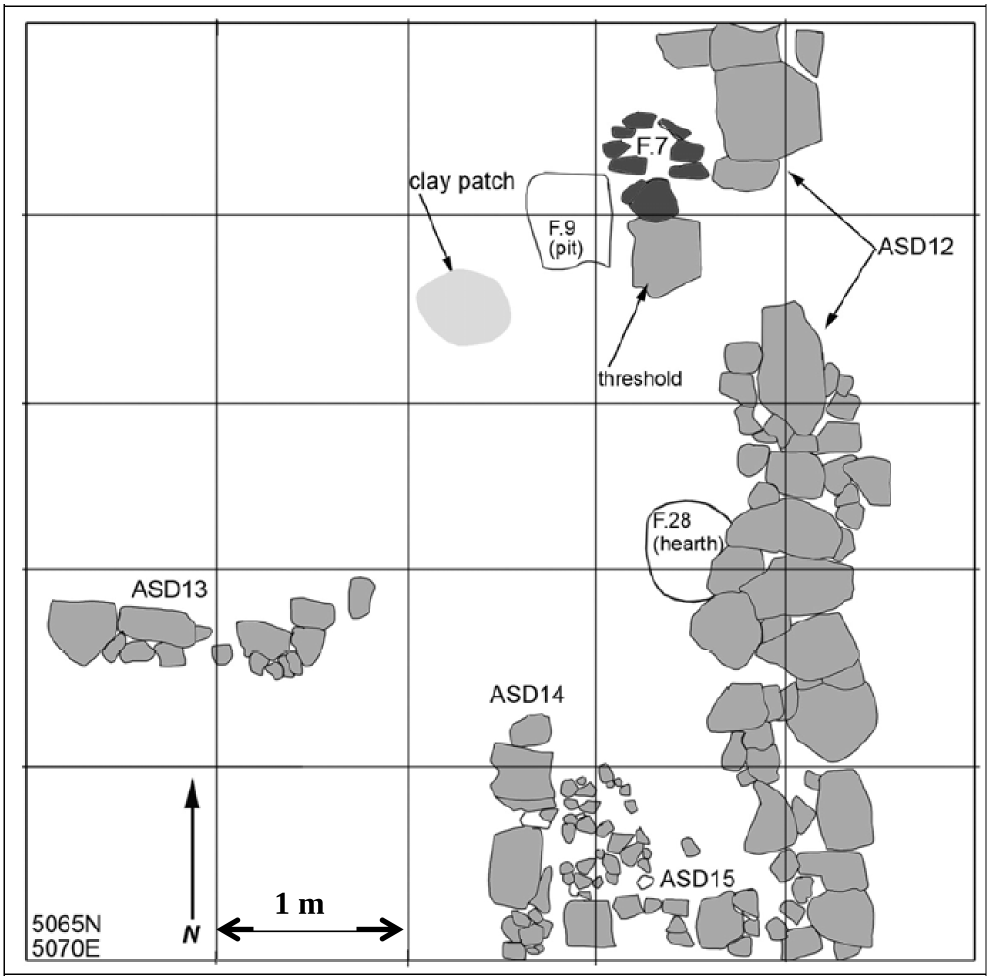

Figure 3.9: Block 2 Final Formative Plan (Klarich 2005a: Figure 29)

Block 3

In contrast to earlier units, Block 3 had only Initial and Final Late Formative occupations. Occupation Surface 2 (OS2), a slightly sloping use surface, served as the foundation of Initial Late Formative activity areas and features. Short, discontinuous wall segments (ASD8, ASD11, and ASD10) separated two activity areas from each other: 1) cooking activities (Feature 6, 13, 14, 15 and pot rest) and 2) a dense primary toss zone of animal bone and ceramic refuse (Feature 17) and the Northwest Corner Midden (lenses 3-5) and North midden (lenses 1-2) (Figure 3.10).

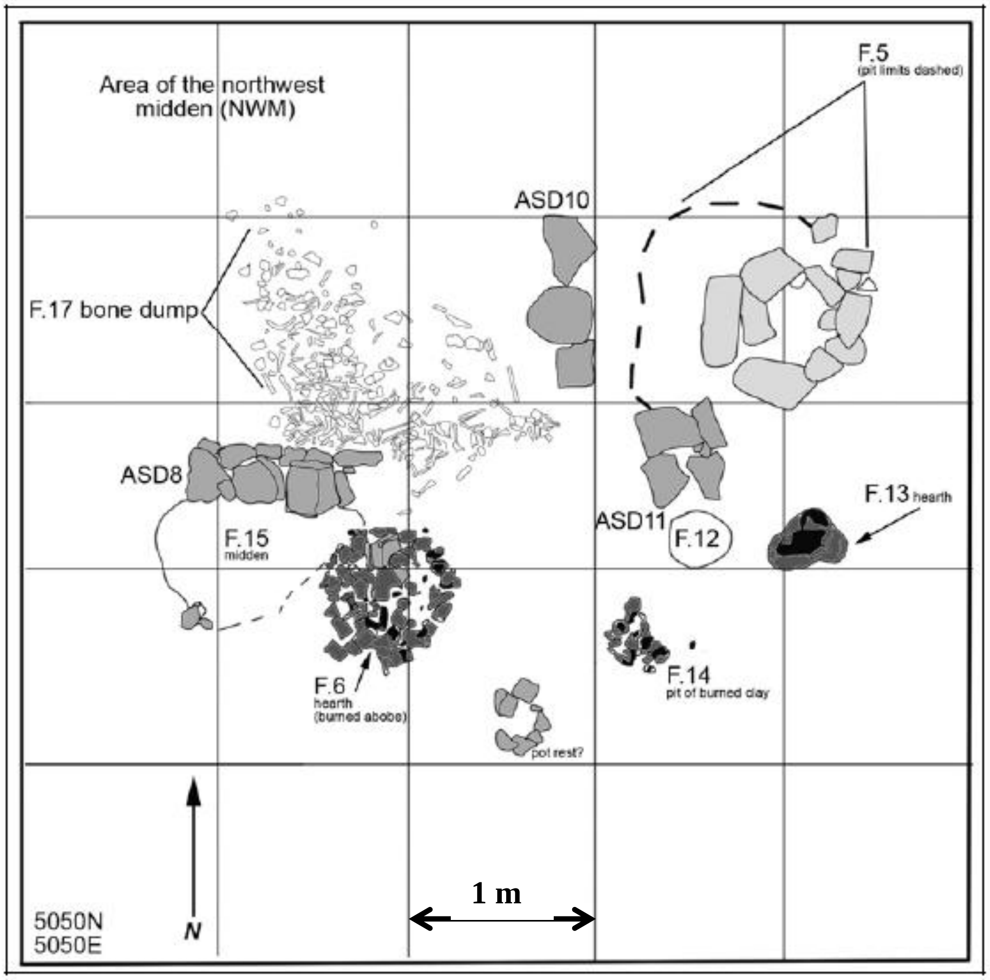

Figure 3.10: Block 3 Initial Formative Plan (Klarich 2005:Figure 37)

Two forms of hearths are present (Feature 6 and the smaller 13). Feature 6 was a straight-walled pit filled at its base with fuel; burnt clay chunks, carbonized materials, stones and soil overlaid the carbonized fuel. The debris and structure compares favorably to a traditional *watiya* roasting pit. Directly adjacent, Feature 15 was a mixed midden, containing ceramics, carbonized material, lithics, bones, burnt clay chunks. Klarich interprets it as refuse generated by cleaning out the Feature 6 Hearth. Feature 13, a smaller pit hearth and Feature 14, a small pit, both had burnt clay and ash. Feature 17 was primarily a deposit of unburned bone, in stark contrast to bone in and associated with the hearth contexts. Additional bone waste was evident in the nearby North and Northwest middens. Two additional features intrude downward onto OS2 from the Final Late Formative stratum above: Feature 12 and Feature 5. They are discussed below.

As seen in Block 2, the Final Late Formative stratum in Block 3 suggests more spatially distinct activity areas. Most of the "floor" was defined as Occupation Zone 1 (OZ1), while smaller areas with preserved, compact patches of intact floor were treated as Occupation Surface 1. A short wall segment roughly separated a primary toss zone, the Northwest midden (lenses 1-2), from a "tidier" adjoining ceramic production area (southeastern portion of the unit) (Figure 3.11). Respectively, pit features 8 and 11 contained unfired and fired clay deposits. Likewise, a thin patch of yellowish clay, Feature 10, may represent pooled "waste" resulting from vessel slipping. Various nearby groundstone tools are associated with early-stage ceramic processing.

Assigning function is more enigmatic for two other features. Feature 12 is described as a multi-use pit. It first served as a hearth and later as a storage or refuse pit. Finally, a large pit filled with rock, Feature 5, had no clear function. It began as a mound of rocks and terminated within the Initial Late Formative stratum. Artifacts were sparse, though part of a burned beam was found and radiocarbon dated (Table 3.3).

Recent Fieldwork at Pukara

On-going investigations of the site by Klarich continued following the 2001 field season. Klarich (2009) used GPS / GIS technology to complete a site-wide survey and mapping project in 2006. This study provided pilot data for a 2009 project that tested three site zones: 1) Kidder's Enclosure 4 (Area V), 2) the Lagunita Mound and 3) the

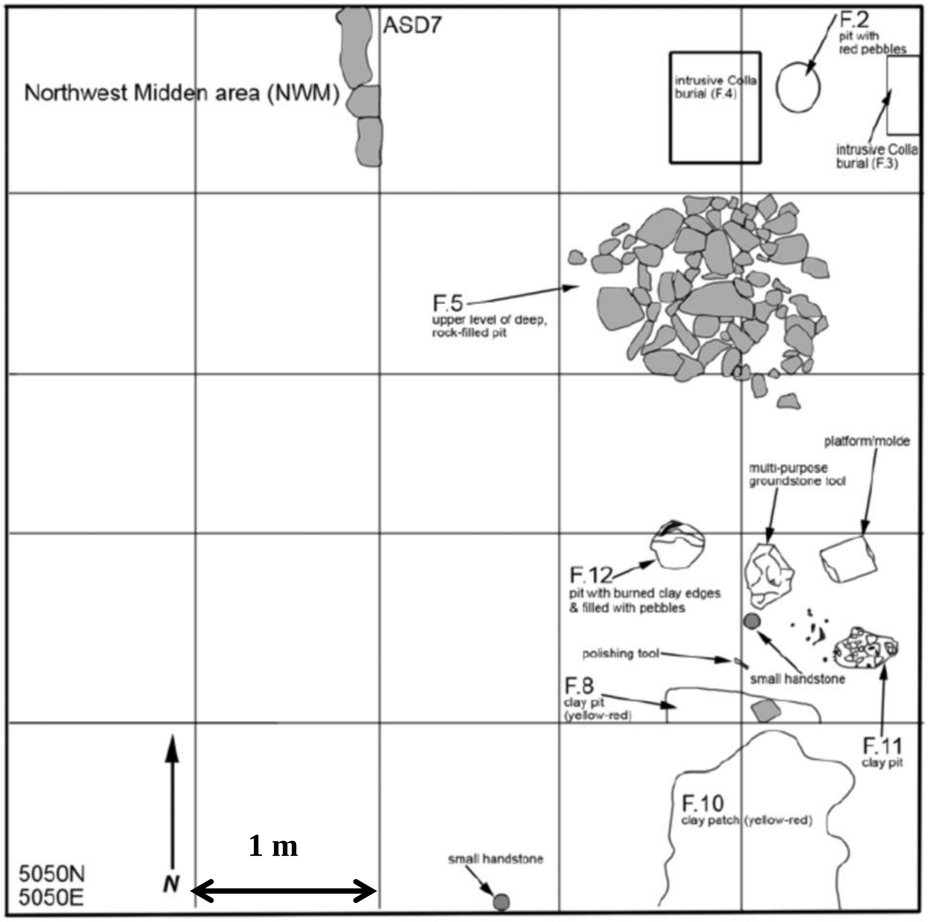

Figure 3.11: Block 3 Final Formative Plan (Klarich 2005a: Figure 36)

site's periphery along the Pukara riverbank. The aim of the project was to further test economic, social, and political models of growth of Pukara as a regional power and gather data about the relative chronology of construction and use of these site sectors (Flores Blanco 2009, Flores Blanco and Klarich 2009)[42]. In 2009 and 2010, project personnel conducted 5 additional test excavations within Enclosure 4, processed soil samples from both seasons, and completed lithic and ceramic analyses (Carabajal Salazar 2010; Klarich and Flores Blanco 2010).

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[42] I had the pleasure to work as a project assistant during the 2009 field season, supervising University of California, Los Angeles field school students in excavations in Zone 2 and 3. I also assisted in the recovery and identification of the camelid offering associated with Zone 2's monolith.

Table 3.4: Radiocarbon Dates from 2001 Pukara Excavation Contexts

Context	Lab ID	Occupation	C-14 Years BP	Calibrated Age (2 sigma)
Bl. 1 F-16, midden	AA57009	Initial	2049±42	180 BC – AD 60
Bl. 1 F-27, midden	AA51772	Initial	2001±37	100 BC – AD 90
Bl. 1 F-21, hearth	AA51767	Middle	2016±33	110 BC – AD 80
Bl. 1 wall construction (same as F-21)	AA57011	Middle	2012±31	100 BC – AD 80
Bl. 2 F-29, hearth	AA51768	Initial	2101±73	260 BC – AD 80 (81.8%) 360-270 BC (13.6%)
Bl. 2 SW midden / OZ2	AA57014	Initial	1981±35	50 BC – AD 90 (92.4%) AD 100-120 (3%)
Bl. 2 OZ1	AA57015	Middle	2072±33	180 BC – AD 10
Bl. 2 OS1	AA51771	Final	1917±33	AD 0-AD 180 (92.5%) AD 190-220 (2.9%)
Bl. 3 F-6, hearth	AA51770	Initial	1889±40	AD 20-240
Bl. 3 F-15, midden	AA57013	Initial	2012±31	100 BC – AD 80
Bl. 3 F-10, clay patch	AA51772	Final	2120±38	240 BC– 40 BC (87.2%) 360-300 BC (8.2%)
Bl. 3 F-11, clay chunk pit	AA57014	Final	1976±31	50 BC – AD 90 (92.9%) AD 100-120 (2.5%)
Bl. 3 F-5, rock pit	AA57011	Final	2024±34	120 BC – AD 70

Note: All samples derive from wood charcoal

To better define the perimeter of Zone 1's Enclosure 4 – an elevated platform (measuring 75 m by 75 m) encircling a central, square depression (40 m by 40 m) – the ground surface was stripped of vegetation. A test excavation, Unit 1, explored the depth, timing, and nature of the platform's central depression, which was hypothesized to be a large sunken court. Excavation, which terminated four meters below the surface, uncovered a series of relatively sterile, multi-colored clay deposits, but no formal floors. Unit 2, located along the west edge of the platform-court transition, uncovered a support wall, possible informal use surfaces, and superimposed clay deposits.

Work in Test Units 3 to 7 revealed details about the diversity of features present and the presence of probable court floors within the central depression. For instance, Unit 3's Feature 5, located near the depression's center, was a secondary burial offering of four human crania and disarticulated postcranial bones. Most significant, diagnostic ceramics analysis indicates a Middle Formative construction date for the platform. This is a much earlier occupation of this location than predicted and appears to predate residential occupations on the site periphery's residential sector (Klarich and Flores Blanco 2010).

Investigations of the Lagunita Mound (Zone 2) focused on profile cleaning of Kidder's 11-meter-long N-S trench and excavation of two other test units. During profile cleaning, a broken monolith was encountered. Discarded because of its imperfections, it was interred as fill. However, the incorporation of the monolith was commemorated by a ritual act. An expedient offering was made, consisting of a partial camelid (see Chapter 5 for more details) and a carved green stone (Klarich personal communication, 2012). The offering simultaneously served to: 1) commemorate the monolith's symbolic weight and the expended labor in its carving and 2) dedicate mound the mound itself. Overall, however, Klarich and Flores Blanco note contexts across the mound appear compromised by looting and disturbances.

Finally, work in Zone 3 included a systematic surface survey followed by excavation of nine test units. Excavations demonstrated subsurface artifacts were scarce and encountered neither features nor architecture. However, the cleaning of a segment of river profile demonstrated again the density of intact midden deposits.

Huatacoa

Designed to characterize Formative settlement patterns in the Pukara River valley, a systematic, total coverage pedestrian survey undertaken between 1998 and 1999 recorded 15 Early and Late Qaluyu sites (Cohen 2001). Six of these sites were abandoned by the Late Formative, as population aggregated in the Pukara center. The Huatacoa site (PC13), which boasts Early through Late Formative occupations, was among the discovered sites.

Huatacoa is located on a low mound four kilometers northeast and across the Pukara River from the primate center of Pukara and the modern town of Pucara. The discovery of a roughly three hectare scatter of Middle Formative ceramics and a sunken depression led to its excavation for Cohen's dissertation project (2010) (Figure 3.12)[43].

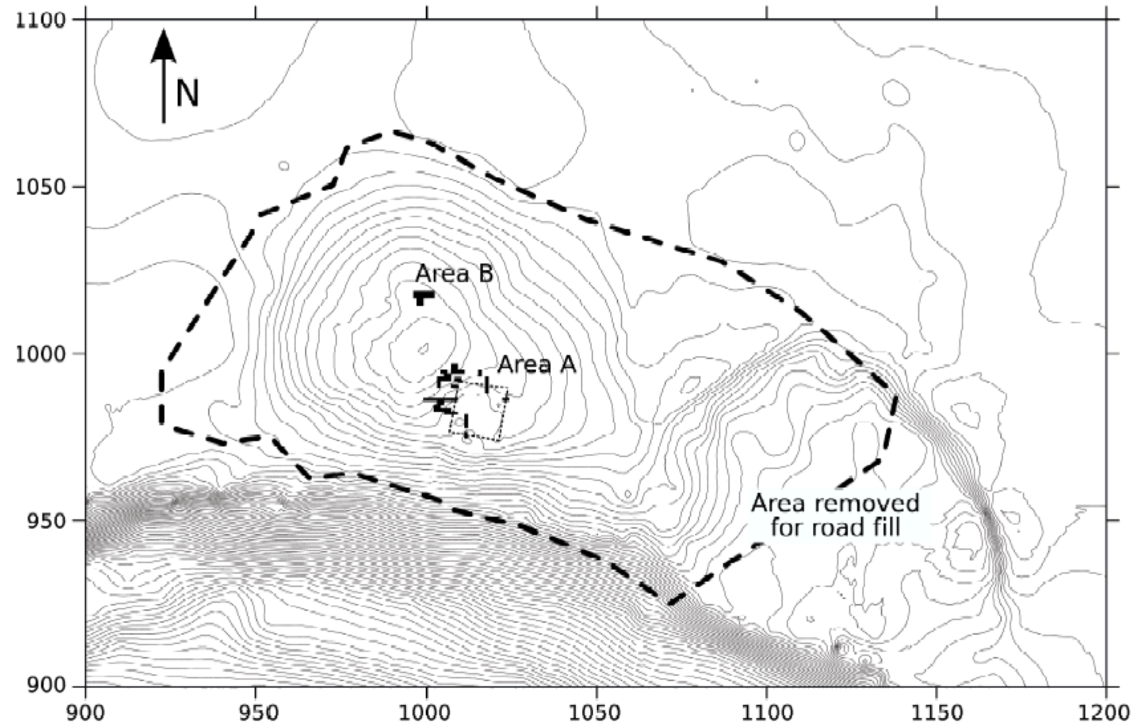

Figure 3.12: Huatacoa Topographic Map (Cohen 2010:Figure 5.1)
Note: Black dashed line denotes the extents of the Middle Formative ceramic scatter. The smaller rectangular, dashed area marks the location and dimensions of the final Pukara sunken court.

Excavation at the site focused on two areas: on a sunken court and ritual complex (Area A) and domestic occupation area (Area B). First, excavation in the Area A

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[43] Unless otherwise noted, the following description of Huatacoa derives from the dissertation.

complex started with 1 x 4 meter unit to define the potential walls of a sunken court. In total, as additional units were dug, a complex stratigraphy and a construction sequence of four different sunken courts and emerged. Second, work in Area B began with a 2 x 2 meter unit. Two additional 2 x 2 meter units extended excavations to the east and south to document an Early Qaluyu domestic structure.

Harris matrices were constructed for each area; contexts were recorded as cultural events, described as a list of cultural context codes (Cohen 2010: Appendix B.4.1). Artifact and animal bone was recovered via 1/4” dry screen and flotation. Contexts from the domestic area are considered first below.

Area B

An Early Qaluyu pithouse was partly exposed at the base of excavations in Area B (Cohen 2010:116). Given the limited nature of excavations conducted on the pithouse, a single associated hearth (event B74) was found. The pithouse floor filled with ashy midden deposits (B66, B69, 72, and B73) during the structure’s use or after its abandonment (see Appendix A:Figure A.1-2; Table A.4).

A subsequent rectangular, adobe-walled Early Qaluyu house was constructed on a prepared clay surface foundation (B57) and preceding ashy midden layers (B58, B59) (Figure 3.13). Chenopodium seeds from the first interior floor date (2σ) the structure’s construction to 1450-1300 cal. BC (Cohen 2010: Appendix B.4.3). The second floor (B55) produced in-situ artifacts (B54), including two bone tools, a broken olla, and grinding stone caked with red pigment, covered by an ash deposit (B53) and small pit feature (B61). Primary midden deposits (B50), found outside of the house, contained ash, animal bone, Early Qaluyu ceramics, and a body sherd from an exotic decorated South Peruvian Coast vessel (Cohen 2010:123-126)[44].

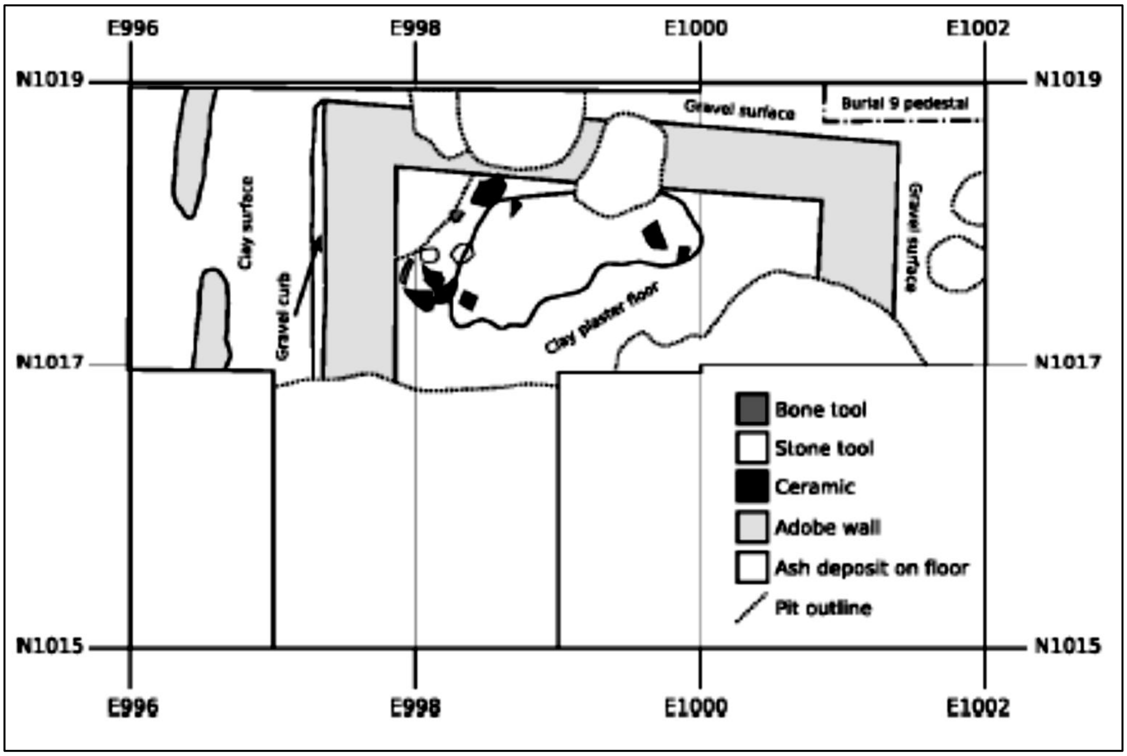

Figure 3.13: Plan of Early Qaluyu Adobe House (Cohen 2010:Figure 5.7)

During the terminal use of the structure two pits were dug outside the structure: a round midden deposit filled one (Feature 52) and an infant burial the other (Feature 51). Finally, portions of the structure were burned. Feature 37, a shallow burned depression (B46), may represent a closing ritual offering or hearth.

Later Early Qaluyu middens and features filled the former domestic area. Of note, several middens (B18, B19) filled and covered the house interior and contained assorted garbage: burnt adobe, ash, ceramics, animal bone and tools, and lithics. Of particular interest was a zig-zag carved bone spoon handle (Figure 3.14). Similar handle

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[44] Within the foundation midden (B 58, B59), fragments of a similar non-local ceramic bottle vessel and carved bone spoon were also encountered.

fragments were recovered from the Early Qaluyu house floor midden, Huatacoa's sunken court and corporate terrace architecture at Cachichupa, in the north-central Titicaca Basin (Plourde 2006). A single contemporaneous pit midden was cut into these midden layers, Feature 25.

Figure 3.14: Bone Spoon Handle - Early Qaluyu, Post-Abandonment House Midden (B18)

Subsequent Late Qaluyu and Pukara middens are present. Late Qaluyu deposits (B17) produced burnt adobe fragments, ceramics, animal bone and tools and lithics. Probable Pukara midden deposits (B15 and B10) contain comparable artifacts and ecofacts. Feature 22 is the lone, large stratified pit cut into B15. In ascending order, it consists of dense bone and artifact midden (B14), a low-density midden (B13), and closing high density midden.

<u>Area A</u>

In a basic sense, contexts within the ritual complex boil down to a five phase architectural chronology: 1) an open plaza (Early Qaluyu), 2) an Early Qaluyu sunken court, 3) the first Late Qaluyu court, 4) the second Late Qaluyu court, and 5) a Pukara sunken court and its abandonment (Appendix A:Figure A.3-A.4; Table A.4). At present, I exclude from analysis fill that accumulated in the final court. The admixture of Qaluyu and Pukara ceramics combined with the lack of associated radiocarbon sequence makes assigning timing and cultural affiliation of its activities difficult.

Portions of the earliest Early Qaluyu use of Area A, the Open Plaza, preserved where construction of the Early Qaluyu court did not destroy it. Cohen recorded evidence of an *in-situ* burning event and lithic scatter (A46). A radiocarbon assay from A46 returned a date of 1390-1130 cal. B.C. (2σ) (Appendix A Table A.5; Cohen 2010:148). An occupation zone (A45) overlays the plaza and contains mixed occupational refuse. A midden deposit accumulated during the use of the plaza (A80) was located to the west.

Early Qaluyu Court

Limited excavations revealed the trapezoidal shape, construction and relative size of the Early Qaluyu sunken court. The court's floor (A53) showed evidence of widespread *in-situ* burning. Feature 21, an adjacent pit, was comprised of two ashy midden deposits (A55 and A39) generated by periodic cleaning of the court's floor. Similarly, a patio area (A36) located outside and above the court floor, displayed ash and carbonized material suggesting extensive burning rites.

Late Qaluyu First Court

The first Late Qaluyu was an elaboration of its antecedent. Work revealed the court floor, patio, a prepared SW corner burial chamber (burials 6-7) and a single niche room. Figure 3.15 depicts excavated proveniences and the hypothetical reconstruction of the court. The stylized head-like appendage projecting from the NW and NE platform corners is reminiscent of catfish images (*suche*) found on Yaya-Mama stelae, making the court double as an effigy religious icon (Cohen 2010:171). The sunken court floor itself (A52) was enclosed to the north, west and east, but sat open facing the river to the south (Cohen 2010:159). If correct, the court's decoration and river-facing, open orientation bespeaks a symbolic focus on water and fertility (see Hastorf 2008).

Excavations demonstrated a complex court construction sequence, modifications, and elaborations. Several fill deposits (A29, A33, A34, A35, and A75) provided a level surface for construction of a court platform. Fill events A33 and A75 produced a large sherd sample of diagnostic utilitarian serving vessels, mainly bowls and ollas. An excavated niche structure contained animal bone and dark soil, suggesting *in-situ* decay of organic matter.

Interestingly, much of the sunken court floor was clean, despite repeated ritual burning activities. Associated contexts include a dedicated fire pit (Feature 28), located at the SW corner of the court floor, and two primary middens (events A78 and A73) located outside the court's exterior. The latter (A73) covered the western patio and its adjacent exterior, rather than the court's floor. It is notable as a ritual burning closing rite; greenish ash, charcoal and a large heavily ash-smudged bowl were discovered.

In association with the closing rite was Feature 57 (A186), a cache pit filled with four vessels and construction debris. Two of the vessels were large bowls, flat-based bowls, and one which displayed carbonized residue showing it served as an *incensarío*.

A third round-based bowl displayed a stylized zig-zag rim reminiscent of the design found on the aforementioned carved bone spoon handles. The final vessel indicates interaction with the South Central Coastal region; this non-local, ovoid form features a double-spot and central handle located on the vessel's top.

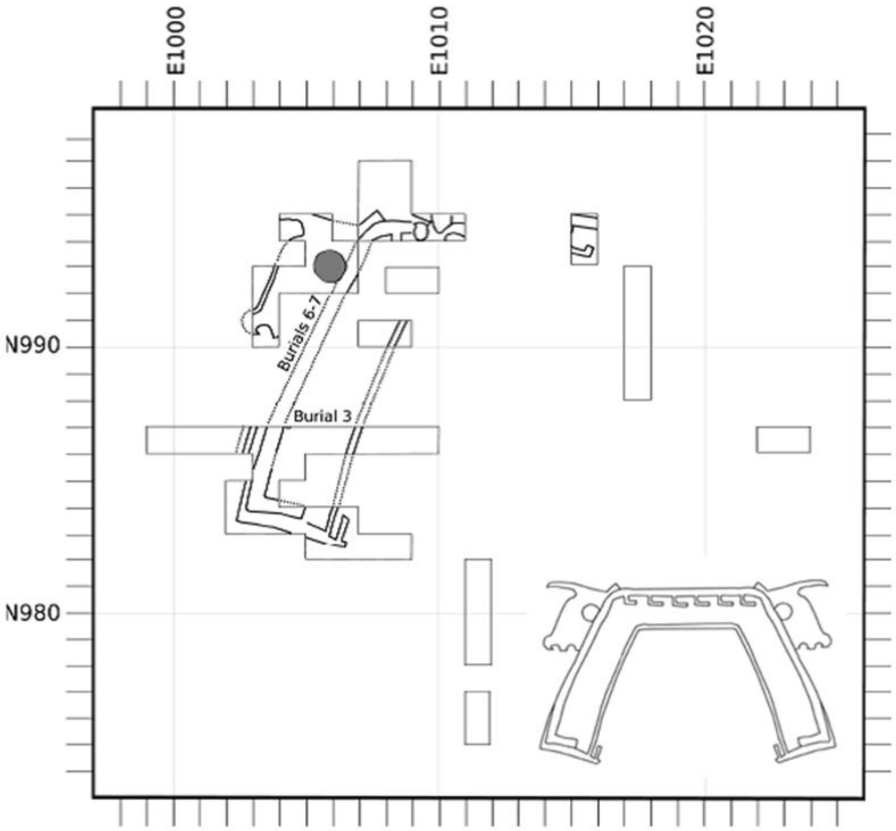

Figure 3.15: Late Qaluyu Court 1 (Adapted from Cohen 2010: Figures 6.1-6.2)

Two burials were interred within the platform. Burial 3 was cut into the patio surface; it represents a potential human offering. In contrast, a mortuary chamber lined with rocks and clay and grass mortar indicates thoughtful care bestowed toward an ancestor. The high-status individual inside (A169, Burial 6) was covered with a crushed, glittery red mineral powder, though otherwise accompanied by few other grave goods. This burial was capped by an offering or "retainer" burial (A170, Burial 7).

Late Qaluyu Second Court

Following the closing rites, the First court was destroyed –its walls were pushed over, burned, and covered with a leveling-fill layer of structural debris (A85). A series of fill deposits (e.g., A 175, A177, and A179-A184) provided a flat foundation surface for the court patio (A18) and court floor (A52) and enlarged the mound's surface. Cohen (2010:190-191) speculates that basket loading of secondary midden fill from around Huatacoa may have generated much of this layer. Figure 3.16 illustrates the layout of contexts associated with the Late Qaluyu Second Court.

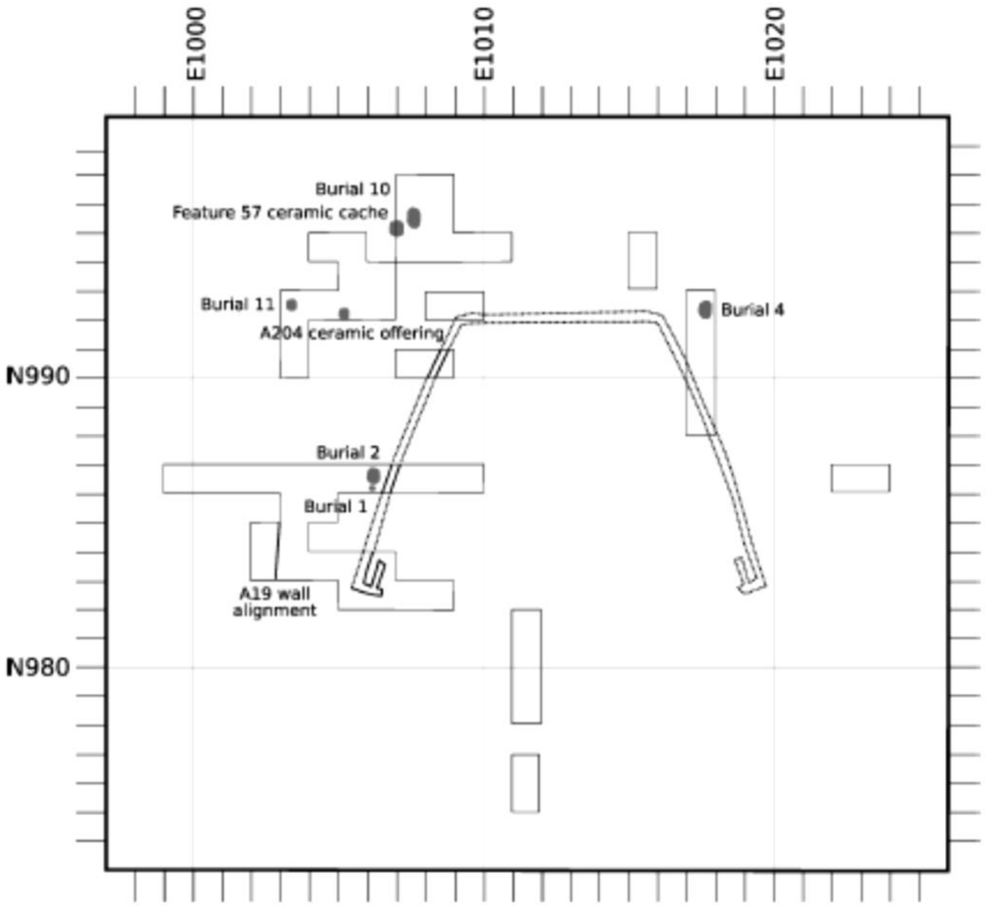

Figure 3.16: Second Late Qaluyu Court (Cohen 2010:Figure 6.18)

Several dedicatory offerings dot the court's perimeter in association with the patio floor's construction. Four human sacrifices, lacking grave goods, were presented as offerings. Prior to the patio's construction, Burial 2 (A21) was interred in a small pit. While poorly preserved, the interred adult appears to have been decapitated. With only two broken obsidian projectile points accompanying the burial, Cohen speculates both were embedded at the time of interment (2010:194). Burial 10 (A174) was laid on a fill layer; its occupant was missing the right lower leg and left foot. Burials 11 and 4 also lacked formal burial pits. A ceramic bowl and olla were offered in an additional pit (A204).

Two features were deposited and created immediately after the patio floor's construction (A18)[45]. Both were mistakenly excavated together, as Feature 1 destroyed part of Feature 6. Feature 6 (A8) is composed of midden fill. Feature 1 (Burial 1) consists of a poorly preserved cranium and mandible – a strong candidate for a trophy head. Its frontal bone is perforated, indicating it was likely suspended by cordage. Yet, it remains possible that the trophy head's interment dates to the Pukara Sunken Court. As noted above, trophy heads are quite common in Pukara iconography.

Pukara Court

The Pukara court was a major break from traditional court layout at Huatacoa – in terms of its position, size, construction technique, alignment, and square shape (Figure 3.16; Appendix A, Figure A.5). Construction is preceded by another destruction event.

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[45] Given patio floor's reuse for the Pukara Court, it remains challenging to disentangle Late Qaluyu from Pukara patio contexts, artifacts, and ecofacts. Being conservative, I analyze only those contexts featuring ceramics diagnostic of one occupation. Additional C-14 dating could disentangle contexts, determine the construction date of both court, and test if Qaluyu and Pukara ceramics were coincident in the latest Middle Formative occupation of Huatacoa.

The Late Qaluyu court was packed with fragments of the A30 internal wall (A51) and secondary or tertiary midden deposits (A40). This matrix served as the foundation surface.

Unlike prior courts, the Pukara court's footprint is shifted slightly southeast. Following excavation to sterile soil (A149), a clay court floor surface was manufactured (A108). Walls (A105) were constructed of a single layer of cobbles mortared together using clay. A midden deposit (A106) filled a slight gap present between the court cut and cobble wall.

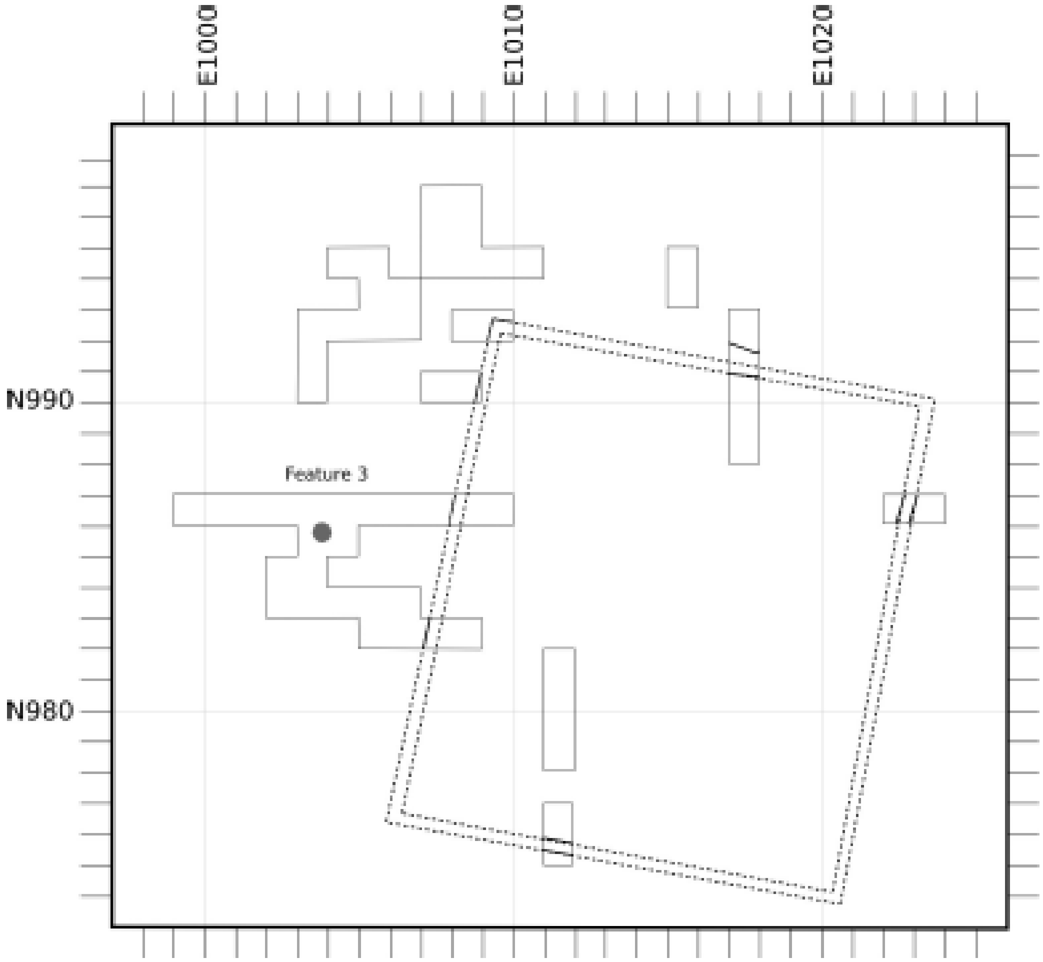

Figure 3.17: Pukara Sunken Court (Cohen 2010:Figure 6.39)
Note: Solid lines mark areas where excavation encountered wall cut or cobble wall.

Meanwhile, various surfaces were exploited as off-court, expedient patio space. Segments of the A18 were reused along with midden surfaces (A40 and A106). Other parts of the A18 patio are resurfaced over time using differing soil matrices, for example the northwest corner (A107) and western edge (with A89, A66-67).

Several features containing faunal remains were dug into the various patio floors, notably Features 3 and 19. Feature 19 was dug into foundation midden deposit (A64). It consisted of a single midden deposit (A48). As I discuss in more detail in Chapter 5, Feature 3 was unique at Huatacoa (Cohen 2010:216-221). This clay-lined, ritual offering pit was carefully organized into a series of deposits (A12-A17). Each stratum contains dense camelid and non-camelid bone, bone tools, and ash. We also see a shift – represented by Late Qaluyu to Pukara diagnostic ceramics – from the earliest to most recent strata.

None of the post-court abandonment contexts are considered in this analysis. The deposits included a mixed midden (A109) that buried the court floor, followed by destruction of the the court's wall (A110), and a rapid sequence of midden deposits (A111-A121)[46]. Mixed Qaluyu- and Pukara-period ceramics suggests mixed secondary midden deposits were procured from multiple context sources (Cohen 2010:224).None of these post-abandonment contexts are considered in this study.

Nonetheless, two western patio occupation surfaces (A65 and A61), which post-date court abandonment, were investigated. Compared to the court middens, both reflect

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[46] Cohen (2010:225) notes a rapid dumping of soil and midden effectively filled and sealed the court. As such, these deposits – because they likely represent secondary and tertiary context – are considered irrelevant for characterizing court-related activities.

remodeling of the patio and local discard of materials. The former is a mixed midden and architectural debris deposited over the A18 floor. The second event (A61) is a prepared clay floor laid over A65. Cut into both events is Feature 24, a stratified storage pit. The pit was lined with silty clay (A83) and subsequent levels deposited: 1) a cobbly ash matrix (A82), 2) an ashy midden (A81), 3) a compact midden (A60), and 4) a loose-soil midden (A59). The presence of a Cusipata-style bowl – a Pukara diagnostic ceramic type – in the A82 deposit strongly supports its association with a post-court use Pukara occupation of the site.

Conclusions

The previous thumbnail sketch illustrates the complex trajectory of social changes, economic interaction and subsistence developments, and political reorganization the characterized the transition from Archaic to Formative lifeways in the Lake Titicaca Basin. During the Middle and Late Formative, Huatacoa and Pukara were part of a landscape increasingly integrated by elite competition and participation in a shared ideology and ritual belief system. Populations became more aggregated and a site-size hierarchy developed. Increasing demand for prestige goods fostered llama caravan trade links to the north (Cusco), to the west (the *selva*), the South-Central Andes (the Moquegua Valley and the Chilean Atacama), and the west-central Basin. Likewise, craft production, of ritual ceramics and carved stelae, and communal labor construction of monumental architecture, became important. Also conspicuous are increasing social differentiation: specialized burial chambers, grave goods, and – at Pukara – segregation of commoner and elite households.

Implications for this Study

These social changes are critically dependent on a reliable subsistence base and surplus production. For agriculture, landscape modification becomes significant, to augment yields, control water availability, create arable land, and make the environment more favorable for crops. Similarly, landscape modification can improve pastoral animal health and wool quality. Creation of *qochas* can create lusher forage for camelids. Herd management is expected to intensify to meet demands – to grow herds, produce caravan animals and better fleece, and provide ceremonial sacrifices and feast foods.

As a result, over the Formative, several trends are anticipated to occur. First, an increasing emphasis is expected on producing larger herds to meet these varied demands. A corollary expectation is an attendant decrease in the value of wild game. If true, we may notice diachronic differences in the use of ecological zones – especially as time is increasingly shifted from hunting and bent toward herding and agricultural surplus, caravanning and craft production.

Second, camelid use in domestic, public feast, and ritual proveniences should display qualitative and quantitative differences – by behavioral context – in body part distribution, age profiles, and the scale of food preparation and bone disposal. Households should display a subset of intact skeletal elements, as carcass processing is more intensive and butchery units may become ch'arki. Young and old spikes are anticipated, indicating use of natural death (sub-yearlings) and old caravan and wool producers. Meals and bone disposal occur at a small scale. Larger, commnunal feasts are expected to feature suprahousehold scale food-consumption and trash disposal. More complete skeletal representation is anticipated, provided culling of multiple animals (i.e. replication of butchery units) and less intensive bone processing. Age profiles should emphasize juvenile and young adult animals because of their greater per carcass meat yield. Ritual practice varies in scale and treatment of skeletal remains processing. Sacrificed animals are often consumed in part and then offered; alternatively complete animals may be interred. Depending on elaborateness (i.e. the number of sacrifices), scale could thus be moderate or large. Age profiles may vary, depending on whether feast meals are served or the efficacy of young versus old animals for successful performance.

Third, both Pukara Valley sites should yield evidence of camelid caravan activity. This may be observable via direct, in camelid bone remains, and indirect measures, via trade links and presence of exotics.

Fourth, I expect to find measurable differences between these two sites – an Early to Late Formative village-center and a Late Formative polity capital – in terms of scale and ways fauna were exploited. Larger scale feasts and potential food provisioning is anticipated to characterize Pukara, given its status as a polity capital and presecnce of multiple sunken court complexes. As the Late Formative capital, Pukara may feature low frequency of wild game, as herd animals became a primary food and economic resource. Meanwhile, Huatacoa is expected to be more provincial, give smaller site size and more permeable spatial boundary between domestic and public, ritual contexts. From Early to Late Formative deposits, wild game use is predicted to decline as the pastoral economy develops and the site is integrated into the Pukara polity's control. Alternatively, wild game may continue to be relevant, while herd animals become drawn toward Pukara as political economy nexus. Analysis of archeological bone from these two sites is necessary to test these expectations and generate additionl future questions for later testing.

CHAPTER 4: METHODOLOGY

The goal of this study of Pukara River Valley fauna was to collect diachronic faunal data spanning the entire Formative Period. Next, bone from domestic, ritual and public, feast contexts were compared, to assess how faunal exploitation differed between the domestic and political economies. To address the questions posed in Chapter 1, I sought to compile robust ¼" datasets at both sites (Huatacoa n=12006, wt=34555.88g; Pukara n=23242, wt=77966.21g). These dataset could characterize taxonomic abundance, skeletal frequency and butchery, camelid species use and culling patterns, and taphonomy and bone modification from Huatacoa and Pukara – under the moniker of the Pukara Valley Zooarchaeology Project.

This analysis is based on an initial sort of fauna from feature and non-feature contexts. Analysis included large samples of 1/4" bone and selected flotation samples (see Chapter 5 for per-provenience counts)[47]. When 1/4" bone alone is studied, a potential bias against recovery of small body taxa – small and medium mammals, fish, birds, and amphibians – may occur (Lyman 2008:154-156; Shaffer and Sanchez 1994).

Specimen identifications proceeded in a two-step process. At minimum, fragments were identified to taxonomic class: mammal, birds, fish, reptile, and amphibians[48]. Assignment to taxonomic class relied foremost upon recognition of the characteristic anatomical traits of specific elements. Coarse identifications employed a 10-power hand-lens to consider bone cortical thickness and internal / external structure.

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[47] Overall, a larger number of Pukara flotation samples were analyzed than for Huatacoa – due to time constraints. Analysis of more Huatacoa samples is a future research goal.

[48] Tallies were made of total number of unidentified bone fragments encountered, but these are not considered in pie charts within Chapter 5.

Family, genus, and species identifications were completed in step two. I consulted comparative and archaeological specimens curated by the Programma Collasuyo, including a juvenile llama, adult alpaca, and fetal/newborn camelid, dog, deer, cuy, viscacha, and a *Cathartidae* raptor. I also prepared additional comparative taxa – an adult llama, a cuy, three wetland birds (Moorhen [*Gallinula chlorpus*], Andean coot [*Fulica ardesica*], and speckled teal [*Anas flavitostris*]), and fish taxa (*Orestias* spp. and *Trichomyterus* spp.). In addition, dentifications were aided with reference to comparative osteology images and textual sources (Altamirano Enciso 1983; Benavente et al. 1993; Gilbert 1990; Gilbert et al. 1996; Pacheco Torres et al. 1986). Further identifications may be possible pending access to an expanded set of comparatives.

The mammal category was subdivided into large, medium, and small mammals (see Chapter 2 for discussion of expected taxa within each size category). This subdivision highlights meat package size and non-subsistence utility differences, two variables that vary across mammal taxa. A general mammal category subsumes mammal specimens identifiable only by cortical thickness and internal / external bone texture.

Bird, fish, and amphibian taxonomic classes are also present. Birds were identified on the basis of cortical thickness and avian anatomical elements. Cranial elements, vertebra, and scales were the primary elements used to identify fish. A hand-lens study also identified fish specimens based on the presence of a lacy, fine-textured, or laminar bone structure. Amphibian class identifications are based upon element forms and their characteristic vertebral pattern.

Analysis by Cultural Context

Our analysis considers two sets of comparative frames of reference: site, time period, and behavioral context. When sample size permitted, intrasite samples for a particular behavioral context (domestic, ritual) were compared in two ways: synchronically (domestic vs. ritual fauna) and diachronically (domestic vs. domestic). Intersite comparisons were compared in like matter. This approach allows us to appreciate similarities and contrast between sites and by context.

Quantification

Following a visual bone sort from each stratigraphic context, quantification of all examined specimens was carried out via two methods: NISP and bone weight (g). Bone weight was collected to the nearest 0.01 g using an Ohaus scale[49]. Values for specimens were recorded on tags and in an Access database and tallied in an Excel spreadsheet. In this study, both techniques estimate abundance and the dietary importance of animal taxa.

NISP, simply defined, is the number of fragments of animal bone, teeth, or antler identifiable to a specific taxonomic category (Grayson 1984:17). As a simple count, it is ideal because it requires no analyst transformation and it makes the fullest use of the available bone sample. These two facts make it amenable to further statistical tests.

In contrast, bone weight is not amenable to further statistical testing. The assumption underlying bone weight measurement is recognition that a strong correlation exists between an animal's live weight and its bone weight. Strong arguments for the feasibility of considering bone weight as a good proxy measure of meat weight are advanced by several researchers (see Hudson 1990; Uerpmann 1973). It will also be

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[49] A 0.01 calibrated Ohaus scale died during data collection (in summer 2006) of Pukara's Block 2 occupations. The substitute was calculated to 0.1 g precision. Subsequent data collection – for Pukara Blocks 1, 3 and Huatacoa – used a new Ohaus scale (calibrated to .01 gram accuracy).

Block 2's impacted bone represents differing proportions of the total occupation NISPs: ILF (31%), MLF (83.5%), and FLF (9%). As a result, reported specimen bone weights are underestimated for the Initial and Middle occupations. Yet, this discrepancy is unlikely to significantly shift taxonomic abundance results.

important as way to contrast taphonomic histories of different taxa at the two sites – by assessing their NISP/weight ratios (Reitz and Wing 2008:211). By their nature, raw NISP and weight totals of taxonomic abundance are potentially influenced by taphonomic transformation and taxonomic contrasts in the number of identifiable skeletal elements and bone density (see Grayson 1984; Lyman 2008; Reitz and Wing 2008). The question of taphonomic factors shaping each site's deposits and faunal assemblages will be considered in Chapter 8.

All animals identified to species-level were assigned minimum number of individuals (MNI) values. In a few instances, MNI values were calculated for taxa identified only to family-level or class-level specificity. MNI provides a lower bound estimate of the number of animals necessary to account for the identified skeletal elements from a taxon in an assemblage (Lyman 1994:100). MNI counts are known to vary depending upon: a) the provenience unit selected for calculation (feature, stratum, site), b) the total sample size (NISP), (3) the most frequently identified skeletal element for the provenience studied, and (4) the ability to differentiate bone using age and side data (Lyman 2008:45-61). Taxa MNI were calculated with cultural stratum as the analytic unit for comparative study. In some instances, feature MNI values were quantified.

Skeletal Frequency and Butchery

Camelids, as the most abundant and largest domesticated animal food (by meat, viscera, and fat weight) identified in most Andean archaeological sites, required closer analysis. Carcass butchery techniques and skeletal element frequency were investigated.

Quantifying Carcass Use

Skeletal element frequency was documented in two manners depending on sample size. First, for suitably large samples, MNE/MAU values (minimum number of elements and minimal animal units) for elements were calculated to study meat food utility and bone density as factors shaping the sample. Whole elements were used as the analytic unit. This acknowledge butchery and carnivore ravaging as potential biases that produce low long bone shaft to articular end ratios (Marean and Frey 1997; Miller 1979:68-75)[50]. Furthermore, the review of Andean butchery (Table. 1.2), I expect these two skeletal segments undergo different butchery and food preparation proceses. This fact in turn exposed them to contrasting taphonomic processes. As a result, long bone and axial elements were segregated for separate analyses.

Utility values derive from a whole skeletal element food utility index (FUI) computed for llamas (Mengoni Gonalons 1991:Table 2). In addition, skeletal frequency was tested against drying utility indices (DUI) for evidence that butchery units were made into *ch'arki* (Nigris and Mengoni Gonalons 2005). For each element, the densest scan site was selected to test for a correlation between element representation and density mediated attrition (Stahl 1999). When total sample size was very low, I've reported element counts soley as tabular NISP and MNE descriptions. For all contexts, skeletal element frequency was tested against FUI, DUI, and bone density. Use of both indices will help in the recognition of meat and ch'arki value as factors that account for the presence or absence (differential transport) of butchery units.

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[50] Articular ends, because of their lower bone density, are prone to destruction. Limb element frequency is often undercounted if relied upon as the sole analytic unit. Shaft landmarks were used in some cases to calculate MNE values for limb bones.

Past ethnoarchaeological and Andean archaeological studies of cutmark location and orientation on particular skeletal elements have found cuts associated with various stages of carcass processing: skinning, dismemberment, and filleting (Binford 1981:87-143; Lyman 1993:294-299; Moore 1989: 195-199). Dismemberment cutmarks are associated with cutting of connective tissue adjacent to joints to separate the carcass into segments. Flensing, or filleting marks, are produced through the removal of meat cuts from the bone. Skinning marks are visible where skin is stretched over bone with little intervening soft tissue – mainly the lower limbs and cranium (Binford 1981:106-107). A hand lens was was used to document placement, orientation, and frequency of cutmarks. Andean ethnoarchaeological accounts of butchery and bone processing were reviewed to compare and demarcate butchering units and bone fracture present within the Formative assemblages (Miller 1979; Olivera and Nasti 2001; Tomka 1994).

Managing the Herd: Breed / Species Use and Culling Practices

Addressing how wild and domesticated camelids were exploited by Formative populations requires explicit methods to identify both forms within the archaeological record. Similarly, reconstruction of past herd management practices, like castration, breed diversity, animal health, and herd economic focus (i.e. meat, secondary products, or mixed focus), rest upon the reliability of our methods to track each within the archaeological record. The methods applied to investigate these issues are discussed in the following sections.

Measure for Measure: Camelid Taxa Body Size and Osteometrics

Osteometrics, the measurement of post-cranial element dimensions on archaeological and modern comparative camelid taxa skeletal elements, provide a window on the use of wild and domesticated camelid use and breed diversity. A small-to-large size continuum characterizes modern Central Andean camelid taxa: from vicuña, alpaca, guanaco, and llama (Mengoni-Goñalons and Yacobaccio 2006). A long history exists within the Andes for the application of osteometrics to distinguish small and large camelid forms (Kent 1982; Miller 1979; Miller and Burger 1995; Moore 1989, 2008; Wing 1972). These size categories subsume vicuña and alpaca (small camelid form) and guanaco and llama (large camelid form).

A Mitutoyo digital caliper, calibrated with 0.01 mm accuracy, was used to collect element metrics. Individual readings were transferred to an Excel spreadsheet via a foot pedal interface between the caliper and laptop. To control for analyst error and reliability, each recorded metric was replicated three times for a specimen, with the mean value considered representative. Measurement protocols, for caliper orientation and placement, and measurements follow Wing (1972) and Kent (1982)[51]. Unless otherwise noted, only fused bone elements were measured and reported.

Osteometrics in the present study were compared using univariate, bivariate, and multivariate techniques. Univariate analysis relies on the use of decision rules (metric values) to distinguish and determine the representation of large and small categories. The present analysis employs decision rules proposed by Moore (1989). Histograms may assist in separation of the two size categories – for samples displaying discontinuities in metric distribution. Descriptive statistics further characterize taxonomic diversity within each site assemblage. Measurement of comparative specimens of known species (Kent

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[51] The database of metrics actually collected during analysis exceeds what is presented within this dissertation. Butchery and taphonomic processes resulted in small sample sizes, for several elements and their metrics, precluding their summary.

1982; Miller and Burger 1995) provided benchmark values for inter- and inter-species variability in given element metrics.

In addition, Miller and Burger (1995) advocate calculation of two additional statistics to aid in univariate analysis. The first is the coefficient of variation[52]. A second value, the index of dimorphism (%D = x^s/x^l * 100) use the means of the small camelid and large camelid group samples within an assemblage (see Miller and Burger 1995: Figure 7). Index values may aid in interpretation of species representation.

Bivariate analyses, where two metric dimensions from a single element are depicted as x/y coordinates, are useful for separating size categories. For example, Figure 4.1 depicts a common first phalanx bivariate plot using Pukara Valley data: the maximum length (xy) plotted against the latero-medial breadth (b).

Typically, plotting a large sample demonstrates one of two patterns in body size: 1) discrete, discontinuous size categories or 2) continuous size distribution. Scenario 1 suggests the management of two distinct camelid taxa breeds, one small and one large camelid. Interpretations of the second pattern are more complex: 1) a mixed hunting and herding economy (multiple taxa present), 2) geographic variation in species size across the Andes, and 3) breeding of domesticated species for size or trait variants, and 4) *waris* (alpaca-llama hybrids) (see Miller and Gill 1990; Miller 2003b; Moore 2006, 2008). Recent archaeological and ethnoarchaeology studies indicate prehistoric camelid body size spread across a continuous distribution, lost with the extinction of breed diversity. Intermediate size, wooly llamas, with higher quality fleece, and cargo llama breeds were

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[52] Coefficient values between 5 and 6 are typical size range variability for a single-species breeding population.

once more common prior to the Spanish Conquest (Miller 2003b; Wheeler et al. 1995; Reigadas 1994).

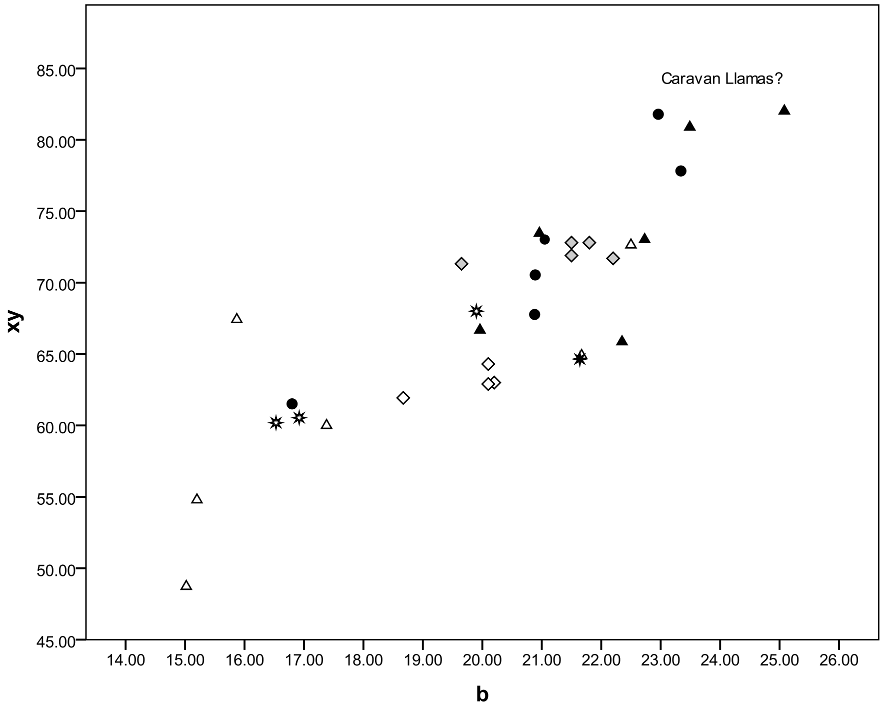

Figure 4.1: Pukara Valley: first phalanxLength (xy) vs. Proximal Depth (b)[53]
Note: Forelimb phalanx = filled, hindlimb phalanges = no fill
Pukara (starbursts, n=4); Huatacoa LQ and LF (circles [n=6], triangles [n=12]);
Argentine guanaco comparatives (diamond, n=9)

As noted in Chapter 1, extended bone growth in castrate camelids may explain a degree of observed body size variability. If true, extremely long elements (e.g. first phalanges) could represent castrate / caravan llamas (see Figure 4.1's upper right Huatacoa specimens; Moore 2006). Muddying the osteometric waters further, castration provides another viable explanation for some intermediate-size (castrate alpaca/wooly llama?) and extremely large camelid forms (castrate llama) recorded in past studies.

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[53] Plotted also were first phalanx fore- and hindlimb metrics for four N Argentine guanacos (Catamarca, Salta) (Izeta et al. 2009: Table 1-2). Length and breadth metrics for guanaco forelimb first phalanx overlap with or approximate values reported for modern llamas from the La Raya collections (Kent 1982; Miller and Burger 1995).

Accordingly, it often helps to compare one's results against plots from prior site studies and those of known camelid taxa. One thing is certain, prehistoric camelid forms found across the Andes evince greater metric and breed variability than characterizes today's camelid taxa (Mengoni Gonalons 2008; Moore 2008:40; Wheeler et al. 1995). Grappling with that variability remains a major theme of research.

Kent (1982; Kent et al. 2001) uses a multivariate classification function using several measurements from a single element to determine probable species affiliation for archaeological specimens. Classification scores for the Pukara Valley first phalanx and second phalanx are calculated and presented in Chapter 7. For example, the forelimb first phalanx function is used below to describe the process. The application of his approach is a three step process (Kent 1982:172-173):

1) **Assign the archaeological phalanx to either the small camelid group (vicuña / alpaca) or the large camelid group (guanaco / llama).**
   Assignment requires comparison of element metrics for the archaeological specimen to group mean values Kent recorded for comparatives of the four modern camelid taxa (Kent 1982: Appendix IV.2)

2) **Compute classification scores for each camelid species within the size group (Kent 1982: Appendix IV.4)**. For example, the llama forelimb score (LL CS) is derived as follows[54]:

   LL CS = A x 1 + B x 2 + C x 4 + D x 5 + *K* (constant value)

3) **Assign the archaeological unknown to the specimen with the highest classification score[55].**

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[54] In the equation, letters represent metric coefficients and numbers represent the archaeological specimen's metric value. Abbreviations are as follow:
A= length (Wing xy) coefficient; B = proximal breadth (Wing b) coefficient; C = Distal breadth (Wing a) coefficient; D = Distal width (Wing a') coefficient.

Incisor Morphology

Jane Wheeler (1982:12-13, 1995), during her study of herd animals (alpacas, llamas, and alpaca-llama hybrids)[56] and vicuña, identified distinguishing traits present on adult camelid incisors (Figure 4.1). In comparison, deciduous incisor morphology is unreliable for taxon classification, as all three species' incisors have roots and enamel, for both vicuña and alpaca, is limited to the upper labial crown surface (Mengoni Goñalons and Yacobaccio 2006:203).

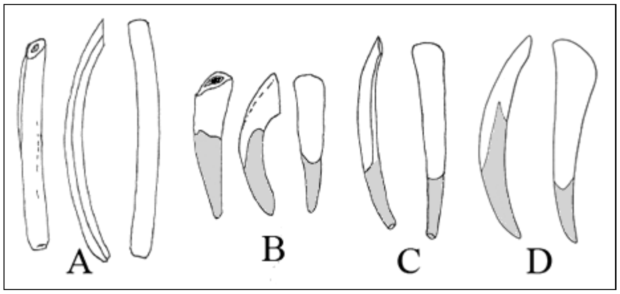

Figure 4.2: *Camelidae* Incisor Morphology

	Vicuña (A)	Alpaca (C)	Guanaco / Llama (B, D)
Shape	Square cross-section	Rectangular cross-section	Spatulate form
Enamel	Entire labial	Upper labial surface	Entire crown
Roots	Absent	Present	Present

Note: A = Vicuña, B/D = Llama/Guanaco, C = Alpaca. Root=grey color. A: Labial, lateral, lingual views (L, center, R); B: lingual, lateral, labial views(L, center, R); C: lateral and labial views (L, R); D: lateral and labial views (L, R).
R and C lateral views: Dentine (right of enamel surface)
Images A-C [modified from (Moore 1989: Figure 7.3)]; D (Wheeler 1995a: Figure 8)

Some variability in incisor form within a species may exist. For alpaca and paco-vicuña hybrid specimens, the enamel-dentine boundary (Moore 1989:243) differs in its

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[55] The difference between the two highest scores determines the confidence of the species assignment and likelihood of misclassification between the two highest score taxa.

[56] Llama and alpaca specimens were of known age, sex, and species. Specimens were collected at the *Instituto Veterinario de Investigaciones Tropicales y Altura* (IVITA) Camelid Research station at the La Raya pass, Peru, located south of Cusco. These specimens, along with vicuña and guanaco ones, later became the data base for critical advances in camelid aging and osteometric methods (see Kent 1982; Miller 1979; Moore 1989). Much to the detriment of future research, these and other camelid comparative specimens have disappeared from the Paleoethnozoology Lab at the University of San Marcos, Lima (Moore 2006, personal communication).

placement. Likewise, alpacas displaying vicuña-form incisors – with open roots and parallel cross-section shape – and llama-like incisors are described (Kent 1982:142, Kent et al. 2001:137). It remains to be determined if such incisor form variability is due to prehistoric management practices (breeding and/or hybridization), inherent fallibility in osteometrics-based species identifications, or examples of greater than previously recognized intra-species genetic variation (Wheeler 1995b:281; Kent et al. 2001). Therefore, morphological data provide an estimate of exploited camelid species.

By applying these visual criteria, the adult camelid incisors were classified to taxa within the two archaeological bone assemblages. Specimens were studied and assigned to one of the three species forms when two or more of the criteria were observable. In practice, despite the durability of teeth, Pukara Valley specimen incisor morphology identifications were impacted by disarticulation, fracture, and low-level recovery of dental remains.

Bone Pathology

Contrary to common perception, living bone is not a static substance. Besides growth occurring prior to adulthood, bone continues additive remodeling or loss – in response to physical activity, disease, injury or fracture. Ante-mortem skeletal pathologies shine light on the nutritional status, overall health, disease, traumas, and labor demands placed upon a particular animal taxon (Baker and Brothwell 1980). As such, pathology data provides a close-up qualitative and quantitative view of health – for an overall herd or individual animals (e.g. in burial contexts)[57].

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[57] As sample size increases, zooarchaeologists can identify the casual factors for pathologies and their relative frequency of observation.

Because no comparatives displaying pathologies were unavailable, I consulted published literature on known skeletal pathologies and infections associated with large domestic and draught species (cattle and horses) and camelids (see Baker and Brothwell 1982; deFrance 2009a; Jubb and Kennedy 1970; Park 2001). Macroscopic analysis of specimen surfaces was conducted using 10x and 25x magnification hand loupes. Observed pathologies were documented by close-focus digital photographs and description. The few pathological camelid bone specimens among the Huatacoa and Pukara samples are described in Chapter 7's herd management discussion.

For llamas, osteoarthritis – a degenerative joint disease – may develop from traumas sustained during a lifetime of heavy-burden transport. To a lesser extent, alpaca may be susceptible based on age-related stresses and genetics (deFrance 2009a:521-522). Documentation and analysis of such patterns help us to track and compare herd management and caravan labor from Andean prehistory to the Colonial Period (deFrance 2009a; Park 2001; Izeta and Cortés 2006; Webster 1993). Traits distinguishing osteoarthritis from other stress-related pathologies are reviewed further in Chapter 7.

Related stress-lesions present on domestic draught animals include spavin and ring bone. Spavin is a condition diagnosed by recognition of exostosis development on joint segments, primarily upon the carpals, tarsals, and proximal metapodia (Baker and Brothwell 1980:117-119). Bone growth accompanies strain, stretching, or trauma effecting attached ligaments. Ring bone is interphalangeal exostoses occurring on the first phalanx (high ring bone), second phalanx (low ring bone), and bone shafts for both phalanges (false ring bone). The purported etiology (Baker and Brothwell 1980:120) is "pedal thump" concussive stress, whereby body and pack weights are transmitted down from the leg to these lower joints[58]. Tendon inflammation, resulting from these forces, fosters articular bone growth. In living animals, all three stress conditions manifest in varying degrees of lameness.

Cartajena and colleagues (et al. 2001:160) defined morphological features resulting from stress-induced bone modifications to cargo llama forelimb and hindlimb phalanges. These features are observable by macroscopic study (Table 4.1), and more rigorously, via discriminant analysis (an osteometric multivariate test). Features develop as strong forces, the result of additional weight from burden-carrying, reshape the bone surface, whereby "[over time] muscular hypertrophy and generalized osseous strengthening can appear, especially at the insertion points under stress" (2001:160).

The latter statistical method was not employed as descriptions of several requisite osteometrics were unavailable to the author at the time of analysis. Nonetheless, an attempt was made to visually identify these traits on complete phalanx specimens when present. What remains unclear is whether some of these bone modifications are routinely identified or equivalent to mild high ring bone cases[59].

Fractures and infections constitute other major identified skeletal pathologies. Fractures are identifiable when bone structure has broken and repaired itself prior to the animal's death. Several infectious vectors are contagious, damage soft tissues, and

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[58] A condition potentially responsible for phalanx and distal metapodia stress lesions is commonly known as "down in the pasterns" or "dropped fetlock". By shifting from a near vertical to a horizontal orientation, the ankle joint can develop osteoarthritis and ligamentitis (Fowler 2011:136). Herd animals noted to be predisposed to this condition include: early-age castrates, overburdened pack animals, obese, and old females who have birthed several offspring (Birutta 1997:94; Fowler 2011:136).

[59] It remains possible that some specimens described in Chapter 7 as high ring bone pathologies actually represent manifestations of these mild stress lesions. Perhaps age and harshness of life-time labor distinguish the degree of exostosis / bone remodeling present, with lesions advancing to moderate or advanced cases of ring bone.

influence herd mortality without visibly effecting bone tissue. Examples include mange insect infestation (*carache, qarachi*) and enterotoximea bacterial infection (see Flannery et al. 1989:102-104; Wheeler 1984:403-404; Tomka 1994:116). As such, such diseases will not be discussed further or considered directly in Chapter 7.

Table 4.1: Minor Stress Cargo Markers (compiled from Cartajena et. al. 2001:161)

	Forelimb	**Hindlimb**
Feature 1	Proximal end: Transversal groove (proximal epiphysis): Distal attachment for Capsular ligament	Proximal end: Distal Sesamoideal ligament attachment: Triangular rough ridges
Feature 2	Proximal end: Distal Sesamoideal ligament Attachment: Triangular rough ridges (resulting from metacarpophalangeal hyperextension)	Proximal end: Attachment eminence for axial / abaxial Metatarsophalangeal collateral ligaments: rough surface texture
Feature 3	Distal end: Pronounced trochlea ridges	Proximal end (dorsal rim): Pronounced concavity in articular surface (resulting from pushing force brought to bear by the metatarsal on articulation)

Inflammatory lesions on cortical bone (osteoperiostisis) and within the marrow-cavity (osteomyelitis) may result from bacterial infection agents, such as *Staphylococci*, *E. coli*, *Streptococci*, and *Actinomyces* sp. (e.g. the latter is a common source of “lumpy jaw”) (Baker and Brothwell 1982). Exterior lesions present as areas of irritated, irregular cortical bone surface. Bone trauma enables infection to spread via the bloodstream into the bone itself. As such infection develops, bone both becomes porous, as dead portions are removed, and regenerates with globular growths, as new bone encases dead tissue and remodels the bone (Jubb and Kennedy 1970:50-51). In extreme cases, the bone shaft swells outward as pus accumulates followed by the rupture of bone and outward drainage into surrounding soft tissues (Baker 1978:109).

A final feature that deserves mention is polydactlism, which occurs on both the proximal and distal metacarpal and metatarsal. Strictly speaking, it is due to a spontaneous genetic anomaly, rather than a true pathology. Normal metapodia each display three proximal articular surfaces (for the carpals and tarsals) and two distal condyles. Instances are identifiable by irregular (extremely wide, multi-faceted) proximal articular surfaces and the presence of multiple distal condyles. Moore (2008:46) recounts the perception among modern camelid herders that this condition is an undesirable – a possible reason why most animals exhibiting the trait were culled at an early age at Chiripa. High incidence of this trait within a bone assemblage could indicate somewhat lax management practices, since individuals were able to pass on this anomaly to their descendants.

Culling Decisions

Several different techniques were applied to further define culling practices. These include macroscopic methods used to sex and estimate age at death. Sexing methods involved study of pelvic and canine morphology. Mortality profiles were generated after study of long bone fusion and mandible dentition.

Sexing

In several instances, intact or mostly whole camelid pubis regions were recovered within the Huatacoa and Pukara assemblages. Moore, during prior study of the IVITA collections, examined and drew cross-sections of the unfused pubic symphysis articular surfaces for camelids of known species, age, and sex (2006, personal communication).

A set of these profile drawings was consulted during data collection. In general, the cross-sectional shape of the nose (anterior) and tail (posterior) halves of symphysis differ between the sexes in juveniles (2+ years of age). Females display more gracile symphysis with a pointed, dorso-convex / ventro-concave pubis nose profile. This profile is mirrored, in a muted manner, in the tail region also. In contrast, males tend to have a more robust overall symphysis, featuring more globular pubic nose and tail profiles.

Pubis fragments from archaeological specimens were photographed and drawn in profile. The resulting profiles were then visually compared to the La Raya and Programma Collasuyuo specimen profile drawings to identify sex[60]. Age and sex of the matching" comparative specimens were recorded.

A second line of evidence used to assign sex to specimens relied on sexual dimorphism manifested in adult camelid canine size and age-at-eruption. Kent (1982: Table II.1) summarizes data from early studies of age-related changes in camelid dentition. For alpacas, the mean ages of eruption for the mandibular canine and maxillary canines are reported: males (C_1=2.5 – 4 years, C^1=3.2 years) and female (C_1=3.5 years, C^1= 6.15 years). In general, this data allows us to conclude adult female canines are smaller and erupt later than those of their male counterparts.

Adult male camelids have evolved noticeably larger "fighting" canines (Wheeler 1982:13-14), which serve as weapons in male-male competition for herd dominance and reproductive access (Tomka 1992). Early castration of males, however, impacts canine growth. Gelded males have noticeably smaller, more "feminized" adult canines (Wheeler 1982; Gunsser 1996:175-176)[61]. If practiced in prehistoric times, castration has the potential to skew zooarchaeological reconstruction of herd sex ratios, if canine size is used as proxy measure.

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[60] At the time of this research, the Programma Collasuyo comparative collection included three female camelids aged by dental eruption and wear by the author: (1) a Stage 8 (4-5 yr) adult alpaca (prepared by Aimée Plourde), (2) a Stage 5 (1.5-2.5 year old) llama (prepared by Karen Doehner), and a Stage 9 (5-9 yr old) adult (prepared by the author).

[61] It is likewise expected that changes in testosterone levels are would influence age at eruption.

With the above caveat in mind, adult canine specimens displaying sex dimorphic features were recorded as male or female. Chapter 7 compiles probable canine sex identifications, along with published eruption age (by sex) of mandibular (C_1) and maxillary canines (C^1).

Mortality Patterns

In this study, age-at-death patterns were analyzed to track culling and management decisions about the economic focus of alpaca and llama herding. Two methods were applied: mandible teeth eruption / wear and bone epiphyseal fusion. Moore's (1989) camelid mandibular age class sequence was employed to analyze and record premolar and molar wear. Fractures observed on mandibula often disarticulated or broke teeth. Refits were made when possible. Yet, to maximize the available dataset, isolated teeth or tooth segments were analyzed. The likelihood of recounting the same individual's left and right pairs was controlled for by collecting side data and considering degree of wear (for each intact tooth).

Mandibula specimens were each assigned to a specific age class. Following assignment, age classes were collapsed together to form five age categories: newborn (birth – 1 month), *cria* yearling (less than 1 year), juvenile (1 – 3 years), adult (3 – 9 years), and old (9 + years old). These coarse age categories more closely correlate to mortality patterns at different life stages, mainly birth, subadult, sexual maturity, and the periods of secondary products utility and its decline. Likewise, these age classes would prove readily comparable to past camelid mortality studies.

Epiphyseal fusion was documented following the fusion sequences reported by Wheeler (1999) and Miller (2003a). Elements were categorized as early, middle, and late-fusion bones. The early category includes skeletal element parts fusing between six months and one and half years of age: the axis and atlas; scapula; the metapodia midline shaft; proximal radio-ulna; the distal tibia and humerus; and acetabula of the pelvis. Middle-category bones include those fusing between two to three years of age: the first phalanx; the calcaneus head; the proximal humerus; and the distal metapodia. The late category includes bones that fuse between three to five years of age: the proximal femur and tibia; the distal femur and radio-ulna; the radio-ulna olecranon process, and the pubic symphisis of the pelvis. The percentages of unfused and fused bones from each age class indicate the frequency of culled yearling, juvenile, and young adult animals.

Despite limitations – mainly precision and the inability to track older adults – fusion data is advantageous for the present study. Each site has a larger sample of postcranial bone, relative to intact mandibles. Likewise, sample availability facilitates inter- and intra-site analysis of diachronic and contextual mortality profiles.

Bone Taphonomy

The variety of behavioral contexts studied and the varying age of depositon increases the likelihood that deposited fauna were subjected to disparate and complex taphonomic processes. Several natural factors could winnow the bone assemblage post-deposition. Signatures of bone weathering, gnawing, and burning were investigated. This enables impact of exposure, carnivore action, and burning on bone representation – to clean floors or as part of rites – to be tracked. Likewise, rate of fragmentation provides a broad appraisal of bone destruction by taxa or context. It was beyond the scope of the dissertation to address in depth production of bone tools as a taphonomic factor.

To compare fragmentation between taxa, the NISP for each identified taxa is divided by their corresponding total weight. This provides a rough index of fragmentation intensity by studied context.

All taxonomically identifiable specimens were scored from zero (no weathering) to five (advanced in-situ splintering, breakdown) on a weathering scale (Behrensmeyer 1978). Scores provide a proxy measure for how long bones in a context were exposed on the ground surface prior to burial.

Bone scavenging by carnivores may shape skeletal element frequency reconstructions representation and identification within archaeological collections (Binford 1981; Elkin and Mondini 2001; Hudson 1993; Marean and Spencer 1991). Fragments were examined for evidence of gnawing, pitting, and punctures, and other damage to determine the extent of carnivore ravaging.

Site formation processes, e.g. burning to dispose of trash or ritual activities, and cooking methods may help explain burned bone and its taphonomic destruction (La Motta and Schiffer 1990:23-24; Moore et al. 2007). As bone burns, organic matter is lost, resulting in bone loss through higher fragmentation (David 1990; Costamagano et al. 2002). This study undertook contextual study of burning features and tallied the degree of bone burning by specimen. Bone color was noted as unburned, charred (brown or black in color), and calcined (blue, grey, and white in color). The above bone tissue color change was correlated with burning temperature and length of exposure to a heat source (Lyman 1994).

CHAPTER 5: ANIMALS OF THE PUKARA VALLEY

This chapter has two main goals. First, I review the results of previous zooarchaeological studies for faunal remains recovered at the sites within the Pukara River drainage. Faunal data is available from the excavations at the sites of Qaluyu, Q'elloqaqa cave, and from Pukara's Qalasaya central sunken court. These studies provide a good starting point to characterize animal use as part of the North Titicaca Basin Formative Period. Secondly, I compile the results of the broad taxonomic abundance obtained from my analysis of fauna from Pukara and Huatacoa. I compare patterns in fauna use through three frameworks: 1) diachronic perspective, 2) inter-site and intra-site differences, and 3) as a component of the household economy versus the public / ritual economies.

Prior Zooarchaeological Studies

Qaluyu and Q'elloqaqa Cave

Karen Mohr-Chávez undertook test excavations of five trenches at the Middle-Formative center and habitation site of Qaluyu (1977). Trench 1 contained extensive Early to Late Qaluyu habitation remains, while Trench 5's upper stratum had a Pukara midden (see Chapter 3 for discussion of occupation dating).

Q'elloqaqa (or Q'Ellokaka), a Middle Formative cave site, is located approximately seven km northwest of Pukara at an altitude of 3830 meters above sea level[62]. Sergio Chávez excavated the cave's occupation, assigning it an Early Qaluyu ceramic date (1400-1000 B.C.). A final, more in-depth account for the site has not yet been published.

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[62] The precise location of this site within the Valley is unclear (see Burger et al. 2002:Figure for approximate location).

Elizabeth Wing's diachronic study of Andean animal domestication (1973; 1978; 1986) described faunal remains from Qaluyu (i.e. Mohr-Chávez's strata B, E, and F) and Q'elloqaqa. The site faunal assemblage was divided into an aggregate Qaluyu strata sample (total NISP=275: trench B) and a Pukara strata sample (NISP=94: trenches B, E, and F) (see Chapter 3, Table 3.2 for C-14).

Q'elloqaqa offered a smaller assemblage (NISP=112)[63]. Despite modest sample sizes by site occupation at Qaluyu, a small camelid astragali metric dataset demonstrates the presence of small- and large-body camelids (Wing 1978). Table 5.1 presents taxonomic abundance results recorded by for both sites[64]. I present MNI abundance values here to emphasize the variety and frequency of wild game found in the samples.

Clear patterns in abundance by MNI are evident in the two Middle Formative (Qaluyu) samples. A broad spectrum faunal diet emphasizes wild and domesticated taxa. Wild taxa are the most significant contribution to the diet, representing nearly 65 percent of the Qaluyu sample and 50 percent of the sample at Q'elloqaqa. Deer are the main wild game at Qaluyu, followed by fish and bird taxa. At Q'elloqaqa, viscacha, bird taxa, and deer were of equal import. Domesticated taxa rank second in importance. Camelids are the primary taxon consumed, averaging between 25 to 35% of the sample. However, if NISP counts are considered, camelids predominate (75% of each site's bone sample), while wild taxa (with the exception of deer) are small contributors (Wing 1986). These NISP patterns match the high camelid emphasis relative to wild taxa found in post-5000

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[63] The Qaluyu assemblage included 470 specimens, leaving 101 UNID specimens unaccounted for in the above aggregate Qaluyu assemblage NISP count. By comparison, Q'elloqaqa had a total assemblage of 142 specimens, with 30 UNID specimens.

[64] Differences in MNIs were found between sources (Wing1973, 1978) for *Camelidae*, *Cervidae*, and *Canis*. In addition, the Homo MNI values are eliminated. MNI values are adjusted to reflect 1978 totals, while maintaining the specificity (e.g. breakdown of wild taxa by MNI) within the 1973 report.

B.P. Andean sites (Mengoni Goñalons and Yaccobacio 2006:235-237; Wing 1986). Future excavation of Qaluyu should incorporate flotation sampling to provide a better estimate of small game, bird, and fish biomass versus large game (Moore et al. 1999) and test for differential preservation by animal class.

Table 5.1: Qaluyu and Q'elloqaqa Fauna (1/4" MNI)

Taxon [1]	**Qaluyu: MF**	%	**Qaluyu: Pukara**	%	**Q'elloqaqa: MF**	%
Camelidae	27	34.18	10	62.50	5	27.8
Cervidae	16	20.25	1	6.25	2	11.1
Skunk (*Conepatus)*	1	1.26	0	0.00	0	0.0
Viscacha (*Lagidium)*	1	1.26	0	0.00	3	16.7
Canis	1	1.26	1	6.25	1	5.5
Cavia	0	0.00	0	0.00	3	16.7
Rodent	3	3.80	0	0.00	0	0.0
Tinamou (*Tinamidae*)	3	3.80	0	0.00	1	5.5
Duck (*Anatidae*)	0	0.00	1	6.25	0	0.0
Coots (*Rallidae*)	0	0.00	1	6.25	0	0.0
Lapwing, Plover (*Charadriidae*)	1	1.26	0	0.00	0	0.0
Accipitridae	2	2.53	0	0.00	0	0.0
Hawk (*Falconidae*)	1	1.26	0	0.00	0	0.0
Bird	10	12.66	2	12.50	3	16.7
Fish	13	16.46	0	0.00	0	0.0
Totals	**79**	**100.00***	**16**	**100.00**	**18**	**100.0**

Note: Data from Wing (1973, 1978), * Rounding error

[1]: List reflects a reassignment of *Craacidae* (a lowland-habitat taxa) into the Bird category and *Buteogallus* into an *Accipitridae*-category. These changes were deemed necessary to update the the taxonomy of the results (Wing personal communication, 2010).

During the Middle Formative, camelid herds were already a major source of meat. However, hunting and foraging for wild game remained important. Deer (*Hippocamelus*, *Odocoileu*s) and viscacha were procured by forays across the hillsides and pampa. Skunk and bird taxa were captured by opportunistic hunting of the pampas. For Qaluyu residents, fish were harvested in the nearby Pukara River and its associated wetland.

In contrast, a nearly exclusive focus on herded animals was encountered in Qaluyu's Pukara-occupation. They represent 62% by MNI and just over 98.6% of the sample's bone NISP. Deer and bird taxa, mainly waterfowl, are minor resources. Fish are conspicuously absent. The notable contrast relative to the early occupation results suggests increasing economic specialization toward herd animals and an opportunistic focus on wetland and pampa resources. It remains possible that the poor wild game representation is an artifact of the small identified bone sample size (see above).

Pukara (The Qalasaaya)

Jane Wheeler analyzed fauna recovered from Plan COPESCO's excavation of the Qalasaya ritual architecture complex (NISP=3906). Most of the faunal sample came from an L-shaped unit excavated in the northwest corner of the central sunken court (court BB, NISP = 2118) (Wheeler and Mujica 1981:73). Data from each Formative occupation at Pukara are represented: Middle Formative (Qaluyu ceramics) (strata F-J), Initial Pukara (strata C-E), and Late Pukara strata (strata A-B) (Table 5.2).

The study produced three valuable contributions for comparative analysis of fauna in Middle and Late Formative Pukara ritual contexts. First, camelids dominate, while domesticated and wild taxa are present with the two Middle Formative strata. Second, culling of juvenile and adult animals was evident by the epiphyseal fusion mortality profile. Animals were culled for meat (juvenile/adult), perhaps after exhausting their secondary products value. Both small and large body camelids are present.

Finally, frequency of bone modification is noted (Table 5.3). Worked bone was common in one Middle Formative stratum and the Initial Pukara one. Burning was most frequent within the Initial Pukara sunken court context. We will reconsider these trends below.

Table 5.2: *Qalasaya* Sunken Court Fauna - NISP and % NISP (¼")

Taxon	Qaluyu 1 (Strata I-J)	Qaluyu 2 (Strata F-H)	Initial Pukara (Strata C-E)[2]	Late Pukara (Strata A-B)
Camelid: Adult [1]	71 (41.5%)	25 (48.1%)	159 (74.6%)	7 (100%)
Juvenile	53 (34.9%)	27 (51.9%)	47 (22.1%)	
Newborn	28 (18.4%)		7 (3.3%)	
Total	152 (25.6%)	52 (19.5%)	213 (17.6%)	7 (14.6%)
Cervid: Adult	9		5	
Juvenile	1			
Newborn				
Total	10 (1.7%)		5 (0.41%)	
Large Mammal	410 (69.1%)	153 (57.3%)	945 (78.1%)	41 (85.4%)
Canidae	2 (0.3%)			
Felis spp.	1 (0.2%)			
Cavia spp.	1 (0.2%)			
Medium / Small Mammal	1 (0.2%)	49 (18.3)	2 (0.16%)	
Amphibian	1 (0.2%)			
Duck (*Oxyura* spp.)	1 (0.2%)		1(0.08%)	
Vultur gryphus			1(0.08%)	
Accipitridae	3 (0.5%)			
Bird			1(0.08%)	
Unid	11 (1.8%)	13(4.9%)	42 (3.47%)	0
Total	**593**	**267**	**1210**	**48** [3]

Note: Data compiled from Wheeler and Mujica (1981: Figure 54). Addition of *Accipitridae* due to reclassification of *Buteogallus urubitinga* (a lowland raptor).

[1] Age based on bone fusion: adult (3.75 yr+), juvenile (2 mo – 3.75 yr), newborn (< 2 mo.).

2 Percentage rounding error.

3 Kidder's prior excavation of this stratum and subsequent disturbance impacted the Late Pukara faunal sample size (Wheeler and Mujica 1981:76).

Table 5.3: Bone Modification in Qalasaya Bone

Stratum	Bone Tools	Cutmarks	Burning	Gnaw
Late Pukara (Strata A-B)	N/A	N/A	N/A	N/A
Initial Pukara (Strata C-E)[1]	59 (1 P)	15	96	1 (CG)
Qaluyu 2 (Strata F-H)	16	2	25	2 (RG)
Qaluyu 1 (Strata I-J)	42 (1 B, 4 P)	15	15	6 (RG)

Note: (P)=polished, (B)=burned, (CG, RG)=carnivore and rodent gnawing

1 Includes one cut condor bone (possible by-product of tool manufacture)

Hautacoa

At Huatacoa, we have the opportunity to study fauna exploitation from two simultaneous perspectives. First, domestic (area B) and sunken court (Area A) contexts host different sequences of social and commensal activities. Second, social behavior in each context may have changed during the Formative, from Early Formative (Early Qaluyu) to Pukara occupations. I will review each context in chronological order[65].

Domestic Occupations (Area B)

Early (Qaluyu) Formative occupation of Area B consists of a three strata sequence generated by domestic habitation (Cohen 2010). The first (B1) is a pit midden or potential pithouse footprint. This stratum terminates in a final midden deposit (events B 58-59). An adobe-foundation house floor, associated living surfaces, and midden deposits make up Stratum B2. Stratum B3 corresponds to the house's destruction, abandonment, and reuse as a general midden area. Each stratum is discussed first, followed by a brief summary of the aggregate Early Qaluyu occupation results.

Early Qaluyu: Pit Midden / Pithouse (B1)

The results by taxonomic category of abundance are shown in Table 5.4 and Figure 5.1. Camelids and undifferentiated large mammals dominate the midden deposit by NISP, MNI, and bone weight. Taruca are uncommon. Two non-antler bones were

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[65] My analysis includes behavioral events attributed by Cohen (2010:Appendix B.4.2) to a specific occupation stratum. In some cases, however, a slight mixing or transition between events is evident. In such instances, associated fauna are folded into the preceding stratum (for consistency). Each area's Harris matrix (Cohen 2010:Figures 5.4,6.3) was reviewed to determine stratum assignments for those events not already designated.

However, when excavation notes indicate a mixed temporal period delineation (e.g. an Early Qaluyu / Late Qaluyu context), the contexts was excluded from consideration. This was done in the interest of not introducing vagaries into temporal faunal use patterns. See Appendix A for a list of analyzed contexts for Huatacoa and Pukara.

identified, an adult 2nd phalanx and a deciduous mandibular incisor (I_d3). If we use age of epiphyseal fusion for white-tailed deer as a proxy for taruca, the animal was at least a young adult (11-17 months old) at death (Purdue 1983). As such, much of the large mammal and *Artiodactyla* bone is attributable to *Camelidae*.

Table 5.4: B1 - Pithouse / Midden Fauna (1/4”)

Taxon	NISP	MNI	% MNI	BoneWt (g)
Camelid	129	3	27.27	725.21
Taruca	6	1	9.09	16.45
Artiodactyla	6			6.82
Large Mammal	595			789.76
Viscacha	1	1	9.09	0.58
Guinea pig	1	1	9.09	0.07
Rodent	1			0.14
Mammal	12			5.12
Duck (*Anas* spp.)	1	1	9.09	0.11
Andean Avocet (*Recurvirostra andina*) cf.	1	1	9.09	0.13
Coot (*Fulica* spp.)	3	1	9.09	0.79
Bird	4			1.21
Orestias spp.	1	1	9.09	0.16
Trichomycterus spp.	1	1	9.09	0.18
Fish	1			0.20
Unid	4			1.13
Total	**767**	**11**	**100.0%***	**1548.06**

Note: Taruca antler: NISP=4, Bone weight=13.10 g, * Rounding error

By NISP, small mammals, birds, and fish constitute about 2% of bone. Birds, primarily those species frequenting wetland, lake, river, or pond habitats, are the second most important resource. Both native fish taxa, viscacha, and cuy appear in the sample, suggesting low-intensity fishing and small game hunting supplement the diet.

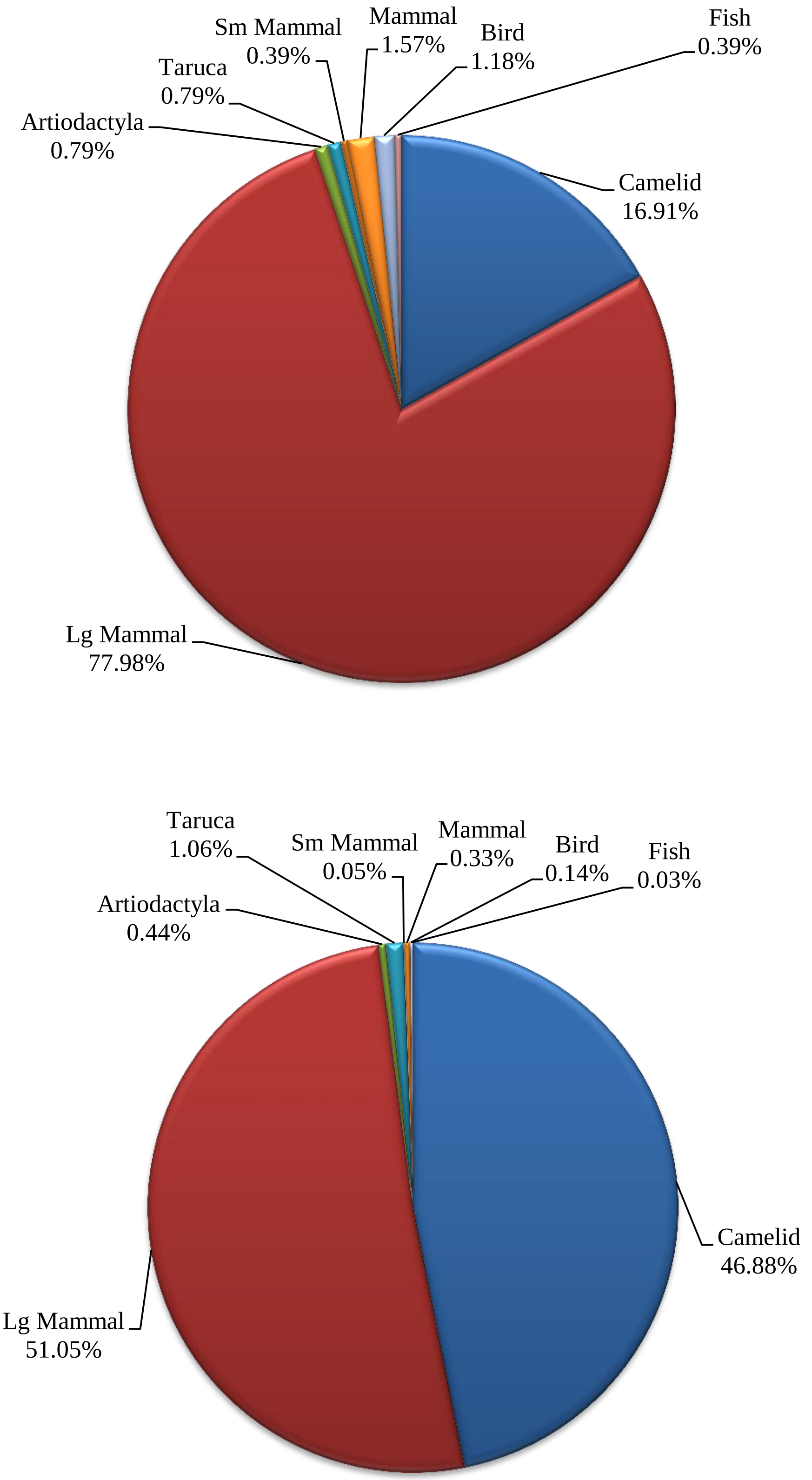


Figure 5.1: B1 - Pithouse / Midden Fauna (1/4" % NISP, Bone Weight)

One flotation sample from level B1 midden (Locus 298) was studied (Table 5.5). Flotation, in this instance, did not impact our understanding of this midden and the pithouse occupation. Most of the sample (by NISP) consists of unidentifiable, crushed mammal bone and fish and small game were a negligible component of the sample.

Table 5.5: B1 - Pithouse / Midden Flotation Sample (Locus 298)

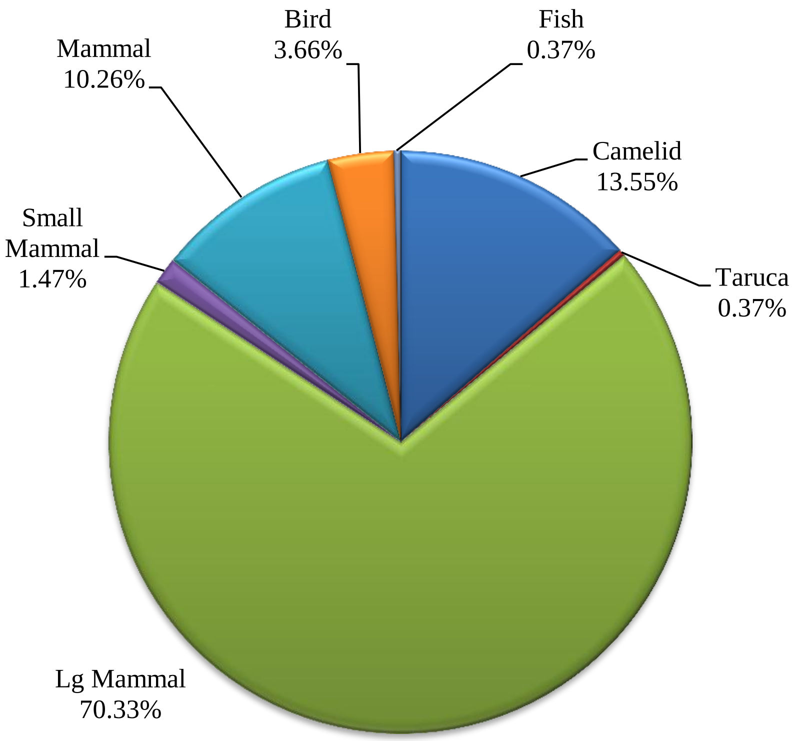
Taxon	Fragment Size	NISP	Bone Wt (g)
Camelid	¼”	2	10.85
Large Mammal	¼” and < ¼”	5	4.40
Mammal	¼” and < ¼”	37	3.46
Fish	< ¼”	1	0.06
	Total	**45**	**18.77**

Early Qaluyu: Adobe House Occupation (B2)

A similar, yet slightly more homogenous subsistence pattern is associated with the rectangular, adobe house. Faunal remains were recovered from a series of interior clay floors (events B57, 55, 51), a primary midden (event B 50) a pit midden (Feature 52), and the immediately adjacent exterior living floor contexts (Table 5.6, Figure 5.3). Fourteen tools, mostly weaving forms, and worked bone fragments were found within the house interior and middens.

Table 5.6: B2 - Adobe House (1/4”)

Taxon	NISP	MNI	% MNI	Bone Wt (g)
Camelid	37	3	37.5	317.07
Taruca	1	1	12.5	5.34
Large Mammal	192			246.55
Mammal	28			24.41
Guinea Pig	4	1	12.5	1.55
Bird	10	2	25.0	0.97
Fish	1	1	12.5	0.08
Unid	10			3.35
Total	**283**	**8**	**100.0**	**599.32**



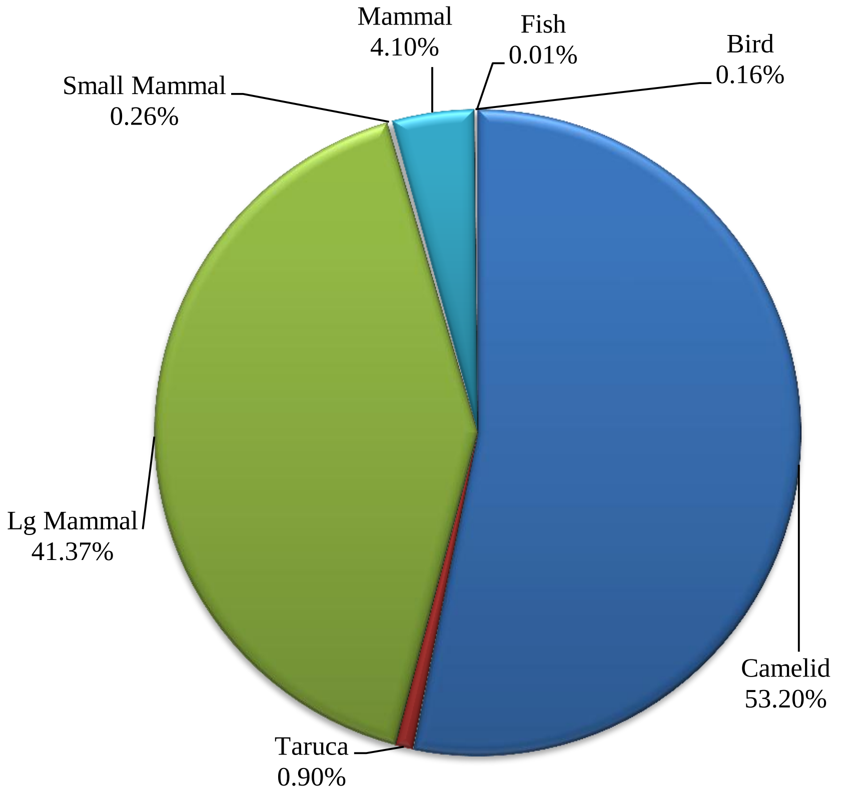


Figure 5.2: B2 – Adobe House Fauna (1/4" %NISP, Bone Weight)

Camelids again were the dominant taxa and the probable source of the large mammal remains. If we combine these two categories, camelids would contribute about 73% of NISP and 94% of bone weight. Taruca is identified by an adult 2nd phalanx.

Bird taxa, cuy, and fish continued to be exploited. When MNI is considered, the combined count of these taxa is comparable to that of camelids. Yet, the camelids' total meat weight contribution may still far outweigh non-camelids. This argument holds even if Formative households only infrequently culled camelids for fresh meat *ch'arki* packets (Miller and Burger 2000). We will discuss and analyze camelid skeletal part frequencies and culling practices in Chapters 7 and 8.

Two flotation samples (from Locus 283 and 281) are reviewed from stratum B2. Both correspond to the house's occupation zone and its compact floor surface (Table 5.7). Few new revelations are offered and taxa MNI remains unchanged. A fish cranial fragment from Locus 283 is identified as *Orestias* spp. A medium-sized mammal incisor is notable, given this category's absence from the coarse mesh sample. Finally, an additional worked camelid ilium tool fragment was discovered.

Table 5.7: B2 - Adobe House and Feature 52 Flotation Sample

Context	Taxon	Fragment Size	NISP	Bone wt (g)
House floor	Camelid	¼"	3	23.87
(Locus 283)	Large Mammal	¼" and < ¼"	12	21.01
	Medium Mammal	< ¼"	1	0.08
	Cuy	< ¼"	1	0.05
	Mammal	¼" and < ¼"	52	10.18
	Orestias spp.	< ¼"	1	0.01
		Total	**70**	**55.20**
House interior				
(Locus 281)	Camelid	¼"	1	78.65
	Mammal	< ¼"	8	0.94
	Amphibia	< ¼"	1	0.01
		Total	**10**	**79.60**

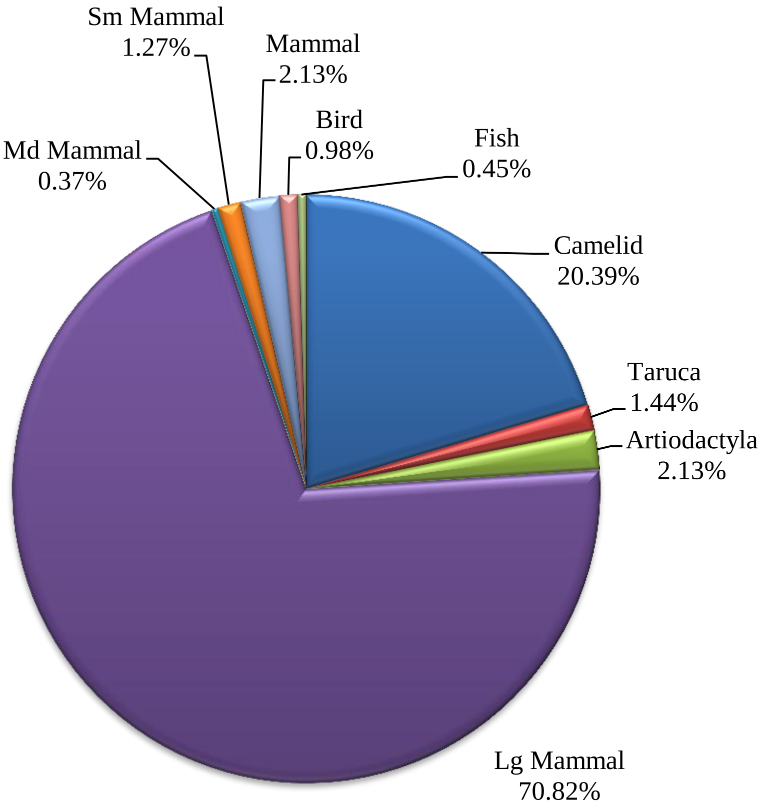
Early Qaluyu: House Abandonment / Midden (B3)

Following its abandonment, the house and its surroundings became the setting for a series of consecutive Early Qaluyu midden deposits, stratum B3 (Cohen 2010:129-131). Each midden was composed of ashy, burnt clay matrices mixed with fauna, ceramics, and artifacts (e.g. Feature 17 [event B 37]; event B 31, and events B 18-19) (Table 5.8, Figure 5.3). These finds and features are hypothesized to be detritus that accumulated following the burning and razing of the house upon its abandonment. Interestingly, the ¼" sample from these deposits contained 74 different worked bone and tool fragments, including awls, spatula forms, wichuñas, and fragments of a zig-zag-carved spoon handles. Cohen made this functional identification of spoon handle based on recovery of a larger fragment of an identical carved spoon from a nearby Formative site (2010).

Table 5.8: B3 - House Abandonment / Midden (1/4")

Taxon	NISP	MNI	% MNI	Bone Weight (g)
Camelid	497	7	35	4175.38
Taruca	35	2	10	176.74
Artiodactyla	52			131.03
Large Mammal	1726			2687.72
Skunk	6	2	10	16.04
Medium Mammal	3			4.70
Viscacha	14	2	10	4.44
Guinea Pig	8	2	10	1.86
Small Mammal	9			1.47
Mammal	52			53.99
Speckled teal *(Anas flavitostris) cf.*	8	2	10	1.95
Andean Avocet (*Recurvirostra andina*) cf.	1	1	5	0.60
Coot (*Fulica* spp.)	4	1	5	2.51
Bird	11			8.76
Orestias spp.	3	1	5	0.92
Fish	8			1.65
Unid	60			21.39
Total	**2497**	**20**	**100.0**	**7291.15**

Note: Taruca antler: NISP=15, bone weight=34.92 g



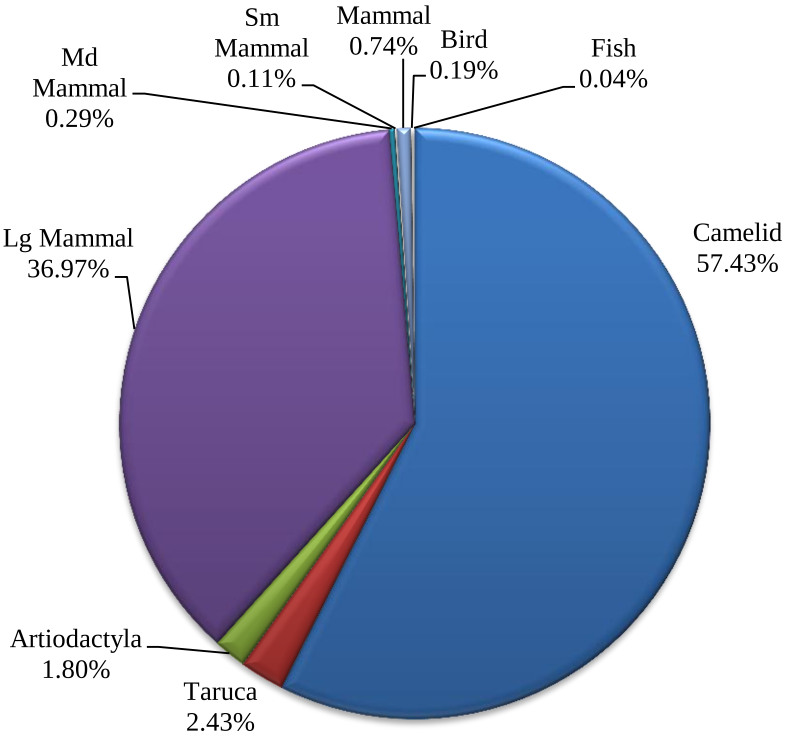


Figure 5.3: B3 - House Abandonment / Midden (1/4” % NISP, Bone Weight)

Compared to the preceding two, Stratum B3 contains a considerably larger bone sample by count and weight. In all likelihood, this reflects domestic trash accumulation over a longer slice of time. Camelids remain the primary resource. Taruca skeletal parts represented are mostly forelimb, mandible, and cervical vertebrae.

Yet, use of taruca, viscacha, and cuy exceeds that seen in previous levels. This fact, combined with the first use of skunk, reveals hunting contributed more to the Early Formative household economy than is evident in earlier strata. Likewise, fish and wetland-habitat birds remain as plentiful as before.

Flotation samples from three different post-house abandonment contexts were studied (Table 5.9). The first flotation sample is from Feature 52, a small pit midden dug into the exterior house floor (event B 100). The Feature 17 pit midden (event B 37) provides two flotation samples; it was excavated into a midden that overlays the exterior occupation floor (event B 41). The final sample was an admixture of midden with house structure roof fall (event B 81).

Features 17 and 52 provide further data to improve our understanding of discrete fishing catches. By siding premaxillary bones and noting size differences, the estimated stratum *Orestias* MNI equals five individuals. Under those circumstances, fish would constitute 21% of the sample relative to camelid’s 29% MNI contribution. Between flotation samples and the coarse mesh, two different sized vertebrae were found. This may indicate netting of large and small *Orestias* species without regard to body-size (see Capriles 2006:62) or relatively complete fish remain deposits. As much of Stratum B3’s bone was burnt, we cannot assess the method by which these fish were prepared.

Table 5.9: B3 - House Abandonment / Midden Flotation Samples

Context	Taxon	Fragment Size	NISP	Bone wt (g)
Feature 52 midden	Camelid	¼”	1	5.66
(Locus 537)	Large Mammal	**¼”**	3	10.12
	Mammal	¼”	10	4.47
	Sm Rodent	< ¼”	1	0.01
	Orestias spp.	< ¼”	1	0.01
	Fish	< ¼”	1	0.06
		Total	**17**	**20.33**
Feature 17 midden				
(Loci 17, 85)	Camelid	¼”	1	9.12
	Lg Mammal	¼” and < ¼”	14	10.18
	Sm Rodent	< ¼”	4	0.04
	Mammal	¼” and < ¼”	54	7.09
	Bird	< ¼”	2	0.02
	Frog	< ¼”	3	0.02
	Orestias spp.*	< ¼”	9	0.08
	Fish	< ¼”	7	0.07
	Unid	< ¼”	6	0.02
		Total	**100**	**26.64**
Roof-fall Midden				
(Loci 410)	Camelid	¼”	4	46.40
	Lg Mammal	¼”	3	3.45
	Mammal	¼”	3	0.79
	Small Bird	< ¼”	3	0.03
	Amphibia	< ¼”	23	0.46
		Total	**36**	**51.40**

*** Includes 1 fish scale**

In sum, the Early Formative (Qaluyu) strata display a mixed household diet and economy. While the diet emphasis was on camelids, cuy and small mammals, birds and fish remain key minor, components. As discussed in Chapter 7, households may have sporadically undertaken low-scale vicuña hunts. Stratum B3, because of its longer accumulation period and ashy matrix, was a more comprehensive sample of daily diet.

Late Qaluyu Midden (Stratum B4)

Stratum B4 (event B 17) was a single thick clay midden composed of burnt adobe structural fragments, ceramics, bone and bone tools, and lithics (Cohen 2010:138). Eighteen worked bone or tool fragments were found within the ¼” screen sample, including weaving, bone working byproducts, and another small spoon handle fragment. The recovered fauna are depicted in Table 5.10 and Figure 5.4. No flotation samples were reviewed for this stratum.

Table 5.10: Late Qaluyu Midden (1/4")

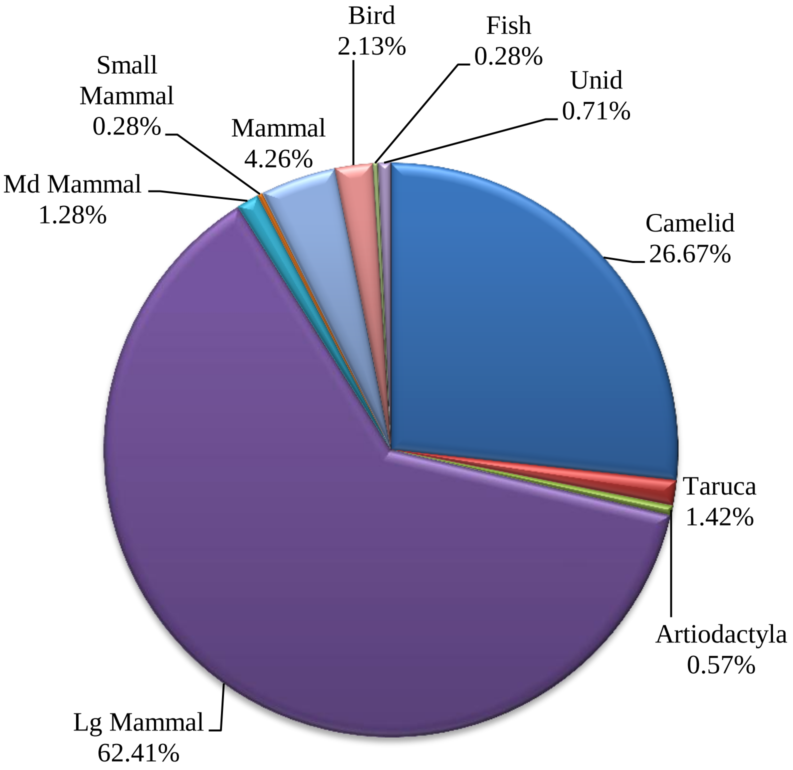
Taxon	NISP	MNI	% MNI	Bone Weight (g)
Camelid	188	4	33.3	1453.84
Taruca [1]	10	2	16.7	111.05
Artiodactyla	4			14.87
Large Mammal	440			862.27
Skunk	8	2	16.7	23.40
Medium Mammal	1			0.73
Small Mammal (Rodent)	2	1	8.3	0.29
Mammal	30			27.84
Slate-colored coot (*Fulica ardesica*) cf.	1	1	8.3	0.38
Speckled teal (*Anas flavitostris*) cf.	1	1	8.3	1.21
Bird	13			5.77
Fish	2	1	8.3	0.51
Unid	5			2.53
Total	**705**	**12**	**100.0***	**2504.69**

<u>Note</u>: [1] Taruca antler: NISP=3, bone weight=15.11g (bone and antler included in Figures)
*** Rounding error**

The Late Qaluyu domestic midden displays the now familiar pattern of Formative faunal exploitation at Hautacoa. While camelids dominate by each quantitative measure, hunting of taruca, skunk, and wetland-habitat birds is an important secondary dietary and economic emphasis. Adult and juvenile taruca skeletal postcranial bones were identified, specifically those from the forelimb, hindlimb, sternum, and cervical column.

Late Formative Midden (Stratum B5)

The final Area B stratum, B5, consists of two probable Pukara-age middens (events B15, B10) and Feature 22, a large stratified pit midden (1.6 m diameter x 1.2 m in depth, events B12-14). Like Stratum B4, its midden deposits are believed to be the result of long-term disposal of domestic occupation debris. Much of the faunal sample and the



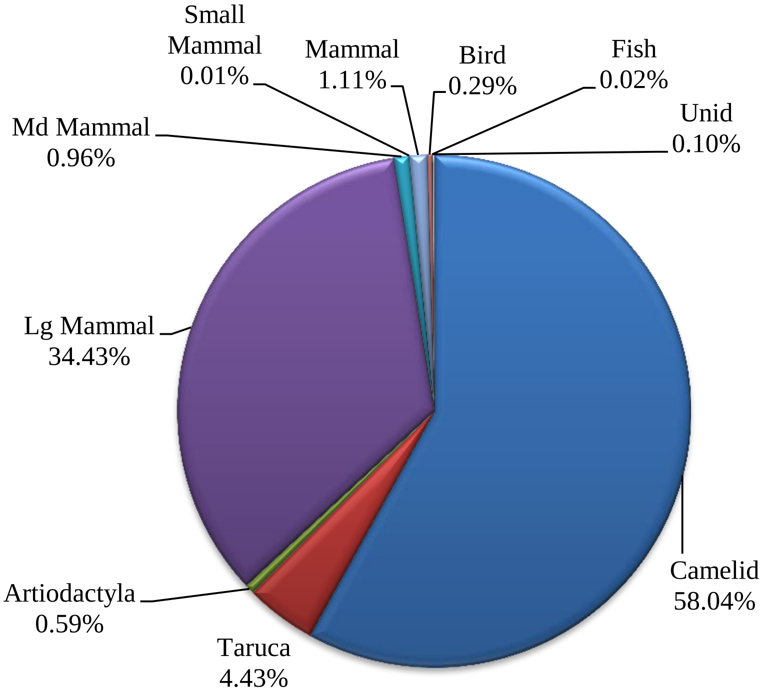


Figure 5.4: B4 – Late Qaluyu Midden Fauna (1/4” %NISP, Bone Weight)

midden matrices display evidence of burning. In addition, thirty worked bone and weaving tool fragments were identified.

Stratum B5 had the highest camelid NISP and bone weight observed for the Late Formative domestic habitation strata (Table 5.11, Figure 5.5). Feature 22 is distinguished by herd animals of varying age and body size and nearly complete absence of all other fauna. This context, like Area A's Features 3 and 24, may represent a special pit preserving trash from a feasting event. Unfortunately, detailed description of ceramics and other artifacts collected from the Feature were not available to provide additional lines of evidence to test this data. This question will be further reviewed in Chapter 8.

Based on MNI counts and NISP, wetland-habitat birds rank second in significance. Taruca, cuy, and fish were less commonly exploited. Identified adult and juvenile taruca skeletal elements include two halves of a pelvis, podial bones, an atlas vertebra, and mandible.

Flotation samples from two contexts, the B15 midden and Feature 22, were examined (Table 5.12). The recovery of fish within the B15 sample augments our understanding. First, killfish (*Orestias* spp.) identification provides a more taxonomically specific identification for the fish identified in the coarse-mesh data. Second, variation in fish cranial element size indicates stratum MNI should be increased to three individuals.

In summary, Area B provides a succinct sketch of the Early through Late Formative Huatacoa domestic diet and economy. It did not dramatically change during the Formative Period. The dominance of domesticated camelids was complemented, at a

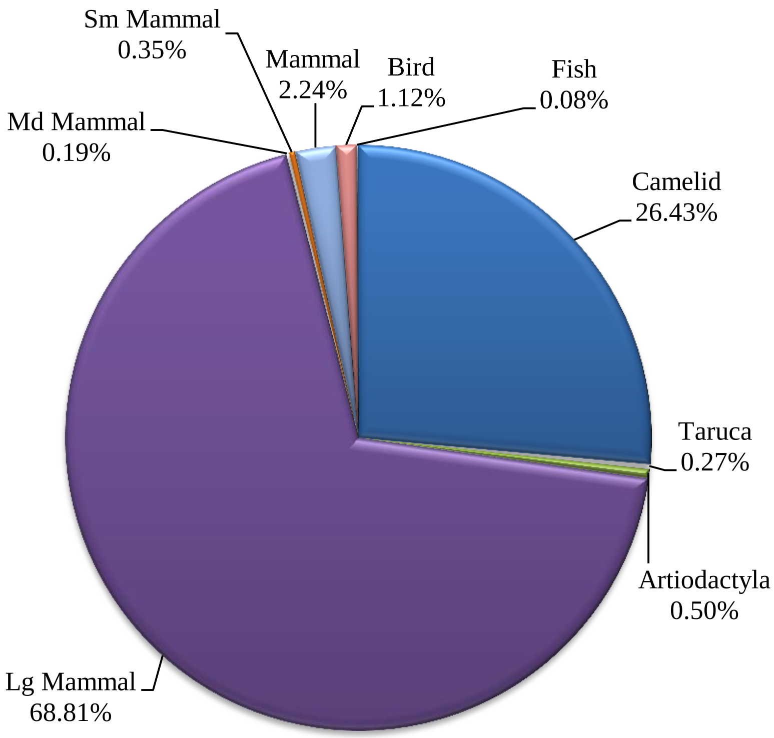
Table 5.11: B5 – Pukara-Period Midden (1/4")

Taxon	NISP	MNI	% MNI	Bone Weight (g)
Camelid	683	5	31.25	5017.77
Taruca	7	2	12.50	96.68
Artiodactyla	13			31.24
Large Mammal	1778			2954.15
Canidae	2	1	6.25	10.66
Medium Mammal	3			3.22
Cuy	5	1	6.25	1.64
Small Mammal	4			1.63
Mammal	58			24.84
Rallidae	2			0.76
Slate-colored coot (*Fulica* ardesiaca) cf.	9	3	18.75	5.07
Duck (*Anas* spp.)	5	2	12.50	1.29
Common Moorhen (*Gallinula chlorpus*) cf.	1	1	6.25	0.60
Bird	12			2.96
Fish	2	1	6.25	0.29
Unid	101			44.74
Total	**2685**	**16**	**100.0**	**8197.54**

Note: Taruca antler: NISP=1, Bone weight=1.75 g (bone and antler included in Figures)

Table 5.12: B5 – Pukara-Period Midden Flotation Samples

Context	Taxon	Fragment Size	NISP	Bone Weight (g)
Feature 22	Camelid	¼"	2	33.40
(Loci 531-532)	Lg Mammal	¼"	11	9.64
	Mammal	¼"	31	11.58
	Fish	< ¼"	1	0.03
		Total	**45**	**54.63**
B 15 midden				
(Loci 507)	Camelid	¼"	4	10.07
	Lg Mammal	¼" and < ¼"	16	11.27
	Cuy	<¼"	1	0.12
	Mammal	¼"	1	0.06
	Slate-colored coot (*Fulica ardesica*) cf.	¼"	1	0.51
	Bird	<¼"	1	0.01
	Orestias spp.	<¼"	1	0.01
	Fish	<¼"	4	0.11
	Amphibia	<¼"	8	0.04
		Total	**37**	**22.20**



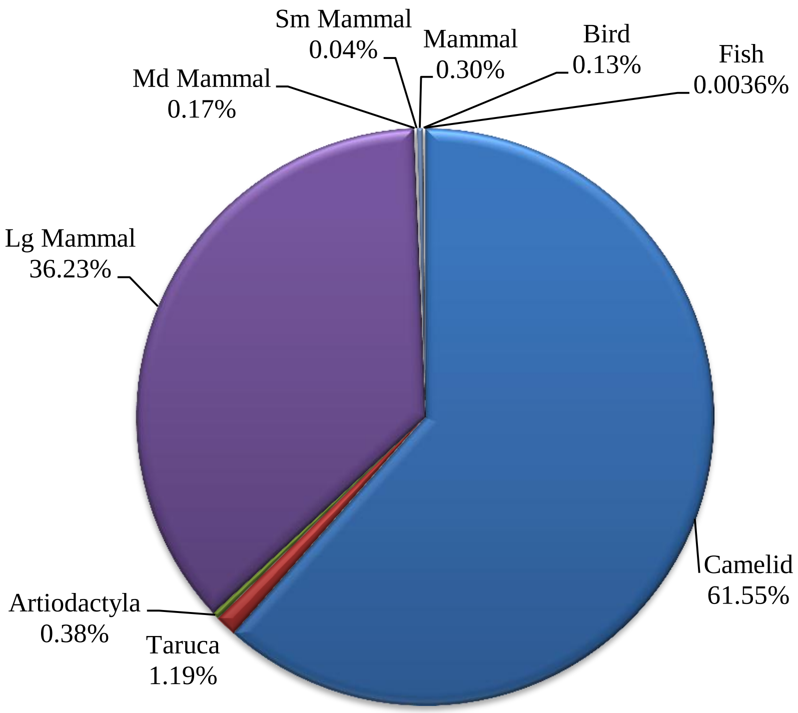


Figure 5.5: B5 – Pukara-Period Midden (1/4” %NISP, Bone Weight)

comparatively lower-intensity, by hunting of vicuña (Early Formative-only), wetland birds and fishing. Late Formative Feature 22 and associated midden deposits may represent trash generated by a suprahousehold, feast.

Analysis of flotation samples increased the visibility of fish and my ability to make more taxonomically specific identifications. Analysis thus led to an increase in their MNI value. In the future, analysis of more flotation samples may allow for a refinement of our understanding of fishing in local subsistence.

Sunken Court Ritual Contexts (Area A)

As in the domestic residence Area B, the ritual precinct had five defined strata dating from the Early Formative (Early Qaluyu) through the Late Formative (Pukara) use of the sunken court (Cohen 2010:234-236). Court strata were somewhat complicated by: 1) between-occupation fill deposits that provided foundations for successive court construction and 2) destruction of or recycling of previously used patio or court surfaces. In contrast to the Pukara faunal analysis, I included fauna from some fill contexts in this stratigraphic analysis[66]. Ambiguous, multi-component event contexts are not included in this analysis.

Early Qaluyu Sunken Court (Strata A1-A2)

Cohen defines two Early Qaluyu strata: stratum A1 and A2 (2010). Stratum A1 preceded the sunken court construction and consists of an open plaza area and an

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[66] Inclusion of fauna from fill is justified based on the assumption that courts, as ritual spaces, were periodically cleaned of debris (Cohen 2010:333-334) to “reset or reorder” the context for future events (however see Janusek 2004b:143 for contrary argument).

New court construction involves reuse and rededication of the sacred space. The “recycled” trash of past rituals represent convenient, or even ritually appropriate, fill to serve as a new foundation. Alternatively, trash may represent *in-situ* deposition or dedicatory rites that are part of court- renewal activities.

associated midden. Stratum A2 was composed of exposed portions of the Early Qaluyu sunken court floor, the court structure, remnants of court floor pit (Feature 21), and an adjacent patio floor. As few faunal remains were recovered from these two contexts, I will discuss them below in a single section.

The earliest Area A occupation surface was a prepared yellow clay plaza floor (event A46) (Cohen 2010:149-150). In-situ burning events are documented by burnt earth and embedded charcoal. Debris associated with the floor's use (A45) included utilitarian Early Qaluyu ceramic sherds, lithics, and animal bone. A nearby midden (A80) holds remains from the use of this plaza: ash, ceramics, two projectile points, and bone tools and unmodified animal bone. An awl, a probable spoon bowl, and small worked bone fragment are present.

The first sunken court structure was identified in two test units (N986 E1003 and N981 E1005). The subterranean court was cut into the preceding plaza ground surface, where a new yellow clay court floor was prepared (event A53). The shallow Feature 21 (event A55), whose fill consists of ashy midden, was dug into the court floor. The feature was truncated by a subsequent, unanalyzed fill deposit (A39) associated with the foundation of the first Late Qaluyu court. An associated above-ground platform patio floor (A36) was found outside the court perimeter. According to Cohen (2010:157), the patio surface yielded evidence of repeated ritual burning events. Almost the entire A2 stratum bone sample derives from this patio and Feature 21.

The very small faunal ¼" samples are composed of large mammal and camelid bone from a subadult / young adult animal (Table 5.14). A bird tibiotarsus was the only non-mammalian bone found. This impression changes only slightly if we consider flotation fauna from Feature 21 (Table 5.15). The sample adds a small bird specimen and two fish (based on vertebrae-size differences). Early Sunken Court consumption focused camelids and fish (now MNI=2).

Table 5.14: Early Qaluyu Bone (1/4")

	Camelid	Large Mammal	Mammal	Bird	Unid	Total
A1 (Plaza): NISP	3	8	1	1		13
A2 (Court)	5	11	3	0	1	21
Total	**8**	**19**	**4**	**1**	**2**	**34**
A1 MNI	1			1		2
A2 "	1					
Total	**1**			**1**		**2**
A1 Bone Weight (g)	14.66	10.42	0.59	0.21		25.88
A2 "	35.02	46.12	1.87		0.04	95.14
Total	**49.68**	**56.54**	**2.46**	**0.21**	**0.04**	**121.02**

Table 5.15: A1 – Feature 21 Flotation Fauna (Locus 166)

Taxon	Fragment size	NISP	Bone Weight (g)
Camelid	¼"	4	5.77
Lg Mammal	¼"	7	14.46
Mammal	< ¼"	20	1.50
Bird	< ¼"	1	0.01
Fish	< ¼"	2	0.02
Unid	< ¼"	3	0.03
	Total	**37**	**21.79**

We can offer three hypotheses for the low frequency of bone: 1) these contexts were not a setting for frequent food consumption, 2) post-disposal taphonomic processes (burning, cleaning of surfaces) destroyed bone, and/or 3) the small area sampled does not provide accurately represent the range of activities enacted. I favor the former two scenarios as explanations. Households likely served as the primary setting for eating and economic activity in this early occupation. Burning features are noted in both the off-plaza midden (Stratum A1) and patio (Stratum A2). These features indicate Early Qaluyu ritual activity included the destruction of food and good offerings by fire.

Late Qaluyu: First Sunken Court Construction / Destruction (A3)

While the Late Qaluyu (LQ) sunken court underwent two construction phases. This analysis considered only fauna from the First Court (A3). Several events accumulated the faunal bone associated with lifecycle of the First court: its foundation (fill deposits), final form, associated with activity areas, a central tomb burial (Burial 7), and post-destruction features / fill (Table 5.16). The potential for analytical ambiguity was too high. The Late Qaluyu Second Court patio floor (A18) was reused for the Pukara sunken court[67].

Fauna were recovered from several deposits that composed the Late Qaluyu (LQ) First court and its adjacent surfaces. The LQ First sunken court-associated stratum consisted of a midden fill-foundation, a platform mound, the sunken court, and near-mound deposits (Cohen 2010:158-192). Midden fill layers (events A29, A33-35, 39, and A75) provided a foundation for the above-court platform patio surface (A25). The platform and court were both trapezoidal in shape. Cohen notes the court itself was relatively clean (2010:167), though some faunal remains were recovered from court's bin structures and from a high –status mortuary tomb (burials 6-7) constructed in the court's wall. Primary middens associated with the court itself included A78 and greenish ashy,

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[67] A decision was made in laboratory to exclude A18 fauna from analysis given the overlap in use of the floor by both the Late Qaluyu- and Pukara-associated occupations.
However, Burial 53 (a pre-Second court dedicatory sacrifice) was included in my assessment of the First court. Technically, this was a transitional event that just predated the laying of the Second Court's A18 floor.

A73 midden. The latter was a burning rite that preceded the First Court's abandonment (Cohen 2010:174-175).

Table 5.16: A3 – Late Qaluyu First Sunken Court (1/4")

Taxon	NISP	MNI	% MNI	Bone Weight (g)
Camelid	508	5	25	4398.90
Taruca [1]	108	2	10	126.79
Artiodactyla	17			28.27
Large Mammal [2]	1481			2386.91
Medium Mammal [3]	3	1	5	4.61
Cuy	11	2	10	2.22
Small Mammal	1			0.07
Mammal	74			27.93
Bird, unidentified	26			5.96
Cathartes aura	4	1	5	8.47
Accipitridae	3	1	5	1.98
Rallidae	1			0.32
Gallinula chlorpus cf.	1	1	5	0.12
Fulica spp.	19	4	20	9.65
Fish	5	2	10	0.79
Amphibia	1	1	5	0.07
Unid	23			4.34
Total	**2288**	**20**	**100.0**	**7007.40**

[1] Taruca non-antler NISP=5, Bone Weight=43.33 g (displayed in subsequent figure).

[2] Includes bone from Fea 53 (burial 10), which has comingled non-human large fauna and a human sacrifice (Lg Mam NISP=249, Wgt=483.20 g) and the Court high status tomb retainer burial (burial 7) – that also contained camelid remains (Lg Mam NISP=27, Wgt=32.06 g).

[3] Much of this bone comes from Fea 53 (burial 10): NISP=2, Bone Weight=4.09 g

Three ritual features and several patio-closing deposits associated with A3 Stratum produced fauna (Warwick 2012). First, the central burial (burial 6) was accompanied by a burnt offering share of the funerary feast that was consumed by relatives. Camelid bone was charred, fractured, and showed cutmarks. Second, the Feature 57 pit (A186), whose contents consist of an offering of four ceramic vessels and fauna, was likely associated with the First Court closing rite burnt midden (A73). This burnt offering (A73) contained a mix of taxa in combined mesh sample. Identified remains included camelid (MNI=4), bird, killfish (MNI=2), bird, *Accipitridae*, cuy, *Chinchillidae*, and taruca (Warwick 2012). Third, Feature 53 (burial 10) is the aforementioned human sacrifice dedicatory offering that preceded the Late Qaluyu Second Court's construction. This dedicatory court human-animal burnt sacrifice juxtaposed camelid, taruca, medium mammal, and bird bones. No cutmarks were recorded on the remains.

Table 5.16 and Figure 5.6 characterize the taxa present and their abundance. Camelids are the most frequently quantified taxa. In all likelihood, crushed camelid bone also is the probable origin for unidentifiable artiodactyl and large mammal bone. Discussed in Chapter 7, phalanx osteometrics record culling of a small camelid (either vicuña or alpaca) as part of Middle Formative rites centered on the Late Qaluyu Second Court's construction. Wetland birds make up the second largest taxonomic group by NISP and MNI count. Cuy, taruca, and fish constitute tertiary taxa. However, if weight is considered, non-camelid taxa represent minor contributor to total sample weight.

In particular, it is worth noting the presence of camelid, small mammal, and bird fauna occur within all court contexts. Each is a component of burial contexts (i.e. formal burials / sacrifices and the ancestor-veneration-associated court bins), primary middens, the burned midden closing rite (A 73), the Feature 57 ceramic offering, and platform foundation midden and post-destruction fill. Thirty-four worked bone and tool fragments were found, including weaving tools, a bead, and five possible snuff spoon fragments[68]. The co-occurrence of these worked bone forms in domestic and ritual contexts further

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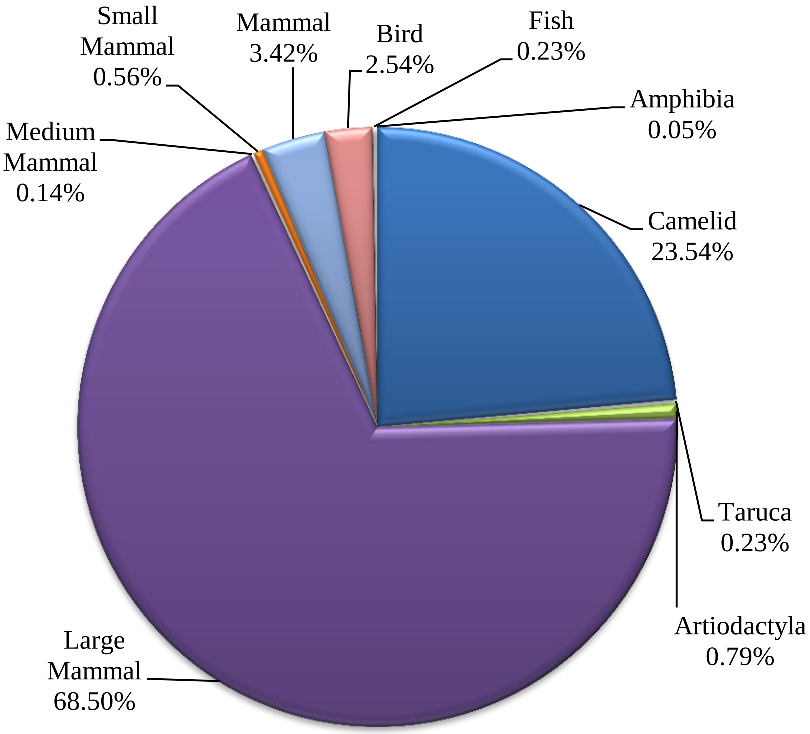
[68] The latter examples appear within Feature 57, Feature 53, and the pre-LQ First Court platform foundation fill midden.



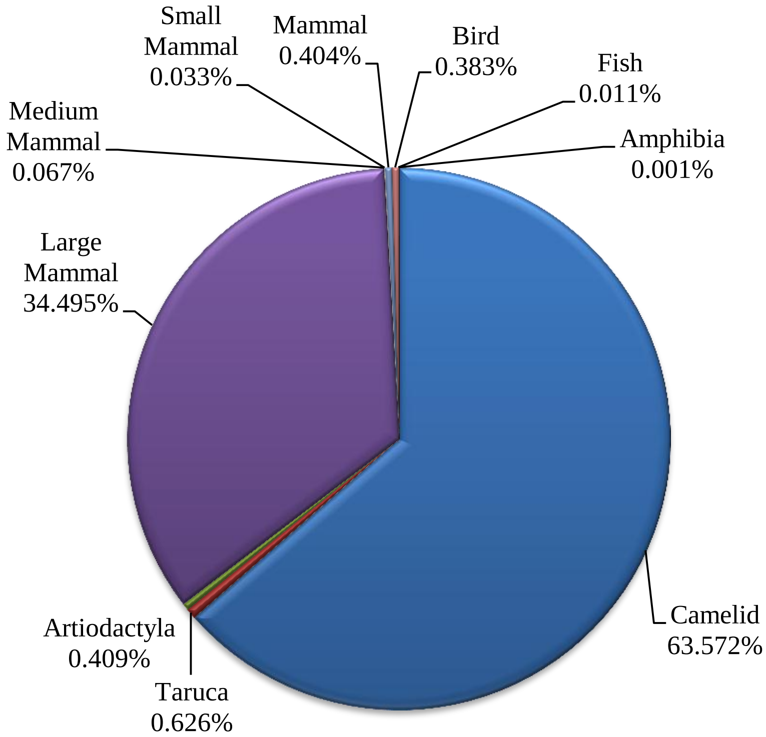


Table 5.6: A3 –Late Qaluyu First Sunken Court Fauna (1/4" %NISP, Bone Weight)

demonstrates the potentially fluid boundary between quotidian domestic and sacred economic activities in Formative society (see e.g. Dean and Kojan 1999).

Many specimens are burnt, suggesting they were part of sunken court burnt offerings. Therefore, residents drew upon the same wild and domesticated taxa, that werepart of the subsistence economy, as components of the ritual economy's sacrifices and meals. Wild game appears particularly concentrated in these ritual- contexts, measured by MNI, relative to the Area B domestic remains. Of final note, both hawk and vulture birds-of-prey (MNI=2) were found in the midden deposits (platform mound base fill, destruction-level middens) and burnt offerings (the closing-rite midden). Cutmarks were identified, on a *Cathartidae* femur and humerus, documenting wing and leg dismemberment. This may have facilitated feather and/or meat fileting.

Table 5.17: A3 –Late Qaluyu First Sunken Court Flotation

Context	Taxon	Fragment Size	NISP	Bone Weight (g)
Primary midden (A78)	Large Mammal	¼”	14	6.94
loci 356, 463	“	< ¼”	1	0.08
	Mammal	< ¼”	8	0.91
	Sm Bird	< ¼”	1	0.02
	Orestias spp. [1]	< ¼”	11	0.06
	Fish	< ¼”	3	0.02
		Total	**38**	**8.03**
Burnt closing rite midden (A73)	Camelid	¼”	4	20.46
loci 242, 254, 462	Large Mammal	¼”	6	6.43
	“	< ¼”	18	1.36 [2]
	Mammal	¼”	19	13.34
	“	< ¼”	27	2.96
	Orestias spp. scales	< ¼”	37	0.13
	Fish	< ¼”	12	0.17
	Amphibia	< ¼”	1	0.04
		Total	**124**	**24.43**
Feature 57: ceramic offering (A186)	Large Mammal	¼”	2	6.06
Locus 577	Mammal	< ¼”	10	0.65
	Amphibia	< ¼”	1	0.03
		Total	**13**	**6.74**

Notes: [1] Includes 1 fish scale, [2] Weight missing for 1 specimen

Flotation data from the A3 Stratum are presented in Table 5.17. Fish remains from both primary middens associated with the court hint they were part of court ritual offerings and meals. For instance, scales, vertebrae, and cranial elements identified to large and small *Orestias* fish species were recovered. Vertebrae size differences in the closing ritual context alone indicate an MNI of 2 – the same MNI value suggested for the stratum as a whole. Overall, the same wild species observed elsewhere at Huatacoa appear also in ritual contexts and offerings.

Early and Middle Formative ritual feasts and offerings, centered on the the Huatacoa sunken court, which were provisioned both by household-level foraging and camelid cullings. The locale became a formalized ritual site starting in the later Early Formative. However, a moderate scale of consumption by multi-family gatherings is indicated. Contrary to our expectations, wild game complemented camelids and cuy as feast and offering components.

Pukara Period: Final Sunken Court (A5)

The final use of the sunken court precinct centers on the construction of a roughly square-shaped, Pukara-style sunken court (Cohen 2010:210-229). Fauna were collected from locations of where court activities took place: 1) from ashy, burned patio deposits (A67, A88, A90); 2) a narrow trench midden encircling the court wall's top (A106), and 3); and possible offering features from nearby patio surfaces (Features 3, 19, and 24).

In several ways, faunal use related with the Late Formative Pukara sunken court activities mirrors observations at other domestic and sunken court contexts (Table 5.18, Figure 5.7). Large mammals, i.e. camelids, outweigh and outnumber by NISP and bone all other taxonomic categories. However, wetland birds and small mammals rival camelid's importance in these ritual contexts. Small toads (*Bufo* spp.) are unexpectedly numerous[69]. Fish exploitation appears to have been relatively low. Furthermore, much of the recovered bone shows a degree of burning indicative of patterns of food preparation and offerings. Finally, twenty-four worked bone or tool fragments were identified.

Table 5.18: A5 – Pukara-Period Sunken Court (1/4")

Taxon	**NISP**	**MNI**	**% MNI**	**Bone Weight (g)**
Camelid	659	4	13.3	5071.05
Taruca [1]	10	1	3.3	61.39
Artidoactyla	26			34.16
Large Mammal	1733			1966.63
Canidae cf.	10	1	3.3	36.96
Medium Mammal	2			14.28
Viscacha cf.	5	2	6.7	3.60
Cuy cf.	22	2	6.7	4.96
Small Mammal	5			0.65
Mammal	176			66.90
Rallidae	6			1.40
Fulica spp.	17	3	10	6.70
Gallinula chlorpus	2	1	3.3	0.91
Anas spp.	6	1	3.3	2.14
Cathartidae spp.	4	1	3.3	1.30
Bird	43			9.23
Trichomycterus spp.	3	1	3.3	0.54
Orestias spp.	2	1	3.3	0.25
Fish	7			0.82
Amphibia [2]	161	12	40.0	5.52
Unid	53			13.65
Total	**2747**	**30**	**100***	**7286.7**

[1] Non-antler bone: NISP=4, Bone weight=54.41 g;
[2] ¼" (and smaller) fragment size from F-3 and 24 coarse-mesh samples
*** Rounding error**

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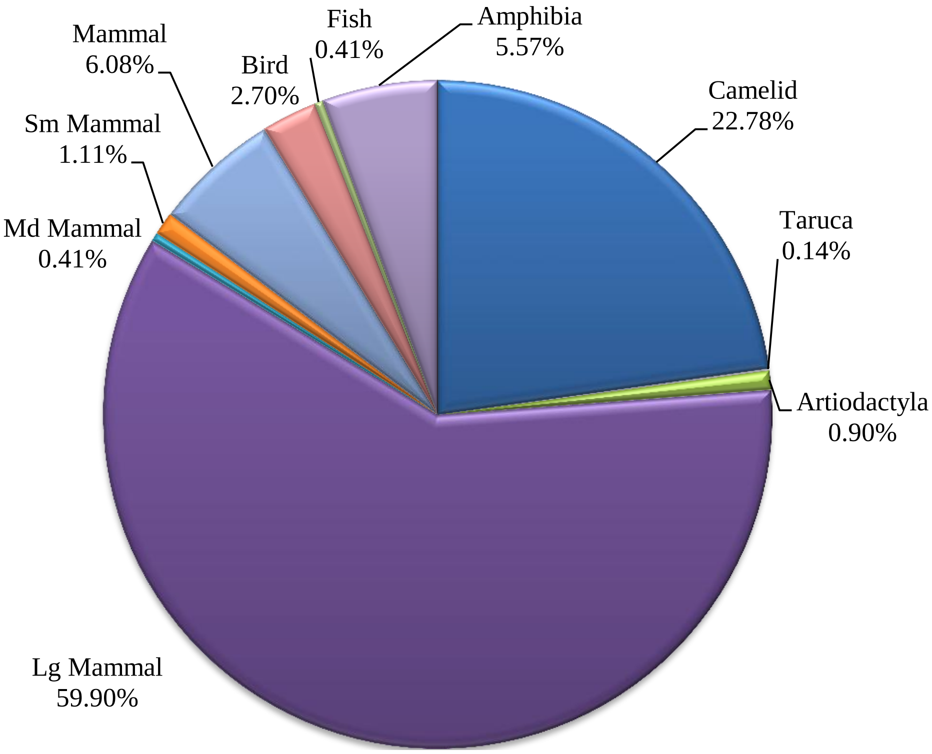
[69] Toads are densely concentrated within Feature 3. This odd concentration is interpreted further below.



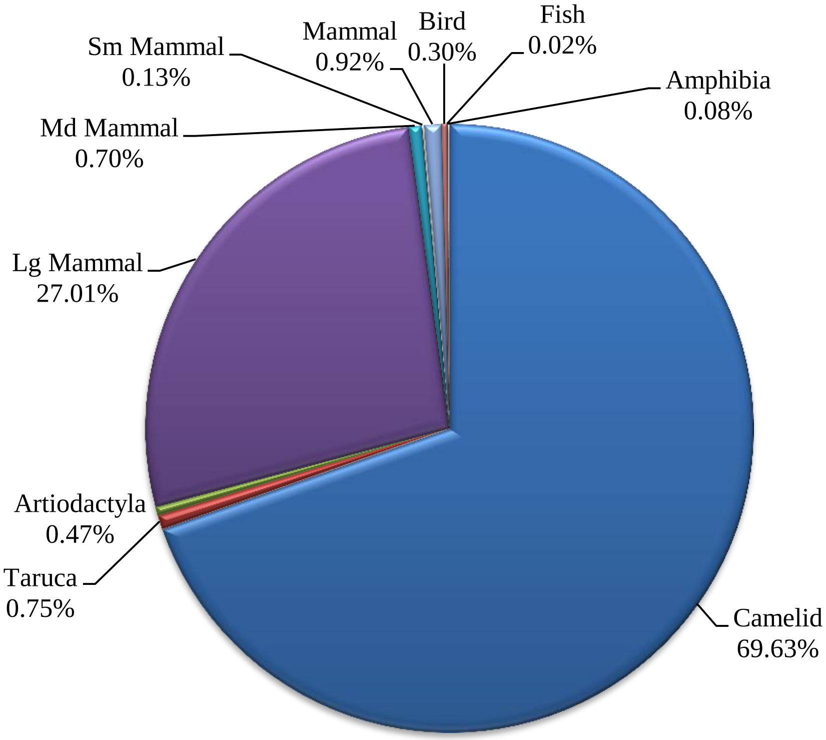


Figure 5.7: A5 – Pukara-Period Sunken Court Fauna (1/4" %NISP, Bone Weight)

A few taxa are predominantly concentrated in a few palimpsest pit midden deposits. For instance, an informal series of ashy midden strata (A129-133) lie within a pit excavated into the patio floor (A61) located on the west side of the court. Its lowest strata (A132-133) contain nearly all of the small dog or fox-sized *Canidae* bone. The pit also contains a diverse and dense bird sample: 1) all four *Cathartidae* bones; 2) several coot and duck remains; and 3) unidentifiable bird specimens. The canid remains are mostly calcined, while the bird and camelid remains are lightly charred. I interpret this as evidence of cleaned debris from a burnt offering and a meal prepared by indirect-fire roasting (Moore et al. 2007). The two midden deposits (A62-63) covering this pit contain the densest accumulation of scorched cuy, moorhen, and fish bone. Likewise, the only identified ¼" viscacha and catfish bone from the final court were encountered within the wall trench midden (A106) that abuts the east court wall.

Table 5.19: A5 – Feature 19 Fauna (1/4")

Taxon	NISP	Bone Weight (g)
Camelid	44	313.14
Taruca (antler)	2	2.35
Artiodactyla	3	5.04
Large Mammal	181	263.39
Mammal	1	1.47
Coot (*Fulica* spp.)	1	0.49
Ducks (*Anas* spp.)	2	0.86
Bird	2	0.22
Unid	3	1.64
Total	**239**	**588.60**

Unlike previous court strata, A5 contains three feature pits excavated into the sunken court's western patio. I will characterize each one's contents and the results of flotation analysis of several samples. As with the informal pits above, these features document residues from discrete ritual meals and offerings. Feature 19 (Table 5.19) is a 1.25 m diameter pit with a moderately dense midden deposit fill (A48), which includes camelid (MNI=2) and large mammal bone, and isolated coot and duck remains (each MNI=1).

In contrast, Features 24 and 3 differ from Feature 19 as clay-lined, stratified pits (Table 5.20). Feature 24 is located somewhat west of the Late Formative court's perimeter. It measures 1.44 m in diameter and one meter in depth; it consists of five strata layers (A59-60, A81-83) (Cohen 2010:227). The two lowest midden fill layers (A81-A82) consist of an ashy matrix. A Pukara bowl fragment (Cusipata style) was found at the base (A82). Camelid dominate (MNI=2)[70]. They are accompanied by one killfish and an avocet (wetland bird) (MNI=1 for both). Raptor and toad bones (both MNI=1) represent probable non-food taxa.

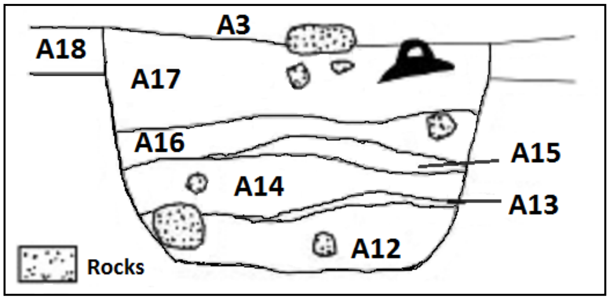


Figure 5.8: Feature 3 North Profile (adapted from Cohen 2010: Figure 6.41)

Feature 3 stands out as a probable organized ritual trash deposit. It featured stratified clay midden deposits of artifacts and animal bone; each clay layer was separated by pebble lenses (A12-17) (Cohen 2010:216-221) (Figure 5.9). Each stratum contained toad bones, sherds, burnt earth, and charcoal. The base stratum (A12) had a Late Qaluyu polychrome bowl sherd, three camelid crania (from a yearling and an alpaca and llama, both 4-5 years old), pupfish bones, and a rib blade tool. Stratum A14 contained fractured limb and rib bones, a wichuña tool, and a Pukara feline-head

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[70] Remains of a probable vicuña are included in Feature 24 (see Chapter 7 phalanx data).

incensarío sherd. Stratum A16 contained lower-limb bone elements and ribs, a possible catfish bone, a weaving shuttle and an abrader. The top stratum (A17) had the top-half of a Pukara olla, whose interior is stained white, suggesting water storage. Taken together, I suspect it as a probable ritual deposit (sensu Kansa and Campbell 2004) because of: the feature's sealed, stratified deposit, evidence of burning, mixture of artifacts, and food non-food taxa.

Table 5.20: A5 – Feature 24 and 3 Fauna (Combined ¼" and Flot bone)

Context [1]	**Taxon**	**NISP**	**Bone Weight(g)**	**Flot NISP**	**Flot Bone Weight(g)**	**Total NISP**	**Total Weight (g)**
Feature 24	Camelid	95	569.40	8	31.97	103	601.37
	Artiodactyla	2	3.53	5	8.53	7	9.06
	Lg Mammal	216	259.20	100	50.61	316	309.81
	Canidae	1	1.23			1	1.23
	Sm Mammal	1	0.07			1	0.07
	Mammal	31	11.66	509	47.99	540	59.66
	Accipitridae			1	0.44	1	0.44
	Avocet (*Recursitova andina*)			1	0.02	1	0.02
	Bird	5	0.47	2	0.09	7	0.56
	Orestias spp.[2]			7	0.05	7	0.05
	Fish			3	0.04	3	0.04
	Amphibia	24	0.76	1	0.01	24	0.77
	Unid	5	1.20	9	0.78	14	1.98
	Total	**380**	**847.52**	**646**	**140.53**	**1026**	**98805**
Feature 3	Camelid	115	1071.30			115	1071.30
	Artiodactyla	11	12.69			11	12.69
	Lg Mammal	261	277.23	78	41.86	339	319.09
	Cuy	2	0.05			2	0.05
	Sm Mammal			1	0.01	1	0.01
	Mammal	42	11.13	249	20.68	291	31.81
	Bird	1	0.02	2	0.16	3	0.18
	Orestias [2]			6	0.03	6	0.03
	Trichomycterus spp.[3]			1	0.01	1	0.01
	Toad (*Bufo*)	140	4.91	275	5.10	415	10.01
	Unid	5	0.19	5	0.18	10	0.37
	Total	**577**	**1377.52**	**617**	**68.03**	**1194**	**1445.55**

[1] **Feature 24 flotation samples: A59 (Loci 178, 254), A61/A81 (Locus 241), A82-83 (Loci 244, 412); Feature 3 flotation samples: A12 (Loci 51, 52, 95), A13 (Locus 69), A16 (Loci 51, 67, 70), A17 (Loci 66)**

[2] **Feature 24 killfish bone count and weight includes 4 scales, while feature 3 includes 6 scales.**

[3] **Dominance of killfish bone calls into question this species identification.**

I believe Feature 3 contains remains created by two fertility rites. A camelid *wilancha* sacrifice, a rite venerating *Pachamama* as the source of herd and pasture fertility, explain the large bone assemblage (Dransart 2002; Janusek 2008:39-40; Tschopik 1951:279). Alternatively, the cull may represent a pago offering meant to renew the Pukara sunken court or commune with the supernatural (Kuznar 2001). The discarded weaving tools suggest a related desire to seek supernatural augmentation of wool production. The animals were consumed as part of a ritual feast, based on the presence of cutmarks (24% of the bone), fragmentation, and low degree of burnt bone. The low burnt bone ratio could suggest that the meat was roasted or boiled. This archaeological example compares favorably with historic *wilancha* accounts, of butchery and bone discard (Miller 1979:91; Natchigall 1975), and the expectations proposed in Chapter 1 for "first offering" meals (Burkert 1983:6-7). I discuss the camelid body part distribution and culling associated with the feature in later chapters.

Likewise, the interred Pukara olla and large quantity of toad remains (combined mesh MNI=21, NISP=415, 10.01 g) may reflect a second fertility offering. As noted before, at the dry season's end, modern Titicaca Aymara capture and store amphibians in water-filled ollas (cf. Binford and Kolata 1996:45; Tschopik 1951). Acting as "intercessors" to *Pachamama* and the ancestors, amphibian croaks bring rainfall (Bandelier 1910:103; Tschopik 1951:277-278). Following performance of this rite, the Pukara olla became a ritually "killed" vessel interred with the toads as a final offering.

The toad body part representation can help us investigate this theory further (Figure 5.9). Limbs, vertebrae, and pelves are better-represented than crania and lower leg elements. If the toads had died in-situ, after hibernating or becoming entrapped prior to the feature's closure, one might expect more complete skeletal preservation (Weissbord and Bar-Oz 2004:22-24). Weissbrod and Bar-Oz report a similar pattern of element frequency from ceramic vessel offerings from Late Bronze Age tomb burials in Israel. Differential bone frequency, they propose, demonstrated consumption, with heads snapped off to skin the body and limbs and pelves crushed to remove the legs. Yet, the small size of toad elements argues against their consumption. Instead, compressive force, generated by backfilling of the strata, may have differentially favored preservation of more durable limb elements.

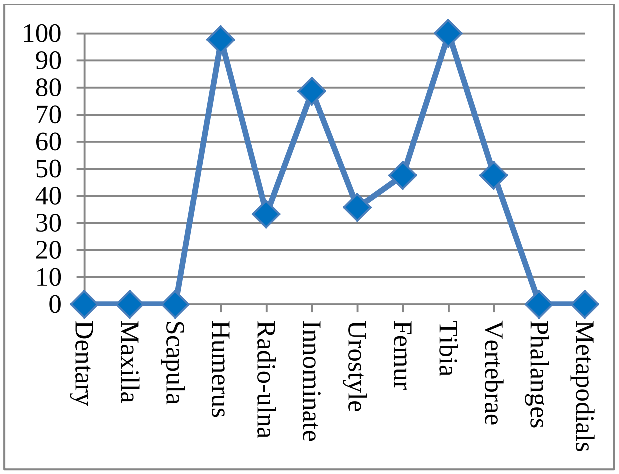


Figure 5.9: Feature 3 Toad Element MNE (% Representation)

Overall, Huatacoa presents a profile of Formative fauna use that varies little by time period or by cultural context, whether associated with domestic habitation or ritual sunken court contexts. Camelids were prime sources of meat and economic goods. There was consistent low-level exploitation of wetland birds, small mammals, fish, and cuy as dietary supplements. We see these taxa within accreted or discrete household middens and as part of ritual meals, feast foods, and offerings.

Pukara

The 2001 at Pukara excavations provided an opportunity to parse taxonomic exploitation in a chronically fine-grained way during the Late Formative polity center's zenith. The zooarchaeological remains analyzed are derived from the Initial through Final Late Formative occupations of the central pampa area (see Chapter 3, Figures 3.2 and 3.5). Studied contexts include communal feast and domestic compounds, where ritual events and work (lithic and ceramic production) took place.

For each occupation, the gross taxonomic representation results (for the ¼" screen sample) and animal body-size categories are presented. Second, to test for bias introduced by recovery method, flotation sample data are compared to the quarter-inch NISP results. Third, a brief reminder of the each occupation's constituent contexts is presented for assemblage bone density and taphonomic condition. Finally, to evaluate how faunal use was shaped by diachronic changes in the function of pampa space, we review each excavation block and occupation-period to document diachronic patterns.

Initial Late Formative

As discussed in Chapter 2, the Initial Late Formative (ILF) pampa deposits contain remains of suprahousehold social gatherings, where feasting was accompanied by small-scale ritual performance and domestic craft production occured. Klarich's assessment is based on the presence of rich middens, multiple hearths forms, ritual items and craft production tools, and ceramic assemblages (2005:247-249, 253). To test this feasting argument, each bone assemblages' taxonomic representation should meet two expectations: 1) high bone density per context and (2) abundant domestic taxa, culled for food surpluses. I test expectations for the multi-activity nature of these occupations, including butchery, bone tool assemblages, and taphonomy, in later chapters.

Table 5.21: ¼" Initial Late Formative Context Bone Density

Context	Volume (L)	Bone (1/4" g/L)
Bl 1 East		
F-16 midden	1654	4.6
F-22 midden	19	4.1
F-23 midden	41	1.3
F-24 midden	120	4.8
F-25 midden	261	7.8
F-27 midden	272	12.1
Bl 1 West		
Occupation Zone 5	1097	0.5
Hearth (L. 902) / pit midden (L. 905)	112	1.6
Bl 2		
Occupation Surface 2	96	2.6
Occupation Zone 2	737	3.1
Occupation Zone 2 lens (L. 869)	66	6.3
Southwest midden	1074	3.3
Southwest midden (upper lens, L. 491)	189	19.6
Bl 3		
Occupation Zone 2	1131	1.0
North midden 1-2	725	6.5
Northwest midden 3-5	927	3.1
F-15 midden	365	1.6
F-17 primary midden	44	48.5

Note: Data source (Klarich 2005a: Appendix 12)

Density of Bones

The pampa was the setting for suprahousehold gatherings and associated food consumption. Each of the three excavation blocks consisted of occupation surfaces and associated middens (Table 5.21). In all three blocks, middens produced very dense bone deposits, likely consisting of all step(s) in animal butchery, food preparation, and disposal associated with large meals. Nearby occupation surfaces, in comparison, had scattered debris generated by carcass processing. Block 2's occupation surfaces are jumbled, suggesting minimal post-food preparation and discard. Hearths, present in block 1 and 3, served to cook and reheat such meals. Furthermore, Blocks 1 and 3 contain many worked bones fragments and varied tool forms.

Taxonomic Results

Large mammal taxa – camelids and the categories of *Artiodactyla* and unidentified large mammal – dominate the coarse-mesh bone assemblages (Table 5.22-4.23, Figures 5.10-5.12). This combined taxa category was responsible for 85% to 95% of bone NISP, and 98 to 99% of the total bone weight. Camelids are the major component of large taxa. Incisor forms suggest use of alpaca and llama throughout, accompanied by a single probable vicuña, within Block 2. In contrast, taruca were rarely hunted; they comprise less than 1% of bone NISP and weight in all assemblage. Weathered antler fragments are common, likely discarded tool fragments (e.g. Block 2's specimens 1602/1604). As only four postcranial elements are taruca (from both ¼" and flotation samples), I believe much of the *Artiodactyla* and large mammal bone is from fractured camelid bone.

Were small and medium mammals, birds, and fish significant in these public Initial Late Formative contexts? Based on ¼" screen sample, they had minimal dietary or economic importance. Taken together, medium and small mammals, birds, and fish comprise less than 1% of bone NISP and weight per block. Medium-sized mammals and birds were most common in Blocks 1 and 2. The absence of wetland birds and fish is conspicuous, given the proximity of the Río Pukara, seasonal wetlands, and nearby lakes (Quequerana and Arapa). Only a single cuy bone is present.

In Block 2, three small game bones show evidence of bone working – a *Cathartidae* ulna and humerus (vulture family) and a medium mammal limb. Each displays groove and split fractures, which suggests they are byproducts of bead or tube manufacture. Raptors might have been economically and symbolically valued for their large size, predatory behavior, and feathers.

Table 5.22: Initial Late Formative occupations (¼" inch bone)

Taxon	**Bl. 1 NISP**	**Wt (g)**	**Bl. 2 NISP**	**Wt (g)**	**Bl. 3 NISP**	**Wt (g)**	**Σ NISP**	**Σ Wt (g)**
Camelid sp.[1]	742	6211.55	791	5694.57	1108	7820.61	2641	19726.73
Vicugna pacos	4	11.30	3	9.10	7	36.35	14	56.75
Vicugna vicugna	0	0.00	3	2.60	0	0.00	3	2.60
Lama glama	7	11.00	5	5.10	31	203.90	43	220.00
Camelid **Σ**	**753**	**6233.85**	**802**	**5711.37**	**1142**	**5797.71**	**2701**	**20006.08**
Taruca[3]: Antler	5	14.83	22	180.60	0	0.00	27	195.43
Non-Antler	1	27.28	2	9.50	0	0.00	3	36.78
Cervid **Σ**	**6**	**42.11**	**24**	**190.10**	0	0.00	**30**	**232.21**
Artiodactyla	182	839.80	282	1048.00	69	222.64	533	2110.44
Lg Mammal	4028	7108.15	2543	3791.20	1834	2557.34	8405	13456.69
Lg Mammal Σ	**4969**	**26733.72**	**3651**	**10740.67**	**3045**	**8577.69**	**14963**	**58386.36**
Caniformia	1	2.41	0	0.00	0	0.00	1	2.41
Canidae	0	0.00	0	0.00	1	17.89	1	17.89
Conep	1	3.38	0	0.00	0	0.00	1	3.38
Md Mammal [2]	7	5.06	23	35.20	0	0.00	30	40.26
Md Mammal Σ	**9**	**10.85**	**23**	**35.20**	**1**	**17.89**	**33**	**63.94**
Cuy cf.	1	0.12	4	0.40	0	0.00	5	0.52
Mammal	760	245.68	308	99.40	128	37.21	1196	382.29
Cathartidae	0	0.00	2	2.30	0	0.00	2	2.30
Bird	2	2.16	11	4.10	0	0.00	13	6.26
Bird Σ	**2**	**2.16**	**13**	**6.40**	**0**	**0.00**	**15**	**8.56**
Fish	1	1.88	1	0.10	0	0.00	2	1.98
Unid	0	0	37	7.60	0	0.00	37	7.60
Totals	**6501**	**33270.37**	**4863**	**16791.24**	**4316**	**14430.50**	**15680**	**79089.54**

Notes:[1] NISP is based on incisor form and non-metric size estimate, but is not an MNI estimate

[2] Taruca non-antler bone included in Figures (% NISP, Bone Weight)

[3] Bone Weight of 3 specimens is absent from category- and total weight for Block 1

Table 5.23: Initial Late Formative - Large Taxa Categories

Taxon	**Bl.1 NISP**	**%**	**Wt(g)**	**%**	**Bl.2 NISP**	**%**	**Wt(g)**	**%**	**Bl.3 NISP**	**%**	**Wt(g)**	**%**
Lg Mammal	4028	81.1	7108.15	50.0	2543	69.6	3791.20	35.3	1834	60.0	3234.00	28.0
Artiodactyla	182	3.7	839.8	5.9	282	7.7	1048.00	9.7	92	3.0	323.93	2.6
Camelid	753	15.1	6233.85	43.8	802	22.0	5711.37	53.2	1142	37.0	8060.86	67.6
Taruca	6	0.1	42.11	0.3	24	0.7	190.10	1.8	0	0.0	0.00	0.0

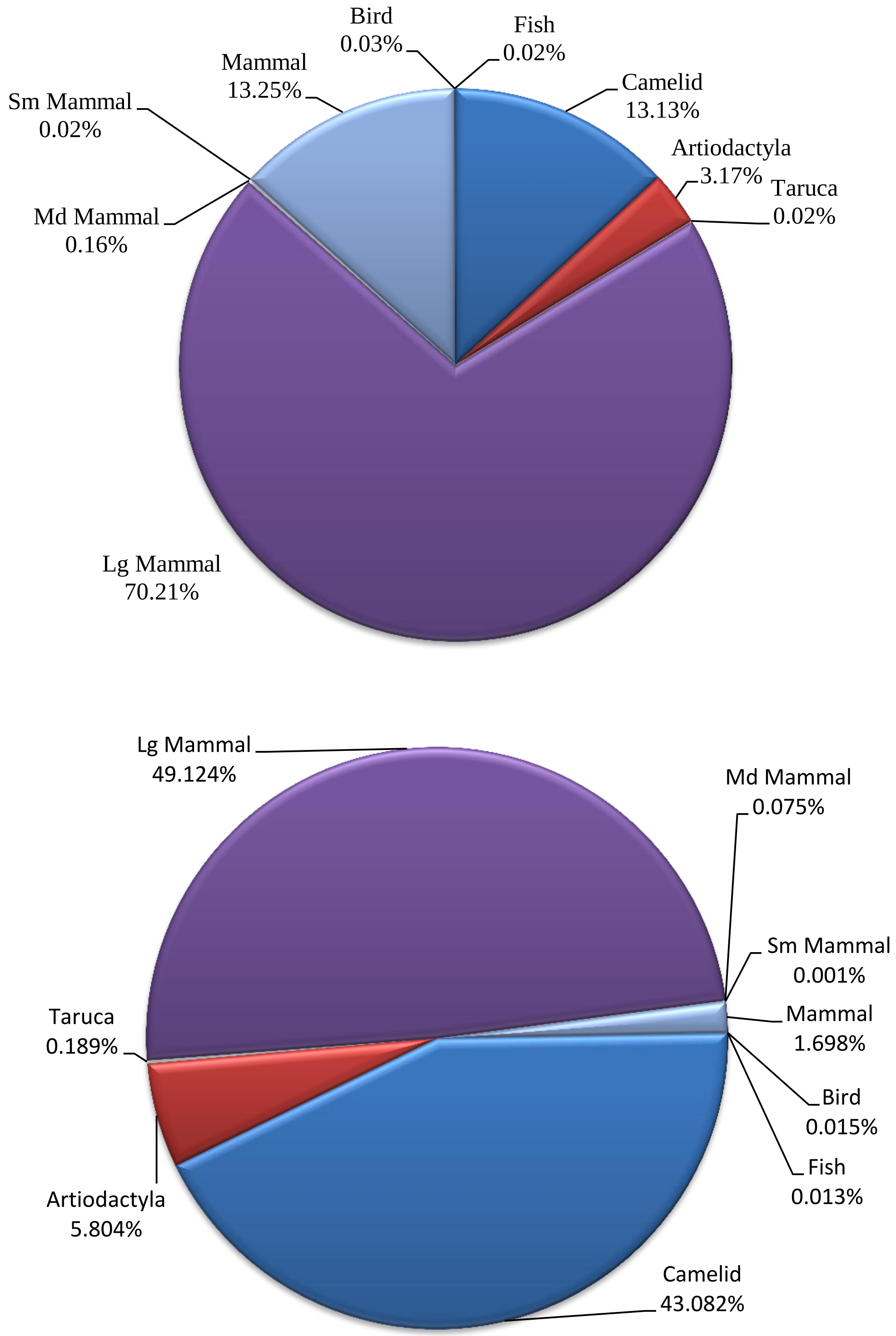
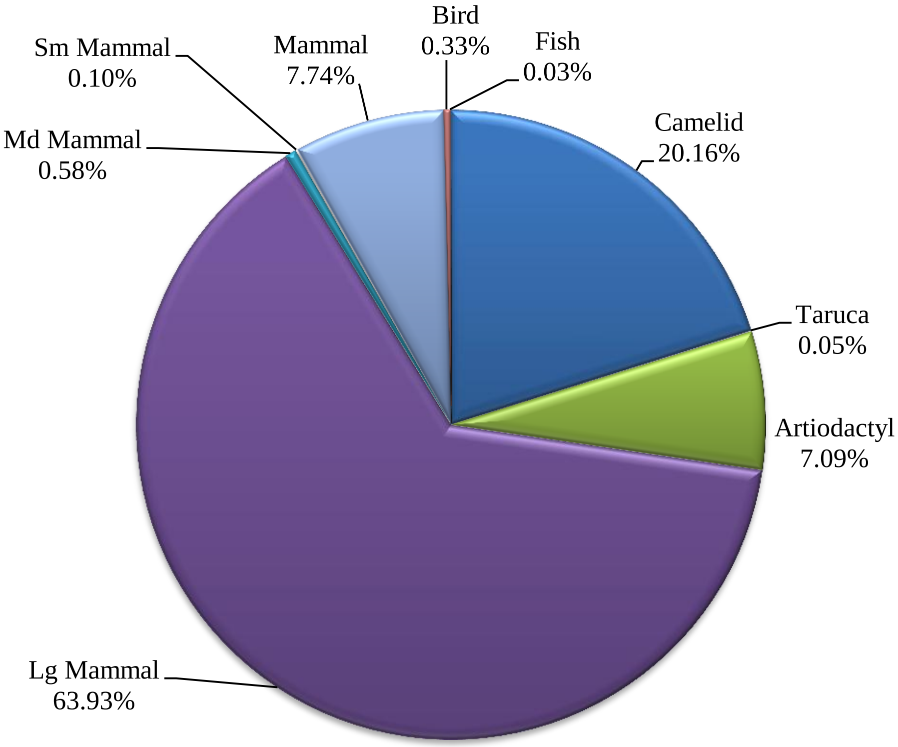


Figure 5.10: Block 1 Fauna - Initial Late Formative (1/4” % NISP, Bone Weight)

[1] **For the Medium Mammal category, recorded weight of 3 specimens was absent in the database. Thus, their contribution to Block 1’s total weight is not reflected in chart above**



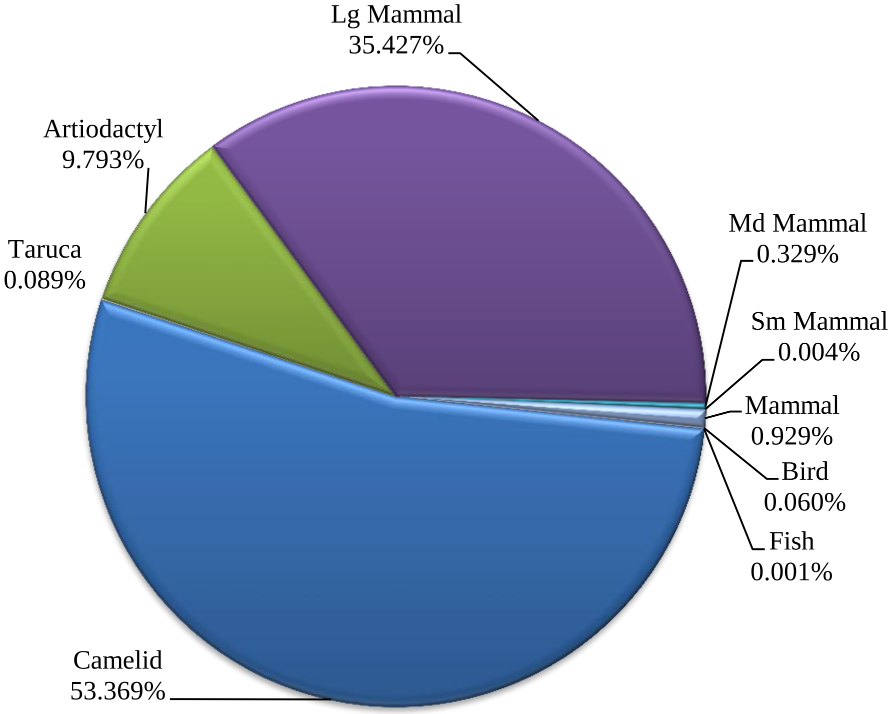
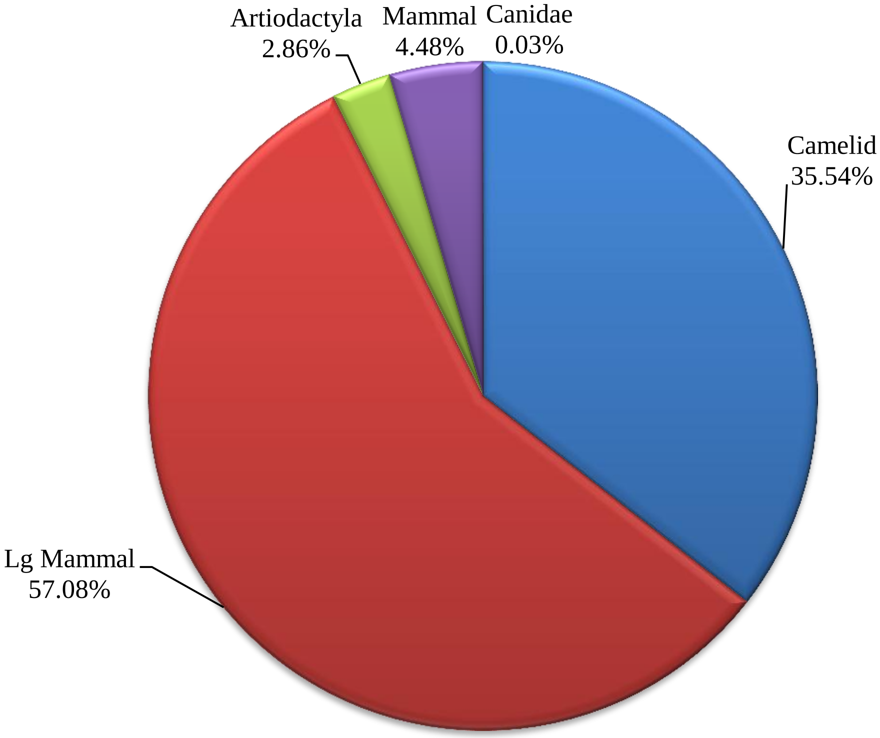


Figure 5.11: Block 2 Fauna - Initial Late Formative (1/4" %NISP, Bone Weight)



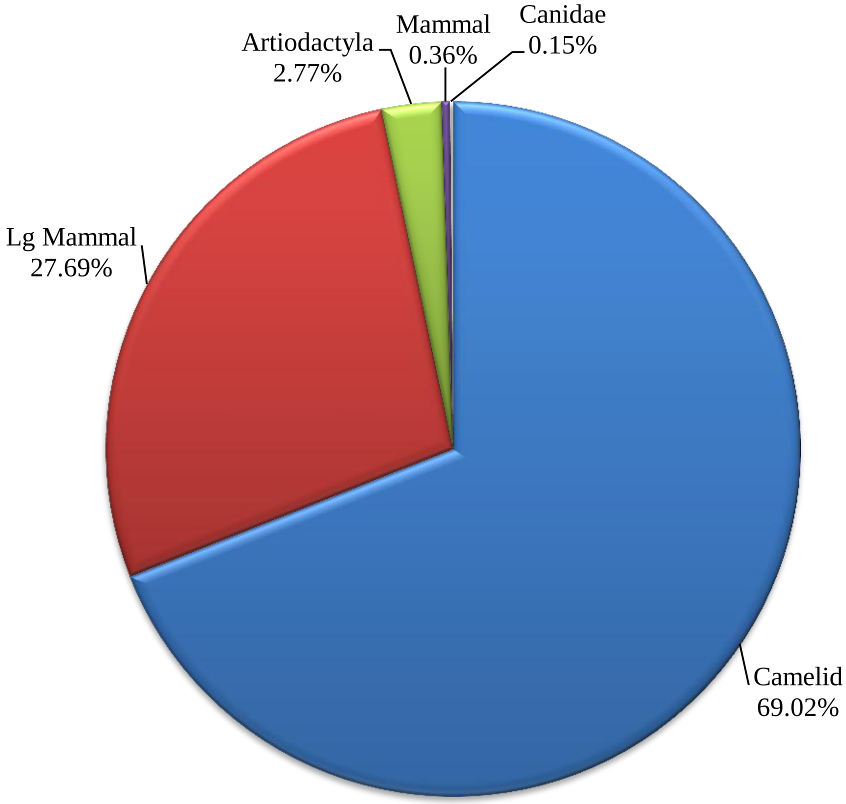


Figure 5.12: Block 3 - Initial Late Formative (1/4”, % NISP, Bone Weight)

Flotation

Do the above results accurately reflect the significance of small game in diet in these contexts? Or is it biased by recovery method and fragmentation? To address this question, bone recovered by flotation from several feature loci is analyzed below (Table 5.24 - 5.25). For some features, all flotation samples for a provenience were studied.

Table 5.24: Initial Late Formative Flotation Samples

Block	Context	Loci
1	F-16 midden	414, 736, 739, 760-763, 766-767
1	F-23 midden	793
1	F-24 midden	796
1	F-25 midden	795, 798
1	F-27 midden	906
2	F-carbon pit	863
2	SW midden	491, 493, 497, 500, 845-846, 852, 854
3	F-6 hearth	810, 811
3	F-13 hearth	819, 830
3	F-14	803
3	F-15 midden	571, 806, 813
3	F-17 primary midden	804
3	N midden	816-817, 821
3	NW midden	298, 501-502, 597-601, 801-802

Table 5.25: Flotation Samples – Taxa NISP and Weight

	Bl. 1 NISP	Bl. 1 Wt (g)	Bl. 2 NISP	Bl. 2 Wt (g)	Bl. 3 NISP	Bl. 3 Wt (g)
Camelid	32	120.43	46	164.03	43	177.57
Taruca	0	0	0	0	3[1]	3.68
Artiodactyla	15	7.35	0	0	2	1.20
Lg Mammal	368	234.40	643	375.39	628	320.31
Md Mammal	0	0	0	0	0	0
Sm Mammal	1	0.10	5	0.06	0	0
Mammal	2492	187.49	3689	134.08	7042	373.78
Bird	7	1.40	2	0.04	0	0
Reptile	0	0	1	0.01	0	0
Amphibian	0	0	0	0	1	0.01
Fish	1	0.01	5	0.07	0	0
Unid	7	3.07	0	0	3	0.29
Total	2789	554.25	4391	673.68	7731	876.91

[1] Flotation NISP=1 antler fragment (1.48g), 2 non-antler bones (2.20g)

Table 5.26: Small Taxa from ¼" and Flotation Samples (NISP, Bone Weight)

Block	Loci	Context	Taxon	1/4" NISP	1/4" Weight (g)	Flot 1/4" NISP	Flot 1/4" Wt	Flot <1/4" NISP	Flot <1/4" Wt
1	738	F-16 midden	*Caniformia*	1	2.41				
1	739	F-16 midden	Cuy cf.	1	0.12				
1	788	F-16 midden	*Conepatus chinga*	1	3.38				
1	762	F-16 midden	Sm Rodent					*1*	*0.10*
1	737	F-16 midden	Bird	2	2.16			*5*	*0.33*
1	737	F-16 midden	Coot (*Fulica* spp.)			*1*	*0.70*		
1	766	F-16 midden	*Cathartidae*			*1*	*0.37*		
1	742	F-16 midden	Fish	1	1.88				
1	767	F-16 midden	Fish					*1*	*0.10*
2	869	OZ 2	Bird	6	1.20				
2	890	OZ 2	Bird	1	0.40				
2	869	OZ 2	*Cathartidae*	2	4.10				
2	885	OZ 2	Fish	1	0.10				
2	846	SW midden	Sm Rodent					*3*	*0.04*
2	493	SW midden	Sm Rodent					*1*	*0.01*
2	491	SW midden	Sm Rodent					*1*	*0.01*
2	497	SW midden	Bird	1	1.80				
2	500	SW midden	Bird	2	0.50			*1*	*0.03*
2	854	SW midden	Duck (*Anas* spp.)					*1*	*0.01*
2	854	SW Midden	Fish					*2*	*0.02*
2	497	SW Midden	Fish					*3*	*0.05*
2	852	SW Midden	Reptile					*1*	*0.01*
3	571	F-15 midden	Sm Rodent					*1*	*0.02*
3	599	NW midden	Sm Rodent					*1*	*0.01*
3	598	NW midden	Frog					*1*	*0.01*
3	816	N Midden	Sm Rodent					*1*	*0.03*
3	821	N Midden	Sm Rodent					*1*	*0.01*
3	804	F-17 midden	*Canidae*	1	17.89				

Note: Italics denote new specimens added by flotation, which impacts NISP, MNI, and weight.

Flotation samples contained a large quantity of camelid, large mammal, and unidentified mammal bone. Very few additional medium and small mammal, bird, and fish taxa were identified (Table 5.26). Overall, small mammals, birds, and fish were minor dietary and economic components based on combined-mesh MNI (Table 5.27).

The recovery of a *Cathartidae* element in Block 1 (a talon), further highlights the economic use of birds-of-prey. Small rodents, a frog, and one reptile were also found.

Given their rarity, they are probable non-cultural inclusions in the ILF sample. In this case, the coarse mesh sample provides a fairly accurate picture of small animal use.

Table 5.27: Initial Late Formative Fauna (Combined MNI 1/4" and flot mesh)

Taxon	Bl. 1	%[1]	Bl. 2	%[1]	Bl. 3	%[1]	Total MNI	%[1]
Camelid	9(1)	60	8(1?), 9	52.94	8(1)	66.67	**26**	59.1
Taruca	1(0)	6.7	1(0)	5.88	0(1)	8.33	**3**	6.8
Canidae	0	0	0	0	1(0)	8.33	**1**	2.3
Skunk	1(0)	6.7	0	0	0	0	**1**	2.3
Cuy	1(0)	6.7					**1**	2.3
Rodent	0	0	2(1), 3	17.65	0(1)	8.33	**4**	9.1
Anas spp.	0	0	0(1)	5.88	0	0	**1**	2.3
Coot (*Fulica* spp.)	0(1)	6.7	0	0	0	0	**1**	2.3
Cathartidae	0(1)	6.7	1(0)	5.88	0	0	**2**	4.5
Fish	1(1)	6.7	1(1)	5.88	0	0	**2**	4.5
Frog	0	0	0	0	0(1)	8.33	**1**	2.3
Reptile	0	0	0(1)	5.88	0	0	**1**	2.3
MNI Σ	**15**	100.0	**17**	100.0	**12**	100.0	**44**	100.0

<u>Note</u>: The coarse mesh(¼") MNI is denoted first, followed by flotation (in parentheses). The total block MNI follows the comma (when the combined mesh MNI sum is greater).

[1] Rounding error

Taken together, the pampa area faunal assemblage reflects an emphatic herd animal-focused diet and economy. Klarich's argument for suprahousehold-scale food production and service during the Initial Late Formative is supported by the abundance of large mammal bone and accompanying features generated by carcass processing, food preparation, and bone disposal. Camelids were the primary taxon consumed in these communal feasts. These gatherings were the setting of food sharing, conversation, weaving, and, based on the presence of non-local and ceremonial ceramics (trumpets, miniature vessel, etc.), small-scale ritual and exchange. To further explore these events, the following chapters investigate butchery, culling practices, and bone modification.

Middle Late Formative

Blocks 1 and 2 contain the only Middle Late Formative (MLF) strata occupations documented in the 2001 excavations. In contrast to the Initial Late Formative occupations, MLF ceramic assemblages are dominated by serving vessels and stone cobble walls were built (Block 1: ASD2/6 and Block 2: ASD12). These walls demarcate individual house compounds with specialized activity areas (Klarich 2005:239-240).

Following wall construction, the east half of Block 1 ceased to generate substantial habitation deposits. Block 1W featured two small informal hearths, food debris, and a possible lithic workshop (based on dense chert and obsidian debitage scatter). It appears to be a domestic occupation floor (occupation zone 4) associated with lithic manufacture and small-scale food preparation and service.

Block 2's occupation was composed of several superimposed occupation surfaces (occupation surface 1). These floors are marked by a scatter of faunal remains and "small dumps of burned ceramics, broken *incensarios*, and ritual artifacts" [e.g. the lone miniature vessel] (Klarich 2005a:240). Fauna may have been a component of meals served as part of ritual activities or as a component of such rites. In the later Tiwanaku culture, *incensarios* are vessels used in mortuary rites and to make burnt offerings (Browman 1978; Janusek 2004a). Miniature vessels may contain pigment and many demonstrate storage of lime, to help catalyze coca (Chavez 1992:514).

Density of Bones

Two low bone density occupation surfaces produced almost all of the bone for the MLF Block 1 and Block 2 (Table 5.28). This contrasts with the ILF contexts where bone density generally exceeds these values by several orders of magnitude. Bone density was not calculated for the Block 1's small hearths because they were removed in their entirety for flotation.

Table 5.28: ¼" Bone Density within Middle Late Formative Contexts

Context	Volume (L)	Bone (g/L)
Bl. 1 West		
Occupation Zone 4	806	1.4
F-21 hearth	All flotation	/
F-26 hearth	All flotation	/
Bl. 2		
Occupation Zone 1	4213	1.4

Taxonomic Results

The most striking feature of Block 1 is the very small bone sample recovered (Table 5.29). It is striking relative to the prior occupation and the contemporaneous assemblage from Block 2. Based on its small quantity, the assemblage was generated by household-scale meals. As noted above, Block 2's sample is a bit more ambiguous in terms of behavioral interpretation, but fauna consumption is moderate in scale.

Camelids remain the key food and economic resource (Table 5.30, Figure 5.13–5.14). Yet, there are differences between the Middle and Late occupations—mainly the use of taruca and large mammal taxa. Taruca hunting and consumption are rare. Specimens mainly consist of antler tools, a billet hammer and possible tine pressure flakers, and several unidentified fragments. A taruca innominate found in Block 2 displays butchery marks.

Table 5.29: Middle Late Formative occupations (¼” inch bone)

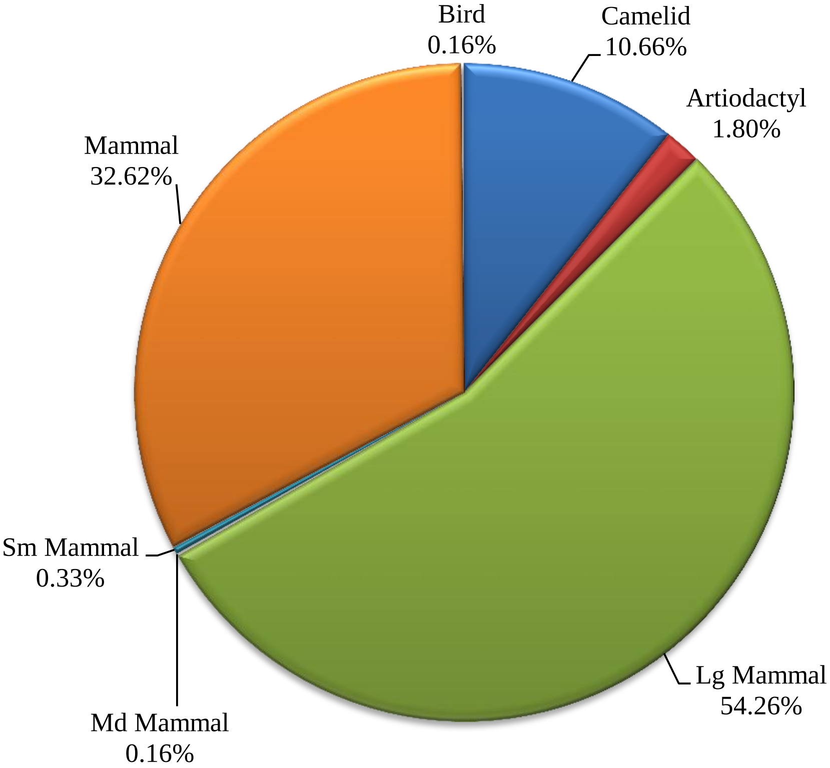
Taxon	Common Name	Bl. 1 NISP	Wt (g)	Bl. 2 NISP	Wt (g)	Σ NISP	Σ Wt
Camelid sp.[1]		65	395.16	516	3002.00	581	3397.16
Vicugna pacos	Alpaca	0	0.00	0	0.00	0	0.00
Vicugna vicugna	Vicuña	0	0.00	0	0.00	0	0.00
Lama glama	Llama	0	0.00	9	8.60	9	8.60
		65	**395.16**	**525**	**3010.60**	**590**	**3405.76**
Taruca [2]	Taruca						
Antler		6	83.65	36	47.10	42	130.75
Non-Antler		0	0.00	3	22.90	3	22.90
		6	**83.65**	**39**	**70.00**	**45**	**153.65**
Artiodactyla	Camelid / cervid	11	58.83	121	385.70	132	444.53
Lg Mammal		331	499.30	2125	2562.00	2456	3061.30
	Lg Mammal Σ	**413**	**1036.94**	**2810**	**6028.3**	**3223**	**7065.2**
Md Mammal	Dog / skunk size	1	16.05	6	10.60	7	26.65
Cavia	Cuy	1	0.72	0	0.00	1	0.72
Lagidium peruanum	Viscacha	0	0	2	1.00	2	1.00
Rodent		1	0.27	0	0.00	1	0.27
	Sm Mammal Σ	**2**	**0.99**	**2**	**1.00**	**4**	**1.99**
Mammal		199	73.32	300	58.70	499	132.02
Cathartidae	Vulture family	0	0.00	1	1.70	1	1.70
Bird		1	0.43	5	1.60	6	2.03
	Bird Σ	**1**	**0.43**	**6**	**3.30**	**7**	**3.73**
Fish		0	0.00	0	0.00	0	0.00
Unid		1	0.43	0	0.00	1	0.43
Totals		**617**	**1128.16**	**3124**	**6101.90**	**3741**	**7230.06**

[1] NISP identified (by morphology of incisors or non-metric size estimate; not an estimate of MNI)

[2] Only taruca non-antler bone is included in Figures (%NISP, Bone Weight)

Table 5.30: Middle Late Formative - Large Taxa Categories

Taxon	Bl.1 NISP	%	Wt(g)	%	Bl.2 NISP	%	Wt(g)
Lg Mammal	331	80.15	499.30	48.1	2125	75.6	2562.00
Artiodactyla	11	2.66	58.83	5.7	121	4.3	385.70
Camelid	65	15.74	395.16	38.1	525	18.7	3010.60
Taruca	6	1.45	83.65	8.1	39	1.4	70.00
Total	413		1036.94		2810		6028.30



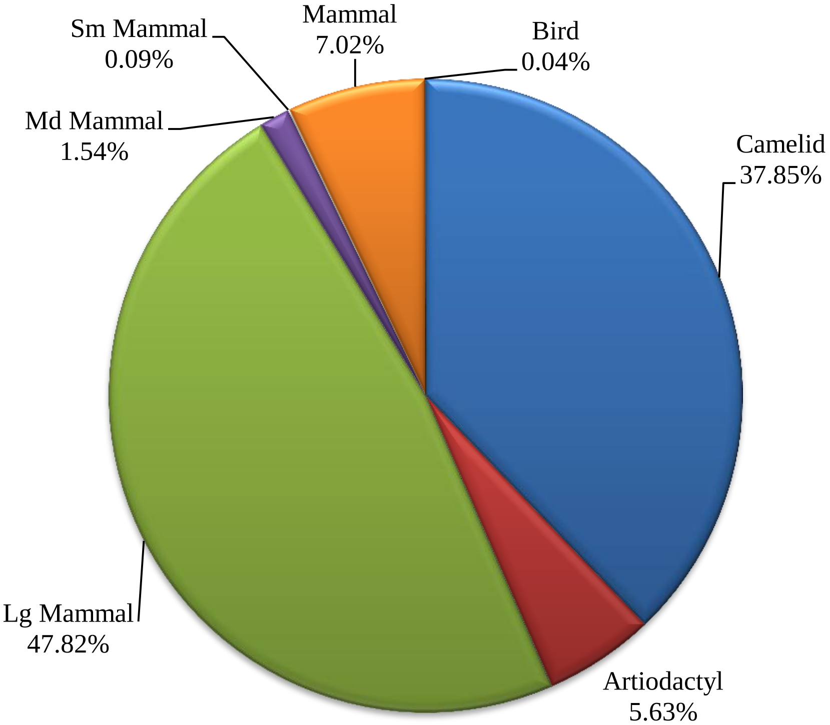


Figure 5.13: Block 1 - Middle Late Formative Fauna (1/4” % NISP, Bone Weight)

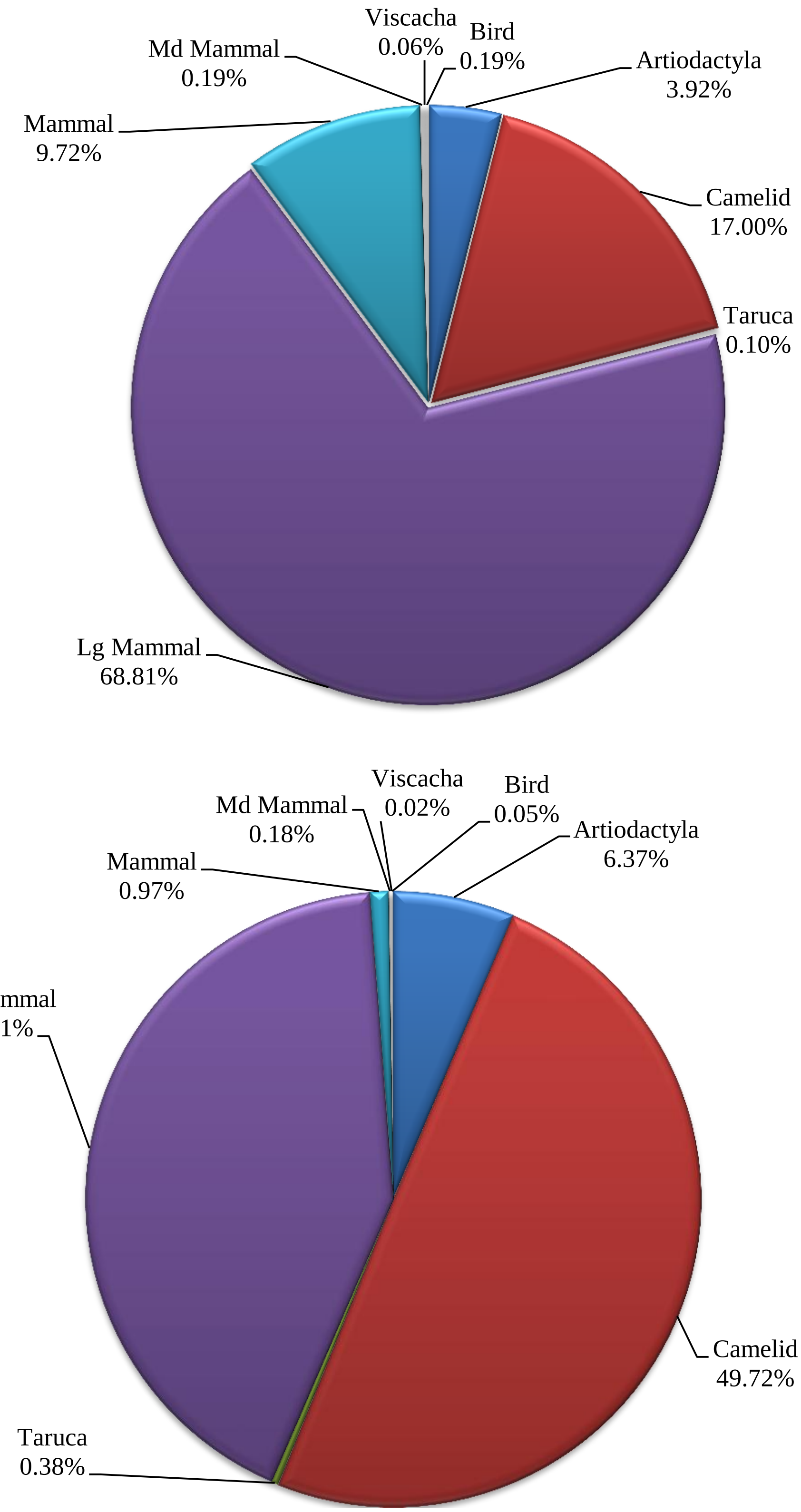


Figure 5.14: Block 2 - Middle Late Formative Fauna (1/4" % NISP, Bone Weight)

Examining large mammal taxa use in more detail, large mammal taxa contribute 64% of the Block 1 NISP and 91% by bone weight. In Block 2, large taxa use mirrors that for the Initial occupations (90% of assemblage NISP and 98.8% of bone weight).

Small game is rare in both Middle Late Formative occupations, representing less than 1% of bone by NISP and weight (Table 5.29 and 4.31; Figures 4.14-4.15). Block 1 contained the second identified cuy specimen from Pukara's Late Formative occupations. Nine worked bone / tool specimens were identified.

Table 5.31: Middle Late Formative MNI

Taxon	Block 1	Block 2	Total
Camelid	3	5	8
Taruca	0[1]	1	1
Cuy	1	0	1
Viscacha	0	1	1
Cathartidae	0	1	1
Total	**4**	**8**	

[1]Block 1 MNI does not include a taruca given the presence of antler only

Block 2 was characterized by greater faunal diversity, camelid MNI, and use of medium-sized mammals and birds (Table 5.31). Identified wild taxa species included a viscacha (MNI=1) and an unmodified *Cathartidae* vulture femur (MNI=1). This femur indicates ritual manipulation of birds-of-prey in this context.

Of further interest is the nature of tool forms from Block 2. All three tools are undecorated and have spatulate, thinned tips. They may have served as expedient spoons possibly for consuming snuff. One is made from a medium mammal metapodial, possibly from a dog or felid. Altogether, the fauna sample traits of Block 2 and its accompanying ceramic assemblage argue for moderate-scale meal service and non-domestic, ritual activities.

Flotation

As no flotation samples were reviewed from Block 2, flotation samples from two Block 1 hearths – Feature 21 (Locus 791) and Feature 26 (Locus 800) — were analyzed (Table 5.32). The fauna present in these contexts do not provide a clear indication as to their function. Processed camelid, large mammal, and mammal bone are all present.

Table 5.32: Block 1 Middle Formative Flotation

	Fragment Size	Feature 21 NISP	Bone Weight (g)	Fragment Size	Feature 26 NISP	Bone Weight (g)
Camelid	¼”	3	9.80	N/A	0	0
Lg Mammal	¼”, < ¼”	19	12.90	¼”, < ¼”	3	2.67
Mammal	¼”, < ¼”	180	14.07	< ¼”	6	0.65
Unid	N/A	0	0	< ¼”	1	0.16
Total		**202**	**36.77**		**10**	**3.48**

Faunal use associated with the Middle Late Formative occupations contrasts with the preceding ILF public feasting assemblages. Middle Formative contexts do not display the large bone middens and accompanying food preparation features. Instead occupation zones serve more discrete, specialized domestic roles, including a small lithic workshop (Block 1) and settings for small-scale rituals (Block 2). Remains from Block 1 reflect small household meals, while those from Block 2 suggest moderate-scale hospitality associated with periodic offerings or rites.

Final Late Formative

Final Late Formative (FLF) occupations are present in all three excavation blocks. These occupations continue the trend of differentiated, household compound space that began in the MLF occupation (Klarich 2005). In Block 1W, the occupation zone 3 floor and ceramic assemblage displays evidence of food disposal activities: Feature 18, a large primary midden deposit with dense animal bone, and two smaller pit middens, Features 19 and 20. The Block 3 occupation floor (surface / zone 1) has artifacts and features indicating early-stage of household ceramic production and food disposal (NW Midden 1-2, Feature 12).

However, Block 2's FLF occupation appears to continue the ritual role it assumed in previous occupations (Klarich 2005a:240). Additional wall construction and modification reshaped its space. It features a clean, prepared gravel floor (occupation surface / zone 1), a small hearth (Feature 28), and two smaller features (7, 9). *Incensario* offering vessels dominate its ceramic assemblage and few serving vessels are present.

Table 5.33: Final Late Formative Bone Density

Context	Volume (L)	Bone (1/4" g/L)
Block 1W: Occupation Zone 3	485.5	1.6
Feature 18 midden	47.5	49.2
Feature 19 pit	1.5	/
Feature 20 pit midden	17.5	/
Block 2: Occupation Surface 1	1148	0.3
Final Deposit OS1	548	0.2
Feature 28 hearth	/	/
Feature 7 pit	/	/
Feature 9 pit	/	/
Block 3: Occupation Surface 1	1050	0.7
Occupation Zone 1	1247	0.3
NW Midden 1-2	565	0.3

Bone Density

With few exceptions, bone density within the FLF block occupations represents a significant decrease relative to those previous strata (Table 5.33). While small, the Feature 18 midden is the only context that presents a high food signature. Overall, food service, consumption and disposal were increasingly secondary activities within these contexts.

Table 5.34: Final Late Formative occupations (¼” inch bone)

Taxon	Common Name	Bl. 1 NISP	Wt (g)	Bl. 2 NISP	Wt (g)	Bl. 3 NISP	Wt (g)	Σ NISP	Σ Wt (g)
Camelid sp.[1]		233	1520.03	55	257.00	203	798.22	491	2575.25
Vicugna pacos	Alpaca	3	1.44	0	0.00	0	0.00	3	1.44
Lama glama	Llama	1	2.75	1	1.40	1	0.80	5	4.95
		237	**1524.22**	**56**	**258.40**	**204**	**799.02**	**499**	**2581.64**
Taruca [2]	Taruca								
Antler		0	0.00	0	0.00	2	4.22	2	4.22
Non-Antler		0	0.00	0	0.00	0	0.00	0	0.00
		0	**0.00**	**0**	**0.00**	**2**	**4.22**	**2**	**4.22**
Artiodactyla		36	106.92	5	6.90	19	36.93	60	150.75
Lg Mammal		1435	1978.99	228	192.60	1040	1135.22	2703	3306.81
	Lg Mam Σ	**1708**	**3610.13**	**289**	**457.9**	**1265**	**1975.39**	**3262**	**6043.42**
Md Mammal		1	3.87	3	1.10	0	0.00	4	4.97
Mammal		279	85.50	61	6.40	207	101.60	547	193.50
Unid		3	0.65	0	0.00	5	1.50	8	2.15
Totals		**1991**	**3700.15**	**353**	**465.40**	**1477**	**2078.49**	**3821**	**6244.04**

[1] NISP identified (by morphology of incisors or non-metric size estimate; not an estimate of MNI)

[2] Only taruca non-antler bone is included in Figures (%NISP, %Bone Weight)

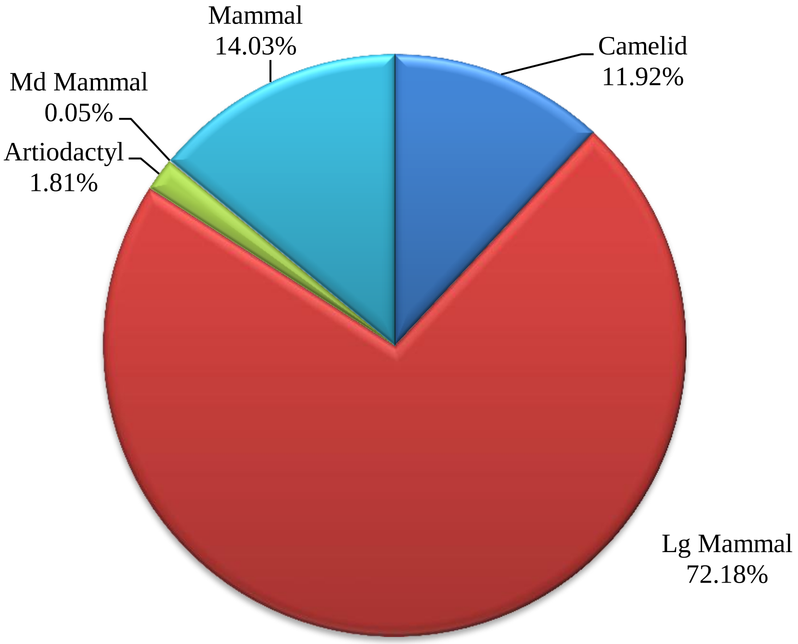
Taxonomic Abundance

The FLF fauna samples from all three units are remarkably homogenous (Table 5.34, Figures 5.15-5.17). Few non-herd animals were identified despite review of ¼” and flotation samples (Table 5.35). An unidentified medium mammal and one bird comprise the remaining specimens. Small amphibian and rodent remains were also recovered. Worked bone and tool forms are found only within Blocks 1 and 3.

Table 5.35: Small Taxa Bone from Dry ¼” and Selected Flotation Samples

Block	Loci	Context	Taxon	Dry 1/4" NISP	Dry 1/4" Wt (g)	Flot 1/4" NISP	Flot 1/4" Wt	Flot <1/4" NISP	Flot <1/4" Wt	MNI +
1	769	F-18 midden	Md Mammal	1	3.87					
1	778	F-20 midden	Amphibia					*1*	*0.03*	*1*
3	560	F-12 thermal feature	Sm Rodent					*2*	*0.02*	*1*
3	560	F-12 thermal feature	Bird					*1*	*0.03*	*1*

Note: Flot contexts; Bl. 1 [F-20 midden (Locus 778)], Bl. 2 [F-clay circle (Locus 476), F-7 pit (Loci 77, 79), F-9 pit (Locus 486), F-28 hearth (Loci 881, 882)], Bl. 3 [OZ 1 (Locus 536), F-8 clay pit (Locus 544), F-10 clay deposit (Locus 550), F-11 clay pit (locus 552), F-12 thermal feature (Locus 560), F- 14 (Locus 594), NW midden 1-2 (Loci 270, 300)]



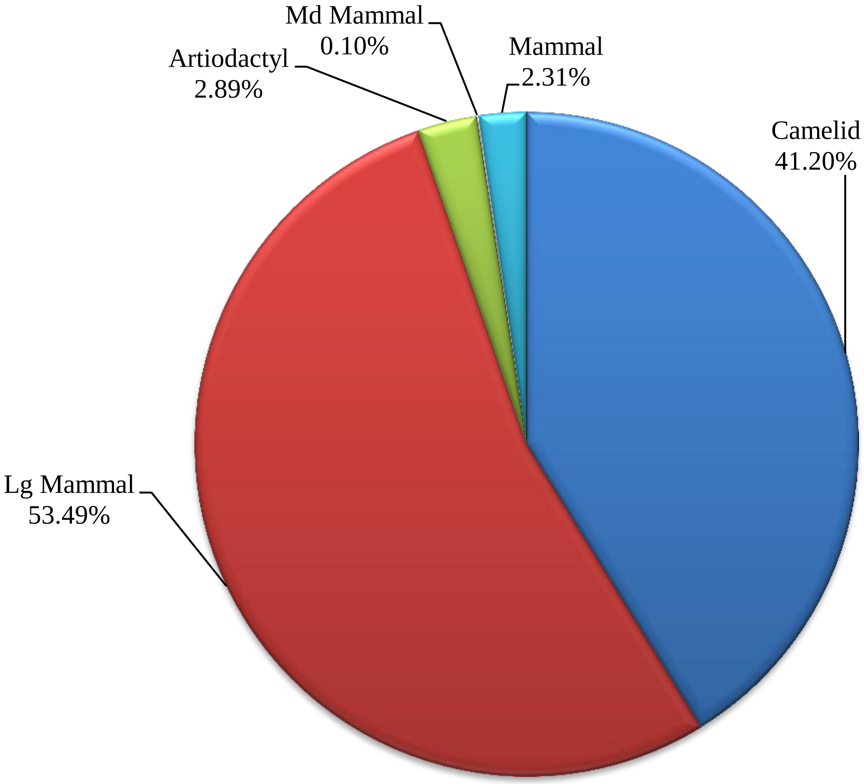
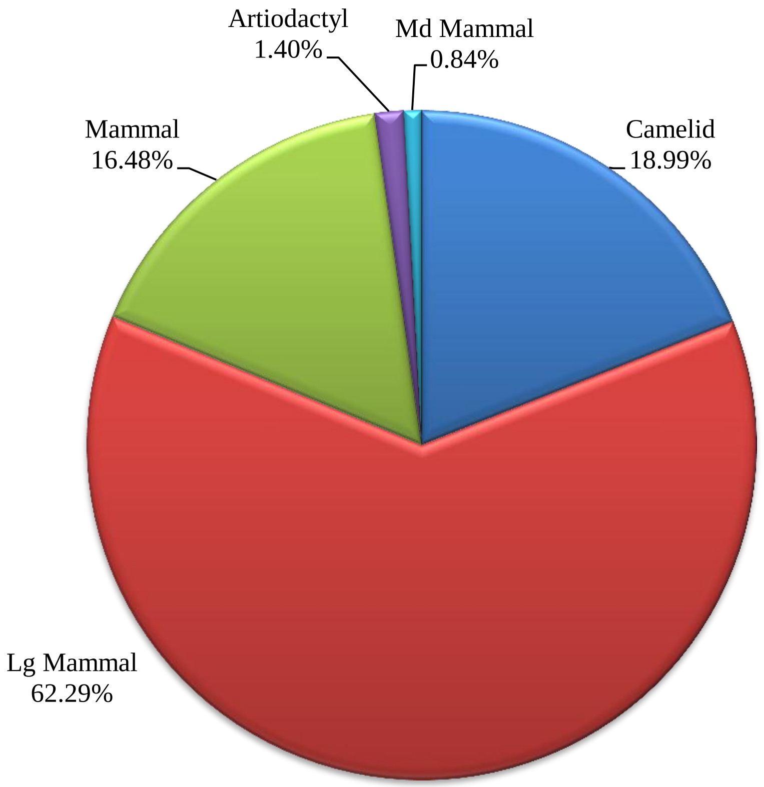


Figure 5.15: Block 1 Final Late Formative Fauna (1/4” %NISP, Bone Weight)



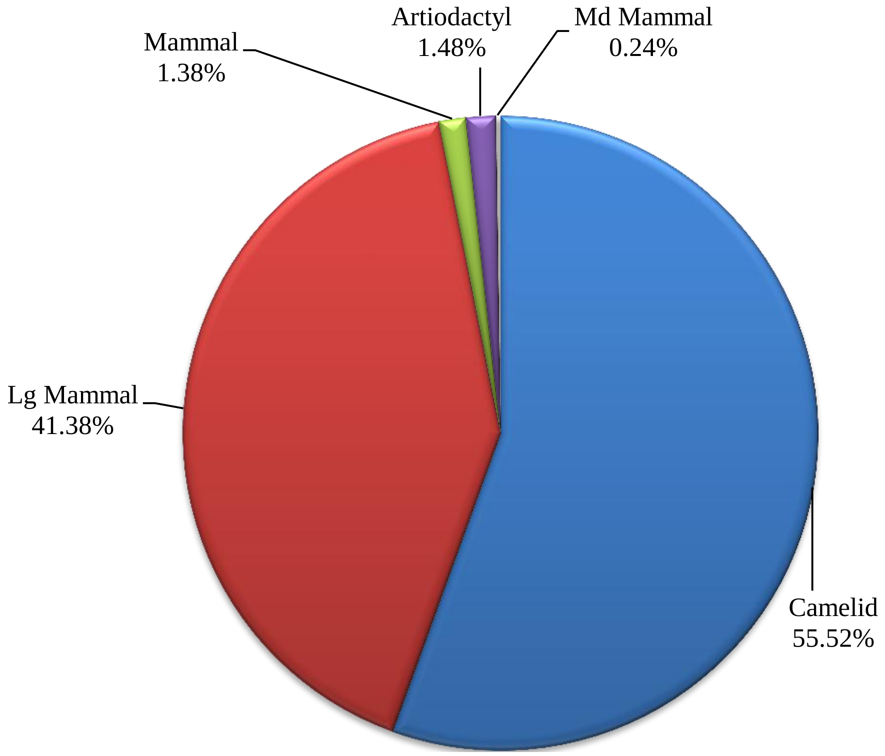
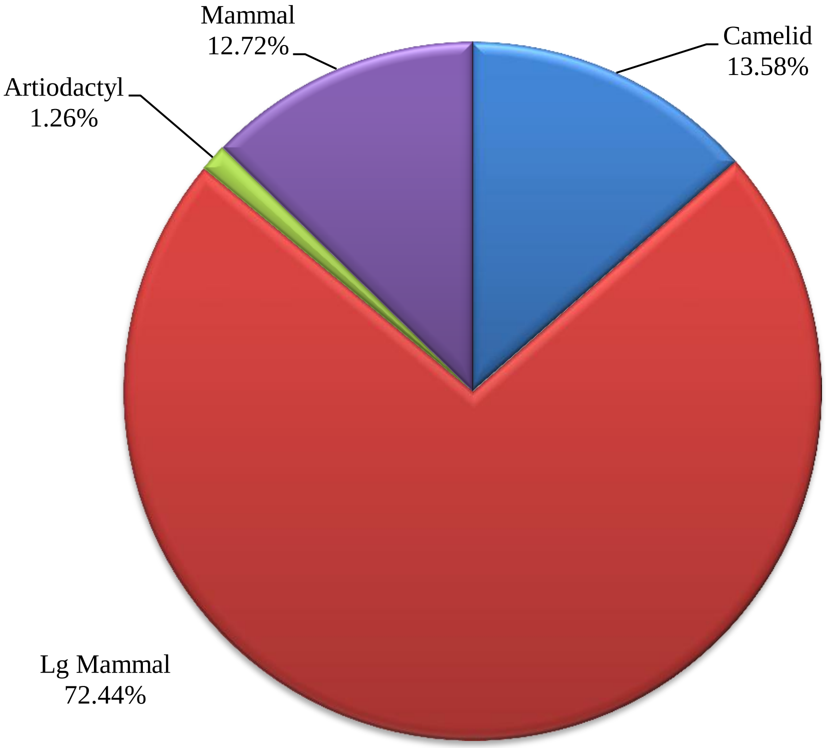


Figure 5.16: Block 2 Final Late Formative Fauna (1/4” %NISP, Bone Weight)



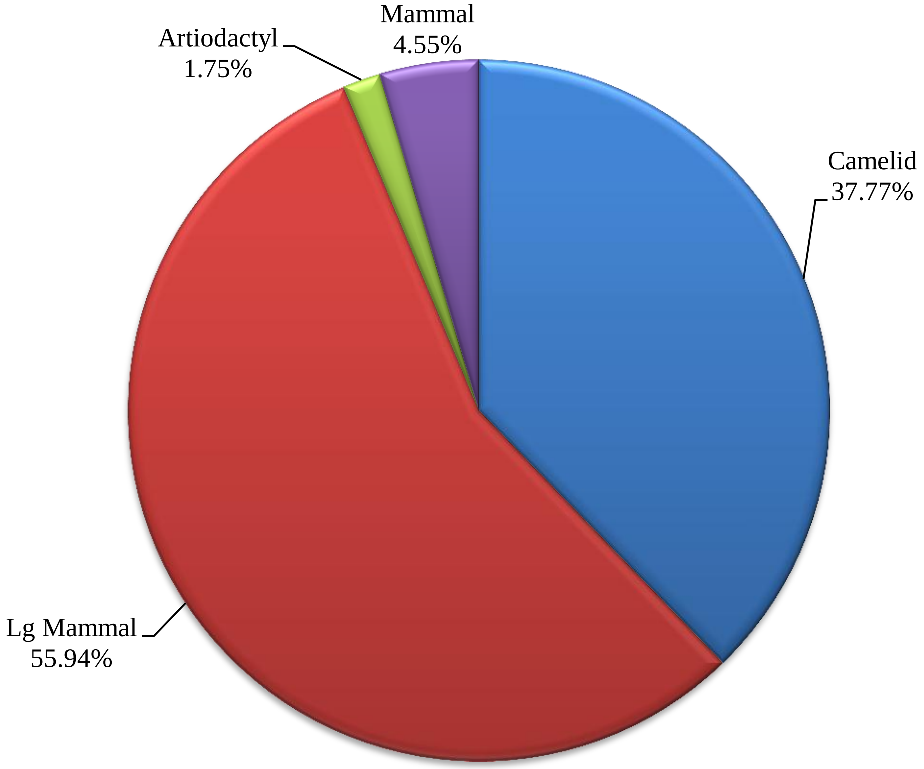


Figure 5.17: Block 3 Final Late Formative Fauna (1/4" %NISP, Bone Weight)

Table 5.36: Final Late Formative Flotation Fauna

	Bl. 1 NISP	Bl. 1 Wt (g)	Bl. 2 NISP	Bl. 2 Wt (g)	Bl. 3 NISP	Bl. 3 Wt (g)
Camelid	0	0.00	3	12.41	0	0.00
Lg Mammal	20	8.08	27	11.57	111	62.20
Sm Mammal	0	0.00	0	0.00	2	0.02
Mammal	432	12.95	172	8.56	467	26.96
Bird	1	0.00	0	0.00	1	0.03
Amphibian	1	0.03	0	0.00	0	0.00
Unid	0	0.00	0	0.00	255	5.68
Total	**453**	**21.03**	**202**	**32.54**	**796**	**92.23**

The herd-animal focus is also evident in the detailed breakdown of the flotation fauna and FLF MNI counts (Tables 5.36-5.37). As noted before, we encounter bone – unidentified large mammal and mammal bits – that undoubtedly were produced by secondary camelid carcass processing and consumption within these contexts.

Table 5.37: Final Late Formative MNI

Taxon	Block 1	Block 2	Block 3	Total
Camelid	3	2	5	**10**
Taruca	0	0	0[1]	**0**
Md Mammal	1	1	1	**3**
Sm Mammal	0	0	1	**1**
Bird	0	0	1	**1**
Frog	1	0	0	**1**
Total	**5**	**3**	**8**	**16**

Lagunita Mound: Camelid Offering

A final set of faunal specimens from Pukara Late Formative occupations were recovered during Klarich's 2009 investigations of the Lagunita Mound. As previously noted one trench had been excavated by Alfred Kidder during his site excavations. Subsequently, looters reworked portions of the trench. While a member of the 2009 crew, I assisted in the cleaning of the mound's trench profile. A rectangular, broken monolith was interred, oriented on its narrow side, below the mound surface.

Table 5.38: Lagunita Camelid Offering (1/4” NISP)

Taxon	NISP	Bone Weight (g)
Camelid	112	276.86
Lg Mammal	6	5.84
Mammal	32	5.80
Total	**150**	**288.50**

While exposing the monolith’s northwest side, fractured large mammal limb bone fragments were encountered. An in-situ camelid cranium was located next to the monolith’s southwest corner (Figure 5.18). The offering represents the articulated, partially crushed fragments of a prime-age llama cranium, mandible, and axis vertebra (Table 5.38). No additional portions of the skeleton were recovered. I interpret these remains as an intentional offering associated with the monolith’s ritual interment in the mound. We will revisit this offering in subsequent chapters.

Conclusions

At this chapter’s end, we can briefly compare results by site, time period, and behavioral context. This review draws upon MNI summary data compiled from flotation and coarse mesh data. Along with camelids, taxonomic abundance from all periods and contexts indicate the importance of water-habitat birds, small mammals, and fish in both the ritual and domestic economies and diet. The greatest diversity and number of taxa exploited are associated with the Huatacoa’s two domestic secondary midden deposits (Early and Late Formative) and surprisingly, the two sunken court contexts (Figure 5.19).

Undoubtedly, sample size plays a role these MNI spikes, as the post-house Early and Late Formative domestic middens contain more bone (by NISP and bone weight) relative to the pre-house and house-associated middens. This was anticipated given the longer time slice represented. Recall, however, Elizabeth Wing recorded greater wild game diversity for the Early and Middle Formative deposits of Qaluyu. Greater household economy dependence on domesticated animals may be Late Formative shift or reflect the household economy of smaller, village-ceremonial sites.

Figure 5.18: Lagunita Mound Camelid Offering

<u>Note:</u> Red circles denote approximate recovery locations of camelid and large mammal bone.

For the two court strata, a greater variety of proveniences were studied, including midden fill. Nonetheless, these samples should present a more representative profile of diverse fauna use seen at Huatacoa. We can recall In particular, the Late Formative Feature 3's exceptional ritual toad deposit stands out, clearly exceeds their "background" frequency in other contexts. Once again, Huatacoa villagers seem to have practiced smaller-scale rites, provisioned by domestic hunting of wild game, household cuy, and fewer culled domesticated camelids.

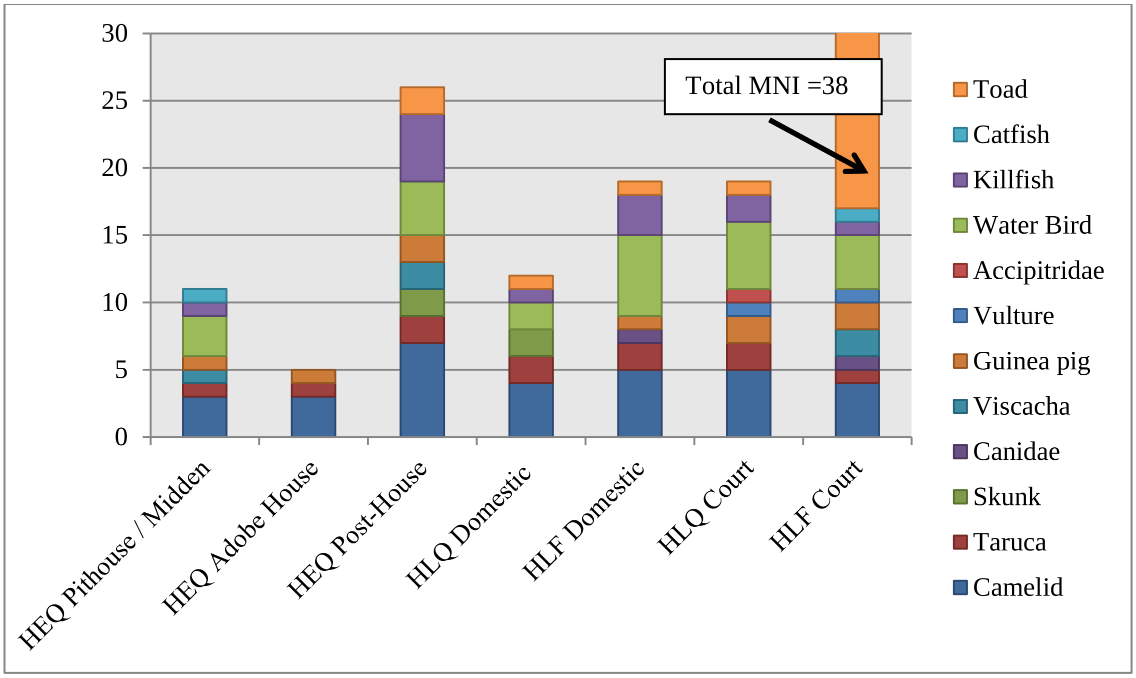


Figure 5.19: Huatacoa Taxa by Context and Time (1/4" MNI)

Noticeable disparities exist between Huatacoa relative to larger polity capital of Pukara. A contrast is evident when I examined Huatacoa ritual court contexts and the Initial Late Formative public contexts from Pukara. Huatacoa's court coarse-mesh assemblages displayed a higher frequency of wild, non-camelid taxa bone relative to Pukara's public feast contexts (Figure 5.20). Camelids account for roughly 25% of sunken court context fauna MNI, at Huatacoa, compared to more than 60% within Pukara's feast contexts. Activities within ritual contexts drew upon household contributions of hunted birds, fish taxa, and household cuy – as locally available and "renewable" taxa for meals, offerings, and ritual feasts[71]. Yet, raptors appear to have been important in public and ritual contexts from both sites (see Table 5.2 above).

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[71] The combined mesh Huatacoa fish MNI, yet, is dwarfed by MNI counts encountered in sunken court pits at Kala Uyuni (Carpiles 2006).

At Pukara, a more calculated expenditure of herd animals for large-scale meat production, at the expense of their future productive potential. Other, more plentifully available taxa were not exploited for communal feasting. We can imagine kin-level feast hosts drew upon kinship relationships to marshal camelids for the cull. Chapter 8 will address the question of intra-site use and possible inter-site provisioning of camelids as elements of the household and political economies.

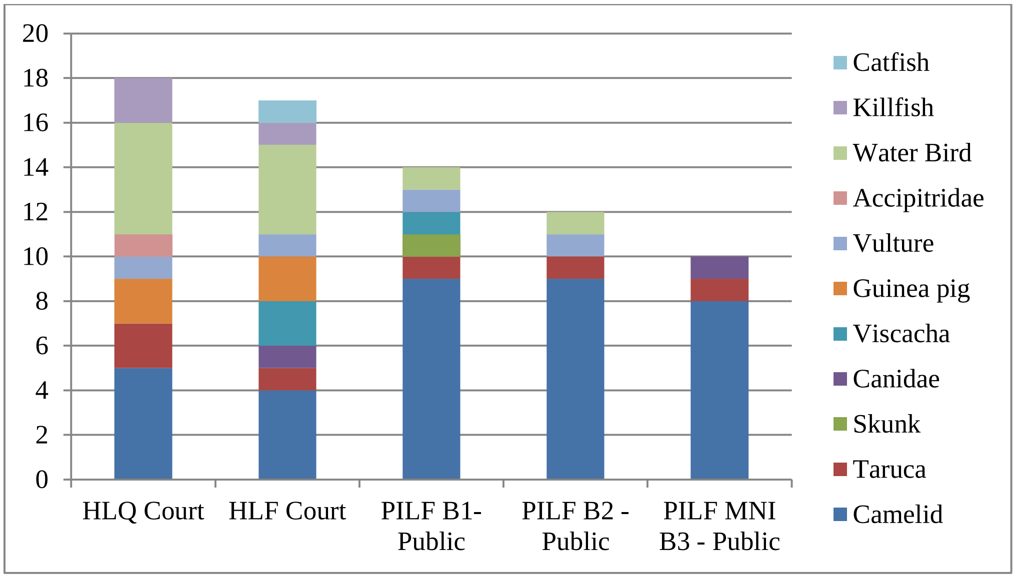

Figure 5.20: Huatacoa Court versus Pukara Public Feast Context (1/4" MNI)

In addition, I found these trends and intersite incongruities in taxa representation extend when I undertook a diachronic comparative study of domestic contexts (Figure 5.21). In each case, Huatacoa domestic contexts had a greater proportion and diversity of wild game than recorded in Pukara Late Formative domestic proveniences. Cuy and fish were conspicuously rare at Pukara. These are strong contrasts that remain viable, despite comparatively small bone assemblages from the first two Early Qaluyu samples.

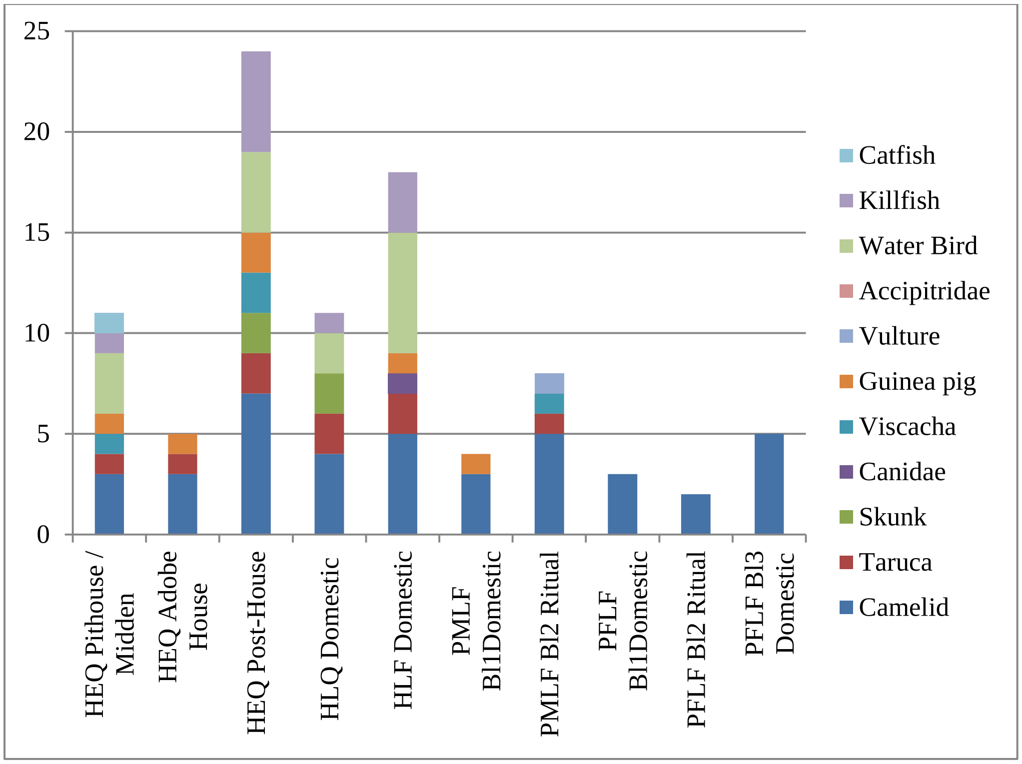

Figure 5.21: Huatacoa Domestic versus Pukara Domestic Contexts (1/4" MNI)

Finally, these patterns continue when we consider a combined coarse-mesh / flotation bone assemblages for both sites (Figure 5.22)[72]. First, there is evidence for a decrease in domestic dietary use of wild resources in over time. This is evident when Huatacoa's Early Formative post-abandonment domestic midden assemblage is compared to Huatacoa's and Pukara's Late Formative domestic context assemblages. Yet, broadly comparable scales of camelid culling are evident, between domestic primary midden and structures for Early Formative Huatacoa and Late Formative Pukara. Also, by MNI, the scale of consumption is comparable to ritual camelid use. Second, as noted above, greater wild fauna use is documented in Huatacoa ritual sunken court contexts relative to Late Formative communal feasts

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[72] This wild/domesticated contrast exists between the two sites despite careful study of a large number of Pukara flotation samples.

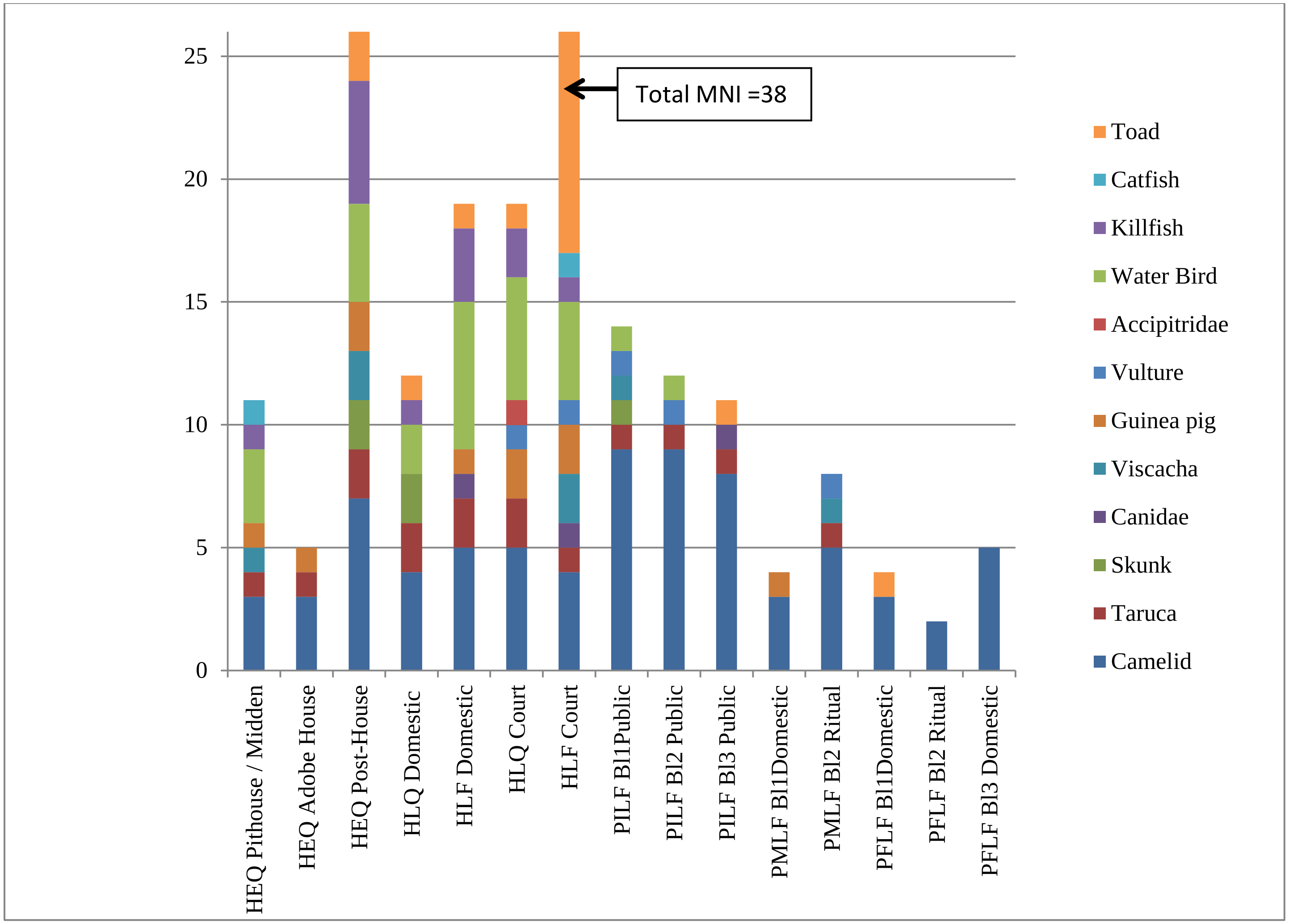

Figure 5.22: Huatacoa and Pukara Fauna by Context (Combined-Mesh MNI)

Note: H=Huatacoa, P=Pukara, EQ=Early Qaluyu, LQ=Late Qaluyu, LF=Late Formative, B=Block

Smaller sample size, however, is a caveat for the Pukara domestic assemblages. Food consumption was a complementary part of economic activities that Late Formative residents of Pukara undertook in pampa household compounds. In contrast to house structure proveniences, the later Huatacoa domestic middens may represent aggregate secondary midden deposits from multiple households. This stands also in contrast to the primary household compound contexts at Pukara.

Conclusions

Interestingly, this wild/domesticated versus domesticated-emphasis dichotomy mirrors Wing's aforementioned results for the Qaluyu's Early/Middle and Late Formative faunal use trends – were a decline in wild game over time was prominent[73]. Qaluyu's Middle Formative assemblage is broadly similar to Huatacoa's faunal assemblages.

Also, it is worth noting what members of the expected taxa are absent or poorly represented. Contrary to expectations, wild canids and felids were nearly absent, while domesticated dogs are very rare in any behavioral context at either site. This fact is vexing, given the frequency of carnivore ravaging noted for Pukara's bone assemblage (see Chapter 6). Dog remains and offerings were rare, which is somewhat contrary to expectations also. One medium mammal bone was noted within Huatacoa's Late Qaluyu court. A single ritual pit offering of calcined indeterminate small dog/fox bone was associated with the Late Formative court patio.

Likewise, I did not observe the great diversity of expected bird taxa. Formative residents of the Pukara Valley appear to have farvored hunting birds inhabiting proximate

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[73] The economic importance of deer reported at Qaluyu stands out as a notable contrast to their observed value at the contemporaneous Huatacoa occupation.

riverine and wetland habitat birds (e.g. abundant qocha / bodefal habitats) over lacustrine bird taxa.

Excavation of additional domestic contexts outside the shadow of Pukara's monumental precinct could test this pattern further. Perhaps we are observing an intra-site-specific herd animal focus for the domestic compound samples because of the close proximity to the *Qalasaya* and other ceremonial and public contexts. The relative, middle-class status of this domestic precinct could generate a skewed snapshot of the daily diet eaten by the commoner populations of Huatacoa and Pukara. Furthermore, excavation of additional Pukara sunken court and ritual contexts would be helpful – to determine if the observed patterns of camelid-focus in Pukara ritual contexts are robust and accurate.

CHAPTER 6: TAPHONOMY

This chapter reviews results of taphonomic observations made on the ¼'' camelid and non-camelid bone at both sites. Careful attention is paid to non-cultural taphonomic conditions as they influence the bone preservation and identification and the reconstruction of food preparation and discard patterns. Attention is focused on recording the degree of burning (exposed temperature), carnivore and rodent gnawing, weathering, and degree of bone fragmentation. Results may indicate differential destruction or treatment of specific fauna or intra-site differences in discard associated with domestic, ritual, and public feasting use of fauna.

Huatacoa Domestic Area (Area B)

Early Qaluyu

Besides butchery and post-deposition fracture, bone within Early Qaluyu domestic contexts are impacted most by burning (Table 6.1)[74]. Charred, blackened bone is characteristic of firing temperatures sufficient to roast meat (Moore et al. 2007). Yet, since most bone was not burnt, meat was prepared in soups or stripped before cooking. Most bone was not thrown into a hearth, given the relatively low frequency of calcined bone. Not surprisingly, given its frequency overall, camelid and large mammal bone are ubiquitous amongst the burned bone sample. Yet, other game show evidence of cooking, including birds, small mammal, and fish. Relative to the two other strata, the Above House midden stratum displays the highest proportion of calcined to charred bone.

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[74] Burnt bone preserves better than fresh bone as organic matter is consumed by the flames. Highly calcined bone, however, becomes friable. This may account for the loss of some bone.

Table 6.1: Early Qaluyu Strata Bone Modification (1/4" NISP)

	Taxa	**B Char**	**B Calcined**	**C Gnaw**	**R Gnaw**	**Worked Bone**	**Total**
Pithouse (B1)	Artiodactyl	4	0	0	0	0	**4**
	Camelid	94	10	0	0	8	**112**
	Taruca	3	2	0	0	1	**4**
	Lg Mammal	399	100	0	0	31	**530**
	Chinchillidae	1	0	0	0	0	**1**
	Sm Rodent	1	0	0	0	0	**1**
	Mammal	6	0	0	0	2	**8**
	R. andina	1	0	0	0	0	**1**
	F. ardesica	1	0	0	0	0	**1**
	Bird	3	1	0	0	0	**4**
	Fish	3	0	0	0	0	**3**
	Total	**516**	**113**	**0**	**0**	**42**	
House (B2)	Artiodactyl	1	0	1	0	0	**2**
	Camelid	27	2	0	0	4	**33**
	Lg Mammal	130	9	0	0	5	**144**
	Cuy	2	0	0	0	0	**2**
	Mammal	10	0	0	0	1	**11**
	Bird	8	0	0	0	0	**8**
	Fish	1	0	0	0	0	**1**
	Unid	10	1	0	0	1	**11**
	Total	**189**	**12**	**1**	**0**	**11**	
Above House (B3)	Artiodactyl	25	16	0	0	3	**44**
	Camelid	276	51	8	1	28	**364**
	Taruca	31	1	0	0	1	**33**
	Lg Mammal	989	355	1	0	56	**1401**
	Skunk	6	0	1	0	0	**7**
	Sm Canid	1	0	0	0	0	**1**
	Md Mammal	1	2	0	0	0	**3**
	Cuy	4	1	0	0	0	**5**
	Chinchilla	1	0	0	0	0	**1**
	Sm Mammal	2	0	0	0	0	**2**
	Mammal	29	6	0	0	4	**39**
	F. ardesica	1	0	0	0	0	**1**
	A. flavtostris	6	0	0	0	0	**6**
	Bird	3	0	0	0	1	**4**
	Fish	1	0	0	0	0	**1**
	Total	**1376**	**432**	**10**	**1**	**93**	
	Grand Total	**2081**	**557**	**11**	**1**	**146**	

Note: B=Burned, C=Carnivore, R=Rodent

Low-level carnivore ravaging is present in the Post-House Abandonment Early Qaluyu midden (A3). Gnaw marks are recorded on first and second phalanges, femur and radio-ulna, scapula, and a calcaneus. Dogs had limited post-discard access to bone. Minimal rodent gnawing is evident. Instead, humans, through butchery or processing, were the main agents of bone destruction.

Tool manufacture and the discard of bone-working "leftovers" are the second most common factor influencing bone destruction – particularly in the Pithouse and Above House strata. Camelid limb elements were selected for tool manufacture, particularly metapodia and radio-ulna. Axial elements used are scapula, ribs, and the innominate. Preferences extend to taruca[75], artiodactyl, and large mammal bone. Weaving tools are the most commonly encountered form. Possible snuffing carved spoon bowls and handles also occur in each Early Qaluyu strata.

Table 6.2: Fragmentation Index: EQ Domestic (1/4" NISP/g)

Taxon	Pithouse	Adobe House	Above House
Camelid	5.62	8.57	8.40
Taruca	2.74	5.34	5.05
Artiodactyla	1.14	0	2.52
Large Mammal	1.33	1.28	1.56
Skunk	0	0	2.67
Medium Mammal	0	0	1.57
Viscacha	0.58	0	0.32
Guinea pig	0.07	0.39	0.23
Rodent	0.14	0	0
Small Mammal	0	0	0.16
Mammal	0.43	0.87	1.04
Duck (*Anas* spp.)	0.11	0	0.24
Andean Avocet (*Recurvirostra andina*) cf.	0.13	0	0.60
Coot (*Fulica* spp.)	0.26	0	0.06
Bird	0.30	0.10	0.80
Orestias spp.	0.16	0	0.31
Trichomycterus spp.	0.18	0	0
Fish	0.20	0.08	0.21

Note: Rounded to nearest hundredth.

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[75] The pithouse stratum had a single taruca antler tool.

Two other physical modifications to bone were considered: weathering and degree of fragmentation. Minimal bone weathering was evident. Nearly all bone scored a zero stage on Behrensmayer's scale (1976). Stage one was the highest level of bone cracking and exfoliation recorded. Discard was apparently rapid and ashy soil matrices may have aided in bone preservation.

Table 6.2 displays the simple index of average weight per identified bone fragment (1/4" NISP) for taxa category. Values are calculated using reported values from Chapter Four's strata tables. Index values provide a proxy measure of intensity of bone destruction by taxon and between strata. Large mammal bone present in larger, less fragmented pieces within the adobe house-associated and post-house abandonment stratum contexts. Smaller game bone fragmentation varies little, likely due to their overall low frequency, lower skeletal-element weight, and possibly lower coarse-mesh recovery[76]. Overall, however, little contrast is evident between these samples.

Late Qaluyu

The broad trends noted for the preceding occupation characterize the Late Qaluyu domestic midden also (Table 6.3-6.4). Charring of bone during roasting predominates as a bone modification. Weaving tool forms were manufactured from limb elements and rib forms. Carnivore damage is observed on one first phalanx and one tibia specimen. Weathering is not extensive. As before, most bone is scored at stage zero. A single tibia fragment displayed exfoliation and cracking characteristic of stage two.

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[76] Sample size between strata and taxa-specific variation in bone density also influence index results.

Table 6.3: Late Qaluyu Bone Modification (1/4" NISP)

	Taxa	B Char	B Calcined	C Gnaw	R Gnaw	Worked Bone	Total
LQ midden (B4)	Artiodactyl	7	1	0	0	1	9
	Camelid	127	8	2	0	7	144
	Taruca	10	0	0	0	1	11
	Lg Mammal	281	22	0	0	22	469
	Skunk	3	0	0	0	0	3
	Mammal	11	0	0	0	1	12
	F. ardesica	2	0	0	0	0	2
	A. flavitostris	1	0	0	0	0	1
	Bird	12	0	0	0	0	12
	Fish	1	0	0	0	0	1
	Total	**457**	**31**	**2**	**0**	**32**	

Note: B=Burned, C=Carnivore, R=Rodent

Table 6.4: Fragmentation Index: LQ and LF Domestic (1/4" NISP/g)

Taxon	LQ Midden	LF Midden
Camelid	7.73	7.35
Taruca	11.10	13.81
Artiodactyla	3.72	2.40
Large Mammal	1.96	1.66
Canidae	0	5.33
Skunk	2.92	0
Medium Mammal	0.73	1.07
Guinea Pig	0	0.33
Small Mammal (Rodent)	0.14	0.41
Mammal	0.93	0.43
Rallidae	0	0.38
Duck (*Anas* spp.)	1.21	0.26
Coot (*Fulica* spp.)	0.38	0.56
Moorhen (*Gallinula chlorpus*)	0	0.60
Bird	0.44	0.25
Fish	0.25	0.14

Note: Rounded to nearest hundredth.

Late Formative

Huatacoa's Late Formative domestic midden replicates trends noted in prior strata (Table 6.4-6.5). Charred and worked limb and rib bones tools are common. Metapodia are the most common discarded tool element followed by scapula, tibia, and radio-ulna.

Bone weathering is uniform at median score of zero. Rare examples of bone displaying stage one and two scores were identified.

The frequency of camelid bone displaying carnivore ravaging is doubled. Gnawing is observed on first through third phalanges, ribs, all vertebral segments, and select limb bones. By the Late Formative, the domestic settlement area might have become an increasingly peripheral, secondary midden dump. This might explain the ability of dogs to access and destroy discarded refuse with greater ease.

Table 6.5: Bone Modification in Late Formative Midden (1/4" NISP)

	Taxa	B Char	B Calcined	C Gnaw	R Gnaw	Worked Bone	Total
Late Fomative Midden (B5)	Artiodactyl	8	3	0	0	0	**11**
	Camelid	303	45	17	0	18	**383**
	Taruca	3	0	0	0	0	**3**
	Lg Mammal	926	195	0	0	17	**1138**
	Canid	1	0	0	0	0	**1**
	Md Mammal	3	0	0	0	0	**3**
	Cuy	2	0	0	0	0	**2**
	Sm Mammal	1	0	0	0	0	**1**
	Mammal	19	1	0	0	1	**21**
	F. ardesica	7	0	0	0	0	**7**
	Anatidae	3	0	0	0	0	**3**
	Bird	9	0	0	0	0	**9**
	Fish	1	0	0	0	0	**1**
	Total	**1286**	**244**	**17**	**0**	**36**	

<u>Note</u>: B=Burned, C=Carnivore, R=Rodent

Huatacoa Sunken Court Complex (Area A)

Early Qaluyu

Faunal remains, including modified bones, are sparse across the Early Qaluyu Plaza and, to a lesser extent, in association with the Early Qaluyu Court (Tables 6.6-6.7). Few burned or worked bone fragments were recovered. Weaving tools were most common. Recovered from the plaza midden was another probable snuff spoon bowl, made from mammal bone. No gawed bone is present.

Table 6.6: Early Qaluyu Plaza and Sunken Court Bone Modification (1/4" NISP)

	Taxa	B Char	B Calcined	C Gnaw	R Gnaw	Worked Bone	Total
EarlyPlaza (A1)	Camelid	1	0	0	0	0	1
	Lg Mammal	1	1	0	0	2	4
	Mammal	0	0	0	0	1	1
	Total	**2**	**1**	**0**	**0**	**3**	
Sunken Court (A2)	Camelid	2	0	0	0	1	3
	Lg Mammal	2	0	0	0	1	2
	Unid	0	1	0	0	0	1
	Total	**4**	**1**	**0**	**0**	**2**	
	Grand Total	**6**	**2**	**0**	**0**	**5**	

Note: B=Burned, C=Carnivore, R=Rodent

We may hypothesize several explanations for the dearth of bone. Bone accumulated in ritual events and subsistence activities associated with these two contexts may remain buried in unexcavated court or court-adjacent proveniences. On the other hand, following ritual events, both contexts might be swept clean of resultant faunal remains and artifacts – to renew the ritual space. Excavations to prepare the court's foundation destroyed much of the plaza and the small test excavation area precluded pursuing the extent of both the plaza and court itself further (Cohen 2010:148). Further testing would rectify these questions and likely provide a better understanding of the range of activities associated with both proveniences.

Table 6.7: Fragmentation Index: EQ Plaza and Court (1/4" NISP/g)

Taxon	EQ Plaza	EQ Sunken Court
Camelid	4.89	7.00
Large Mammal	1.30	4.19
Mammal	0.59	0.62
Bird	0.21	0

Late Qaluyu Court 1

The Late Qaluyu First Court and adjacent contexts contain a range of ceremonial deposits. Notable among these contexts are a series of sacrificial dedicatory burials, burned patio middens, court-associated storage bin structures, the Feature 57 closing-ceramic offering pit, and in court abandonment fill.

Table 6.8: Late Qaluyu First Court Bone Modification (1/4" NISP)

	Taxa	B Char	B Calcined	C Gnaw	R Gnaw	Worked Bone	Total
LQ Court (A3)	Artiodactyl	10	2	0	0	3	**15**
	Camelid	316	13	2	0	20	**351**
	Taruca	105	1	0	0	0	**106**
	Lg Mammal	980	66	0	0	36	**1082**
	Md Mammal	3	0	0	0	0	**3**
	Cuy	4	0	0	0	0	**4**
	Chinchillidae	1	0	0	0	0	**1**
	Mammal	39	1	0	0	1	**42**
	F. ardesica	7	0	0	0	0	**7**
	Bird	11	4	0	0	0	**15**
	Fish	2	0	0	0	0	**2**
	Total	**1478**	**86**	**2**	**0**	**60**	

Note: B=Burned, C=Carnivore, R=Rodent

Fauna were consumed in ritual meals or as offerings associated with each (Table 6.8-6.9). Camelid bone is the common thread encountered in these court ritual contexts. Burnt camelid limb and cranial bone (MNI=2) accompanies medium mammal, taruca (antler and postcranial bone), and small bird remains in the Feature 53 (Burial 10) dedicatory sacrifice[77]. Burnt camelid, cuy, and fish remains occur within the Feature 57 closing rite. Camelid bone also appears within the patio storage bins, burnt court-use middens, and burnt midden fill associated with the Late Qaluyu First Court's destruction and the platform foundation for the Second Court. Several camelid bones display cut

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[77] No clear butchery remarks were recorded on burnt camelid bone from this burial making it a good candidate for a burnt offering.

marks, indicating food preparation and consumption occurred as a part of burning rites and court building, dedicatory, use, and destruction events.

Yet, charred *choka* bird limb bones (*F. ardesica*) are found associated with a black charred lens (A64) and bin structures[78]. Several burned bird remains and cuy found elsewhere around the court lack clear butchery marks. These may represent burnt offerings. Burnt offering pits containing varied fauna, *oca*, and chuño are recorded adjacent the Ch'isi, Bolivia sunken court (Chavéz 2004). Whether burnt or not, a rather diverse range of fauna is associated with the court.

Charring was the most prominent form of bone modification noted by context and across taxa. Calcination of bone is rare. The higher incidence of charring, rather than calcination, resulted in favorable bone preservation. Possible explanations for the absence of calcined bone are that bone was rarely exposed to sustained heat or court surfaces were periodically swept clean.

Dogs did not regularly scavenge bone generated by court-use activities. It appears that carnivores did not have frequent, long-term access to these contexts. Tool manufacture, use, and disposal account for the destruction and presence of some bone within court contexts also. Bone weathering was minimal, with median scores of 0 and 1. While court taxa were more diverse, comparison of bone with domestic middens suggests a bit higher fragmentation rate for bone identified as artiodactyl and large mammal. Larger fragments may have been removed from the courts or burned up in their entirety.

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[78] Bin structure-associated caravan llama remains are described in Chapter 7.

Table 6.9: Fragmentation Index: LQ and Pukara Courts (1/4” NISP/g)

Taxon	LQ First Court	LF Court
Camelid	8.65	7.69
Taruca	1.17	6.14
Artiodactyla	1.66	1.31
Large Mammal	1.61	1.13
Canidae	0	3.70
Medium Mammal	1.54	7.14
Viscacha	0	0.72
Guinea pig	0.21	0.22
Small Mammal	0.07	0.13
Mammal	0.38	0.38
Rallidae	0.32	0.23
Cathartes aura	2.12	0
Cathartidae spp.	0	0.32
Accipitridae	0.66	0
Coot (*Fulica* spp.)	0.51	0.39
Moorhen (*Gallinula chlorpus*)	0.12	0.45
Anas spp.	0	0.36
Bird	0.23	0.21
Trichomycterus spp.	0	0.18
Orestias spp.	0	0.12
Fish	0.16	0.12
Amphibia	0.07	0.03[1]

[1] ¼” (and smaller) fragment size from F-3 and 24 coarse-mesh samples

Late Formative Court (Pukara)

Associated with the Pukara Court are patio surfaces, pit Feature 19, and two ritual pits – Feature 24 and Feature 3. Camelid bone and large mammal bone dominate the burnt assemblage. Charred birds are significant components of most Pukara Court activities: 1) midden pit fill (Feature 24 and Feature 33) and 2) thermally altered patio surfaces. Some of these specimens may be burnt offerings, not consumed foodstuffs. Definite burned offerings of cuy are associated with a post-court-abandonment patio resurfacing event; they may serve a commemorative, closing rite function. One remarkable fact is the relative rarity of burned bone within the Feature 3 ritual pit – regardless of taxa (Table 6.10).

Two trends regarding court space remain consistent from the preceding Late Qaluyu First Court. First, the Pukara ritual refuse assemblage was not greatly shaped by carnivore or rodent gnawing damage. Two fragments of camelid with gnaw marks from Feature 3 demonstrate its bone was not immediately deposited after the rite's completion. Tool production was prominent practice shaping bone representation. Two examples of worked bird bones as byproducts of bone bead or tube production were found. Camelid bones recorded as worked or as confirmed tools are innominate, metapodials, radio-ulna, ribs, scapula, and tibia. Metapodials and ribs were the most frequent elements recovered. Low weathering scores and fragmentation compare favorably to prior strata results (Table 6.9). The highest weathering score recorded was three on a small bone subset; most bone scored at zero or one.

Table 6.10: Late Formative Court Bone Modification (1/4" NISP)

	Taxa	**B Char**	**B Calcined**	**C Gnaw**	**R Gnaw**	**Worked Bone**	Total
LF Court (A5)	Artiodactyl	14	1	0	0	0	**15**
	Camelid	320	33	4	0	28	**385**
	Taruca	5	1	0	0	0	**6**
	Lg Mammal	830	129	0	0	38	**997**
	Canid	4	3	0	0	0	**7**
	Md Mammal	1	0	0	0	0	**1**
	Cuy	22	0	0	0	0	**22**
	Rodent	1	0	0	0	0	**1**
	Sm Mammal	1	0	0	0	0	**1**
	Mammal	43	19	1	1	4	**68**
	F. ardesica	10	1	0	0	1	**11**
	G. chlorpus	1	0	0	0	0	**1**
	Anatidae	3	0	0	0	0	**3**
	Cathartidae	3	0	0	0	0	**3**
	Rallidae	7	0	0	0	0	**7**
	Bird	23	0	0	0	1	**24**
	Amphibian	1	0	0	0	0	**1**
	Fish	4	0	0	0	0	**4**
	Unid	20	0	0	0	1	**21**
	Total	**1313**	**187**	**5**	**1**	**73**	

Note: B=Burned, C=Carnivore, R=Rodent

Pukara

Initial Late Formative

I now shift to a characterization of taphonomy recorded on bone from the three Late Formative occupations at Pukara. My expectations were that feasting refuse deposited in Initial Pukara pampa occupations would be rapidly deposited and covered by fill. Accordingly, lower rates of bone scavenging and low weather were anticipated. Roasting was considered a probable food preparation technique, which would produce at most charred bone. Furthermore, given worldwide accounts of feasting, a meat-emphasis on carcass use was predicted. A corollary of this hypothesis was that bones would be present as larger fragments than typically found in household contexts.

For each Initial occupation, many of the predictions proved false – demonstrating a more complex profile for feasting events than previously thought (Tables 6.11-6.12). First, we note that each block displays a reversal of the ratio of charred to calcined bone observed for Hautacoa. Yet, we see that most of the calcined bone likely represents fragmented camelid bone. One possible explanation for this observed trend is the greater disposal of bone by hearth burning, calcined bone's friability, and the ease of assigning small bone splinters to large mammal bone category. Most bone was spread over the pampa ground rather than deposited in pit features. A median weathering score of one suggests at least short-term exposure to the elements. Given the sheer quantity of bone present, cleaning of surfaces may not have been sufficient to discourage scavenging and odors. Following consumption, bones may have been disposed of in hearths.

Table 6.11: Initial Late Formative Bone Modification (1/4" NISP)

	Taxa	B Char	B Calcined	C Gnaw	R Gnaw	Worked Bone	Total
Bl 1	Artiodactyl	25	12	0	0	0	**37**
	Camelid	20	17	171	1	26	**235**
	Lg Mammal	289	265	0	0	39	**593**
	Cervid	0	0	0	0	1	**1**
	Mammal	2	10	0	0	4	**16**
	Total	**336**	**304**	**171**	**1**	**70**	
Bl. 2	Artiodactyl	32	52	122	0	3	**209**
	Camelid	29	74	231	2	30	**366**
	Taruca	1	0	1	0	2	**4**
	Lg Mammal	246	454	2	0	35	**737**
	Md Mammal	1	2	3	0	1	**6**
	Mammal	8	16	0	0	1	**25**
	Cathartidae	0	0	0	0	1	**1**
	Bird	2	1	0	0	0	**3**
	Fish	1	0	0	0	0	**1**
	Total	**319**	**599**	**359**	**2**	**74**	
Bl. 3	Artiodactyl	4	3	0	0	2	**9**
	Camelid	13	28	94	0	100	**235**
	Lg Mammal	45	115	0	0	63	**223**
	Mammal	0	2	0	0	0	**2**
	Total	**62**	**148**	**94**	**0**	**165**	
	Grand Total	**717**	**1051**	**624**	**3**	**309**	

6.12: Fragmentation Index: Initial Late Formative Contexts (1/4" NISP/g)

Taxon	Block 1	Block 2	Block 3
Camelid	8.37	7.20	7.05
Taruca [1]	7.02	7.92	0
Artiodactyla	4.61	3.72	3.23
Large Mammal	1.76	1.49	1.39
Canidae / Caniformia	2.41	0	17.89
Skunk	3.38	0	0
Medium Mammal	0.73	1.53	0
Guinea pig	0.12	0.10	0
Mammal	0.32	0.32	0.29
Cathartidae spp.	0	1.15	0
Bird	1.08	0.37	0
Fish	1.88	0.10	0

Two other patterns stand out: the remarkable frequency of carnivore ravaging observed and the sheer density of worked bone. Again, the quantity of bone deposited, combined with the open space associated with butchery, food preparation, and bone disposal, may have played a role. Dogs would be little discouraged to access the large quantities of camelid bone waste. Gnawing was observed on bone from the entire skeleton: limbs, the axial skeleton, as well as carpals and tarsals. Gnawing was also a factor shaping the preservation of feasting refuse.

The frequency of worked bone per excavation block exceeded the count observed in any of the Huatacoa strata. Bone fragmentation and gnawing, however, raise the potential for misidentification of bones as worked. A follow-up microwear study would be helpful to confirm that pseudotools are not present. Large fragment weight characterizes camelid and artiodactyl bone relative to Huatacoa contexts.

Middle Late Formative

Overall, Middle and Final Late Formative strata are characterized by considerably reduced faunal remains. As a proportion burned bone is less common in the Block 1 occupation. A significant spike in calcined bone is associated with the dense Southwest Corner Midden in Block 2. Block 2 also displays more bone tools than the Middle occupation in Block 1. Tools were manufactured mainly from metapodials and mandible. Five first phalanx bones recovered represent worked bone byproducts from bead making. Neither trend is surprising given the limited frequency of bone and ephemeral nature of the Block 1 occupation zones (Table 6.13).

Camelids and artiodactyl bone in Block 2 displayed the highest frequency of gnawing seen in any of the analyzed Formative strata. By comparison, Block 1 had few gnawed bones. It appears the greater bone frequency and open compound floor plan facilitated scavenger access to bones. As such, gnawing clearly impacted camelid bone preservation and identification.

Table 6.13: Middle Late Formative Bone Modification (1/4" NISP)

	Taxa	B Char	B Calcined	C Gnaw	R Gnaw	Worked Bone	Total
Bl. 1	Artiodactyl	0	1	0	0	0	**1**
	Camelid	0	1	9	0	2	**12**
	Lg Mammal	56	30	0	0	5	**91**
	Md Mammal	0	0	1	0	0	**1**
	Mammal	0	5	0	0	2	**7**
	Total	**56**	**37**	**10**	**0**	**9**	
Bl. 2	Artiodactyl	8	6	57	0	3	**74**
	Camelid	17	13	209	0	25	**55**
	Taruca	0	0	1	0	1	**2**
	Lg Mammal	126	2141	5	0	39	
	Md Mammal	0	1	1	0	1	**3**
	Mammal	22	6	0	0	0	**28**
	Total	**173**	**2167**	**273**	**0**	**69**	
	Grand Total	**229**	**2433**	**283**	**0**	**78**	

Note: B=Burned, C=Carnivore, R=Rodent

The bone weathering and bone fragmentation indices, in turn, were more pronounced in Block 1 (Table 6.14). Nine bones displayed scores of stages two to three; the median score was stage 1. For Block 2, the median scores were stage zero and one; nine fragments scored at stage 2. Whereas camelid bone fragments were larger in Block 1, fewer camelid bones were encountered. Furthermore, artiodactyl bone was significantly more fragmented than recorded in Block 2.

Table 6.14: Fragmentation Index: Middle Late Formative Contexts (1/4" NISP/g)

Taxon	Block 1	Block 2
Camelid	6.08	4.67
Taruca (mostly antler)	0	1.79
Artiodactyl	1.51	3.18
Large Mammal	1.38	1.20
Medium Mammal	16.05	1.77
Guinea Pig	0.72	0
Viscacha	0	0.50
Rodent	0.27	0
Mammal	0.37	0.19
Cathartidae	0	1.70
Bird	0.43	0.55

Final Late Formative

The final domestic assemblage consisted of moderately large bone assemblages for each excavation block. Burning was rare, with Block 3 the marked exception to this trend. Most of the burned bone present in Block 3 is associated with the Occupation Surface and Zones 1 (OS/OZ1). Overall, a greater proportion of camelid bone, and not surprisingly artiodactyl and large mammal was burned within this block also. Compared to the other two excavation blocks, a different regime of hearth-base food preparation (perhaps meat roasting) and/or discard appears to have been practiced.

Differences in carnivore ravaging and bone working are apparent. Block 1 demonstrates the highest frequency of gnawing and worked bone. For each area, gnawing was identified on a wide range of skeletal elements. In Block 1, working was almost exclusively observed on limb shaft fragments. For Block 3, metapodials were the most common worked element, followed by mandibles and other limb bones.

Weathering scores varied by excavation block. The highest frequency of weathering was present within Block 1. While its median score was stage zero through one, 29 fragments scored Stage 2 and five fragments were categorized as Stage 3 wear. Bone in the other two Blocks had a median score of Stage 0 to 1. Thus, bone processing, gnawing, and disposal methods seemingly exposed Block 1 bone to the elements for a longer time period or sped up its destruction. Meanwhile, little difference was noted in degree of fragmentation (Table 6.l6). Artiodactyl bone in Block 1 appeared less fragmented.

Table 6.15: Final Late Formative Bone Modification (1/4" NISP)

	Taxa	B Char	B Calcined	C Gnaw	R Gnaw	Worked Bone	Total
Bl. 1	Artiodactyl	0	0	4	0	0	**4**
	Camelid	1	4	28	0	20	**53**
	Lg Mammal	41	17	0	0	34	**92**
	Total	**42**	**21**	**32**	**0**	**54**	
Bl. 2	Artiodactyl	0	1	2	0	0	**3**
	Camelid	6	3	13	0	0	**22**
	Lg Mammal	23	12	1	0	0	**36**
	Total	**29**	**16**	**16**	**0**	**0**	
Bl. 3	Artiodactyl	8	8	0	0	0	**16**
	Camelid	21	36	16	1	12	**86**
	Taruca	0	1	0	0	0	**1**
	Lg Mammal	168	155	0	0	33	**356**
	Mammal	11	28	0	0	0	**39**
	Total	**208**	**228**	**16**	**1**	**45**	
	Grand Total	**279**	**265**	**64**	**1**	**99**	

Note: B=Burned, C=Carnivore, R=Rodent

Table 6.16: Fragmentation Index: Final Late Formative Contexts (1/4" NISP/g)

Taxon	Block 1	Block 2	Block 3
Camelid	6.52	4.67	3.93
Taruca [1]	0	0	2.11
Artiodactyla	2.97	1.38	1.56
Large Mammal	1.38	0.84	1.09
Medium Mammal	3.87	0.37	0
Mammal	0.30	0.10	0.3

Conclusions

Following my examination of each sample, I identified several consistent trends and a few contrasts that characterize bone. First of all, burning was across the board the most common modification observed on bone regardless of behavioral context or site. Charring was the most consistent form of burning present. This has clear implications for our reconstruction of food preparation methods. Meat roasting was practiced as a viable cooking technique by Formative agro-pastoralists.

A distinct reversal of the proportion of charred to calcined bone is clear within most Pukara Late Formative contexts. Calcination, as we noted, reduces bone preservation – if bone is burned for a sufficient amount of time. Different bone disposal practices are being practiced by Pukara residents than for Huatacoa. Oddly, few of Huatacoa's sunken court burned offerings display calcination. This contrasts with the ethnographically observed nature of pago offerings. Some offering may have consisted of animals that were roasted, consumed, and then deposited as offerings. Alternatively, a much lower temperature fire was used to make offerings.

The second most ubiquitous way in which bone was modified is through tool production and bone working. Examples of disposed or intentionally interred tools occur in each Formative context. The selection of particular elements (e.g. metapodials, radio-ulna, scapula) may result in an overrepresentation of certain body parts (particularly within domestic contexts). Most recovered tools served weaving functions, such as wichña, awls, needles, and combs.

The significantly high frequency of worked bone noted for Pukara is remarkable. In feast and ritual contexts, it could mean that household weaving was still important as a practice – even as one attended a communal gathering or religious rite. That said, butchery-associated fragmentation is likely the most significant influence skewing the identification and quantification of body parts.

Carnivore gnawing also shapes the recovery and identification of Formative bone. Again Pukara displays an extremely high proportion of gnawed bone. This may be the consequence of setting. The wide open pampa area in front of the Peñon for Initial Late Formative feast context and subsequent wall-divided Middle and Final Late Formative household compounds were favorable scavenging grounds for carnivores. Unexpectedly, Early Formative domestic contexts produced minimal evidence of carnivore ravaging.

Slight upticks are observed, however, for the Early Qaluyu midden, deposited after the adobe house was abandoned, and within the Late Formative domestic midden. Bone accumulated and disposed of in Huatacoa ritual contexts rarely displays damage.

Only slight patterning was observed in bone weathering and degree of fragmentation. Most animal bone scored at a low weathering of stage 0 to 1. This suggests the surface of most bone was only slightly exfoliated by butchery and non-cultural factors (exposure, burning, and gnawing). In general, bone was in good condition.

Finally, use of the fragmentation index yielded mixed results. One must closely compare NISP sample size and total bone weight by category. Given the preponderance of camelid bone, results were most instructive when we consider bone that likely represents butchered camelids (i.e. artiodactyl, large mammal, and unidentified mammal). The smaller sample sizes recorded for smaller mammals, birds, and fish produce deceptive results – especially when only a single identified bone was present.

CHAPTER 7: MANAGING CAMELID HERDS

The archaeological record produces an incomplete picture of past hunting and herd management practices. This chapter is a broad-stroke study of the roles played by wild and domesticated camelids in Formative Andean domestic and political economies. We investigate two fundamental topics: 1) which camelids supplied meat, wool, and caravan labor? and 2) what trends in age-at-death are evident from mortality profile data? Together, data may speak to how productive goals correlated with or were shaped by the sociopolitical activity. Huatacoa and Pukara data sets are presented in tandem to facilitate comparative analysis.

How will these two questions be answered? To answer the first question, incisor form and metrical analysis help to identify which camelid species were slaughtered. Also, available qualitative, individualistic data were considered, specifically sex and bone pathology life-history data. Second, age profiles are constructed from tooth eruption and wear and epiphyseal fusion data to discern camelid culling patterns. I contrasted my results with past Andean and Titicaca Basin studies. Taken together, these analyses enable us to generalize on the goals Formative herders pursued when hunting wild camelids and raising and culling domesticated herds.

Skeletal Biography: What Animals Are Being Culled?

Metric Analysis: Univariate and Bivariate Analysis

Osteometrics provide one method to begin to identify which camelid species are present within a bone assemblage. As we discussed in Chapter 4, modern camelid body size for the South Central Andes cluster along on a small to large body size continuum – vicuña, alpaca, guanaco, and llama – visible on bivariate charts. Data point clusters adjacent to modern species clusters characterize wild versus domesticated camelid ratios and serve as a proxy measure of economic focus on wool production, meat, or carvanning animals (i.e. very large llamas). Overall, data from all weight-bearing elements is helpful to characterize body size. In particular, first phalanges are dense, frequently recovered bones and particularly invaluable data sources, because so many past studies report data.

Univariate, bivariate, and multivariate tests of select skeletal elements were conducted and discussed below. Univariate analysis was conducted on the 1st phalanx, astragalus, and femur for both sites[79]. The proximal medio-lateral breadth (Wing b) and proximal dorso-plantar width (Wing b') of the first phalanxwere recorded[80]. Box plots for each site's sample metrics and their associated mean and median are presented below (Figure 7.1). Table 7.1 presents descriptive statistics for these two metrics.

First Phalanx

Despite distribution overlap, the Huatacoa bone indicates greater variability in camelid body size. Both by phalanx metrics in Figure 7.1, larger and smaller forms were present. Furthermore, contrasting the small-large category decision rules (gray dashed lines) and the median phalanx breadth suggests llama-size camelids were more common than small forms at Huatacoa. An Early to Late Formative increase in the importance of llama-size camelids, amongst Taraco Peninsula, Bolivian sites, is argued to correlate with climatic aridity and increasing importance of llama caravan trade (Moore 2010:263-267).

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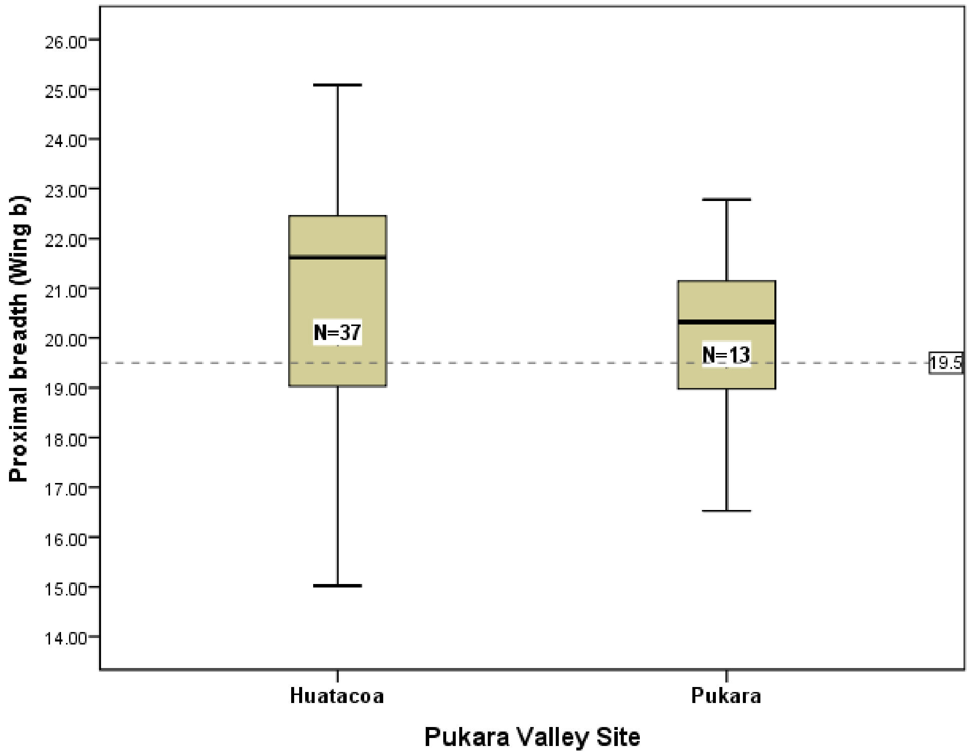
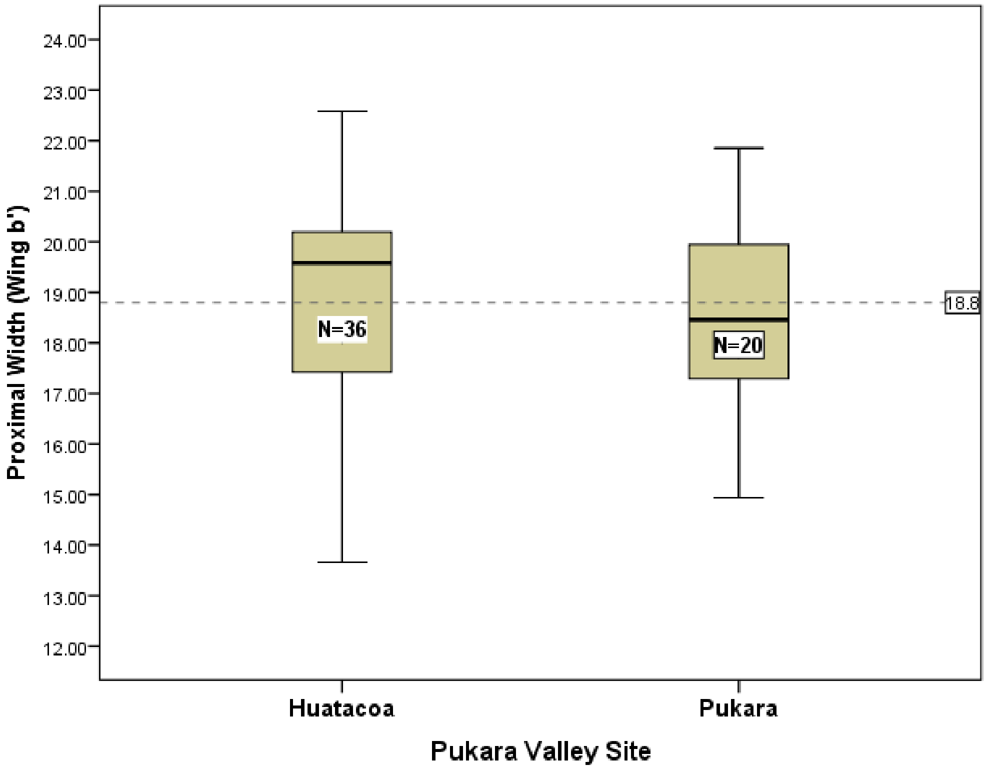
[79] I have also collected and compiled summary data tables for additional univariate osteometrics data that was collected for each site (but not discussed within this chapter [see Appendix B:Tables B-1 and B-2]).

[80] These metrics are equivalent to Kent's FP1V2/BP1PV178 and F1PV3/BP1V179. See Appendix B Figure B-1 for a depiction of these osteometrics.



Huatacoa (Mean=20.62; Median=21.62); Pukara (Mean=19.82; Median 20.32)



Huatacoa (Mean=18.83; Median=19.59); Pukara (Mean=18.42; Median 18.46)

Figure 7.1: Proximal First Phalanx Boxplots (19.5 and 18.8 cm decision rules)

The Pukara Valley’s drier pampa and *cerro* vegetation certainly might favor higher llama dependence, without active efforts by Formative populations to increase bofedal vegetation to support alpacas. As I discuss below, very large (cargo) llama-size forms were associated with the Middle and Late Formative sunken court offerings and meals.

Table 7.1: First Phalanx b and b’ Metrics: Titicaca and Formative Sites[1]

Sample	N	Mean	SD	Range	V
Marcavalle (Formative)**, L**	12	22.50	1.00	21.10 – 24.30	4.50
Chiripa (E Formative 1)		15.30			
(E Formative 2)		21.20			
(M Formative)		20.80			
Kala Uyuni (Late Formative)		21.10			
Iwawi (Tiwanaku)**, S forelimb**	4	17.70	1.60	15.90 – 19.30	2.50
Iwawi (Tiwanaku), **L forelimb**	13	21.70	2.00	19.60 – 25.10	4.00
b; Huatacoa, all	36	20.74	2.73	15.02 – 25.08	7.48
b; Pukara, all	13	19.82	1.93	16.53 – 22.78	3.72
Huatacoa, S:	9	16.60	1.24	15.02 – 19.03	1.55
Forelimb	1	19.03			
Hindlimb	3	15.90	0.89	15.02 – 16.80	0.79
Huatacoa, L	27	22.11	1.31	19.71 – 25.08	1.72
Forelimb	12	21.87	1.56	19.71 – 25.08	2.43
Hindlimb	3	22.06	0.42	21.67 – 22.50	0.17
Pukara, S	5	17.83	1.31	16.53 – 19.47	1.72
Hindlimb	3	17.42	0.54	16.53 – 18.98	1.08
Pukara, L	7	20.98	0.94	19.90 – 22.78	0.88
Forelimb	3	21.16	0.60	20.48 – 21.64	0.37
Hindlimb	1	19.90			
b’; Huatacoa, all	36	18.71	2.48	13.66 – 22.58	6.14
b’; Pukara, all	20	18.42	1.90	14.94 – 21.85	3.60
Huatacoa S	13	15.98	1.70	13.66 – 18.71	2.88
Forelimb	3	17.67	1.28	16.24 – 18.71	1.64
Hindlimb	7	15.77	1.52	13.66 – 18.19	2.31
Huatacoa L	23	20.42	1.09	18.93 – 22.58	1.20
Forelimb	10	20.39	1.18	19.12 – 22.53	1.40
Hindlimb	2	21.26	1.23	20.39 – 22.13	1.51
Pukara S	11	17.02	1.17	14.94 – 18.74	1.37
Hindlimb	5	16.58	0.94	16.53 – 17.92	0.88
Pukara L	9	20.14	0.89	18.80 – 21.85	0.80
Forelimb	3	21.16	0.60	20.48 – 21.64	0.37

Note: Data for b metrics compiled for Marcavalle (Miller 2003b:Table 1.4); Chiripa and Kala Uyuni (Moore 2010: Table 9.4); Iwawi (Park 2001: Table16)

[1] Decision rules for small / large camelid categories (b=19.5, b’=18.8 cm)

Huatacoa phalanx data histograms help to characterize the resident camelids further (Appendix B: Figure B-2 – B-3). The distribution's mode, median, and mean cluster within the reported guanaco / llama camelid size range (Appendix B: Table B-3). Small camelid phalanges, possibly from vicuña- and alpaca-size forms, occur from 15 cm to 18 cm frequency break. The b' metric has a trimodal distribution: 1) two small camelid peaks (at 14 cm and 16.50 cm, e.g. vicuña- and alpaca-size forms) and 2) a major large camelid one (at 19.50 cm)[81].

Table 7.2: Huatacoa T-tests of Proximal Breadth and Width

Group	N	Mean	t	P
H Small b	9	16.34		
H Small b'	13	15.97		
vs. Vicuña				
Miller Fore/hind b (15.50)			2.925	.019
Kent Fore b (15.53)			2.821	.022
Kent Fore b' (15.09)			1.889	.083
vs. Alpaca				
Miller Fore/ Hind b (17.68 cm)			-4.677	.002
Kent Hind b (16.90 cm)			**-1.957**	**.086**
Kent Fore b' (16.37)			**-.830**	**.423**
H Large b	28	22.00		
H Large b'	23	20.42		
vs. Guanaco				
Izeta Fore/ Hind b (20.63 cm)			5.151	.000
Izeta Fore b (21.33)			3.110	.004
Izeta Fore b' (18.35)			9.072	.000
vs. Llama				
Miller Fore/Hind b (21.30 cm)			2.639	.014
Kent Fore b (22.16 cm)			**-.585**	**.563**
Kent Fore b' (19.98)			**1.937**	**.066**

For Huatacoa residents, large camelids were a key resource in the Early Formative; by the Middle and Late Formative, a mixed meat-cargo-wool economy (c. 60-

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[81] Unlike the breadth metric, a more equal dependence on the two camelid forms is proposed by the width metric, suggesting alone. As a result, I selected the breadth metric to assess frequency of large and small camelids, given its greater separation between the size categories (Moore 1989:232).

40) operated (Appendix B: Figure B-4). Early to Middle Formative domestic deposits emphasized large camelids, presumably as household meat source.

T-test results of the Huatacoa small and large category b and b' metrics against modern taxa comparatives assist our classification somewhat (Table 7.2)[82]. This table compiles also first phalanx metrics collected by others for comparative study against my specimens: La Raya alpaca, llama, and vicuña specimens (mean values for the b metric [Miller 2003b] and fore and hindlimb b and b' means [Kent 1982] and Argentinian guanaco (fore and hind b and b' means [Izeta et al. 2009]).

La Raya llamas and alpacas proved to be the best comparatives for classifying the Huatacoa large and small camelids. The llama proximal forelimb breadth fits well with the reported Huatacoa value. While the Huatacoa mean exceeds Kent's llama proximal width mean, the llama forelimb again provides the closest approximation. For the small Huatacoa camelid, the alpaca proved the closest match tested, respectively for hindlimb proximal phalanx breadth and forelimb width means.

The imperfect correspondence between modern alpacas and llamas and the large and small Huatacoa camelid forms is interesting. In all likelihood, these disparities were the fingerprint of different management practices and/or phenotypic variability characterizing the Formative.

Huatacoa's proximal phalanx breadth index of dimorphism value (0.74) indicates a sample dominated by vicuña- and llama forms (Miller and Burger 1995:433-

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[82] Archaeological specimens include largest sample available, rather than just fore and hind limb phalanges sorted by size category. However, results should be contrasted with the sorted phalanx means and bivariate plots.

435). I feel this is a false assessment, given the skewed sample distribution and dissimilarity in large and small camelid category ranges (5.37 vs. 1.78). First, alpaca-size forms were more common (Wing b, n=7) from the Middle Formative onward. Low-level vicuña hunting is likely, since Early to Late Formative domestic and Middle Formative court contexts produced a few projectile points (Cohen 2010). Vicuña-size phalanges were rare, occurring in Early Qaluyu (Wing b, n=1; Wing a, n=1), Late Qaluyu (b, n=1), and Late Formative (Wing b, n=1; a, n=1) contexts. Meanwhile, divining the import of guanaco proved difficult. Many Early to Late Formative phalanges (n=11) cluster within the llama / guanaco range overlap (Figure 7.2). Specimens may represent two hunted guanacos (n=2), indeterminate form (n=2), and a gracile llama form (n=7) (see Pukara discussion below). Late Formative domestic midden produce two guanaco candidates.

I now turn to the results from the Pukara sample (Appendix B: Figures B-5 – B-6). The Pukara proximal breadth distribution is bimodal. Peaks occur at about 16.53 and about 21 cm. The lower mode, and its trough (up to 17.25), overlap with the alpaca range. Both the mean and second mode overlap the guanaco / llama size ranges. The proximal width metric (b') presents a trimodal distribution, with peaks at 15, 17.6, and 19.65 cm. The near equal economic value placed on meat / wool / cargo (large) and wool production (small form) compares with level Late Formative contexts at Huatacoa.

T-tests were of Pukara small and large categories with modern species were equivocal (Table 7.3). The La Raya llamas and alpacas again proved to the best matches. It is important to emphasize two things about these results. First, most Pukara small camelids were alpacas. Vicuña identifications are largely restricted to the Initial Late

Table 7.3: Pukara T-tests of Proximal Breadth and Width

Group	N	Mean	t	P
P Small b	5	17.83		
P Small b'	11	17.02		
Vicuña: Miller Fore/hind b (15.50)			3.976	.016
Kent Fore b (15.53)			3.925	.017
Kent Fore b' (15.09)			5.453	.000
Alpaca:Miller Fore/ Hind b (17.68 cm)			**.256**	**.811**
Kent Fore b (17.60 cm)			**.393**	**.715**
Kent Fore b' (16.37)			**1.830**	**.097**
P Large b	8	21.06		
H Large b'	9	20.14		
Guanaco: Izeta Fore/ Hind b (20.63 cm)			**1.357**	**.217**
Izeta Fore b (21.33)			**-0.846**	**.426**
Izeta Fore b' (18.35)			6.00	.000
Llama: Miller Fore/Hind b (21.30 cm)			**-.751**	**.477**
Kent hind b (20.33)			2.301	.055
Kent fore b (22.16)			-3.457	.011
Kent Fore b' (19.98)			**.540**	**.604**

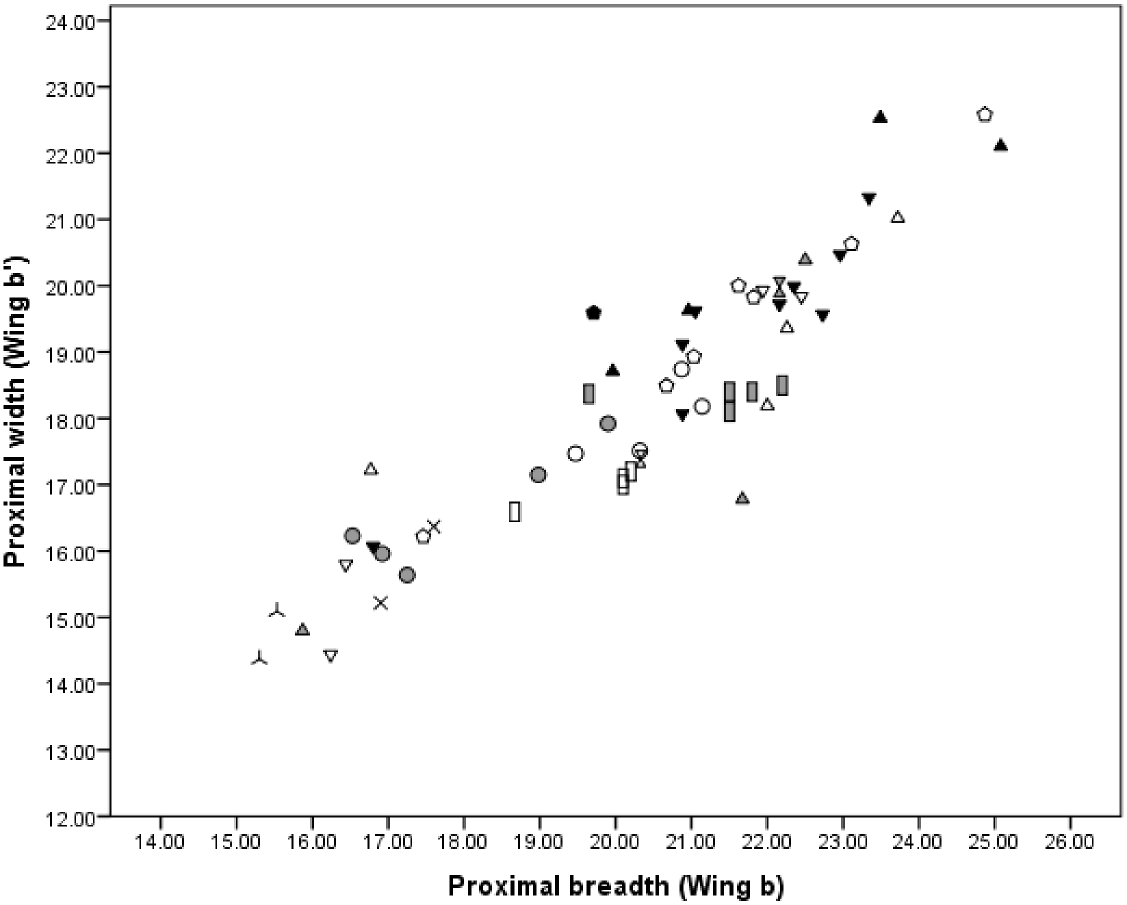

Figure 7.2: Pukara Valley: First Phalanx Metrics Plot (H, n=32; P, n=9)

Note: Forelimb=black; Hind=grey; no fill=unknown (comparatives: Fore=grey, Hind no fill).
Pukara Valley: Pukara=circle; EQ Huatacoa=pentagon; LQ H=down triangle; LF H=up triangle.
Modern (fore/hinds): Vicuña =jack; Alpaca=X; Llama=hourglass; Guanacos=rectangle.

Formative occupation, based on incisor morphology and phalanx size. Second, the "mean" Pukara large camelid is a more gracile, guanaco-sized llama (c. n=6) – shown by close guanaco / llama t-test scores and the Pukara Valley phalanx bivariate plot (Figure 7.2). These small and large camelids forms are discussed further below.

In turn, wild camelid hunting diminished by the Late Formative Period. Possible hunting is indicated by three recovered vicuña incisors and a few projectile points (see Burger et al. 1992). Taken together, Pukara's llama-like second mode, the presence of intermediate-size camelids (Figure 7.2), and the coincident absence of "very large" camelids is instructive. I hypothesize that culled large camelids represent both a "modern-size" llama breed and a smaller, intermediate-size wooly llama breed (*chaku*), used for mixed meat/wool production (see Lamas 1994; Mengoni-Goñalons 2001; Wheeler et al. 1995). The alternative, a mixed guanaco hunting-herding economy, is very improbable for the Late Formative polity capital.

Puzzingly absent at Pukara were the "very large" size, non-wooly cargo llamas (*ccara*, *q'ara*), observed in Huatacoa's court contexts and within Middle and Late Formative Taraco Peninsula, Bolivia sites (Moore 2006, 2010: Figure 9.5). Whereas sample size likely influenced observation to a degree, their scarcity could reflect culling in as yet unsampled contexts at Pukara (e.g. in sunken court contexts) and/or at farther-afield exchange-linked Polity periphery sites. Augmenting the the metric sample size will improve the reliability of our answers to these two scenarios.

Finally, the calculated index of dimorphism (D) value for Pukara's proximal width metric is 0.85, providing further evidence that the majority of Pukara's camelids represent alpaca and llama herd populations. Taken together, our t-test and index values support a strong domesticated camelid focus for Pukara's Late Formative occupation.

A few trends are notable from available specimens analyzed by a phalanx bivariate plot. First, the observed small camelid specimens strongly resemble modern alpaca and vicuña. At Huatacoa, alpaca forms were found in Late Qaluyu sunken court contexts, Burial 10 (a human sacrificial offering interred the Late Qaluyu Second Court patio floor) and in midden fill between the Late Qaluyu First and Second Court floors (total N=2). Two alpaca-sized phalanges were associated with Huatacoa domestic contexts, an Early Qaluyu pithouse midden and Late Formative midden.

At Pukara, two alpaca-size phalanges were found in Initial Late Formative middens and one was associated with a Middle Late Formative occupation surface (Block 2). Post-Early Formative vicuña-sizes phalanges (n=2) were solely identified within Huatacoa ritual contexts, mainly Middle Formative midden fill between the Late Qaluyu First and Second Court floors and a Late Formative, large lined pit (Feature 24). Vicuña are a rare component of Pukara Valley's Formative economy: going from a rare domestic wild game (Early Qaluyu, n=1) to consumptive exclusivity in rites and public events (Late Qaluyu and Late Formative). They may have become a marked symbol, employed in rites to both acknowledge Pachamama's wool generative power and as a slightly exotic, wild resource. Alpaca, in contrast, appear transposable as food and ritual resources.

Second, intersite separation of small / large camelid forms varies, being more pronounced for Huatacoa and minimal for Pukara. Intermediate-sized camelids (n=3), falling between the alpaca and llama ranges, comprise a larger proportion for the Pukara dataset. At Huatacoa, normal llama-sized forms predominant, with a few large or extra-large forms (n=8) observed. These size differences may signal economic foci: 1) a Pukara focus on younger and/or smaller body llamas, bred for meat and/or wool, and alpaca and 2) a greater Huatacoa focus on older and cargo (*ccara*) llamas and alpaca. The llama's predominance over guanaco is supported by multivariate tests below. We will return to the debate over management in our later discussion of mortality patterns.

Astragalus

The following measurements were collected for the astragalus: distal latero-medial width (Wing a) and shortest / maximum trochlear lengths (Wing c, c'). Table 7.3 presents the univariate datasets along with comparative site samples. Foremost, a greater width variability (metric range) characterizes Huatacoa relative to Pukara, despite comparable sample sizes.

T-tests were conducted on Pukara Valley large camelid forms alone, due to sample size for small forms. The large Huatacoa camelids proved a poor match against Miller's La Raya llama specimens (t=3.382, df=12, p=.005). Pukara's large camelid, however, was fairly likely comparable to the La Raya llama (t=1.392, df=9, p=.197). To further explore the univariate data, indices of dimorphism were calculated for the distal width metric. Results point to a mixed vicuña hunting / llama herding economic profile, at Qaluyu (0.79) and Huatacoa (0.77), and an alpaca / llama based-herding economy existed, at Marcavalle (0.85) and Pukara (0.87)[83].

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[83] Nonetheless, as a caveat, the sample sizes of identified small camelid forms leave much to be desired for this index.

Figures 7.3 and 7.4 are bivariate plots of distal width versus shortest trochlear length and plotted against maximum trochlear length. These bivariate scatterplots were visually compared to those previously presented by Miller (1979:Figure 5.12), Miller and Gill (1990: Figure 2), showing La Raya comparatives, and Moore's results for Panalauca, Peru and Formative Chiripa and Santa Rosa sites, Bolivia (2006). The broad stroke impression arising from both plots corroborates our earlier phalanx results: Pukara displays a narrower, largely bimodal split between large and small camelid forms than Huatacoa. This size category split makes both sites more comparable to Moore's Panalauca, Peru sample than the continuous size distribution noted for several Taraco Peninsula, Bolivia assemblages (Moore 2006).

In Figure 7.3 and 7.4, Hautacoa shows a distribution highly skewed toward llama-sized and a few extra-large llama forms (from Middle and Late Formative contexts). Only two alpaca-sized forms were found. Notable are four "very large" astragali. Three come from First Late Qaluyu court contexts (the middle court foundation midden fill; the subsequent court floor; and midden fill, capping its destruction) and one from within an Early Formative post-house abandonment domestic midden. Only very large llama forms, possibly older cargo animals, would have such large astragali. Butchery and burning suggest such animals were key ritual meals or auspicious sacrifices for court-associated construction and renewal activities and as well as sources of domestic labor and meat.

Three clusters are evident for Pukara, suggesting managed breeding of alpaca forms, an intermediate-size llama breed (between alpaca/llama, n=5) or *wari / huarizos* (i.e. alpaca-llama crosses), and llama forms (Miller 2003b:35). No very large forms are

Table 7.4: Astragalus a, c, and c' Metrics: Formative Sites [1]

Sample	N	Mean	SD	Range	V
Latero-Medial Width (Wing a)					
Comparative vicuña	6	22.30	0.80	21.40 – 23.10	3.60
Comparative alpaca	18	23.20	0.57	22.70 – 23.80	2.50
Comparative llama	10	27.20	2.24	25.60 – 28.80	8.20
Marcavalle (Formative)	15	28.33	2.53	24.10 – 31.00	8.93
Small	2	24.50		24.10 – 24.90	
Large	13	28.92	2.15	26.20 – 31.00	7.43
Qaluyu (Formative)	6	27.03	3.74	23.50 – 31.60	13.84
Small	3	23.90	0.36	23.50 – 24.20	1.51
Large	3	30.17	2.31	27.50 – 31.60	7.66
Huatacoa	15	28.32	3.03	22.16 – 33.42	9.21
Small	2	22.64	0.68	22.16 – 23.12	0.46
Large	13	29.19	2.12	25.50 – 33.42	4.51
Pukara	15	26.73	2.17	23.26– 30.77	4.72
Small	5	24.38	0.76	23.26 – 24.94	0.58
Large	10	27.90	1.58	25.54 – 30.77	2.51
Shortest Trochlear Length (Wing c)					
Marcavalle (Formative)	16	34.54	2.42	29.00 – 37.50	7.04
Small	1	29.00			
Large	15	34.91	2.00	32.60 – 37.50	5.73
Qaluyu (Formative)	7	31.73	4.38	27.10 – 38.40	13.80
Small	3	27.10	0.75	27.10 – 28.60	2.69
Large	4	34.60	3.51	31.1 – 38.40	10.14
Huatacoa	13	33.55	3.56	26.27 – 39.18	12.66
Small	3	28.35	1.80	26.27 – 29.50	3.25
Large	10	35.08	2.07	32.52 – 39.18	4.31
Pukara	15	31.79	1.86	28.42 – 34.19	3.46
Small	3	28.62	0.34	28.42 – 29.01	0.12
Large	12	32.56	1.09	31.26 – 34.19	1.19
Maximum Trochlear Length (Wing c')					
Huatacoa	12	44.26	4.17	35.63 – 49.99	17.39
Small	2	36.79	1.65	35.63 – 37.96	2.71
Large	10	45.75	2.47	42.42-49.99	6.08
Pukara	13	41.47	2.27	37.36 – 45.26	5.15
Small	5	39.15	1.39	37.36 – 41.02	1.92
Large	8	42.92	1.21	41.54 – 45.26	1.46

Note: Data compiled for modern taxa *a* metric (Miller and Burger 1995: Table 2); Marcavalle and Qaluyu (Wing 1973:32-35).

[1] Moore (1989: Table 8.2) cut values (a=25.4, c=30.8, c'=41.1 cm) for size categories

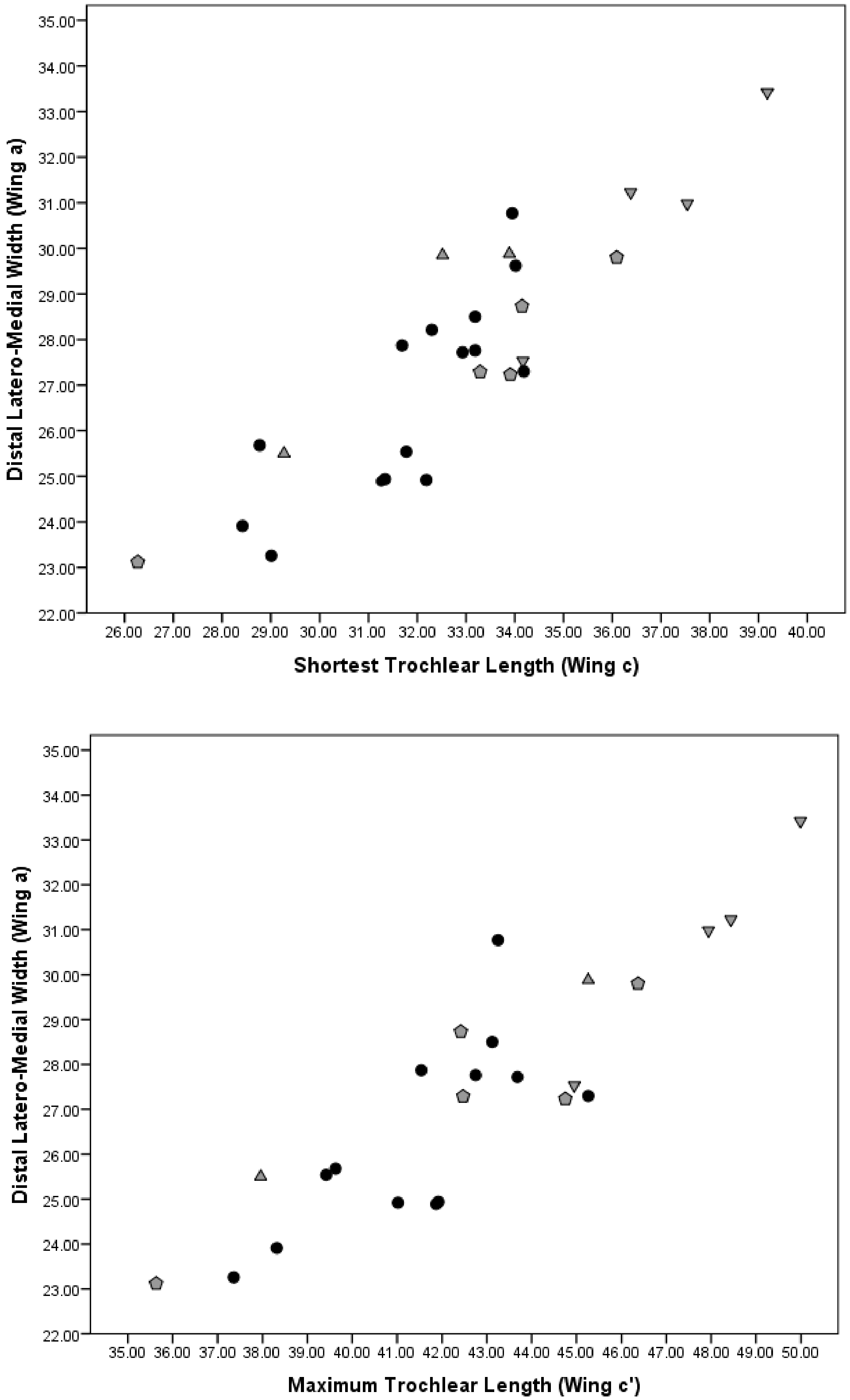

Figure 7.3: Astragali (Width vs. Shortest Trochlear and Maximum Lengths)

<u>Note</u>: Pukara=circle (Fig. 7.3:n=15, 7.4:n=13); Huatacoa: EQ=pentagon, LQ=down triangle, LF=up triangle (Fig. 7.3:n=12, 7.4:n=11)

present. Low phalanx and astragali coefficients of variance suggest relative breeding population homogeneity at Pukara, while Huatacoa had greater heterogeneity.

A final trend should be considered briefly. We previously discerned greater heterogeneity in the Huatacoa assemblage, extending to phalanx and astragalus metrics. Clearer evidence for Early Formative household vicuña hunting and Middle-Late Formative ritual exploitation was found. Given Huatacoa's greater temporal spread, this variation provides snapshots of a broader range of activities (both domestic and ritual) and culling events than we see within the Pukara sample (Moore 2006) [84]. In particular, the Huatacoa's robust, more "bracketed" diachronic record of domestic and ritual activities may explain this contrast.

Femur

The femoral head breadth (Wing k') is the final osteometric focus of osteometrics analysis. As Moore previously noted (2006, 2008:39-41), the femoral head, because of its late-fusion age (> 36-45 months), provides a great benchmark to tease out the presence of different camelid size categories that were subject to different management practices (age-at-cull) and used for different economic functions. While meager (n=10), the Pukara sample of fused and unfused proximal femora were studied.

Figure B-6 (Appendix B) depicts a histogram of fused and unfused femoral head data. If we accept the two camelid breed model and size category cutpoint, three

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[84] Moore (2006) reports astragalus specimens of comparable size to Huatacoa's at the Santa Rosa site on the Taraco Peninsula, Bolivia. However, considerably larger phalanges and astragali are recorded for Chiripa.

specimens should be categorized as small camelids and seven as large camelids. This seems unfeasible given the trimodal nature of the data.

When histograms for fused and unfused femoral heads alone are considered, patterns begin to emerge. Fused specimens include one small fused camelid (26.37 cm) and two large (31.45, 32.22 cm). Unfused camelids include two small forms (26.84, 27.62 cm), two intermediate-size (29.59, 29.85 cm), and three large (31.19, 32.15, and 32.42 cm). It is possible to begin to reconstruct the role played by each form, based on culling age-at-death: 1) one small adult camelid (wool production); 2) two small camelids, two intermediate-size, and three large juvenile forms (as meat, and possibly short-term wool, producers), and 3) two large adult camelids (pack animals, breeding stock?). The intermediate-size appears to have been a key source of meat, as none of this below-modern llama size animal managed to survive to adulthood. Therefore, we have three potential management strategies shaping the Pukara assemblage: wool production; meat / short-term wool production, and cargo / breeding llama stock. While not represented in the femoral dataset, given the presence vicuña teeth, it is inferred that a very small form was exploited as a source of fine fiber and meat.

Multivariate Classification

A second method contrasts Pukara Valley camelids with historic camelids of known species affiliation, drawing upon a multivariate classification equation developed by Kent (1982). Given fragmentation or missing metric data, often one (or more) metrics necessary to undertake classification were unavailable for fused elements. Variation in element representation also complicates intersite comparisons. I review classification results for first phalanx (fore- and hindlimb) and second phalanx. Specimen measurements and classification results are summarized in Appendix C.

First phalanx

First phalanges were the most ubiquitous element for classification analysis (Table 7.4 – 7.5; Table B-2). Pukara’s Initial occupation has a llama-size and vicuña-(or more likely alpaca-) size camelids. In contrast, the Middle occupation hindlimb metrics identify an alpaca-size camelid and a large-body camelid (identified in Table 7.5 as guanaco [#1705]). As noted in Chapter 4, use of Patagonian guanacos as the basis for historic guanaco-size distribution for past Central Andean guanaco populations may be incorrect. Besides the maximal phalanx length (BP1V177), the means for this specimen’s metrics fall within or just below the reported modern llama size distribution (Kent 1982: Appendix IV.2). I favor classifying this specimen within a larger, prehistoric llama-size category.

Table 7.5: Forelimb first phalanxClassifications
(Bold indicates borderline coefficient identifications)

Site / Context	**Vicuña**		**Alpaca**		**Guanaco**		**Llama**		**Σ N**
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	
P / ILF	0	0	0	0	0	0	1	100	1
H / LQ	**1**	**16.7**	0	0	**1**	**16.7**	4	66.7	6
H / LF [1]	0	0	0	0	1	16.7	**5**	**83.3**	6

[1]: Coefficient difference for < 2 (1 llama)

Table 7.6: Hindlimb 1st Phalanx

Site / Context	**Vicuña**		**Alpaca**		**Guanaco**		**Llama**		**Σ N**
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	
P / ILF [1]	**1**	**100**	0	0	0	0	0	0	1
P / MLF	0	0	1	50	1	50	0	0	2
H / LF [2]	**2**	**33.3**	2	33.3	1	16.7	1	16.7	6

[2]: Coefficient difference < 2 (1 vicuña)

Larger samples from Huatacoa reveal greater variability in the Pukara Valley camelid body-size forms. Large body camelids outnumber (83.3%, n=5) small-body, vicuna-sized camelid within the Middle Formative (Late Qaluyu) forelimb phalanx sample. Four phalanges fall towards the large end of the modern llama-size distribution and one is tentatively classified as guanaco.

Two forelimb phalanges (specimens #4641 and 5174) are notable, as they hardily exceed the modern llama comparatives in length, breadth and width. How might we classify such extra-large camelids? I hypothesize this and additional extra-large specimens could be older adult castrate, male cargo animals (e.g. compare with bivariate phalanx and astragalus data above) (Miller 2003b:35-37). The former, specimen 4641, appears in a primary midden deposit within the bin storage chamber of the First Middle sunken court. Macroscopic study of this specimen found all three forelimb first phalanx morphological criteria characterizing caravan llamas present (Cartajena et al. 2001:161): distal trochlear ridges and strong capsular and distal sesamoideal ligament attachments. A second, juvenile, llama-sized camelid (# 4647) was found within this context also. I suspect this context preserved butchery and meal remains from a Middle Formative sunken court ritual feast/meal event.

Huatacoa’s Late Formative combined fore and hindlimb sample shows a similar three-to-one ratio of large to small-body camelid. Modern llama-size camelids alone occur in the domestic contexts. In contrast, sunken court contexts contain small body (vicuna- and alpaca-size) and large-body camelids (adult llama and probable caravan llamas). A second probable caravan llama (specimen #3407) – displaying distal trochlear ridges and strong sesamoideal ligament attachments – was found in a Late Formative court provenience[85].

Table 7.7 Second Phalanx Classifications
(bold indicates borderline coefficienct classifications)

Site / Context	**Vicuña**		**Alpaca**		**Guanaco**		**Llama**		**Σ N**
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	
P / ILF	0	0	1	100	0	0	0	0	1
P / MLF	0	0	3	100	0	0	0	0	3
H / EQ	0	0	0	0	**1**	**33.3**	2	66.7	3
H / LQ	0	0	0	0	0	0	4	100	4
H / LF	1	100	0	0	0	0	0	0	1

Second Phalanx

Several complete second phalanges proved amenable to multivariate classification (Table 7.6, Appendix B: Table B-3). The entire Pukara sample (n=4) was classified as alpaca. Early Formative Huatacoa domestic (n=3) were composed of specimens classified as probable llamas. Two specimens (#2736, 5119) are significant due to their size, in terms of length and their articular metrics. In all likelihood these specimens represent full-grown adult llamas. Analogous to the above Early Formative specimens in size are the Middle Formative domestic midden (n=1) and sunken court specimens (n=3). The large llama specimens, as for the astragali noted above, show associations with the First Middle Qaluyu court contexts: its foundation (#2516), the court bins (#4650), and a post-destruction midden fill (#5246). As before, specimens display butchery and cooking evidence associated with ritual meal preparation and disposal. A final Late Formative specimen, displaying cutmarks, from a court associated pit-midden deposit is classified by the multivariate equation as a vicuña.

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[85] Kent’s equation also classified this large specimen as a guanaco.

The above multivariate classifications, though for smaller samples, corroborate our previous univariate and bivariate test results. For most time period comparisons, domesticated camelid forms are the dominant camelid forms present for both sites. Llamas were the most common form regardless of occupation considered, though Late Formative court contexts had recognizable alpaca-size phalanges. Evidence of vicuña hunting is sparse, limited to the Huatacoa Middle and Late Formative court contexts and the Pukara Initial Late Formative occupation. We now explore incisor morphology criteria as our final direct line of evidence for species classification.

Incisor Morphology

Incisors are a coarse means of classifying archaeological specimens as vicuña, alpaca, and llama/guanaco (Moore 1989:240-247; Wheeler 1984). Intact, often disarticulated teeth and mandibula segments were relatively scarce at both sites (Table 7.7). Given fragmentation, the greatest sample size from both Huatacoa and Pukara consisted of disarticulated incisors and incisor/mandibular body segments.

For both Formative sites, a domesticated camelid emphasis is suggested by the recovered incisors. At Huatacoa, the llama/guanaco form is associated with domestic and sunken court contexts from Qaluyu and Pukara occupations. The Late Formative (Pukara) Feature 3 ritual feast pit contains the sole adult alpaca form incisor. All classifiable incisors studied were disarticulated, despite recovery of anterior mandibular body segments.

Table 7.8: Frequency of Identified Camelid Incisor Forms[86]

Unit / Stratum	Part	Llama-Guanaco	Alpaca	Vicuña	Total # ID
H: B3 Domestic (EQ)	Incisors	2 (1 subadult)	0	0	2
	Mandible	0	0	0	0
H: A3 Ritual (LQ)	Incisors	7 (2 adults)	0	0	7
	Mandible	0	0	0	0
LQ Total	**Incisors**	**9 (1 subadult, 2 adults)**	**0**	**0**	**9**
H: B5 Domestic (LF)	Incisors	3 (1 adult)	0	0	3
	Mandible	0	0	0	0
H: A5 Ritual (LF)	Incisors	2 (subadult / yearling)[1]	1 (adult)	0	3
	Mandible	0	0	0	0
LF Total	**Incisors**	**5 (1 adult, 1 yearling)**	**1**	**0**	**6**
Huatacoa Total	**Incisors**	**14**	**1**	**0**	**15**
P: B1 Public ILF	Incisors	7 (subadult, yearling)[2]	3	0	10
	Mandible	0	0	0	0
P: B2 PublicILF	Incisors	4 (adult, subadult)[3]	0	3	7
	Mandible	0	1 (1 adult)	0	1
P: B3 Public ILF	Incisors	5	0	0	5
	Mandible	1 (1 yearling)	0	0	1
ILF Total	**Incisors**	**16**	**3**	**3**	**22**
	Mandible	**1**	**1**	**0**	**2**
P: B2 Ritual MLF	**Incisors**	9 (subadult / adult)[4]	0	0	9
	Mandible	0	0	0	0
P: B1 Domestic FLF	Incisors	1	3[2]	0	4
	Mandible	0	0	0	0
P: B3 Domestic FLF	Incisors	4	1	0	5
	Mandible	2 (1 yearling, 1 prime)	1 (1 yearling / prime)	0	3
FLF Total	**Incisors**	**14**	**4**	**0**	**18**
	Mandible	**2**	**1**	**0**	**3**
Pukara Total	**Teeth**	**30**	**7**	**3**	**37**
	Mandible	**3**	**2**	**0**	**5**

Note: H=Huatacoa, P=Pukara

[1] 1 deciduous and 1 permanent incisor (latter is not erupted)

[2] 1 deciduous and 6 permanent incisors lack roots (permanent ones are not erupted)

[3] 1 deciduous incisor

[4] 3 deciduous and 5 permanent incisors

Meanwhile, the Pukara samples display greater complexity by time period. The llama/guanaco form predominates in each occupation, though the alpaca form is ubiquitous. Intriguingly, vicuña form incisors suggest that wild camelid hunting probably provided game for public consumption in Block 2 Initial Late Formative

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[86] Additional highly fragmented incisors (lacking species-specific morphology) and mandibula contribute to camelid NISPs and weight presented in Chapter 5.

context. Initial Late Formative public contexts produced the greatest number of classifiable camelid incisors and mandibula body segments. Overall, within behavioral and diachronic samples, domesticated forms, primarily llama, were utilized by Formative agropastoralists.

Table 7.9: Pathology Distribution

Pathology Location	**Huatacoa (%)**	**Pukara (%)**
Phalanges	57.1	63.6
Hindlimb	14.3	18.2
Forelimb	0	9.1
Rib	14.3	9.1
Thoracic vertebra	14.3	0

Pathology

Eighteen camelid bone specimens displayed signs of pathology in the ¼” mesh samples from Huatacoa (n=7) and Pukara (n=11). Pathology was found on–respectively for Huatacoa and Pukara–0.002% and 0.01% of the identified camelid bone. Phalanges had the most pathologies by count, though ribs, hindlimb and forelimb elements, and thoracic vertebral column also displayed lesions (Table 7.8; Figure 7.5).

As such, rigorous tests of the hypothesis linking pathology to animal labor (Baker 1984:253), or intersite contrasts of overall Formative herd health, are anecdotal. Answers to the following questions also remain speculative: 1) does poor health increase the likelihood of culling? and 2) does the frequency of stress pathologies demonstrate long caravan service by individual llamas? Instead, we will consider basic trends observed, their distribution (Table 7.9), and how they compare to prior animal pathology studies of Formative (Chiripa) and Tiwanaku Period contexts.

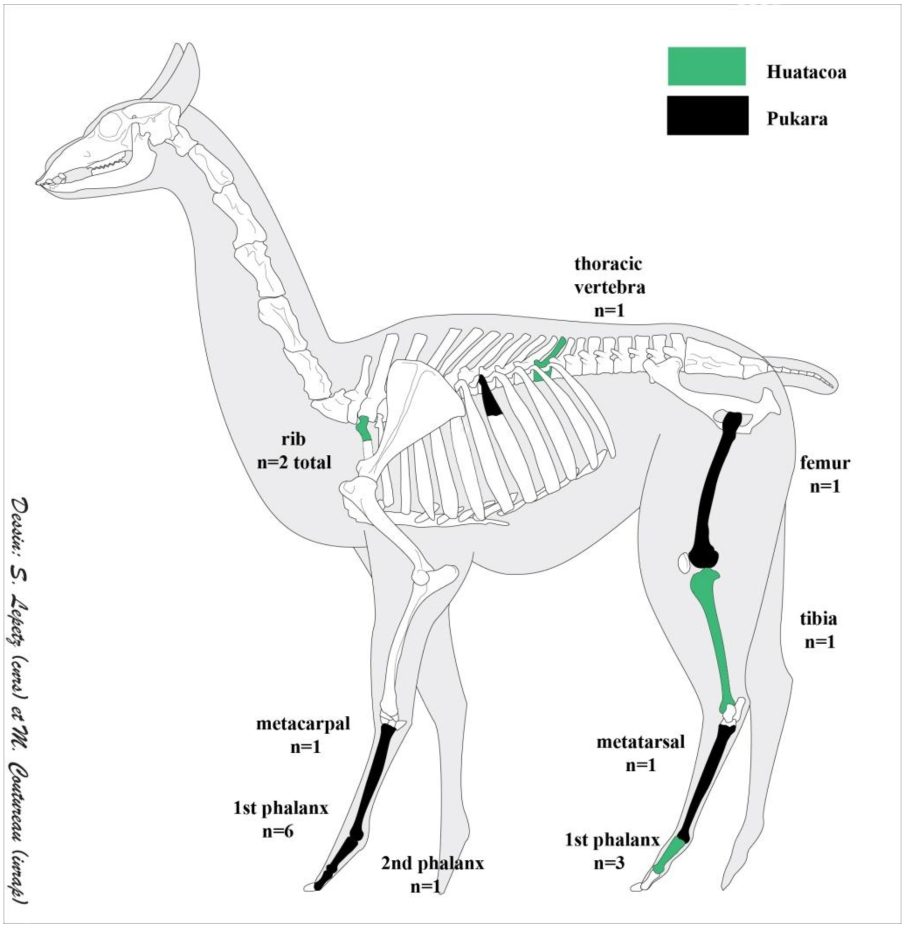

Figure 7.4: Skeletal Pathologies

<u>Stress</u>

Stress-associated lesions account for more than 80% of pathologies observed on the Pukara Valley camelids. Osteometric identifications found stress pathologies occurred most frequently on llama forms (n=4) relative to smaller camelid forms (intermediate n=1; alpaca n=1). Phalanges dominate as the primary pathological elements, with high and low ring bone present[87]. Most affected specimens present minor exostoses at and/or slight lipping of the proximal articulation. These characters likely reflect mild connective tissue inflammation markers of cargo-use (described by Cartajena et al. 2001). Unexpectedly, fragmentary phalanges from Huatacoa's Early Qaluyu

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[87] Characteristic lipping and mild exostoses occur on Pukara specimen # 3213 and 2011 (Figure B-7, B-8).

domestic area display more pronounced phalanx exostoses relative to Pukara, suggesting perhaps a more rigorous lifetime of labor, movement, or advanced-age specimens. A related phenomenon resulting from weight-bearing is squat, wide articular surfaces. Pukara specimen #2011 provides a prime example of this.

Table 7.10: Camelid Bone Trauma Observed on Formative Specimens

#	Context	Type	Element	Pathology / Marker
	Huatacoa			
2122	Stratum B3 midden (EQ)	Stress	V, thoracic (11th vert)	Posterior articular facets: arthritic? (porosity, exostosis, eburnation)
2407	“	Stress	1st Phalanx	Distal articular surface (trochlea): exostoses (side, tendinitis?)
2408	“	Stress	1st Phalanx	Proximal articular surface: exostosis (medio-lateral, dorsal margin)
2409	“	Stress	1st phalanx	Proximal articular surface: exostoses (side, ventral side tendinitis?)
2433	“	Stress	1st Rib	Head/ neck/ tubercule: exotosis, osteophytes
2579	A3; Feature 53 / Burial 10 (LQ)	Infection	1st phalanx	Shaft: ventral-dorso-lateral bone growth, porous, sinus
4164	A3; LQ First Court (destruction midden)	Stress	Tibia	Lateral condyle (posterior edge): exotosis
	Pukara			
504	Bl2: SW Midden (ILF)	Trauma	Rib	Costal angle / blade: healed fracture
2011	Bl2: Occ. Zone 2 (ILF)	Stress	Llama: 1st Phalanx, Forelimb	Robust muscle attachments Articular surfaces: flattened, minor lipping (proximal, dorsal margin), articular grooving, eburnation, low ring bone
3042	Bl l: F-16-1 (ILF)	Stress	Llama: 1st Phalanx, forelimb	Articular surfaces: robust margins
3084	Bl l. F-16-1 (ILF)	Stress	Llama: 1st Phalanx	Proximal articulation / shaft (dorsal / side margin): lipping, hyptertrophy
3428	Bl1: F-16-1 (ILF)	Stress	1st Phalanx	Proximal articulation: robust muscle attachment (dorsal), weak exostoses (medio-lateral margins), Minor lipping
4161	Bl3: F-17 midden (ILF)	Stress (Spavin) Polydactyl	Llama: Metacarpal	Proximal articular surface: broad, wide Anterior shaft: exostosis (below 3rd carpal)
4493	Bl3: NM-1 midden (ILF)	Trauma, stress	Femur	Head/ proximal shaft: dislocated/ fractured articulation, exotosis, porosity, eburnation
2507	Bl1:Occ. Zone 5 (ILF)	Stress (Spavin)	Metatarsal	1st tarsal facet / posterior elevated extension (anterior margin): exostosis, lipping
1258	Bl2: Occ. Zone 1 (MLF)	Stress	1st phalanx	Proximal articular margin (ventral): irritated texture, robust muscle attachment
1957	Bl2: Occ. Zone 1 (MLF)	Stress	Alpaca: 2nd Phalanx, Hindlimb	Articular surfaces: robust, squat, wide; Ventral shaft: robust, broad muscle attachments
3213	Bl1: Occ. Zone 3 (FLF)	Stress	Intermediate: 1st Phalanx, Hindlimb	Proximal articulation margin: irritated texture, robust muscle attachments

Note: Pukara specimens identified to probable species by osteometric data (univariate, multivariate)

Beyond the phalanges, a few axial skeletal elements (at Huatacoa) and limbs demonstrate some stress lesions. An 11th thoracic vertebra (#2122, Figure B-9) showed minor arthritic symptoms on its posterior articulating facets and spinous process: eburnation, porosity, and osteophytes growths. A first rib had osteophytic growth along its tubercule and head facet and minor articular grooving. Both suggest degenerative effects of shifting forces and weight sustained by the back, though not to the extreme reported for Colonial Times (see deFrance 2009a).

At Pukara, two metapodia exhibited mild cases of spavin, defined by proximal articular lipping and exostoses. Specimen 4161 (Figure B-10), a proximal metacarpal, also shows evidence of polydactyl herd animal. This genetic mutation is demonstrated by the extremely broad proximal articular surface. Finally, as discussed below, a past injury to a femur resulted in bone remodeling, stress inflammation, and osteoarthritis.

Trauma

Two instances of trauma are noted among Pukara's Initial Late Formative bone samples. A rib specimen (specimen #504, B-11), found in Block 2's Southwest midden, was fractured. It features a moderate healed-fracture callus along the internal costal angle – blade transition segment. The placement and shapes of healed fracture suggests trauma caused by an inward-directed force. Perhaps this fracture indicates recovery from an instance of pack over-burdening on a pack llama's back.

A proximal femur specimen (#4493; Figure B-12) was associated with Block 3's North midden 1 deposit. Extensive irregular bone exostoses are present across the proximal diaphysis' anterior, medial, and posterior sides. The femoral "head" and neck surface appears to be wholly remodeled following fracture. The ensuing bone repair process would have been arduous. The dense blood vessel network of the head-acetabulum joint is torn, which disrupts the blood and nutrient flow and may cause necrosis of adjacent bone marrow (Jubb and Kennedy (1970:50-52). For juvenile or young prime age animals, healing also necessitates reconstruction of a fractured proximal neck shaft and (late-fusing) head epiphysis. At Chiripa, 16% of recorded femoral lesions occurred at this proximal articulation (Moore 2008:45).

Rather than a spherical ball-joint, the new articulation has a lozenge-like shape, whose surface is pitted, grooved and eburnated, suggesting subsequent bone-on-bone arthritic joint contact and near-joint tissue inflammation (Baker and Brothwell 1980:115). The animal in question had lived to a ripe age prior to its cull – judging by limb shaft size and fused-healed joint surface. In all likelihood, the animal received post-injury care, until arthritic pain finally rendered it lame. Formative herders were not overly hasty to treat even major injuries as a rationale to cull animals.

Infection

Infectious lesions were observed on one bone, a first phalanxfrom Huatacoa. At Huatacoa, the disarticulated remains of two camelids are associated with the Late Qaluyu Second Court patio Burial 10’s (Stratum A3) human sacrifice. A single infected juvenile-age first phalanx (#2579; Figure B-13) was identified. A hard ash-charcoal-soil matrix adhering to the bone surface proved impossible to completely remove. Nonetheless, an elliptical bone growth projects outward along the entire dorsal, lateral, and–to a lesser extent—the ventral sides of the phalanx shaft. The shaft surface is porous and has a sinus drainage canal on the shaft's latero-ventral side. As a result, the animal likely had a limping gait and outward signs of infection, thereby making it an ideal accompanying offering.

Table 7.11: Previous Pathology Studies in Titicaca Basin and Neighboring Locations

Path Type	Huatacoa	Pukara[1]	Chiripa	Iwawi	Tiwanaku Valley	Moquegua Valley
Stress	6	10	22	45	20	10
Infection/ Nutrition	1	1	11	14	-	-
Trauma	-	2	2	5	3	-
Oral	-		2	5	1	-
Polydactlism	-	1	3	-	2	-
Misc.	-	-	-	1	-	-
	n=7	n=13	n=40	n=70	n=26	n=10

Note: Pukara femur specimen (#4493) is counted twice (trauma, stress)

Three major Titicaca Basin and one sierra Moquegua Valley studies of camelid pathology provide comparative data (deFrance 2009a; Moore 2008; Park 2001; Webster 1993) (Table 7.10). Pathologies were observed generally on less than 1% of the identified camelid bone assemblage. Chiripa had a surprisingly high 2.7% frequency (n=817 identified camelid bone).

Stress-related lesions, a category which here includes osteoarthritis and joint degeneration, were the most frequently recorded pathology. The most common elements affected were phalanges and cervical and thoracic vertebrae. Less common elements with such lesions include ribs, forelimbs (scapula and humerus), hindlimbs (pelvis and femur), metapodia, lumbar vertebrae, and carpals and tarsals. Our results accord well with the frequency and location of lesions, though they seem to be less severe cases.

Nonetheless, these studies document further pathologies and abnormalities less common in the Pukara Valley. For instance, infection was considerably more common among studied specimens at Chiripa and the Tiwanaku site of Iwawi. Moore and Webster likewise record examples of polydactyl metapodia with three condyles. This genetic mutation is encountered among prehistoric and modern herds; these animals were preferentially culled early to eliminate this trait (Moore 2008:46).

When osteometric, age, and pathology data are compared, medium-sized and large camelids often display more stress-related lesions, while small camelids – which presumably survive to an older age for wool production – display more infectious and trauma lesions (deFrance 2009a:Table 3; Moore 2008:46). For Pukara, the former trend holds for llama first phalanges (specimens #2011 and 3042) and probable medium-sized camelid second phalanx (#1957). It is increasingly clear that pathological lesions are an unintended outcome of domesticated camelid life, a low-frequency consequence of herd corralling, long-distance caravan labor, and extended life spans[88]. Formative herders perceived animals with minor stress injuries or diseases as productive herd animals until late in life. Culling was favored to eliminate undesirable traits or as a last resort (i.e. when the injuries or disease became debilitating).

Mortality Patterns: Or Is That Llama Getting Long in the Tooth?

Our assessment considers the coarse and fine-grained mortality pattern profiles, derived from long bone epiphyseal fusion classes and tooth eruption/wear stages. Identification of culled animal sex – based on pubic symphysis profile and canine size yields a third, albeit rough estimate of age-at-death and herd management.

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[88] Most telling, despite analysis of Panaulauca's large camelid bone assemblage for (n=64359), stress-related lesions were recorded on only one wild camelid lumbar vertebra and two phalanges (Moore 2008:45).

Teeth Eruption and Wear

Mandible samples, consisting of intact teeth rows and some isolated teeth, were analyzed to construct eruption / wear mortality profiles for both sites. Site-wide mortality profiles are presented in Figure 7.6 (Huatacoa n=13, Pukara n=41).

More in-depth study of the Huatacoa sample provides details on management decisions in Early through Late Formative contexts (Figure 7.7). Early Formative household yearling mortality (67%) is twice the adult rate (33%). Among modern Bolivian herder households, most meat derives from culled subadult (3-5 months old), sick subadult / juveniles, and adults made into *ch'arki* for exchange (Tomka 1994:382). Annual mortality due to from natural means (weather and predation) is highest during the first year of life (Browman 1974; Moore 1989). These animals had not yet reached

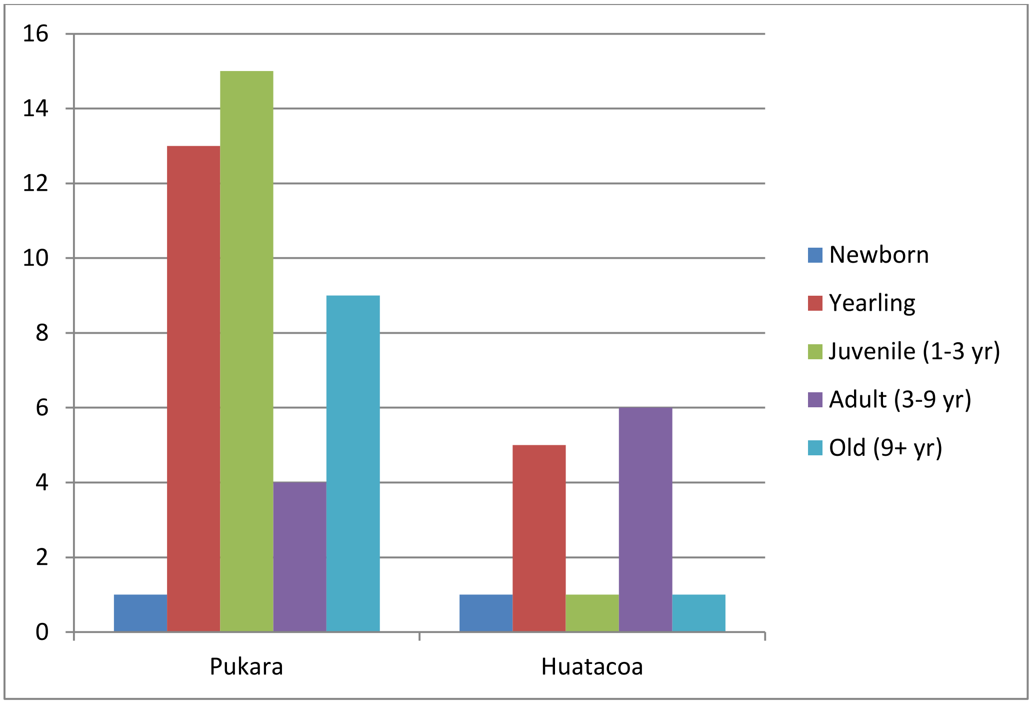

Figure 7.5: Formative Mortality Profile (Mandible)

maximum body size. Management of camelids to adulthood suggests wool production, transport use, and subsequent *ch'arki* production.

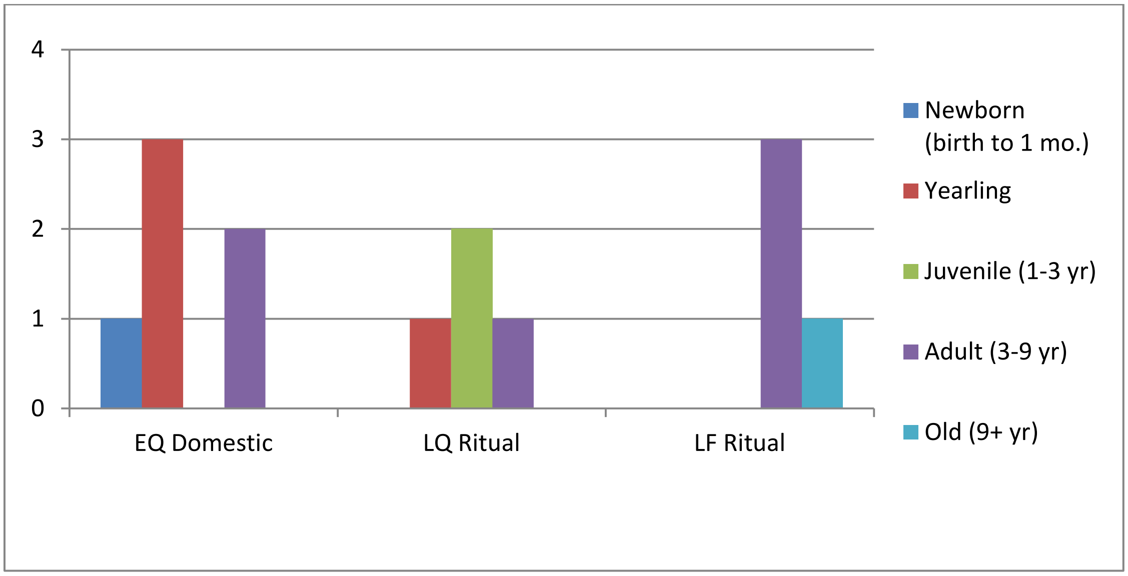

Figure 7.6: Huatacoa Mortality Profile

Sunken court contexts show greater evidence of culling of adult animals that had served a lifetime of wool and burden-carrying. These Middle and Late Formative contexts display animals that had reached maximum size (3 + years of age). These ritual culls are good analogs for *wilancha* sacrifice / feasts. Such animals would provide larger total nutritional package (i.e. meat, fat, internal organs) relative to yearling animals. Likewise, they would also have served numerous years as secondary economic producers. Public sacrifice of large-bodied, old animals likely was the best of both worlds. Social prestige would accrue to the donor and communal food would be shared in such ritual meal / sacrifices. Meanwhile, the resulting loss to household production would be low, given the fall-off in wool / transport productivity.

Pukara displays a relatively more complex profile. Overall, a robust mixed meat-secondary economy is illustrated in Figure 7.6. Animals that represent the largest meat package (juveniles, adults) comprise 43% of the sample. Few animals died between three and nine years of age, showing the growing non-subsistence value of camelids. Osteometric results corroborate Pukara's greater wool production (alpaca and possibly wooly llama). Old animals are represented in domestic, public, and ritual contexts. Given its "tough" nature, meat from old animals required careful preparation (e.g. roasting, simmering) or became *ch'arki*. Figure 7.8 displays the mortality profiles by behavioral interpretation: domestic, public, and ritual contexts[89].

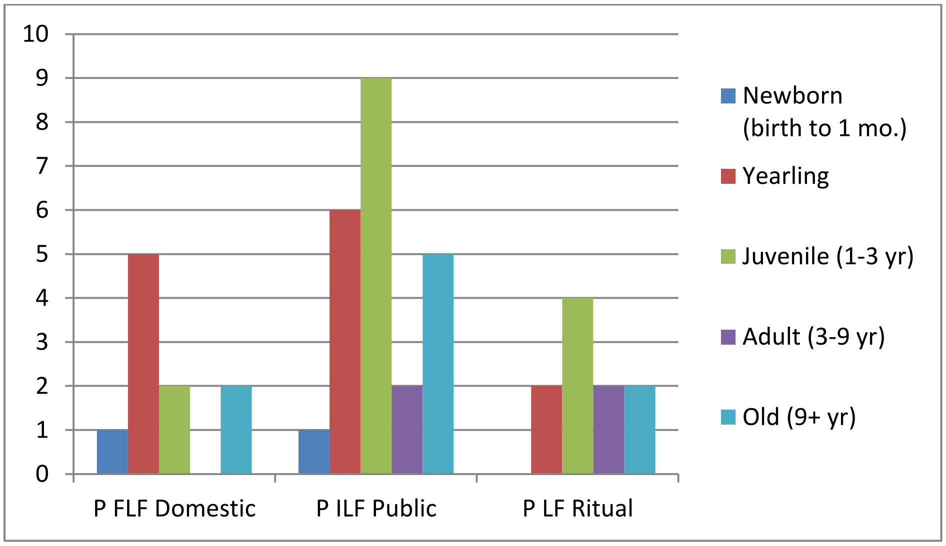

Figure 7.7: Pukara – Mortality by Behavioral Context

Contrasting mortality profiles are present within these contexts. The Initial Late Formative public area, dedicated to communal food preparation and cooking features and disposal middens, features a mixed profile of yearling and larger-bodied juvenile and adult animals. Blocks 1 and 2 are somewhat anomalous. Block 1 features a yearling,

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[89] Appendix B: Figure B-13 presents a more detailed provenience-by-provenience breakdown for Pukara.

juvenile, and old animal focus; Block 2 has an even spread of mortality ages. During the Formative, no strong norms yet existed concerning the 'proper' age of animals a household shared to meet feast obligations. Juvenile (and older) animals are more common in feast contexts than observed in most domestic and ritual contexts.

Pukara ritual contexts display two mortality profiles. The best "non-domestic", management analog to the Initial Late Formative public contexts comes from the Middle occupation of Block 2. Like Huatacoa's Late Formative court, juvenile and older camelids supplied meat for smaller-scale ritual meals. A second ritual behavior – offerings – is not well-documented by mortality profile data. The partial adult camelid discovered in the Lagunita Mound associated with an interred carved stone monolith is the best example of this practice at Pukara. Similarly, at Huatacoa, the interment of a juvenile camelid offering with the dedicatory human sacrifice (Feature 53, burial 10) in Second Late Qaluyu court patio floor is a documented dental mortality profile example.

Domestic dental mortality profiles for the two sites are broadly comparable (see Figures 7.7, 7.8 and Appendix B: Figure B-13). Nonetheless they contrast in two ways. Culling of juvenile camelids for meat characterizes households at Pukara. Likewise, by the Late Formative, households managed very old herd animals for long-term wool production and possibly transport, as corroborated by femoral head fusion, dental mortality, and osteometrics data.

Epiphyseal Fusion

Bone fusion provides a larger subsample of bone that can be examined for age profile data than the above mandibular age profile. The Huatacoa sample consisted of

609 element specimens and the Pukara sample had 566 specimens. Elements were divided into early-fusing (0.5-1.5 years old), middle-fusing (2-3 years old), and late-fusing (3+ years old) categories. See Chapter 4 for a description of the elements considered and epiphyseal fusion charts presented by Wheeler (1999) and Miller (2003a).

I begin by considering Huatacoa's domestic and sunken court contexts (Figures B-14 – B-15). In Huatacoa domestic contexts, yearling to juvenile-aged animals dominate. The largest diachronic trend occurs between the in the early- and middle-categories from the Early Formative onward. The frequency of animals with non-fused bones increases, suggesting greater use by households of yearling and juveniles during subsequent periods.

Table 7.12: Age Class Profiles for Pukara Valley

Site	Area / Block	Temporal Period	Early Un	F	Middle Un	F	Late Un	F
Huatacoa	B	E Qaluyu	16	36	59	29	27	3
	B	L Qaluyu	8	11	21	3	12	2
	A	L Qaluyu	18	22	23	19	15	4
	B	L Formative	29	21	54	17	30	4
	A	L Formative	29	21	36	17	23	0
		Total	**100**	**111**	**193**	**85**	**107**	**13**
Pukara	Bl 1	Initial LF	10	34	14	14	32	11
	2	Initial LF	19	45	17	22	23	6
	3	Initial LF	30	26	23	22	19	11
	1	Middle LF	2	4	2	3	0	0
	2	Middle LF	7	27	17	24	30	4
	1	Final LF	2	5	8	5	5	1
	2	Final LF	0	3	3	2	0	0
	3	Final LF	4	12	4	2	7	5
		Total	**74**	**156**	**88**	**94**	**116**	**38**

Middle and Late Formative ritual court contexts display greater use of yearling and juvenile camelids relative to Huatacoa domestic contexts. The Late Qaluyu courts drew upon a higher proportion of adult camelids (three to five years of age).

Finer-grained study of culling associated with small-scale court rites at Huatacoa is possible. Sunken court ancestor veneration rites (Hastorf 2003), where food is periodically offered in mortuary tomb-associated contexts, were identified within the First Late Qaluyu Court "storage" bins. Cohen (2010:168) concludes that dark soil within this 70 cm x 70 cm court feature derived from in-situ decay of organic matter. An associated offering was made of camelid skeletal remains (one juvenile [and possibly a yearling]), an Andean coot (*choka*), and a taruca antler. Furthermore, food remains accompanied the central burial, adjacent to these bins. Presumably, elite ancestors were feted to maintain kin relations and reciprocity with descendants.

Feature 57, interpreted as a closing rite preceding the construction of the Second Late Qaluyu court, also sheds light on sunken court rites. Four ceramic vessels were offered, in a shallow cache pit, and a ritual midden was burned. Cuy, bird, and fish bone, taruca antler, and camelid remains were identified in this burnt midden. Epiphyseal fusion data indicates the culling of a yearling and a juvenile camelid to commemorate rites of renewal for the Late Qaluyu court.

Moving on to Pukara, the Initial Late Formative public feast contexts differ considerably from those at Huatacoa (Figure B-15). Most animals were culled between one and a half and three years of age. Greater use of adult animals is demonstrated by 20 to 40% rates of fused late-fusing bones. Block 3 is conspicuous by its larger proportion of yearlings mixed with higher proportions of juvenile and adult animals.

Middle Late Formative ritual / domestic contexts at Pukara are dominated by juvenile-aged animals (Figure B-17). Wool production and transport were not significant within these contexts, given the poor representation of adult animals.

Pukara Final Late Formative domestic contexts are characterized by disparate economic foci. In all excavation blocks, many animals were culled after reaching early juvenile age (less than 2 years old). Apparently, the importance of older camelids greatly differed between Block 1 and 3. Negligible dependence is found for Block 1. Although based on a smaller sample size, a remarkable emphasis on adult animals marks Block 3. The combined presence of ceramic production artifacts and features and spindle whorls indicates a female gendered, craft production activity area (Klarich 2005a:240). Based on the frequency of small utilitarian serving vessels and absence of hearths, she proposes that food was supplied to craft producers. An interesting possibility is that an energy flow existed between herding, food production, and crafting. Old alpacas and llamas provided the ingredients for *ch'arki*-based soups that nourished textile and ceramic production.

Sex

Preservation of the pelvis's pubic region provides means to track herd culling by sex and indirect measure of age at death. Huatacoa contains a small sample compiled primarily from Middle Formative contexts (n=6), whereas Pukara has a larger sample spread between its Initial and Middle Formative contexts (ILF n=9; MLF n=6) (Table 7.12).

Table 7.13: Pubis Fragments: Culling Decisions by Sex

Site	Context	Cat #	Side	Profile Portion	Comparative	Sex
H	B3-Domestic midden (EQ)	2334	L	Nose	PR-A227: 10 yr alpaca	F
	B4-Domestic midden (LQ)	88	L	Nose	PR-A220: 3.75 yr camelid	M
	B4-Domestic midden (LQ)	90	L	Tail	PR-A237: alpaca (age?)	M
	A3-Fea 53 burial (LQ)	2579	R	Nose	PR-A265: 2 yr alpaca	F
	A3-Court midden (LQ)	3852	R	Nose	A243: 1 yr camelid	M
	A5-Court Fea 3 pit (LF)	721	L	Nose	PR-A274: ~ 5 yr alpaca	F
P	B1: 16 Public midden (ILF)	2707	R	Nose	PR-A274: ~ 5 yr alpaca PR-A112: 8 yr llama	F
	16 Public midden (ILF)	2743	R	Tail	PR-A237: alpaca (age?) A107: 15 yr alpaca-vicuña	M
	16 Public midden (ILF)	2764	L	Nose	A214: 1.3 yr camelid A243: 1 yr camelid	M
	16 Public midden (ILF)	2836	L	Nose	PM-A221: 2.25 yr alpaca PR-265: ~ 2 yr alpaca	F
	16 Public midden (ILF)	3345	L	Tail	PR-A237: alpaca (age?)	M
	16 Public midden (ILF)	3426	L	Tail	PR-227: 10 yr alpaca	F
	B2: Public Occ. Zone 2 (ILF)	70	L	Nose	PR-A265: ~ 2 yr alpaca PM-A221: 2.25 yr alpaca	F
	Public Occ. Zone 2 (ILF)	138	R	Nose	PR-A261: 5 yr llama	cf. F
	B2: Public SW Midden (ILF)	1547	L	Nose	PR-A118: 9 yr huarizo	M
	B2: Ritual Occ. Zone 1 (MLF)	659	L	Nose	Doehner llama (1.5-2.5 yr)	cf. M
	Ritual Occ. Zone 1 (MLF)	898	L	Tail	PR-A220: 3.75 yr alpaca	cf. M
	Ritual Occ. Zone 1 (MLF)	1016	R	Tail	Doehner llama (1.5-2.5 yr)	cf. M
	Ritual Occ. Zone 1 (MLF)	1264	R	Nose	PR-A274: ~ 5 yr alpaca PR-A265: ~ 2 yr alpaca	cf. F
	Ritual Occ. Zone 1 (MLF)	1418	R	Nose	PR-A221: 2.25 yr alpaca PR-A112: 8 yr llama	F
	Ritual Occ. Zone 1 (MLF)	1686	R	Nose	Doehner llama (1.5-2.5 yr)	cf. F

Note: I referenced several pubic bone cross-sections drawings made by Kate Moore of camelid specimens from the Laboratorio de Paleoetnozoología, Universidad Nacional Mayor de San Marcos. Unfortunately, this reference collection no longer exists (Katherine Moore, personal communication 2006). Origin of specimens: PR=La Raya, Peru; Machuwasi, Peru.

The meager Huatacoa sample shows an even male-female split. Despite the small sample, probable male pelvises specimens correlate with historic comparatives of a younger (prime or young adult) cull age than the recovered females. The young male/aged female trend is echoed in the Late Formative contexts at Pukara. Most of the Initial Late Formative sample derives from the Block 1 Feature 16 sheet midden, whereas the Middle Late sample is associated with the Block 2 “ritual” occupation floor. Just over half (56%) of the former sample are late prime age or old females. In contrast, the Middle sample is a 1:1 sex split.

Adult sexual dimorphism in canine size provides a second means to culling by sex (Table 7.13). Observed results corroborate culling of juvenile (or older) males and adult (or old adult) female. Sunken courts, at Huatacoa, and the public contexts, at Pukara, demonstrate use of alpaca and llama alike for food and ritual practice. In several cases, both small and large forms were culled within the same provenience.

Table 7.14: Canine Size as Marker of Culled Animal Sex

Site / Age	Male (n)	Female (n)
Huatacoa		
LQ: First Court Destruction Fill	1 Llama (1 Mand)	-
LQ: 2nd Court foundation	-	1 Alpaca (R Mand)
LF: Feature 3 Offering / Ritual	-	Alpaca (L Max)
LF: Domestic Midden	2 L max (1 Llama); 1 R Max	-
Pukara		
Bl. 1 Initial: Feature 16 Midden	1 (R/L Max)	2 (2 R/1 L Mand)
Feature 25 Midden	-	2 Alpaca (R Max)
Feature 27 Midden	-	1 (R Mand)
Bl. 2 Initial: SW Midden		1 (L Max)
Bl. 3 Initial: NW Midden	Llama (1 L Max)	1 Llama (1 L Max)
NM Midden	1 (L Max)	1 (R/L Max)
Feature 15 Midden	-	1 Llama (L Max); 1 Alpaca (R Max)
Occ. Zone 2	-	1 Llama (L Max)
Bl. 2 Middle: Occ. Zone 1	1 (Max)	1 (R Max)
Bl. 1 Final: Occ. Zone 1	1 (R Max)	
Bl. 3 Final: Occ. Zone 3		1 (Max R)

Note: Mand=Mandible, Max=Maxillary. Best match with species comparative and context-wide MNI/MNE values (by side) were recorded when possible.

A striking pattern is the high frequency of identified female animals, particularly for Pukara's contexts. One or more possible explanations exist. We may posit a Pukara economy increasingly skewed toward use of adult male and female llama and alpaca, for wool and transport functions. This is certainly corroborated by the mortality profiles constructed for Pukara. Said animals, however, become consumed items – in rites, communal meals, and daily household consumption – later in their careers. Then again, Formative herders may have routinely practiced castration, which could muddy our canine-based sex ratio (see Chapters 1 and 4). In this case, smaller female canines and female culling might be over-estimated. The cultural logic behind frequent culling of females is problematic, unless they had exceeded their reproductive and productivity value for a household. Therefore, a middle-of-the-road hypothesis whereby both factors are operating is credible.

Conclusions: Diachronic and Contextual Trends

Periodic hunting of wild vicuña (and possibly guanaco) and steady use of domesticated camelids (alpaca and llama) sustained household and political economies of the Formative Pukara Valley. I suspect this contextual contrast illustrates a mixed hunting-herding economy, wherein two management foci exist. Early through Late Formative household meals exploited primarily llama meat. In the Early Formative, vicuña were a supplementary large mammal game for households. Middle to Late Formative public-ritual contexts show a more complex exploitation of camelid forms and age groups, accrued through varied social practices, including sacrifices, ritual meals, and feasts. Vicuña, (presumably older) alpaca, and llamas (of varying size and age) were each viable as commodities consumed by political economy transactions.

Overall, a mixed meat-first / secondary products program of camelid management is operating by the Middle Formative period. Apparent context-specific and diachronic trends in management develop in the Formative Period. Domestic contexts emphasize male yearlings (as foodstuffs) and some older castrate and females (incorporated when their non-subsistence utility is exhausted). By the Late Formative, household herd management incorporates meat (juveniles) and greater use of camelid secondary products (adult, old adults). When advanced age animals succumbed to illness and lameness or produced poor quality wool, they were culled. Moreover, Formative economies lacked the adult-dominant, secondary products-focused economies characteristic of later prehistoric and modern herders (see Chapter 1).

Public and ritual contexts display a more complex management pattern. Small and large camelid taxa of juvenile males, adults, and old adult animals were common within Formative feasting contexts. No rigid cultural rules require herders to provide only large, prime age animals (see Burkert 1983). Communal feasts drew upon a greater age range of herd animals than previously anticipated by my model. Most culled juveniles were likely males, while adults had lost their utility as wool producers or caravan animals.

At least three ritual practices are evident at Huatacoa. Alpaca and llama figure as elements of ritual sacrifice / meals, comparable in form to the *wilancha* ceremony, associated with Late Formative court activities. Second, herd animals feature as participants in Middle Formative (Late Qaluyu) ancestor veneration and in court renewal rituals. Finally, camelid dedicatory offerings are also evident in association with the *Lagunita* Mound at Pukara and Huatacoa's Second Late Qaluyu sunken court patio. Adult or old animals take on greater significance because of their size (conspicuous consumption) and supplementary food value.

CHAPTER 8: CAMELID BUTCHERY AND SKELETAL FREQUENCY

In this chapter, contextual analyses of herd animal exploitation are undertaken using two related methods: 1) butchery marks demonstrating evidence of skinning, dismemberment, and meat cut filleting and 2) deposits of carcass butchery units (skeletal element frequencies). I expect to see differences between domestic, ritual and public feast contexts could exist in both data sets. Expectations will be briefly discussed below.

First, butchery marks are predicted to mark almost all of the camelid bone. Potential differences in cooking techniques practiced in household, public and ritual contexts could be reflected by cutmark placement. Bone fileting demonstrates meat was stripped away from bone to prepare meat for boiling, roasting, and perhaps *ch'arki* production. The former preparation technique and the addition of bones to soup were predicted to characterize domestic consumption. Public feasts were expected to highly focus more on larger quantities of meat. Finally, it is predicted that camelid ritual offerings in some cases may not involve consumption. The presence of cut marks and fractured bone provides definitive evidence of consumption, while the absence of such marks could suggest a non-food disposition.

Second, because large, well-preserved camelid bone samples were recovered from Huatacoa and Pukara, bone deposits provide fairly intact, albeit jumbled, processual records of animal butchery, processing of meat and bone for cooking, and garbage disposal. Yet, once an animal is culled, bone is destroyed when it is butchered, consumed by carnivores, made into tools, or burned. Bone also becomes dispersed across sites through food sharing, *ch'arki* production, and periodic cleaning of living and special-use areas. Alternatively, ritual animal deposits could appear as articulated, unbutchered specimens. In Chapter 6, marked intersite variation in bone taphonomy – burning, carnivore ravaging, and bone tool production – was noted. If postitve correlations between element frequency and bone density are recorded, it will demonstrate taphonomic processes strongly winnowed bone assemblages[90].

Third, the three behavioral contexts under study were predicted to generate skeletal element frequencies biased by meat emphasis or drying for *ch'arki* preparation. Given unequal distribution of meat across the camelid carcass, skeletal frequencies may demonstrate exploitation emphases for low, moderate or high utility butchery units. Alternatively, lack of correlation would indicate no particular emphasis or use of a complete culled animal. Prior studies of feasting suggest high utility units may be preferentially served (deFrance 2009b; Kelly 1999). To produce large food outlays, a several animals are served at once. This should be tracked by element MNE and camelid MNI values. Domestic contexts are more likely to emphasize use of the entire carcass or greater use of lower utility units. Animals are consumed at lower frequency than seen in feasts. One notable exception may correlate with higher status households, where moderate and higher utility meat cuts are more common. Likewise, the drying index values for carcass elements were examined for contexts. Household production of *ch'arki* is predicted as a possibility.

Butchery Marks

Rich records of camelid butchery cutmarks are preserved at both Pukara Valley sites. At Huatacoa, they are frequent in Early through Late Formative domestic middens and Middle and Late Formative ritual contexts (see Appendix C). For Pukara, cutmark

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[90] Insignificant correlations demonstrate taphonomic process and bone density are not factors strongly shaping skeletal frequency.

frequency – the count of elements displaying cutmarks – provides a proxy measure of scale of butchery and consumption and camelid bone sample sizes. Initial Late Formative feasting contexts contain the highest counts per element of butchery marks. With the exception of the Middle Late Formative Block 2 stratum, a decline occurs in distribution of cutmarks and how specimens of each element display cut marks.

Butchery marks are widely dispersed and common amongst all anatomical units. Skinning cuts were observed on the cranium frontal bones and mandibles and the metapodial condyles and phalanges. Dismemberment cuts are observed on vertebral elements; across the carpals, tarsals, and patellae; on the margins of the glenoid fossa (scapula) and acetabulum (innominate); and proximal and distal limb articular margins. Probable dismemberment fractures were recorded crisscrossing acetabula and illial wings. Major muscles (i.e. meat cuts) were fileted away from femur, humerus, tibia, and radio-ulna bone shafts. Additional longitudinal and oblique filet cuts occur on scapula blades, illial wings, and the ventral sternum.

Other cutmarks were observed with less frequency. Of particular interest, multiple cuts on a single hyoid from the Late Qaluyu court suggest that the animal's throat was cut prior to butchery. Two Initial Late Formative Block 2 hyoids also display cutmarks. Such cuts would facilitate the collection of blood for *wilancha* offerings to *Pachamama* or the *apus*. Dismemberment cuts, demonstrating removal of the tongue, were sometimes observed on the lingual portion of the mandible body or diaphysis.

Spiral fractures on most bones document post-butchery cooking processing at both sites (sensu Miller 1977:53-68). With carnivore ravaging rarely recorded at

Huatacoa, butchery fracture seems the most parsimonious explanation for spiral fractures in that context. In contrast, at Pukara, ravaging was common. Therefore, natural actors (carnivore) explain a proportion of bone fragmentation at Pukara. Dogs, foxes, and omnivores could have been attracted by larger bone middens and disposal of bone with bits of adhering meat intact.

Skeletal Element Frequency

Huatacoa: Early Qaluyu Plaza (A1)

Excavation of the Early Formative Plaza produced a very small sample of identifiable camelid skeletal elements. This is not a surprise, given the low frequency of ¼” faunal remains [91] (Table 8.1). Three butchery units are present: the head, the neck (cervical column), and the lower limbs. Spiral fractures were present on the cranium, along the maxillary fusion line, and across the vertebra.

Table 8.1: EQ Plaza Camelid Skeletal Frequencies (1/4” bone)

Element	NISP	MNE
Cranium	1	1
V, cervical	1	1
1st Phalanx	1	1

Thus, our account of post-dismemberment, cooking preparation and discard must remain speculative. The missing camelid butchery units either: 1) remain intact within neighboring proveniences, 2) were transported away from the plaza, or 3) were disinterred during subsequent construction of the sunken courts. Further excavation testing may reveal their whereabouts and condition.

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[91] As previously noted, much of the Plaza Floor was destroyed in the process of constructing subsequent sunken court architecture. Cohen (2010:148) suggests excavation of additional Plaza floor, beyond the very small portion exposed, would prove challenging. No flotation samples from Plaza contexts were analyzed.

Early Qaluyu Court (A2)

The Early Qaluyu Court did not contain an abundance of slaughtered camelids or their identified skeletal elements. This is understandable because of the small area of the court exposed by excavations (Table 8.2). This reality exacerbates interpretation of whether Early Qaluyu court floor and patio contexts served as the site of camelid butchery or solely as sites of later cooking, consumption, and disposal of camelid bone.

Head, neck, ribcage, upper forelimb, and upper hindlimb butchering units were utilized and consumed during use of the court floor. Analyzed camelid bone came from Feature 21, with the exception of the femoral shaft bone tool found on the court floor itself[92]. Since tools are generally curated and mobile until the end of their use life, the femora may represent tool discard, rather than food consumption discard.

Table 8.2: EQ Sunken Court Camelid Skeletal Frequencies (1/4" and flotation bone)

Element	NISP	MNE
Cranium (p^4 cusp)	1	1
V, cervical	4	2
Rib	2	2
Scapula	2	1
Femur	1	1

Note: Includes Feature 21 flotation sample

With the exception of one rib bone, spiral fractures cross cut limb shafts and axial elements in patterns comparable to cooking preparation. Incised grooving of the rib blade facilitated a controlled split in order to produce a spatula tool blank. No butchery marks are recorded on bone. This implies that meat was removed after tenderizing via boiling or roasting.

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[92] The Feature 21 pit is composed of deposits created during court floor burning events. This is confirmed by matching pit orientation (with the Early Court foundation cut) and the absence of evidence of *in-situ* burning of its contents.

In sum, the low frequency of camelids remains recovered from the Early Formative plaza floor and court is difficult to explain. It may be an artifact of limited excavation or document very small-scale, simple rituals were practiced and feasting was rarely practiced.

Late Qaluyu Court (A3)

The First Late Qaluyu Court contains a moderately sized, yet diverse camelid element assemblage (Table 8.3). All butchering units are present, though elements from most occur in frequencies below 50%. The cranial, neck, sternum and vertebral column units are moderately well-represented. The upper forelimb segment (e.g. ribs) and thoracic vertebrae are found in conspicuously low frequencies, while the lower half of the hindlimb unit (tibia and metatarsal) is well-represented.

The mixed frequencies seen across butchery units are peculiar. This conglomerate bone assemblage is composed of trash accumulated in several types of small-scale suprahousehold ritual meals. Bone was disposed of across the court floor and in a high-status burial, a niche structure, and burnt court patio closing rites.

Recently a more fine-scale study of each provenience was undertaken (Warwick 2012). In each provenience subsample, incomplete butchery unit representation was noted. The evidence suggests that community members attended several court-associated rites wherein camelids were sacrificed and consumed. In each case, animals were butchered. Certain butchery units were deposited within court proveniences[93], while

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[93] This interpretation helps explain the high frequency of axial vertebrae (MAU=6) – which were recorded amongst the court niches, burnt primary middens, the first court destruction midden, and the 2nd Late Qaluyu court dedicatory rite.

other carcass parts were removed by participants for later household consumption. Bone was subsequently burned in post-event offerings, becoming a physical marker of past events that was incorporated into the sunken court's structure and its features. A future comprehensive micro-scale study of court features would be beneficial.

Table 8.3: First LQ Sunken Court Skeletal Element Frequencies (1/4" and flotation)

Element	NISP	MNE	MAU	%MAU	FUI	DUI	Density
Cranium	46	2	2	33.3	14.75	0.4	NA
Mandible	27	4	2	33.3	9.90	18.4	7.23
V, atlas	5	3	3	50	8.60	60.5	1.94
V, axis	11	6	6	100	8.60	60.5	1.66
V, cervical	62	12	2.4	40	64.20	60.5	1.33
V, thoracic	31	7	0.583	9.72	61.80	39.2	1.97
V, lumbar	31	7	1	16.7	77.9	49.1	3.02
Ribs	50	21	0.875	14.6	100	100	3.36
Sternebrae	3	1	1	16.7	99.40	66.7	1.98
Scapula	11	4	2	33.3	41.66	16.8	2.22
Innominate	22	5	2.5	41.7	40.18	34.8	5.04
Sacrum	1	1	1	16.7	77.97	49.1	1.71
Humerus	15	6	3	50	36.68	1.30	1.42
Radio-ulna	16	3	1.5	25	23.00	1.4	2.06
Metacarpal	5	4	2	33.3	6.53	2.0	3.43
Femur	13	5	2.5	41.7	75.94	1.3	1.50
Patella	6	6	3	50	75.94	1.3	2.61
Tibia	22	9	4.5	75	43.04	1.1	2.09
Metatarsal	18	9	4.5	75	11.46	2.0	2.92
1st Phalanx	35	17	2.125	35.4	4.78	1.5	3.2
C, unciform	3	3	1.5	25	11.46	2.0	2.68
C, scaphoid	2	2	1	16.7	11.46	2.0	2.22
C, cuneiform	3	3	1.5	25	11.46	2.0	1.66
C, lunar	3	3	1.5	25	11.46	2.0	1.86
C, magnum	1	1	0.5	8.3	11.76	2.0	1.86
C, trapezoid	1	1	0.5	8.3	11.76	2.0	2.34
T, astragalus	5	5	2.5	41.7	21.88	2.3	2.14
T, cuboid	5	5	2.5	41.7	21.88	2.3	1.49
T, calcaneus	8	8	4	66.7	21.88	2.3	3.75
T, ectocunieform	3	3	1.5	25	21.88	2.3	2.45
T, navicular	4	4	2	33.3	21.88	2.3	2.39
Hyoid	2	2	2				

We now turn to skeletal frequency correlations (Table 8.4). Two significant correlations were found, between both limb meat utility and axial meat utility and each category's respective skeletal element frequencies. The limb subsample presents a positive correlation. Thus, Late Qaluyu court ritual meals involved preferential consumption or household provisioning of meatier limb units.

Table 8.4: Sunken Court Spearman rho Correlation Results

Correlation	LQ First Court	LF Court
Carcass FUI	df = 28 p = 0.3879 r = -0.164	df = 24 p = 0.7414 r = -0.068
Carcass DUI	df = 28 p = 0.3374 r = -0.182	df = 24 p = 0.1778 r = -0.273
Carcass Density	df = 27 p = 0.7206 r = -0.069	df = 23 p = 0.5304 r = 0.132
Limb FUI	df = 16 p = 0.027 r = 0.520	df = 12 p = 0.4155 r = 0.237
Limb DUI	df = 16 p = 0.6868 r = -0.102	df = 12 p = 0.0745 r = -0.491
Limb Density	df = 16 p = 0.7624 r = 0.077	df = 12 p = 0.8784 r = 0.045
Axial FUI	df = 10 p = 0.003271 r = -0.772	df = 10 p = 0.0365 r = -0.607
Axial DUI	df = 10 p = 0.8181 r = -0.074	df = 10 p = 0.0197 r = -0.659
Axial Density	df = 8 p = 0.4324 r = -0.264	df = 9 p = 0.4671 r = 0.245

Key: Food uility index (FUI), drying utility index (DUI)

On the other hand, axial element representation is highly negatively correlated to meat utility. Since carnivore ravaging is negligible, more than one seems likely. Ribs and vertebral segments (e.g. sternebrae, thoracic, lumbar, and sacral vertebrae) may have been divided amongst meal attendees for later consumption. Alternatively, intensive fragmentation might have rendered fragments unidentifiable. The latter hypothesis is undercut by the relatively small samples of large mammal and mammal bone encountered within the Late Qaluyu court assemblage and amongst individual feature proveniences.

Late Formative Court (A5)

Overall, skeletal element frequencies associated with the Pukara Period sunken court are comparable to the preceding Late Qaluyu context (Table 8.5). One major contrast is the higher frequency representation of the posterior axial column elements (thoracics, lumbars, sternum, and sacrum) and head. As noted for the Late Qaluyu court, segments of the axial skeleton were likely carried away as “leftover” food from feasts. This is corroborated by the strong negative correlations toward axial element meat utility (Table 8.4). In contrast, insignificant correlations demonstrate a more unbiased exploitation of entire limbs in court consumption.

Early Qaluyu Pithouse (B1)

Table 8.6 presents the camelid skeletal elements associated with the pithouse and pre-adobe house midden deposits. Each major butchering package is present, though their proportional representation varies. The cranium (head and upper cervicals) and upper hind- and forelimb units are the most common components. Food preparation butchery, particularly of the axial skeleton (eg. the ribcage, vertebral column, and sternum), seems to have fragmented bone beyond identification – leading to conservative, low MNE counts and %MAU values. This is corroborated by the lower fragmentation index noted in Chapter 6

Table 8.5: LF Sunken Court Skeletal Frequencies (1/4" and flotation)

Element	NISP	MNE	MAU	%MAU	FUI	DUI	Density
Cranium	72	4	4	80	14.75	0.4	NA
Mandible	41	8	4	80	9.90	18.4	7.23
V, atlas	2	2	2	40	8.60	60.5	1.94
V, axis	2	2	2	40	8.60	60.5	1.66
V, cervical	49	8	1.6	32	64.20	60.5	1.33
V, thoracic	34	22	1.83	36.6	61.80	39.2	1.97
V, lumbar	42	10	1.43	28.6	77.9	49.1	3.02
Ribs	100	18	0.75	15	100	100	3.36
Sternebrae	4	2	2	40	99.40	66.7	1.98
Scapula	21	4	2	40	41.66	16.8	2.22
Innominate	20	8	4	80	40.18	34.8	5.04
Sacrum	2	2	2	40	77.97	49.1	1.71
Humerus	13	5	2.5	50	36.68	1.30	1.42
Radio-ulna	27	5	2.5	50	23.00	1.4	2.06
Metacarpal	10	4	2	40	6.53	2.0	3.43
Femur	19	5	2.5	50	75.94	1.3	1.50
Metatarsal	20	8	4	80	11.46	2	2.92
Tibia	30	10	5	100	43.04	1.1	2.09
1st Phalanx	31	23	2.875	57.5	4.78	1.5	3.2
C, unciform	2	2	1	20	11.46	2.0	2.68
C, scaphoid	2	2	1	20	11.46	2.0	2.22
C, lunar	2	2	1	20	11.46	2.0	1.86
C, magnum	1	1	0.5	10	11.76	2.0	1.86
T, astragalus	4	4	2	40	21.88	2.3	2.14
T, calcaneus	4	4	2	40	21.88	2.3	3.75
T, lat malleolus	1	1	0.5	10	21.88	2.3	2.84
T, navicular	2	2	1	20	21.88	2.3	2.39
Hyoid	9	9	4.5				

Also notable are the poor representation of the upper forelimb and lower hindlimb elements. Two factors may be at play here. First, it may reflect more intensive fragmentation, for marrow use and soup-making, associated with domestic cooking. Second, the frequent manufacture of bone tools from metapodia, tibiae, and radio-ulnae could contribute to their low occurrence. Tool production may obscure identification of these elements. Furthermore, such tools traveled with their users and were likely discarded when they outlived their usefulness.

Skeletal element frequency demonstrated few significant correlations to bone density, meat utility, or *ch'arki* production (Table 8.7). Only axial skeletal elements are high negatively correlated to their overall meat utility. It is unclear whether higher utility axial elements were cooked and consumed outside of the house structure or transported elsewhere. The negative relationship supports deletion of high utility parts or possible ch'arki manufacture. We note no strong biases toward use or discard of low or high utility limb elements. As such, culling, carcass processing, and disposal of meal trash took place in close proximity to Early Formative domestic structures.

Early Qaluyu Adobe House (B2)

The adobe house structure and its surrounding midden and activity area preserved a much smaller bone assemblage. Each major butchery unit was observed. However, meatier limb elements, the femur and humerus, were notably absent. Meaty axial elements were also not common. In fact, axial element frequency is negatively correlated against their corresponding meat utility. Bone tool use again can explain the "absence"of some elements from MNE counts. One camelid radio-ulna, two rib, and one innominate bone tool four additional large mammal limb bone tools were recovered from the structure. Moreover, the narrow excavation window does not capture the entire domestic structure, nor in all likelihood its associated activity areas and midden deposits. As a consequence, additional camelid remains were likely unobserved.

Early Qaluyu Above House Midden (B3)

The larger domestic midden stratum contained a larger camelid bone assemblage (Table 8.7). It clearly constitutes a longer temporal slice and represents a secondary domestic midden deposit generated by the trash disposal of multiple households. This stratum exhibited the highest frequency of discarded camelid and large mammal bone tools and worked bone fragments associated with Early Formative habitation at the site (see Table 6.1). Recorded tools were made from ribs, humeri, femora, innominates, metacarpals, metatarsals, radio-ulnae, scapulae, and tibiae. Consequently, tool manufacture and discard strongly influenced limb bone body part distribution.

Table 8.6: EQ Pithouse Skeletal Frequencies (1/4" and flotation)

Element	NISP	MNE	MAU	%MAU	FUI	DUI	Density
Cranium	7	2	2	66.7	14.75	0.4	NA
Mandible	4	2	1	33.3	9.90	18.4	7.23
V, atlas	6	3	3	100	8.60	60.5	1.94
V, axis	3	2	2	66.7	8.60	60.5	1.66
V, cervical	5	3	0.6	20	64.20	60.5	1.33
V, thoracic	12	2	0.167	5.57	61.80	39.2	1.97
V, lumbar	3	1	0.142	4.73	77.9	49.1	3.02
Ribs	20	5	0.208	6.93	100	100	3.36
Sternebrae	2	1	1	33.3	99.40	66.7	1.98
Scapula	13	4	2	66.7	41.66	16.8	2.22
Innominate	9	4	2	66.7	40.18	34.8	5.04
Sacrum	2	1	1	33.3	77.97	49.1	1.71
Humerus	1	1	0.5	16.7	36.68	1.30	1.42
Radio-ulna	3	1	0.5	16.7	23.00	1.4	2.06
Femur	4	3	1.5	50	75.94	1.3	1.50
Metatarsal	4	2	1	16.7	11.46	2.0	2.92
Tibia	1	1	0.5	16.7	43.04	1.1	2.09
1st Phalanx	13	6	0.75	25	4.78	1.5	3.2
C, unciform	1	1	0.5	16.7	11.76	2	2.68
T, astragalus	1	1	0.5	16.7	21.88	2.3	2.14
T, cuboid	2	2	1	33.3	21.88	2.3	1.49
T, ectocunieform	2	2	1	33.3	21.88	2.3	2.45
T, 1st Tarsal	1	1	0.5	16.7	21.88	2.3	2.62
T, navicular	2	2	1	33.3	21.88	2.3	2.39

Table 8.7: EQ Spearman Correlations (by Strata Context)

Correlation	Pithouse	Adobe House	Above House Midden
Carcass FUI	df = 21 p = 0.0687 r = -0.386	df = 11 p = 0.009634 r = -0.686	df = 27 p = 0.5172 r = -0.125
Carcass DUI	df = 21 p = 0.9442 r = 0.015	df = 11 p = 0.171 r = -0.404	df = 27 p = 0.9885 r = -0.003
Carcass Density	df = 21 p = 0.5465 r = -0.133	df = 10 p = 0.6869 r = 0.130	df = 26 p = 0.3526 r = -0.182
Limb FUI	df = 9 p = 0.6153 r = 0.171	df = 3 p > 0.10 r = 0.354	df = 15 p = 0.1519 r = 0.363
Limb DUI	df = 9 p = 0.4299 r = 0.266	df = 3 p > 0.10 r = -0.363	df = 15 p = 0.7935 r = -0.069
Limb Density	df = 9 p = 0.4396 r = -0.260	df = 3 p > 0.10 r = -0.707	df = 15 p = 0.3544 r = -0.240
Axial FUI	df = 10 p = 0.006609 r = -0.734	df = 6 0.025 > p > 0.01 r = -0.828	df = 10 p = 0.0183 r = -0.665
Axial DUI	df = 10 p = 0.5975 r = -0.170	df = 6 p>0.10 r = -0.435	df = 10 p = 0.3493 r = -0.297
Axial Density	df = 9 p = 0.6691 r = -0.132	df = 5 p > 0.10 r = 0.018	df = 9 p = 0.774 r = -0.098

Key: Food uility index (FUI), drying utility index (DUI)

Table 8.8: EQ Adobe House Skeletal Frequencies (1/4” and flotation)

Element	NISP	MNE	MAU	%MAU	FUI	DUI	Density
Cranium	5	1	1	100	14.75	0.4	NA
V, atlas	1	1	1	100	8.57	60.5	1.94
V, cervical	1	1	0.2	20	64.15	60.5	1.33
V, thoracic	2	1	0.083	8.3	61.75	39.2	1.97
V, lumbar	4	2	0.286	16.7	77.97	49.1	3.02
Ribs	8	3	0.125	12.5	100	100	3.36
Scapula	3	1	0.5	50	41.66	16.8	2.22
Innominate	2	2	1	100	40.19	34.8	5.04
Radio-ulna	2	2	1	100	23.00	1.4	2.06
Tibia	1	1	0.5	50	43.04	1.1	2.09
Metatarsal	2	1	0.5	50	11.46	2.3	2.92
1st phalanx	4	4	0.5	50	4.78	1.5	3.20
T, calcaneus	1	1	0.5	50	21.88	2.3	3.75

Table 8.9: EQ Post-House Midden Skeletal Frequencies (1/4" and flotation)

Element	NISP	MNE	MAU	%MAU	FUI	DUI	Density
Cranium	46	5	5	100	14.75	0.4	NA
Mandible	31	4	2	40	9.95	18.4	7.23
V, atlas	6	3	3	60	8.57	60.5	1.94
V, axis	5	5	5	100	8.57	60.5	1.66
V, cervical	49	6	1.2	24	64.15	60.5	1.33
V, thoracic	32	6	0.5	10	61.75	39.2	1.97
V, lumbar	12	3	0.43	8.6	77.97	49.1	3.02
Ribs	75	28	1.167	23.34	100	100	3.36
Sternebrae	3	2	2	40	99.40	66.7	1.98
Scapula	18	6	3	60	41.66	16.8	2.22
Innominate	19	10	5	100	40.18	34.8	5.04
Sacrum	2	2	2	40	77.97	49.1	1.71
Humerus	14	6	3	60	36.68	1.30	1.42
Radio-ulna	17	5	2.5	50	23.00	1.4	2.06
Femur	18	6	3	60	75.94	1.3	1.50
Patella	2	2	1	20	75.94	1.3	2.61
Tibia	8	4	2	40	43.04	1.1	2.09
Metatarsal	8	5	2.5	50	11.46	2.3	2.92
1st Phalanx	33	16	2	40	4.78	1.5	3.2
C, unciform	2	2	1	20	11.46	2.0	2.68
C, scaphoid	2	2	1	20	11.46	2.0	2.22
C, lunar	2	2	1	20	11.46	2.0	1.86
C, trapezoid	1	1	0.5	10	11.46	2.0	2.34
C, cunieform	1	1	0.5	10	11.46	2.0	1.66
T, cuboid	8	8	4	80	21.88	2.3	1.49
T, astragalus	6	6	3	60	21.88	2.3	2.14
T, calcaneus	6	4	2	40	21.88	2.3	3.75
T, navicular	4	4	2	40	21.88	2.3	2.39
T, lat malleolus	3	3	1.5	30	21.88	2.3	2.84
T, ectocunieform	1	1	0.5	10	21.88	2.3	2.45
Hyoid	2	2	2	40			

Head, neck, forelimb, hindlimb, and lower limb butchery units were common. In contrast, most vertebral and axial elements occurred in low frequency. A significant negative correlation between axial frequency and meat utility was observed. Fragmentation of vertebral elements was a probable factor impacting axial elements.

Late Qaluyu and Late Formative Above House Middens (A4-A5)

The Middle Formative (LQ) domestic midden assemblage contrasts with the previous above house midden. While each butchery unit was present, only the head and upper neck unit are present in high frequency. Altogether, the lower neck, axial column, forelimb, hindlimb, and lower limb units are underrepresented in overall frequency (Table 8.10). In fact, bones that comprise each unit are present in nearly equivalent proportions. Portions of these butchery units were likely deposited within nearby primary midden and habitation proveniences. Unlike the prior stratum, only a handful of elements were made into tools or worked: metapodia, ribs, and one radio-ulna.

Table 8.10: LQ Domestic Midden Skeletal Frequencies (1/4" and flotation)

Element	NISP	MNE	MAU	%MAU	FUI	DUI	Density
Cranium	25	3	3	75	14.75	0.4	NA
Mandible	7	4	2	50	9.95	18.4	7.23
V, atlas	1	1	1	25	8.57	60.5	1.94
V, axis	7	4	4	100	8.57	60.5	1.66
V, cervical	16	3	0.6	15	64.15	60.5	1.33
V, thoracic	15	6	0.5	12.5	61.75	39.2	1.97
V, lumbar	24	3	0.25	6.25	77.97	49.1	3.02
Ribs	12	9	0.375	9.375	100	100	3.36
Scapula	12	3	1.5	37.5	41.66	66.7	1.98
Sternebrae	4	1	1	25	99.40	16.8	2.22
Innominate	7	3	1	25	40.18	34.8	5.04
Sacrum	1	1	1	25	77.97	49.1	1.71
Humerus	5	2	1	25	36.68	1.30	1.42
Radio-ulna	4	2	1	25	23.00	1.4	2.06
Metacarpal	2	2	1	25	6.53	2.0	3.43
Femur	6	4	2	50	75.94	1.3	1.50
Patella	1	1	0.5	12.5	75.94	1.3	2.61
Tibia	6	3	1.5	37.5	43.04	1.1	2.09
Metatarsal	1	1	0.5	12.5	11.46	2.3	2.92
1st phalanx	10	4	0.5	12.5	4.78	1.5	3.2
T, calcaneus	2	2	1	25	21.88	2.3	3.75
T, cuboid	2	2	1	25	21.88	2.3	1.49

Table 8.11: LF Domestic Midden Skeletal Frequencies (1/4” and flotation)

Element	NISP	MNE	MAU	%MAU	FUI	DUI	Density
Cranium	99	6	6	100	14.75	0.4	NA
Mandible	29	7	3.5	58.3	9.95	18.4	7.23
V, atlas	4	4	4	66.7	8.57	60.5	1.94
V, axis	9	5	5	83.3	8.57	60.5	1.66
V, cervical	97	16	3	50	64.15	60.5	1.33
V, thoracic	33	19	1.58	26.3	61.75	39.2	1.97
V, lumbar	33	7	1	16.7	77.97	49.1	3.02
Ribs	93	39	1.63	27.2	100	100	3.36
Scapula	17	5	2.5	41.7	41.66	16.8	2.22
Sternebrae	4	1	1	16.7	99.4	66.7	1.98
Innominate	24	9	5.5	91.7	40.18	34.8	5.04
Sacrum	3	2	2	33.3	77.97	49.1	1.71
Humerus	21	5	2.5	41.7	36.68	1.30	1.42
Radio-ulna	21	8	4	66.7	23.00	1.4	2.06
Metacarpal	11	8	4	66.7	6.53	2.0	3.43
Femur	17	5	2.5	41.7	75.94	1.3	1.50
Patella	2	2	1	16.7	75.94	1.3	2.61
Tibia	18	7	3.5	58.3	43.04	1.1	2.09
Metatarsal	12	7	3.5	58.3	11.46	2.3	2.92
1st Phalanx	51	28	3.5	53.3	4.78	1.5	3.2
C, unciform	3	3	1.5	25	11.46	2.0	2.68
C, lunar	2	2	1	16.7	11.46	2.0	1.86
C, cuneiform	2	2	1	16.7	11.46	2.0	1.66
C, scaphoid	2	2	1	16.7	11.46	2.0	1.98
C, pisiform	1	1	0.5	8.3	11.46	2.0	2.61
T, calcaneus	8	8	4	66.7	21.88	2.3	3.75
T, astragalus	6	6	3	50	21.88	2.3	2.14
T, cuboid	3	3	1.5	25	21.88	2.3	1.49
T, lat malleolus	3	3	1.5	25	21.88	2.3	2.84
T, ectocunieform	1	1	0.5	8.3	21.88	2.3	2.45
T, 1st tarsal	1	1	0.5	8.3	21.88	2.3	2.34
T, navicular	2	2	1	16.7	21.88	2.3	2.39
Hyoid	4	4	4	66.7			

The Late Formative secondary domestic midden displays the now familiar pattern. Head and upper neck units continue to be common (Table 8.11). Next, lower fore- and hindlimb elements outnumber their upper limb peers. As high marrow-content bones, femora and humeri may have been processed for their meat and internal nutrient packages. Axial column elements were slightly better represented within this stratum than the Late Qaluyu midden. Bone tools were constructed from several camelid radio-ulna and tibia and large mammal limb shafts. A smaller sample of camelid scapula, metacarpals, first phalanges, ribs, and one humerus became tools or worked bone byproducts.

Table 8.12: LQ and LF Domestic Midden Spearman rho Correlations

Correlation	LQ Midden	LF Midden
Carcass FUI	df = 20 p = 0.1304 r = -0.333	df = 29 p = 0.2669 r = -0.206
Carcass DUI	df = 20 p = 0.2026 r = -0.283	df = 29 p = 0.7289 r = 0.065
Carcass Density	df = 19 p = 0.6096 r = -0.118	df = 28 p = 0.4207 r = 0.153
Limb FUI	df = 8 0.1 > p > 0.05 r = 0.466	df = 17 p = 0.8111 r = -0.059
Limb DUI	df = 8 p = > 0.10 r = -0.372	df = 17 p = 0.4053 r = -0.203
Limb Density	df = 8 p > 0.10 r = -0.382	df = 17 p = 0.1428 r = 0.349
Axial FUI	df = 10 p = 0.008865 r = -0.716	df = 10 p = 0.002189 r = -0.791
Axial DUI	df = 10 p = 0.1369 r = -0.455	df = 10 p = 0.1166 r = -0.477
Axial Density	df = 9 p = 0.9779 r = 0.010	df = 9 p = 0.8844 r = -0.050

Key: Food uility index (FUI), drying utility index (DUI)

Both strata display significant correlations between axial element frequency and meat utility (Table 8.12). Highly significant negative correlations are observed between axial elements and their utility. This likely relates to aforementioned fragmentation associated with cooking processing and deposition elsewhere within primary household middens. Unexpectedly nearly significant correlation between meat utility and the Late Qaluyu limb bone subsample was found.

Table 8.13: Block 1 ILF Skeletal Frequencies (1/4" and flotation)

Element	NISP	MNE	MAU	%MAU	FUI	DUI	Density
Cranium	64	5	5	58.82	14.75	0.4	NA
Mandible	84	12	6	70.59	9.95	18.4	7.23
V, atlas	2	2	2	23.52	8.57	60.5	1.94
V, axis	3	2	2	23.52	8.57	60.5	1.66
V, cervical	50	13	2.6	30.59	64.15	60.5	1.33
V, thoracic	52	30	2.5	29.41	61.75	39.2	1.97
V, lumbar	44	16	2.29	26.94	77.97	49.1	3.02
Ribs	218	35	1.42	16.71	100	100	3.36
Sternebrae	2	1	1	11.76	99.40	66.7	1.98
Scapula	49	16	8	94.12	41.66	16.8	2.22
Innominate	142	17	8.5	100	40.18	34.8	5.04
Humerus	51	17	8.5	100	36.68	1.30	1.42
Radio-ulna	56	13	6.5	76.47	23.00	1.4	2.06
Metacarpal	25	15	7.5	88.23	6.53	2.0	3.43
Femur	40	17	8.5	100	75.94	1.3	1.50
Patella	2	2	1	11.76	75.94	1.3	2.61
Tibia	47	15	7.5	88.23	43.04	1.1	2.09
Metatarsal	25	14	7	82.35	11.46	2.3	2.92
1st Phalanx	31	18	2.25	26.47	4.78	1.5	3.2
T, cuboid	4	4	2	23.53	21.88	2.3	1.49
T, astragalus	2	2	1	11.76	21.88	2.3	2.14
T, calcaneus	3	3	1.5	17.65	21.88	2.3	3.75
T, navicular	1	1	0.5	5.88	21.88	2.3	2.39
Hyoid	3	2	2				

Pukara: Initial Late Formative

We now shift our exploration of camelid body part representation to Pukara and its Late Formative assemblages. The three Initial Late Formative datasets display broad similarities. Block 1 through 3 display very high frequency representation of fore- and hindlimb butchery units (Tables 8.13-8.15), regardless of what limb element is considered. In declining frequency rank, we find head, neck / axial column, and lower limb butchery units. Ribs are found in moderate frequency, except for within Block 1. Phalanges, sternebrae, and sacra are found in in comparatively low frequencies.

Table 8.14: Block 2 ILF Skeletal Frequencies (1/4" and flotation)

Element	NISP	MNE	MAU	%MAU	FUI	DUI	Density
Cranium	75	8	8	100	14.75	0.4	NA
Mandible	76	12	6	75	9.95	18.4	7.23
V, atlas	5	5	5	62.5	8.57	60.5	1.94
V, axis	3	1	1	12.5	8.57	60.5	1.66
V, cervical	78	15	3	37.5	64.15	60.5	1.33
V, thoracic	48	43	3.583	44.79	61.75	39.2	1.97
V, lumbar	58	9	1.286	16.07	77.97	49.1	3.02
Ribs	284	33	0.625	7.81	100	100	3.36
Sternebrae	1	1	1	12.5	99.40	66.7	1.98
Scapula	57	11	6.5	81.25	41.66	16.8	2.22
Innominate	36	14	7	87.5	40.18	34.8	5.04
Humerus	65	16	8	100	36.68	1.30	1.42
Radio-ulna	57	13	6.5	81.25	23.00	1.4	2.06
Metacarpal	18	10	5	62.5	6.53	2.0	3.43
Femur	55	16	8	100	75.94	1.3	1.50
Patella	1	1	0.5	6.25	75.94	1.3	2.61
Tibia	36	14	7	87.5	43.04	1.1	2.09
Metatarsal	44	9	4.5	56.25	11.46	2.3	2.92
1st Phalanx	36	16	2	25	4.78	1.5	3.2
C, magnum	1	1	0.5	6.25	11.76	2.0	1.86
C, unciform	1	1	0.5	6.25	11.76	2.0	2.68
C, scaphoid	2	2	1	12.50	11.76	2.0	2.61
C, pisiform	2	2	1	12.50	11.76	2.0	2.61
C, cuneiform	1	1	0.5	6.25	11.76	2.0	1.66
T, cuboid	2	2	1	6.25	21.88	2.3	1.49
T, astragalus	5	5	2.5	31.25	21.88	2.3	2.14
T, calcaneus	7	5	2.5	31.25	21.88	2.3	3.75
T, lat malleolus	1	1	0.5	6.25	21.88	2.3	2.84
T, navicular	1	1	0.5	6.25	21.88	2.3	2.39
Hyoid	6	6	6				

Skeletal element frequency displayed no significant relationship to bone density or meat utility were observed. Instead, within each block excavation, strongly negative correlations between drying index utility and axial elements. In Block 1, a negative correlation marks limb frequency and their corresponding value as potential *ch'arki*.

Table 8.15: Block 3 ILF Skeletal Frequencies (1/4" and flotation)

Element	NISP	MNE	MAU	%MAU	FUI	DUI	Density
Cranium	66	8	8	100	14.75	0.4	NA
Mandible	61	14	7	87.5	9.95	18.4	7.23
V, atlas	1	1	1	12.50	8.57	60.5	1.94
V, axis	4	3	3	37.5	8.57	60.5	1.66
V, cervical	42	13	2.60	23.25	64.15	60.5	1.33
V, thoracic	37	20	1.67	20.87	61.75	39.2	1.97
V, lumbar	44	19	2.71	33.87	77.97	49.1	3.02
Ribs	159	36	1.5	18.75	100	100	3.36
Sternebrae	1	1	1	12.5	99.40	66.7	1.98
Scapula	39	15	7.5	93.75	41.66	16.8	2.22
Innominate	23	16	8	100	40.18	34.8	5.04
Sacrum	1	1	1	12.50	77.97	49.1	1.71
Humerus	65	16	8	100	36.68	1.30	1.42
Radio-ulna	50	13	6.5	81.25	23.00	1.4	2.06
Metacarpal	21	14	7	87.5	6.53	2.0	3.43
Femur	52	14	7	87.5	75.94	1.3	1.50
Patella	4	4	2	25	75.94	1.3	2.61
Tibia	40	14	7	87.5	43.04	1.1	2.09
Metatarsal	37	16	8	100	11.46	2.3	2.92
1st Phalanx	37	25	2	25	4.78	1.5	3.2
C, magnum	1	1	0.5	6.25	11.76	2.0	1.86
C, lunar	1	1	0.5	6.25	11.76	2.0	2.59
T, cuboid	1	1	0.5	6.25	21.88	2.3	1.49
T, astragalus	4	4	2	40	21.88	2.3	2.14
T, calcaneus	6	6	3	37.5	21.88	2.3	3.75
T, lat malleolus	1	1	0.5	6.25	21.88	2.3	2.84
Hyoid	5	3	3				

Table 8.16: ILF Spearman rho Correlations (by Block Excavation)

Correlation	Block 1	Block 2	Block 3
Carcass FUI	df = 21 p = 0.866 r = -0.037	df = 25 p = 0.8027 r = 0.050	df = 22 p = 0.5106 r = -0.141
Carcass DUI	df = 21 p = 0.0895 r = -0.362	df = 25 p = 0.3735 r = -0.178	df = 22 p = 0.0576 r = -0.393
Carcass Density	df = 20 p = 0.8394 r = -0.046	df = 25 p = 0.6554 r = 0.090	df = 21 p = 0.1358 r = 0.325
Limb FUI	df = 10 p = 0.5581 r = 0.188	df = 14 p = 0.4672 r = 0.196	df = 10 p = 0.506 r = 0.213
Limb DUI	df = 10 p = 0.0497 r = -0.577	df = 14 p = 0.1127 r = -0.412	df = 10 p = 0.3455 r = -0.299
Limb Density	df = 11 p = 0.9467 r = -0.021	df = 14 p = 0.8755 r = 0.043	df = 10 p = 0.9107 r = 0.036
Axial FUI	df = 9 p = 0.3165 r = -0.333	df = 9 p = 0.0978 r = -0.524	df = 10 p = 0.1755 r = -0.419
Axial DUI	df = 9 p = 000791 r = -0.855	df = 9 p = 0.000314 r = -0.883	df = 10 p = 0.008855 r = -0.716
Axial Density	df = 8 p>0.10 r = 0.353	df = 9 p = 0.3084 r = 0.339	df = 9 p = 0.1763 r = 0.439

Key: Food uility index (FUI), drying utility index (DUI)

One important observation is the absence of positive correlations between limb element frequency and utility associated with these feast contexts. Therefore, we lack strong evidence that additional high-utility upper leg haunches were brought into provision suprahousehold meals. I do note, however, negative correlations with axial drying utility values and one, in Block 1, with limb DUI values. Given the quantity of meat produced during these events, it would not be unexpected that portions of the skeleton where taken away to become household or traded ch'arki. Perhaps provisioning herders were returned these shares of the animal as thanks reciprocal acknowledgement of their generosity.

Instead, it seems animals were culled within or proximate to provenience and their remains discarded into large feast middens. Second, the greatest number of discarded worked bone and bone tool elements are associated with the Initial Late Formative (Table 6.11). Their presence perhaps inflates the frequency that some limb elements occur. Finally, carnivore ravaging predominates on all elements within these feast contexts. Some bone was likely destroyed by carnivores.

Table 8.17: Block 1 MLF Skeletal Frequencies (1/4" and flotation)

Element	NISP	MNE	MAU	%MAU	FUI	DUI	Density
Cranium	13	1	1	66.7	14.75	0.4	NA
Mandible	7	2	1	66.7	9.95	18.4	7.23
V, atlas	2	1	1	66.7	8.57	60.5	1.94
V, axis	1	1	1	66.7	8.57	60.5	1.66
V, cervical	6	2	0.4	26.7	64.15	60.5	1.33
V, thoracic	2	1	0.083	5.53	61.75	39.2	1.97
V, lumbar	3	2	0.286	19.07	77.97	49.1	3.02
Scapula	2	2	1	66.7	41.66	16.8	2.22
Innominate	1	1	0.5	33.3	40.18	34.8	5.04
Humerus	5	3	1.5	100	36.68	1.30	1.42
Radio-ulna	4	3	1.5	100	23.00	1.4	2.06
Metacarpal	1	1	0.5	33.3	6.53	2.0	3.43
Femur	3	2	1	66.7	75.94	1.3	1.50
Tibia	3	2	1	66.7	43.04	1.1	2.09
1st Phalanx	5	5	0.625	41.7	4.78	1.5	3.2
C, scaphoid	1	1	0.5	33.3	11.76	2.0	1.98
T, lat malleolus	1	1	0.5	33.3	21.88	2.3	2.84
Hyoid	1	1	1				

Middle Late Formative

During the Middle Formative occupation, one large bone assemblage, in Block 2, stands out against a more modest one within Block 1 (Table 8.17). Within Block 1, the head, neck, forelimb, and hindlimb butchery units predominate. Noticeably less common are metapodials and the axial column unit and ribs. Although few metapodial tools were observed, their valued use as wichuña weaving tool blanks might explain their corresponding low frequency. Following butchery, metapodia were collected and removed from the discarded midden assemblage.

Table 8.18: MLF Spearman rho Correlations (by Block Excavation)

Correlation	Block 1	Block 2
Carcass FUI	df = 16 p = 0.3917 r = -0.214	df = 22 p = 0.4334 r = -0.168
Carcass DUI	df = 16 p = 0.1332 r = -0.369	df = 22 p = 0.4958 r = -0.146
Carcass Density	df = 15 p = 0.3762 r = -0.229	df = 21 p = 0.8368 r = 0.045
Limb FUI	df = 7 p = 0.6202 r = 0.192	df = 11 p = 0.7991 r = 0.708
Limb DUI	df = 6 0.1>p>0.05 r = -0.530	df = 11 p = 0.2612 r = -0.336
Limb Density	df = 6 0.1>p>0.05 r = -0.596	df = 11 p = 0.646 r = -0.141
Axial FUI	df = 6 0.005>p>0.001 r = -0.897	df = 9 p = 0.1364 r = -0.479
Axial DUI	df = 6 p>0.10 r = -0.087	df = 9 p = 0.1073 r = -0.512
Axial Density	df = 6 p = 0.9563 r = 0.023	df = 8 p > 0.10 r = 0.261

Key: Food uility index (FUI), drying utility index (DUI)

On the other hand, we encounter questions when axial skeletal element frequency is discussed. A very strong negative relationship between axial elements and their utility value is noted (Table 8.18). Klarich (2005) believes Middle and Final Late Formative contexts were transformed to mixed ritual and domestic contexts. As previously noted, this provenience contained evidence only of an open compound area occupation floor, featuring two smaller hearths and a lithic knapping area. This domestic compound likely contained additional midden or trash pits, associated with the domicile. Other food remains were likely consumed and discarded adjacent to the house structure itself.

Table 8.19: Bl 2 MLF Skeletal Frequencies (1/4" and flotation)

Element	NISP	MNE	MAU	%MAU	FUI	DUI	Density
Cranium	35	3	3	100	14.75	0.4	NA
Mandible	30	6	3	100	9.95	18.4	7.23
V, atlas	7	3	3	100	8.57	60.5	1.94
V, axis	2	1	1	33.3	8.57	60.5	1.66
V, cervical	57	14	2.8	93.3	64.15	60.5	1.33
V, thoracic	29	24	2	66.7	61.75	39.2	1.97
V, lumbar	83	15	2.14	71.3	77.97	49.1	3.02
Scapula	15	5	2.5	83.3	41.66	16.8	2.22
Sternebrae	4	1	1	33.3	99.4	66.7	1.98
Innominate	30	5	2.5	83.3	40.18	34.8	5.04
Sacrum	3	2	2	66.7	77.97	49.1	1.71
Humerus	23	6	3	100	36.68	1.30	1.42
Radio-ulna	22	5	2.5	83.3	23.00	1.4	2.06
Metacarpal	14	6	3	100	6.53	2.0	3.43
Femur	38	5	2.5	83.3	75.94	1.3	1.50
Patella	4	4	2	66.7	75.94	1.3	2.61
Tibia	15	4	2	66.7	43.04	1.1	2.09
Metatarsal	19	6	3	100	11.46	2.3	2.92
1st Phalanx	33	18	2.25	75	4.78	1.5	3.2
C, unciform	2	2	1	33.3	11.76	2.0	2.68
C, pisiform	2	2	1	33.3	11.76	2.0	2.61
T, calcaneus	2	2	1	33.3	21.88	2.3	3.75
T, astragalus	3	3	1.5	50	21.88	2.3	2.14
T, cuboid	3	3	1.5	50	21.88	2.3	1.49
T, lat malleolus	3	3	1.5	50	21.88	2.3	2.84
Hyoid	2	2	2				

High frequency butchery units present include the entire carcass minus the ribcage: head, lower neck, axial column, sternum, forelimb, hindlimb, and lower limb (Table 8.19). Discarded tools forms in Block 2, which may inflate their respective element frequencies, were made from camelid mandibles and metapodia. Likewise, household bone tool manufacture, which used bone raw material readily accessible from food debris, could explain the discarded large mammal limb shaft bone tool assemblage. No significant correlations with skeletal frequency were observed.

Table 8.20: Block 1 FLF Skeletal Frequencies (1/4" and flotation)

Element	NISP	MNE	MAU	%MAU	FUI	DUI	Density
Cranium	21	4	4	100	14.75	0.4	NA
Mandible	18	3	1.5	37.5	9.95	18.4	7.23
V, axis	2	2	2	50	8.57	60.5	1.66
V, cervical	18	4	0.80	20	64.15	60.5	1.33
V, thoracic	18	16	1.33	33.2	61.75	39.2	1.97
V, lumbar	17	3	0.428	10.7	77.97	49.1	3.02
Ribs	1	1	0.0417	1.04	100	100	3.36
Innominate	12	4	2	50	40.18	34.8	5.04
Scapula	10	3	1.5	37.5	41.66	16.8	2.22
Sternebrae	1	1	1	25	99.4	66.7	1.98
Humerus	12	5	2.5	62.5	36.68	1.30	1.42
Radio-ulna	18	4	2	50	23.00	1.4	2.06
Metacarpal	6	5	2.5	62.5	6.53	2.0	3.43
Femur	13	4	2	50	75.94	1.3	1.50
Patella	1	1	0.5	12.5	75.94	1.3	2.61
Tibia	15	6	3	75	43.04	1.1	2.09
Metatarsal	3	2	1	25	11.46	2.3	2.92
1st phalanx	12	4	0.5	12.5	4.78	1.5	3.2
C, magnum	1	1	0.5	12.5	11.76	2.0	2.59
C, unciform	1	1	0.5	12.5	11.76	2.0	2.68
T, astragalus	3	3	1.5	37.5	21.88	2.3	2.14
T, lat malleolus	1	1	0.5	12.5	21.88	2.3	2.84
Hyoid	1	1	1				

Final Late Formative Domestic

Domestic, ritual and small-scale lithic and ceramic production are recorded in Final Late Formative domestic occupations in front of the Qalasaya complex (Tables 8.20-8.22). Block 1 contained bone midden and ceramic scatters. Block 2 was the setting of small-scale ritual activities and food debris. Block 3 contained household food consumption trash and a ceramic production activity area. Klarich (2005) argued "middle class" craft specialists resided and worked within these household compounds. Camelid bone and large mammal bone tools and worked bone were common within Blocks 1 and 3, but altogether absent from Block 2.

In Block 1, head, forelimb, and hindlimb are the most frequent butchery units observed. Lower limbs, phalanges, ribs, and lumbar vertebrae were found in very low frequencies in midden and occupation surface trash. Axial element frequency was negatively correlated with their relative food utility, as expected given the absence of ribs and paucity of the axial column (Table 8.22).

Table 8.21: FLF Spearman rho Correlations (by Block Excavation)

Correlation	Block 1	Block 2	Block 3
Carcass FUI	df = 19 p = 0.3903 r = -0.066	df = 15 p = 0.5933 r = -0.140	df = 20 p = 0.6834 r = -0.092
Carcass DUI	df = 19 p = 0.0622 r = -0.414	df = 15 p = 0.3285 r = -0.252	df = 20 p = 0.006 r = -0.566
Carcass Density	df = 18 p = 0.2537 r = -0.268	df = 14 p = 0.7073 r = 0.102	df = 17 p = 0.9844 r = 0.005
Limb FUI	df = 9 p = 0.3644 r = 0.303	df = 7 0.05<p<0.025 r = 0.633	df = 12 p = 0.0185 r = 0.618
Limb DUI	df = 9 p = 0.1089 r = -0.510	df = 7 p > 0.10 r = -0.375	df = 12 p = 0.158 r = -0.399
Limb Density	df = 9 p = 0.2956 r = -0.347	df = 7 p = 0.2834 r = -0.402	df = 10 p = 0.352 r = -0.295
Axial FUI	df = 9 0.005>p>0.001 r = -0.850	df = 6 0.05>p>0.025 r = -0.713	df = 6 0.025>p>0.01 r = -0.760
Axial DUI	df = 8 0.025>p>0.01 r = -0.723	df = 6 p > 0.10 r = -0.446	df = 6 0.025>p>0.01 r = -0.793
Axial Density	df = 7 p > 0.10 r = 0.037	df = 5 p > 0.10 r = 0.489	df = 5 0.1>p>0.05 r = 0.650

Key: Food uility index (FUI), drying utility index (DUI)

Compared to Blocks 2 and 3, bone fragmentation in Block 1 was not as intensive (Table 6.16). Besides bone fracture associated with domestic cooking preparation, bone tool production and carnivore ravaging shaped camelid bone representation (Table 6.15). Tools and worked bone were manufactured from first phalanges, femora, innominates, metapodia, radio-ulnae, scapulae, and tibiae.

In Block 2, the artifact assemblage and features suggest ritual or high status meals were served. However, a modest scale of food consumption is indicated, suggesting food merely accompanied ritual events (Table 8.22). All butchery units are represented at modest frequencies, though the axial column and phalanges are rare. Cooking preparation and carnivore gnawing are confirmed factors affecting bone fragmentation.

Table 8.22: Block 2 FLF Skeletal Frequencies (1/4" and flotation)

Element	NISP	MNE	MAU	%MAU	FUI	DUI	Density
Cranium	3	1	1	50	14.75	0.4	NA
Mandible	2	1	0.5	25	9.95	18.4	7.23
V, axis	1	1	1	50	8.57	60.5	1.94
V, cervical	3	1	0.2	10	64.15	60.5	1.33
V, thoracic	3	3	0.25	12.5	61.75	39.2	1.97
V, lumbar	3	2	0.286	14.3	77.97	49.1	3.02
Innominate	4	4	2	100	40.18	34.8	5.04
Scapula	2	1	0.5	25	41.66	16.8	2.22
Humerus	2	1	0.5	25	36.68	1.30	1.42
Radio-ulna	1	1	0.5	25	23.00	1.4	2.06
Metacarpal	1	1	0.5	25	6.53	2.0	3.43
Femur	1	1	0.5	25	75.94	1.3	1.50
Tibia	7	2	1	50	43.04	1.1	2.09
Metatarsal	2	1	0.5	25	11.46	2.3	2.92
1st phalanx	1	1	0.125	6.25	4.78	1.5	3.2
C, magnum	1	1	0.5	25	11.76	2.0	2.59
T, astragalus	2	2	1	50	21.88	2.3	2.14
T, navicular	1	1	0.5	25	21.88	2.3	2.39

Correlations with food utility were observed for Block 2's limb and axial elements (Table 8.21). Axial element frequency was negatively related to food utility, in all three Block excavations, and drying utility value, in Blocks 1 and 3. In Block 3 alone, carcass-wide element frequency showed a very strong negative relationship to all elements' utility as *ch'arki* raw material. The utility correlations demonstrate high utility axial bones were consumed and deposited in primary midden contexts located elsewhere in each compound. Axial elements, however, were probably freeze-dried as ch'arki, provided the greater significance of the drying utility correlations.

Table 8.22: Block 3 FLF Skeletal Frequencies (1/4" and flotation)

Element	**NISP**	**MNE**	**MAU**	**%MAU**	**FUI**	**DUI**	**Density**
Cranium	32	3	3	75	14.75	0.4	NA
Mandible	22	3	1.5	37.5	9.95	18.4	7.23
V, cervical	6	2	0.4	10	64.15	60.5	1.33
V, thoracic	8	5	0.417	10.4	61.75	39.2	1.97
V, lumbar	5	2	0.286	7.15	77.97	49.1	3.02
Ribs	20	10	0.417	10.4	100	100	3.36
Innominate	15	5	2.5	62.5	40.18	34.8	5.04
Scapula	21	4	2	50	41.66	16.8	2.22
Humerus	12	8	4	100	36.68	1.30	1.42
Radio-ulna	9	4	2	50	23.00	1.4	2.06
Metacarpal	8	3	2.5	62.5	6.53	2.0	3.43
Femur	10	4	2	50	75.94	1.3	1.50
Tibia	15	7	3.5	87.5	43.04	1.1	2.09
Metatarsal	5	3	1.5	37.5	11.46	2.3	2.92
1st phalanx	10	3	0.375	9.37	4.78	1.5	3.2
C, magnum	1	1	0.5	12.5	11.76	2.0	2.59
C, lunar	1	1	0.5	12.5	11.76	2.0	1.86
C, unciform	2	2	0.5	12.5	11.76	2.0	2.68
T, calcaneus	2	2	1	25	21.88	2.3	2.14
T, cuboid	2	2	1	25	21.88	2.3	2.39
Hyoid	1	1	1	25			

In contrast, a significant positive correlation between limb frequency and utility was observed. Ritual meals served within Block 2 were provisioned with high meat yield elements for consumption. Discarded remains might represent informal food offerings. Additional excavation of this household compound might reveal the residence of a higher-status or ritual specialist.

Ceramic manufacture in Block 3 was accompanied by small-scale food consumption (Table 8.23). Head, upper and lower limb butchery units were the most common elements present. Axial column elements and phalanges are present in very low frequencies. Carnivore ravaging and tool manufacture complement cooking preparation as sources of bone fragmentation (Table 6.18). Elements used to construct tools or bone ornaments include first phalanges, femora, humeri, tibiae, scapulae, and metapodia.

Skeletal element frequency correlations mirror results for Block 2. Limb frequency displays a highly significant relationship to food utility. Meanwhile, we again find a negative correlation between axial skeletal element frequency and food utility. Ceramicists within the household compound were provisioned with meals consisting of higher-utility limb meat cuts.

Conclusions

Butchery cutmarks were consistent in location and frequency on camelid bone at both Pukara Valley Formative sites. The full suite of cutmarks, documenting skinning, dismemberment, and meat fileting, are recorded for large samples. Likewise, cutmarks indicative of ritual blood offerings (hyoid) and controlled, grooved bone fracture to construct tools were observed. No clear temporal or contextual differences were identified.

Body part analysis produced informative results. In contrast to predictions, positive food utility correlations were rarely observed in any of the contexts categories. I suspect the lack of correlation reflects the entire animals were slaughtered and discarded *in situ*. In total, only the Middle Formative sunken court and two of Pukara's Final Late Formative domestic occupations (in Block 2 and 3) had significant positive correlations with limb element frequency. Camelid meat, from upper limb butchery units, was provisioned for ritual meals, set in the Middle Formative sunken court, and a ritual space within one Late Formative household. Likewise the daily meals of ceramic manufacturers were provisioned. We currently lack firm evidence that food provisioning – of the best meat cuts – was related to status.

Second, in several instances, axial element representation was negatively correlated with food utility. Several other taphonomic and cultural processes impacted the preservation of skeletal elements. First, post-butchery cooking, processing and carcass unit transport away from a butchery locus complicates reconstructions of contextual deposits of camelid bone. Second, carnivore gnawing and bone tool manufacture were major factors impacting element frequency. Each of these three factors shaped the recovered bone samples, along with the accurate identification and quantifcation of skeletal elements. Yet, density mediated attrition (bone density) was not a significant factor shaping skeletal part frequency in any of the studied social settings.

Interpretation of the body part results depends upon the provenience under study. First, within Huatacoa's Early Formative household structures and midden, newly butchered parts were transported away, consumed, or discarded outside of the structure and the post-abandonment domestic midden. This pattern also holds for the subsequent Middle and Late Formative secondary domestic midden deposits and two of Pukara's domestic occupations: the Block 1 Middle Late Formative occupation and Block 2 Final Late Formative domestic ritual space. Contrary to prior expectations, the alternate signature – that supports absence of bone according to its *ch'arki* value – occurred solely within Pukara's Initial Late Formative feast contexts. Thus, Pukara's communal feasts produced sufficient surplus meat to both serve cooked meat to attendees and afford take-away sharing of remanant carcass units – either as payment to herd animal suppliers or as extended largesse redistributed to attendees.

Because of the partial overlap in value between these two indices, when both display significant relationships our explanation becomes is constrained by equifinality. I know that axial elements were transported away from the studied provenience, or if animals were butchered elsewhere, or were never served within the studied context. One is at pains, however, to determine if meat was dried or cooked post-butchery. This coincident correlation was noted for Huatacoa's Late Formative Court and two of Pukara's Final Late Formative domestic compounds (Blocks 1 and 3).

CHAPTER 9: CONCLUSIONS AND FUTURE RESEARCH

This dissertation examined how zooarchaeological data can contribute to our reconstruction of Formative society and the wide-ranging social transformations accompanied its emergence in the Pukara River Valley, North Titicaca Basin, Peru. Two archaeological sites were studied: Huatacoa, a small village-ceremonial center, and Pukara, the capital of a major Late Formative North Basin polity. The multifaceted exploitation of wild and domesticated animal within the Formative domestic and political economies was tracked, by exploring three provenience categories: domestic households, public feasting contexts, and ritual space.

This contextual study allowed me to address several research questions. Varied data sets were explored to measure scale of wild and domesticated taxa use, taphonomy, food preparation and consumption, herd management, and extra-subsistence use of fauna (in feasts, rites, caravanning, and wool production) associated with each provenience category (see Table 1.1). These strategies enabled us to contextualize each function and document intra-site, intersite or diachronic variation of specific practices.

First, I studied the consumption of wild and domesticated taxa in domestic and ritual meals and feasts. I predictd the diachronic expansion of camelid pastoral production and – from the Early to Late Formative Period – prompted a concurrent decline in the hunting of mammals and bird and fishing. This shift toward domesticated herd (and perhaps cuy) was anticipated to be exaggerated within feast and ritual contexts. Ultimately, taxonomic representation and abundance trends should reflect: 1) intersite contrasts (small village versus. large polity capital) and 2) the different social unit served (domestic versus suprahousehold units), and 3) different social events (household meals and industry, communal feasts, and animal sacrifices).

Wild versus Domesticated Taxa

Contrasts exist between Huatacoa Formative domestic contexts and Pukara Late Formative domestic compounds (see Table 1.1). Contrary to the expectation, all studied Huatacoa domestic contexts had greater wild fauna diversity and abundance compared to Pukara contexts. Taruca, viscacha, skunk, and wetland and pampa birds, and fish were exploited by households as a complement to camelid meat (see Figures 5.23, 5.24). Unexpectedly, Middle and Late Formative ritual proveniences at Huatacoa showed similar mixed use of wild game and camelids (see Figures 5.21-5.22, 5.24)[94]. For example, low-intensity taruca hunting is attested by non-antler elements that occur in domestic and sunken court contexts. Hunting, gathering, and fishing, perhaps on opportunistic or periodic forays, continues to supply food for household hearth and sunken court rites at this village.

Study of Huatacoa's First Late Qaluyu- and Pukara Period sunken courts recorded variability in animal use as part of ritual deposits (see also Chapter 5). For instance, fauna accompanying ancestor and dedicatory burials received different treatment. The juvenile camelid associated with human sacrificial (burial 10) was a burned sacrifice, as post-slaughter butchery marks are absent. Similarly burnt, unbutchered bird and cuy were accompanying offerings. On the other hand, burnt camelid remains accompany the high-status, central court burial (Burial 6) along with weaving tool grave goods. The

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[94] Wild game seems to remain a complement to Huatacoa subsistence and element in ritual.

presence of a single cut mark suggests sharing of meal between the deceased and his/her descendants. Community members shared very different relationships with these two individuals.

Other ritual deposits include Late Qaluyu burned midden contexts and court bins, and the Pukara Period dedicatory Feature 3. Both represent discard of court-associated consumption events. The former two events show evidence of disposal of partial camelid skeletal remains that were butchered, consumed, and then burned as offerings. The bin context contains possibly articulated butchery units: the cervical to thoracic column, thoracic to lumbar column, ribs, and fore- and hindlimb elements. Feature 3 stands out as a ritual camelid sacrifice (*wilancha*), ritual meal, and organized disposal combined with a toad associated rite that facilitates seasonal rains. These events are accompanied with cuy and fish remains and symbols of cultural industry – utilitarian ceramics, a Pukara incense burner fragment, and weaving tools.

Further study of Huatacoa flotation samples would underline further the use of wild fauna in domestic and sunken court meals and rites. It, however, remains to be seen if such study would document a comparable fish frequency associated with Lake Titicaca adjacent Formative sites (see Capriles 2011; Moore 2011; Moore et al. 1999)[95]. Meanwhile, the Middle Formative Yaya-Mama iconographic emphasis on fertility and water might explain the ritual deposits of wetland, riverine or lacustrine taxa. The symbolic weight seems to survive into the Late Formative beyond as evidenced by Feature 3's frog and rain-perpetuating rite.

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[95] If qochas and raised field canals increased available habitat for fish, however, the potential Formative harvest for both fish taxa may have been higher than anticipated.

Ideally, further sampling of domestic and ritual contexts at Huatacoa could be undertaken to further characterize domestic consumption and ritual behavior. Alternatively, one could explore archaeological deposits at other Formative village-ceremonial center sites discovered by Cohen in her Pukara Valley survey or the Qaluyu site. Likewise, an effort to examine Late Formative sunken court or ritual enclosure contexts at Pukara could demonstrate contrasts and variability in Formative ritual activity.

At the Pukara polity capital, feasts and domestic meals almost exclusively served camelid meat. Wild game and guinea pig were infrequent side dishes in feasting contexts and almost absent from Middle Late Formative and Final Late Formative domestic compound contexts. This trend holds even following analysis of flotation samples from Initial feast context to Middle and Final Pukara domestic occupations.

Two potential foci of future research of the non-camelid fauna exploitation at Pukara should be pursued. First, further excavation of the riverbank midden's "commoner" households and Area IV domestic compounds could improve our understanding of intrasite variation in the Pukara domestic diet and economy. This could test if observed frequencies are status- or suprahousehold-related consumptive phenomena – whether communal feast attendees (ILF) and "middle-class" artisans (FLF) enjoyed more camelid meat than the average commoner (Klarich 2005a:264, 2005b:200-204). Alternatively, they may reflect an intrasite contextual bias against small game or a site-wide Late Formative subsistence reality. Second, fauna recovered during the 2010 excavations of the Area V enclosure could provide comparative Middle Formative ritual context data for contrast against our Huatacoa results.

Thus the site’s position in the sociopolitical landscape seems to play a greater role than does change over time.

Suprahousehold, Ritual, and Domestic Consumption

Ceramic serving ware (Klarich 2005a; Steadman 2007:80) and faunal data (Gladwell 2010; Warwick 2010) suggest courts and large public plazas both hosted feasts. I anticipated that the growing factional politics and corporate labor projects, undertaken during the Middle and Late Formative, should correlate with feasting. Corporate lineages supply food as reciprocal payments for labor, to recruit new families, and maintain the loyalty of their allies. At Pukara these events were very visible, public affairs.

At these public events, I expected meaty, high utility butchery units may dominant body part representation. Therefore, meaty ribs and cervical columns would be highly represented along with upper limb segments. Lower utility parts could be discarded or taken away by attendees as leftovers. Assuming meat was the primary emphasis, I expected bone to be minimally butchered and fractured in these contexts. On the other hand, household butchery was expected to feature some higher utility parts, but be dominated by moderate or lower utility parts. However, the prehistoric reality was much more nuanced.

Contextual study in this dissertation demonstrated that suprahousehold meals operated at two scales: court-associated, ritual meals and communal feasts. At the smaller, corporate group-scale, ritual meals often preceded and structured the composition of interred court offerings. Feature 3 and 24 illustrated how village-scale, ritual sunken court operated during the Middle and Late Formative. We now have more focused ideas about what we might expect these faunal assemblages to look like. This sealed context contains, at minimum, partial remains of butchered yearling camelid and an adult llama and alpaca. They are accompanied by bird, fish, and cuy remains. The fragmented portions of much of the skeleton were recovered, suggesting *in-situ* butchery and consumption. Feature 24, also associated with the Pukara court, may document a similar commensal event.

Feasting

In Pukara communal feast contexts, the bulk meat package camelids provided were the preferred menu item – provided the sheer bone volume whether measured by NISP, bone weight, or MNI. Camelids were most common by NISP, bone weight, and MNI counts in Pukara's Block 1 through 3 feast contexts A variety of cooking features are present also reinforcing food preparation was a primary focus of activities.

Body part representation data indicates bone, while ravaged by post-deposition carnivore scavenging, was not shaped by density mediated attrition. Several results proved contrary to my expectations. All three communal feast contexts showed no evidence of high utility part provisioning. Instead, in-situ culls likely create unbiased utility profiles. Axial elements instead were carried away as leftovers destined to become *ch'arki*.

Ritual

The two Ritual court strata produced mixed results for skeletal element frequency analysis. Bone from neither strata displayed a relationship with bone density. For the

Late Qaluyu First Court, I found meatier limb elements dominated, given a significant correlation with utility. Ritual meals, in this case, were provisioned with high utility upper limb elements. At the same time, a highly negative food utility correlation to axial elements suggested high utility axial skeletal elements were transported away from Court ritual meals, rather than consumed *in situ*. Similarly, for the Late Formative Court, axial element representation was highly negatively correlated with food and drying utility. Again, a pattern of transport of high utility ribs and vertebrae parts away from court meals was suggested.

Domestic

Domestic context study produced mixed results. Two Pukara Final Late Formative domestic occupations (in Block 2 and 3) had significant positive correlations with limb element frequency. Camelid meat was provisioned, from upper limb butchery units, for ritual meals, in Block 2, and the daily meals of ceramic manufacturers. This seems to demonstrate social differentiation in status and/or part-time craft specialization had developed. At the same time, axial elements were used elsewhere within compounds. Likewise, Huatacoa domestic contexts, from all occupations, saw newly butchered, axial parts moved away, consumed, or discarded away from household structures and secondary middens.

Taphonomy

Bone taphonomy is fairly consistent within, but not between Huatacoa and Pukara. Bone was modified by butchery, burning, and tool manufacture. Contrary to expectations, bone in ritual and feasting contexts was fragmented in levels comparable to domestic consumption. This is interpreted as evidence that meat was prepared in soups as well as roasted over hearths and in an earth *watiya* oven.

However, two differences can be discerned. Huatacoa bone displays greater evidence of low-heat burning (charring), while Pukara has a greater proportion of calcined bone. The former may result from a combination of meat roasting and low-heat ritual burning. I already noted above that ritual offerings often correlated with burning as means to concluding, consecrating act. Contrary to expectations from modern pago burns, high-heat burning of bone did not characterize ritual contexts at Huatacoa. Likewise, variability was noted in the pre-burn condition of bone (e.g. butchered : unbutchered, cut : uncut, fractured : relatively intact). These conditions provide clues to ritual intent - whether offerings involved direct commensal communion (i.e. consumption prior to offering) or in-toto offerings to the supernatural.

Greater calcination at Pukara may reflect greater emphasis on burning bone as a disposal process or as fuel. Most of the bone was calcined after being heavily processed for meals – to the point it identified as large mammal bone. Pukara proveniences were also marked by greater evidence of carnivore destruction of bone. This could be a result of two realities: the relative large open, accessible nature of occupation space and large accumulated assemblage of food and bone waste. Both would entice hungry scavengers.

Herd Management Practices

The large camelid bone assemblages recovered from each site also facilitated analysis of a variety of measures of herd management. I predicted by the Late Formative, greater emphasis on wool production, caravan transport, or both would be evident in the frequency that llamas or alpacas were represented. I also predicted increased burden-carrying would increase the frequency that stress pathologies were observed in Middle and Late Formative caravan llamas.

First phalanx osteometrics provided a proxy measure of which camelid taxa were exploited within each site. During the Early Formative, large llama-size (cargo) camelids predominate, but by the Middle Formative a mixed llama (meat-cargo) and alpaca (wool production-meat) pastoral economy was in place. Within the Middle Formative court, small vicuña- and alpaca-size animals and probable large cargo llamas were culled. Caravan animals were more prominent in Huatacoa contexts over time suggesting its residents may have focused more managing the logistical transfer of exchange goods as an economic and power strategy.

At Pukara, the economic focus was a mixed meat-cargo (llama) and wool production emphasis. Two llama forms are documented at Pukara, an intermediate-size wooly llama and a standard-size llama. As a consequence, it appears culled animals document a greater caravan emphasis in Huatacoa contexts, while Pukara emphasized wool production – with alpaca and a wooly llamas present.

Pukara’s economic focus is corroborated by analysis of width of fused and unfused femoral heads, a late-fusing bone. I recorded an intermediate-sized, juvenile age camelid culled for meat, along with adult small-body wool producers and large-body cargo animals. However, analyses of multivariate osteometric and incisor morphology suggest the persistence of periodic wild camelid hunting following the emergence of a herding at both sites.

To reconstruct the biographies for culled animals, patterns of bone pathology were examined. Prominent stress-related lesions were recorded on first phalanges – probable markers of lifetime of rigorous burden-carrying or advanced age. More Huatacoa camelids displayed this pathology than Pukara. Possible caravan animal pathologies were observed at both sites, documenting the importance of llamas as Middle and Late Formative, possibly Early Formative, prestige and subsistence good transporters. Minor stress injuries or diseases were not cause for immediate culling. Instead, herders continued to care for and use these caravan animals.

Management strategies, whether a meat- or second products focus (wool and transport) were expected to produce distinct mortality profiles. Pukara's feast contexts were predicted to focus on young males culled at maximal body weight, which is achieved at three years old. Domestic contexts were expected to show a secondary-product focus, where animals were culled when they were no longer fit to be wool producers or caravan animals (roughly at eight years of age). Females, because of their reproductive potential, were expected to be culled later in life.

Sex ratio data, based on pubic surface profile and canine teeth form, produced fairly suprising results. Both indicate a higher than expected female cull rate: roughly 50:50 (for pubii) and perhaps a greater female-male ratio (for canine teeth). For pubii, I expect two factors might introduce uncertainty. First, the infrequent preservation of more than half of the pubis (head or tail portion) could result in misidentifications. Likewise, the impact of castration on pelvic shape is unknown. The differential hormone levels of castrates could produce borderline female, gracile profiles. The one advantage of this method is tentative specimen age can be assigned using comparatives of known age, sex, and species.

On the other hand, canine size is somewhat less precise. Published data records a general age range for eruption only, but age at death is unknown. Furthermore, the presence of two mandibular canines and two maxillary caniform incisors and deciduous forms muddies the ease of this tool for sex discrimination. As for the pubis, I am currently ignorant to potential developmental impact that castration has on dentition. However, I suspect it could produce correlate with with female-like smaller fighting teeth. At best, sided teeth might be able to compile sex ratio.

Mandibular tooth eruption and wear and epiphyseal fusion and pubic bone cross-sections and canine size helped characterize cull age at death and sex of animals. We consider dentition and sex results now. For Huatacoa domestic contexts, culled animals were mainly yearlings and adults. On the other hand, Middle to Late Huatacoa ritual contexts display greater emphasis on larger, older juvenile to old adult animals. These animals provided larger meat packages than yearlings and served as secondary products producers. In Pukara feast contexts, juvenile and older animals were culled in greater frequency than domestic and ritual contexts. Ritual context culls were comparable between sites, though Late Formative ritual contexts display culling of more juvenile to old adult animals. Domestic household animal culling, for “middle-class” resident meals, emphasized a greater proportion of larger juvenile animals. Otherwise it approximated the general domestic pattern recorded for Huatacoa. As expected, males were culled with greater frequency and at a younger age than females to preserve the dual reproductive and productive value of female camelids.

In summary, how did this research answer the questions posed in Chapter 1?

Did the use of wild fauna decrease over time? Yes and no. Yes, in the sense that they were rare in the Late Formative at the site of Pukara. No, also because wild taxa continued to be incorporated into both meals and rituals throughout the Formative Period at the village site of Huatacoa. As detailed above, village households and communities may have maintained a level of flexibility and relative autonomy even as the larger sociopolitical landscape was becoming more centralized.

Did camelid use strategies and culling practices change over time in response to increasing demands of political economies? Did they differ between village and polity center? Yes, there is evidence that surplus production focused increasingly on secondary products. At Huatacoa there is increasing use over time of camelids for caravanning. At Pukara, in contrast, the emphasis appears to be on wool production. At both sites camelids were important sources of meat in all three social contexts: domestic meals, feasts, and rituals. Culling strategies focused on two age sets, the "tender and meaty" young adults and the "past their prime" older adults, both compatible with long-term herd maintenance agendas.

Did feasting and ritual increase in scale over time? In the case of feasting, yes, feasting events at Late Formative Pukara occur at a larger scale than those at Huatacoa, as seen by within the Initial Late Formative contexts at the polity capital of Pukara In the case of ritual, the answer is more complex, given the range of different ritual events involved, and their presence at both sites.

As always, our current results raise further questions, inspire further excavation and survey, and demand rigorous research designs to maximize the richness of our faunal data and its integration into answering questions of broader anthropological signficance.

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APPENDICES

Appendix A: Analyzed Excavation Contexts

Table A.1 – Pukara Contexts Analyzed by Block and Occupation

Block 1: Initial Late Formative	**Loci**
Feature 27: Midden	906
Feature 25: Midden	794-795, 797-798
Feature 24: Midden	796
Feature 23: Midden	793
Feature 16-1: Midden	737-744
16-2	761-768
16-3	781-788
16-4	759-760, 780
Feature 16 / ASD6 wall	914
Occupation Zone 5	779, 904
Informal midden pit	905
Middle Late Formative	**Loci**
Occupation Zone 4	771, 790
Feature 26: Hearth	800, 909
Feature 21: Hearth	791
Final Late Formative	**Loci**
Occupation Zone 3	750-753, 756-757, 775
Feature 18: Midden	769
Feature 19: Trash pit	733
Feature 20: Midden	778

Block 2: Intial Late Formative	**Loci**
Occupation Surface 2	870, 886
Occupation Zone 2	859, 861, 866, 878, 880, 885, 887-888, 890
Occupation Zone 2 (lens)	869
SW Midden	491, 493, 497, 500, 836, 839, 845-846, 850, 852, 854, 856
Feature 29: Hearth	892, 894
Carbon pit	863, 865
Middle Late Formative	**Loci**
Occupation Zone 1	448, 455-456, 458, 460, 463, 465-467, 469-470, 472-473, 475, 490, 492, 495-496, 498, 832, 834, 837, 840-841, 844, 851, 855, 857, 860, 862, 864 867-868, 872, 874-875, 883
Final Late Formative	**Loci**
Occupation Surface 1	195, 410, 431, 433-434, 441-442, 444-445, 447, 449-454, 461, 480, 485, 487, 489,
Feature 7: Pit	177-179, 199, 847
Feature 9: Pit	486
Feature 28: Hearth	881-882
Clay circle	476

Block 3: Intial Late Formative	**Loci**
Occupation Zone 2	511, 516, 522, 526, 528, 585, 590, 592-593, 808, 812, 822
North Midden-1, -1/2, -2	816, 817, 818, 821, 820
North West Midden 3-5	501-503, 597-598, 802
Feature 6: *Watiya* Hearth	810, 811
Feature 13: Hearth	819, 827, 830
Feature 14: Pit	594, 803
Feature 15: Midden	571, 806, 813-814
Feature 17: Primary toss zone	804
Final Late Formative	**Loci**
Occupation Zone 1	266, 271, 281-282, 299, 506, 513, 524, 529-534, 536, 538-542
Occupation Surface 1	504, 512, 519, 543, 554, 556, 558-559, 561, 563-568, 584
Feature 12: Hearth / Storage Pit	560
NW Midden 1-2	267, 270, 298, 300
Feature 5: Rock-filled Pit	293, 297, 505, 807, 809, 815, 823-826, 828

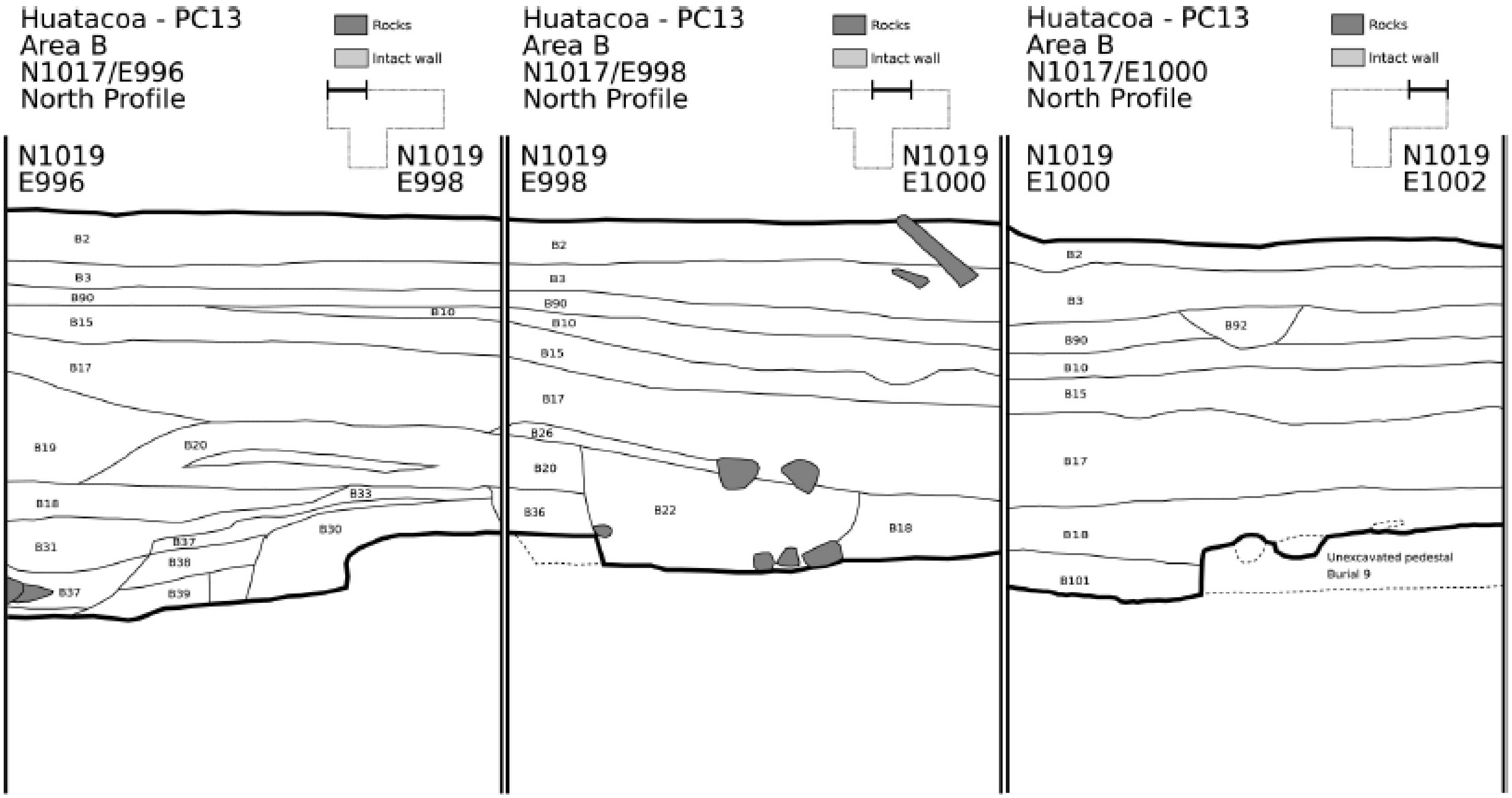


Figure A.1: Huatacoa Area B: North Profile of Domestic Area (Cohen 2010:Figure 5.1)

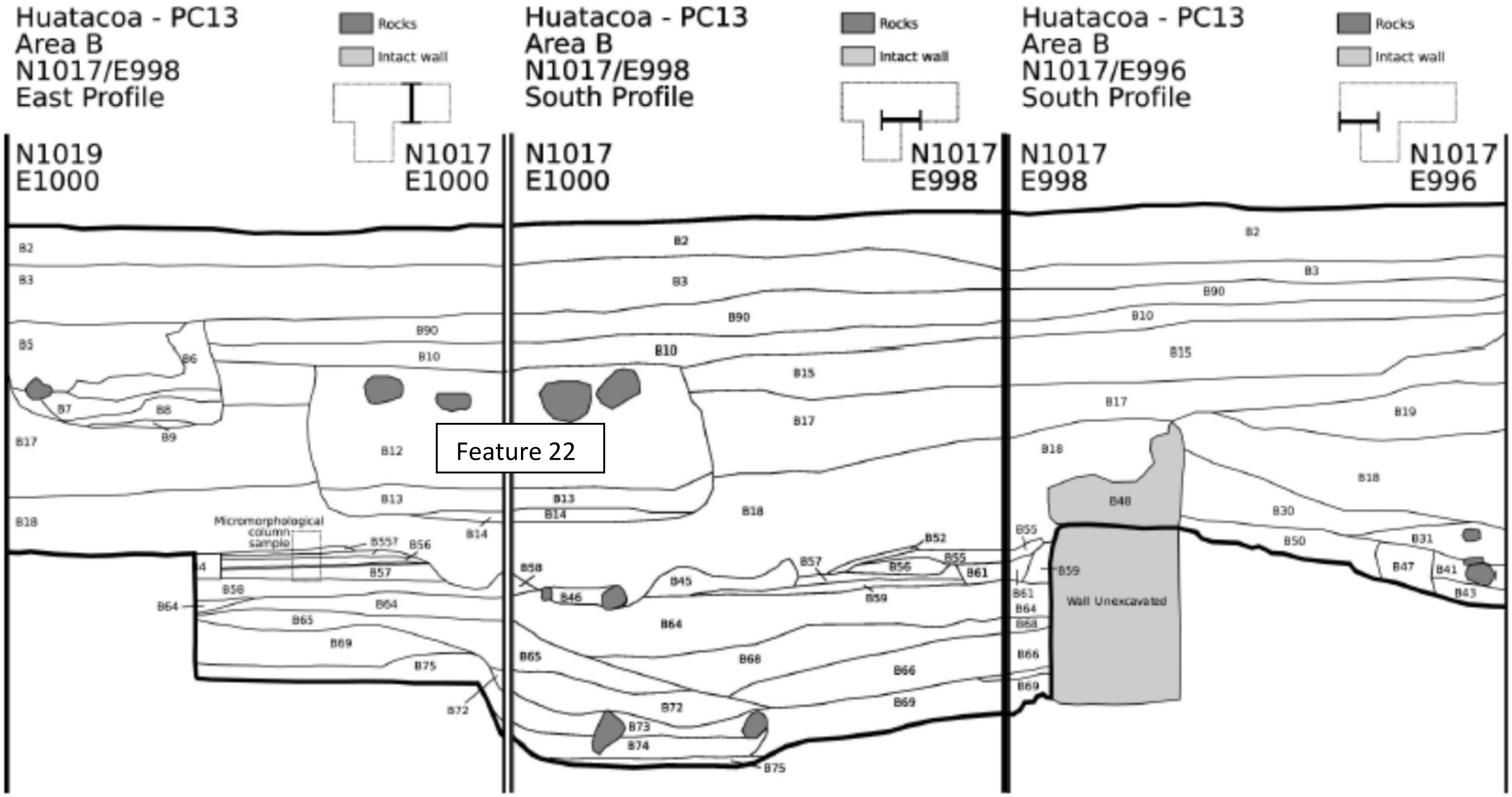


Figure A.2: Huatacoa Area B: East and South Profile Domestic Area (Cohen 2010:Figure 5.2)

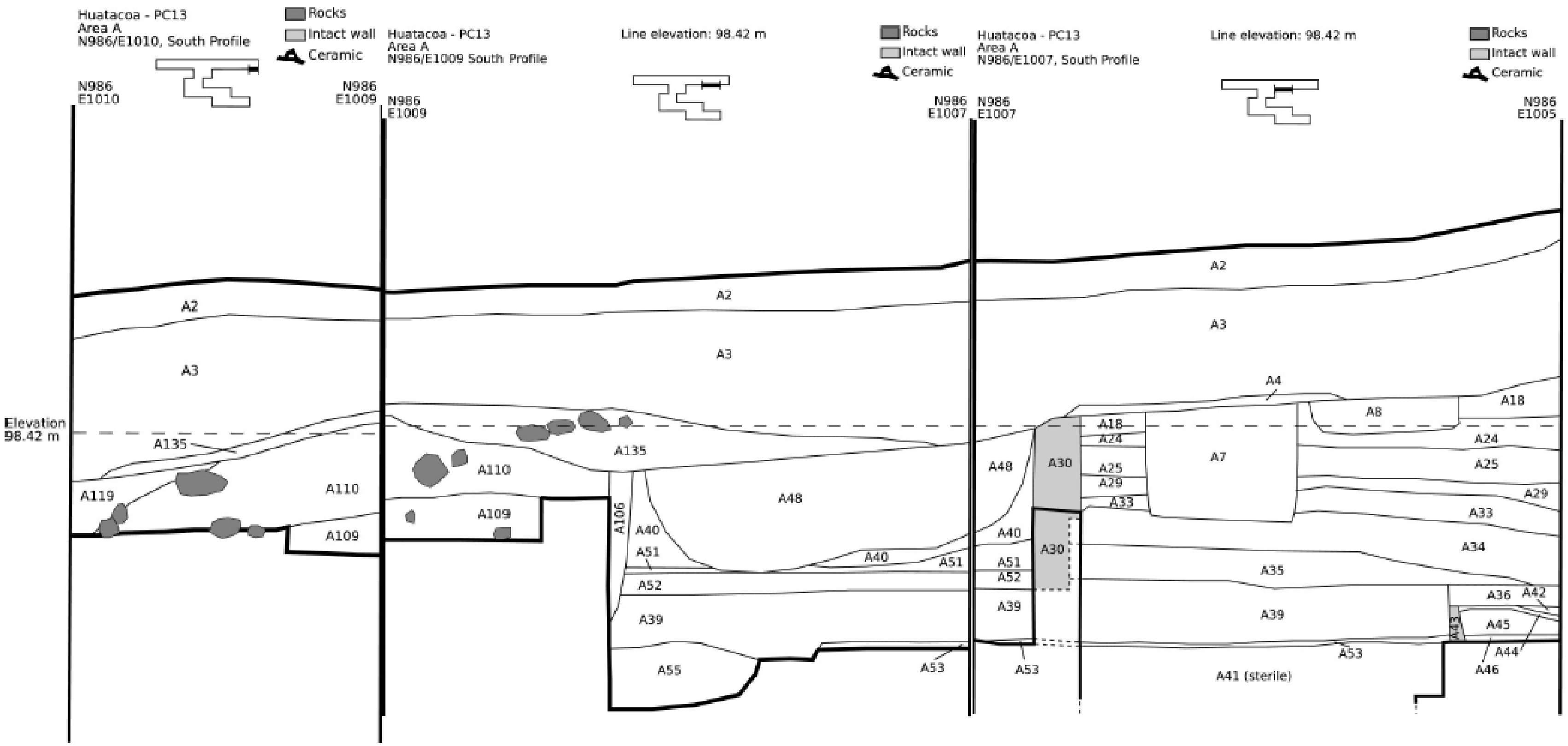


Figure A.3: Huatacoa Area A: Eastern Profile of Qaluyu Sunken Courts (Cohen 2010:Figure 6.1)

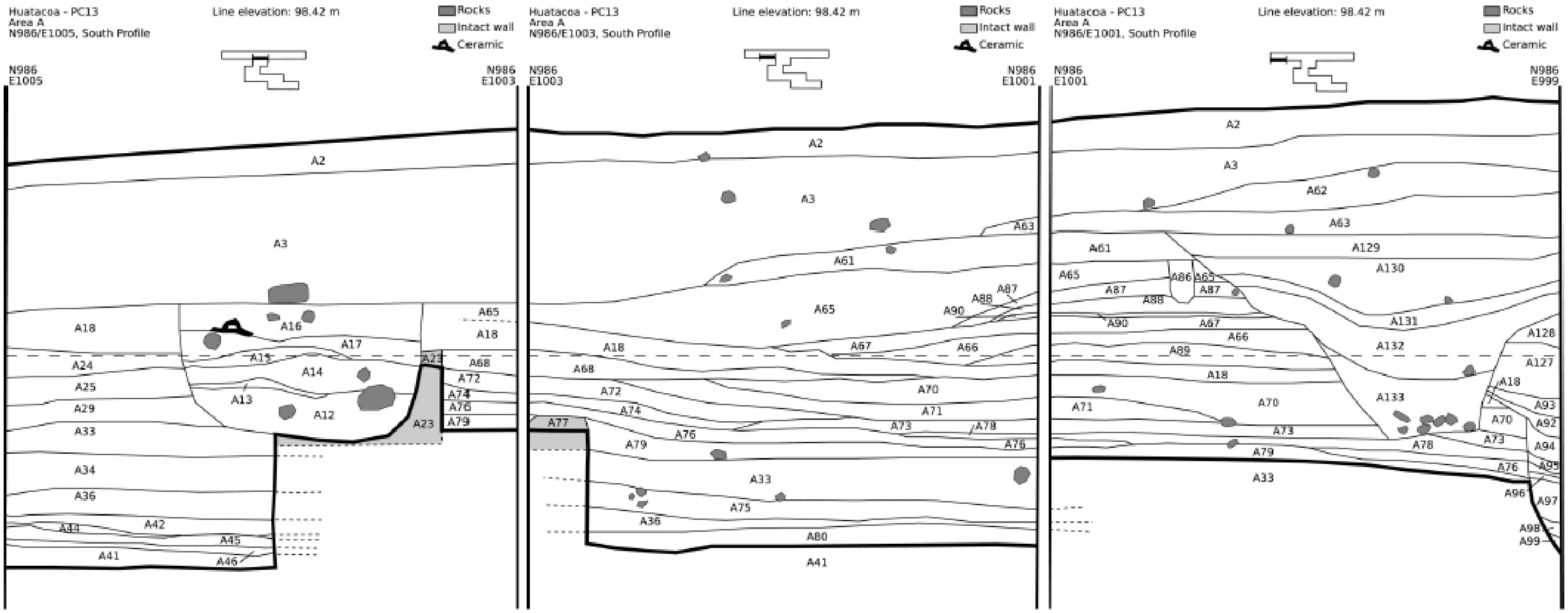


Figure A.4: Huatacoa Area A: Western Profile of Qaluyu Sunken Courts (Cohen 2010:Figure 6.1)

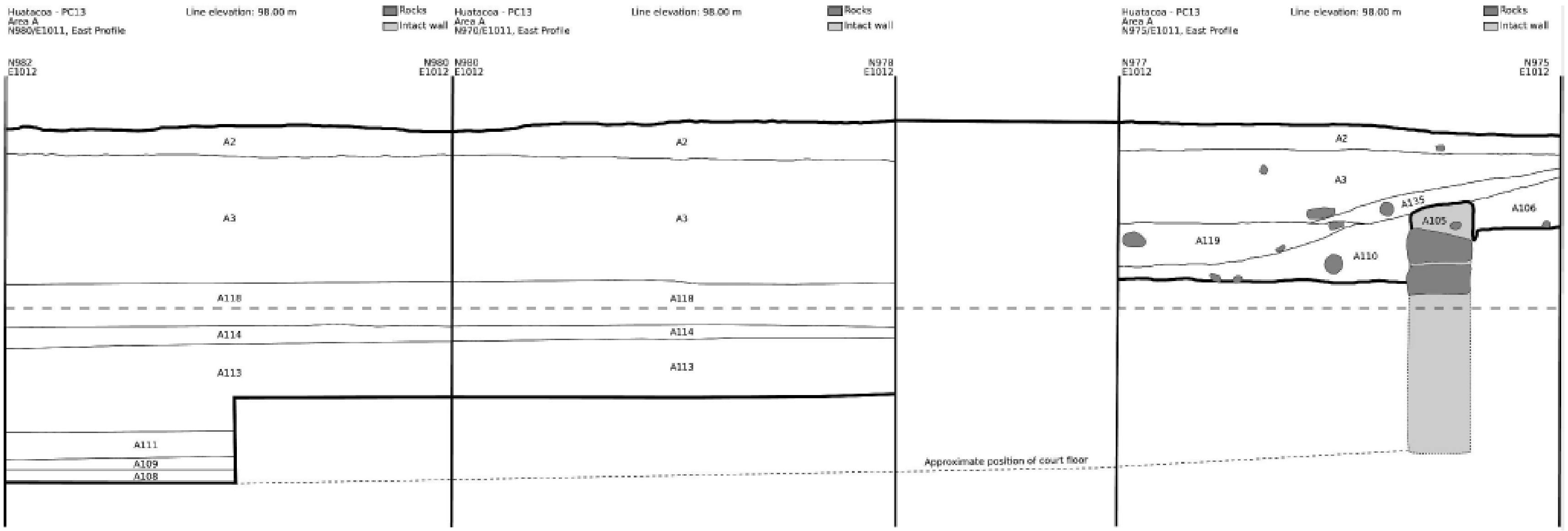


Figure A.5: Huatacoa Area A: Eastern Profile of Pukara Sunken Court (Cohen 2010:Figure 6.40)

Table A.2 - Huatacoa Contexts Analyzed by Occupation

Area A: Occupation Stratum	**Events**
A1: EQ Plaza	A45, A80
A2: EQ Court	A26, A36, A42-A44, A55
A3: LQ First Court	A23-A25, A28-A29, A33-A35, A64, A71, A73, A75, A100-A103 A136-A139, A142-A143, A146-A147, A158, A165, A170, A174-A175, A177 -A182, A184, A186, A191, A201, A206
A5: Pukara Court	A12-A17, A48, A50, A59-A63, A65, A67, A82-A83, A88, A90, A92-A99, A106, A108, A126-A128, A130-A134
Area B: Occupation Stratum	**Events**
B1 EQ Pithouse	B59, B62-B70, B72-B74, B87
B2: EQ Adobe House	B45-B46, B50, B52, B54-B58, B61, B83, B85, B89, B101, B103
B3: EQ Above House	B18, B19, B20, B31, B41, B42, B43, B81, B98, B100
B4: LQ Midden	B17
B5: Pukara Stratum	B10, B12-15

Appendix B: Metric Tables and Figures

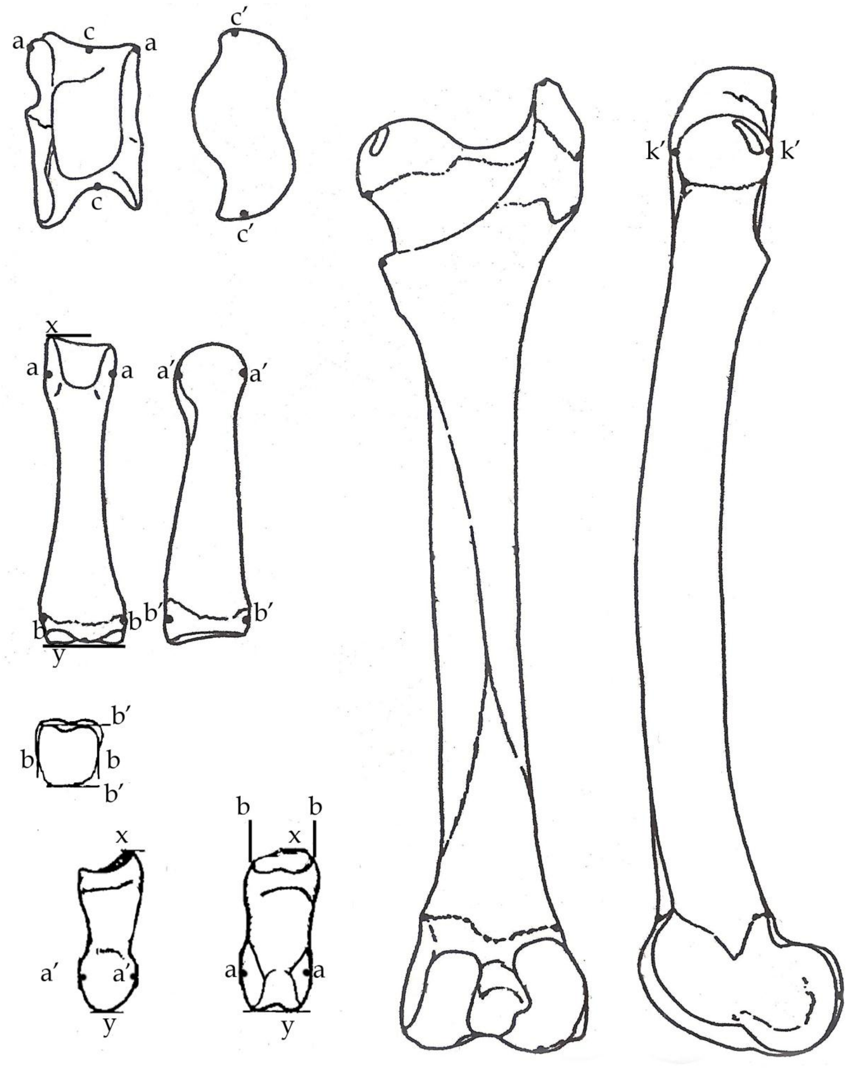
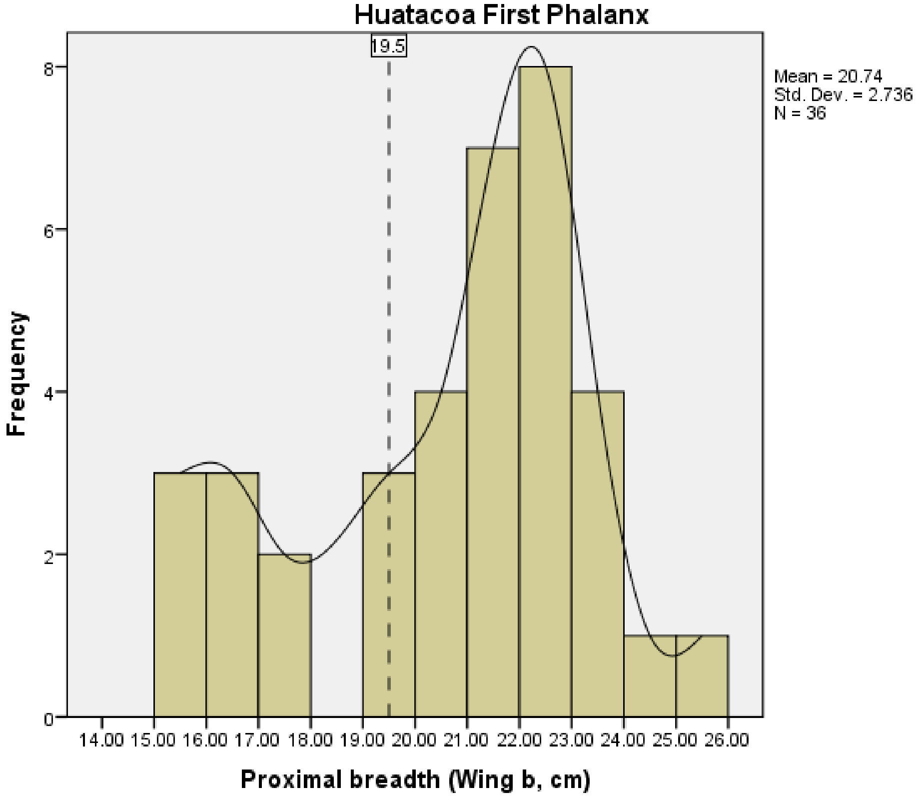
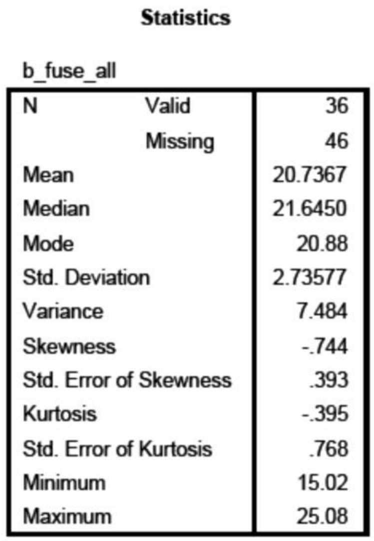


Figure B-1: Measurements Used in Present Study

**<u>Note</u>: Images modified from Wing (1972: Figure 2), Kent (1982: Figure 151)
First Phalanx Wing xy modified to reflect Kent 1 approach. Metrics correspond to equivalents, albeit differentially designated, by Kent (except for Wing's astragalus).**





Statistics

b_fuse_all

N	Valid	36
	Missing	46
Mean		20.7367
Median		21.6450
Mode		20.88
Std. Deviation		2.73577
Variance		7.484
Skewness		-.744
Std. Error of Skewness		.393
Kurtosis		-.395
Std. Error of Kurtosis		.768
Minimum		15.02
Maximum		25.08

Figure B-2: Huatacoa First Phalanx (Wing b)

Table B-1: Huatacoa Univariate Camelidd Metric Data Summary (Continued next page)

Bone	Metric Code[1]	N	Dec. Rule	Small Camelids				S_x	CV	Large Camelids				S_x	CV
				N	X	Min	Max			N	X	Min	Max		
Cunieform	Length (A)	6	25.0	1	23.5700	23.57	23.57	-	-	5	27.9580	25.72	32.84	3.08346	**10.04**
	Greatest W (B)	6	16.5	1	16.4700	16.47	16.47	-	-	5	20.3840	17.30	22.94	2.02167	**9.92**
	Narrow W (C)	6	11.0	-	-	-	-	-	-	6	16.1650	12.78	19.25	2.12747	**13.16**
Lunar	Length (A)	8	18.0	-	-	-	-	-	-	8	22.1488	19.24	26.42	2.34098	**10.57**
	Width (B)	9	17.0	-	-	-	-	-	-	9	22.0133	20.11	23.56	1.12632	5.12
	Depth (C)	9	11.0	-	-	-	-	-	-	9	13.3511	11.13	14.28	1.09376	**8.19**
Scaphoid	Length (A)	7	22.0	1	19.0700	19.07	19.07	-	-	6	26.1683	22.37	28.20	2.39118	**9.14**
	Greatest H (B)	7	18.0	3	15.4333	13.40	17.46	2.03001	**13.15**	4	19.5300	18.06	21.16	1.38509	7.09
	Least H (C)	7	14.0	3	11.2400	8.87	15.12	2.29464	**20.41**	4	14.6625	14.12	15.12	0.43022	2.93
Unciform	Length (A)	7	28.0	-	-	-	-	-	-	7	30.5486	28.08	35.44	2.69774	**8.83**
	Width (B)	8	19.0	-	-	-	-	-	-	8	22.1863	20.87	24.22	1.02763	4.63
Navicular	Length (A)	13	26.0	8	23.6012	19.73	25.77	2.10325	**8.91**	7	28.8140	26.46	30.44	1.53420	5.32
	Width (B)	13	17.0	7	14.5300	11.52	16.11	1.54874	**10.66**	6	18.3617	17.41	19.71	1.06612	5.81
Cuboid	Length (B)	19	31.0	8	27.9950	25.16	30.83	2.16089	**7.72**	11	35.0082	31.63	37.26	1.76276	5.03
Astragalus	Width (a)	15	25.4	2	22.6400	22.16	23.12	0.67882	3.00	13	29.1915	25.50	33.42	2.12309	7.27
	Short L (c)	13	30.8	3	28.3467	26.27	29.50	1.80212	6.36	10	35.0830	32.52	39.18	2.07519	5.91
	Length (c’)	12	41.1	2	36.7950	35.63	37.96	1.64756	4.48	10	45.7550	42.42	49.99	2.46634	5.39
Calcaneus	Length (xy)	2	83.0	2	103.940	101.92	105.96	2.85671	2.79	0	-	-	-	-	-
	Depth (a)	12	39.1	4	35.3275	33.51	47.26	2.24280	6.35	8	41.5838	34.14	47.26	4.38251	**10.54**
	Width (b’)	12	26.0	3	23.6433	21.79	24.78	1.61871	6.84	9	32.3544	26.26	38.85	1.67196	5.17
Lat Mal.	Length (A)	7	22.0	2	20.8800	20.83	20.93	0.07071	0.34	5	25.4340	23.97	26.40	0.98343	3.87
	Width (B)	7	18.5	3	16.9233	15.96	18.36	1.26808	**7.49**	4	20.4700	19.24	22.48	1.48068	**7.23**
1st Phalanx	Length (xy)	15	66.5	6	58.9900	47.68	65.86	6.31377	**10.70**	9	73.3244	66.35	80.37	5.03251	6.86
forelimb	Length (xy)	10	66.5	3	64.1900	60.36	66.35	3.32591	5.18	7	73.7529	68.44	80.37	4.77627	6.48
hindlimb	Length (xy)	5	66.5	4	56.9300	47.68	63.47	6.66509	**11.71**	1	77.3000	77.30	77.30	-	-
“	Prox Width (b)	48	19.5	18	16.7528	14.23	19.03	1.30436	**7.78**	30	21.9230	19.71	25.08	1.37216	6.26
forelimb	Prox Width (b)	14	19.5	2	17.9400	16.85	19.03	1.54149	**8.59**	12	21.9492	19.71	25.08	1.62220	7.39
hindlimb	Prox Width (b)	8	19.5	5	16.6520	15.02	18.19	1.24421	7.47	3	22.2367	21.67	22.54	0.49116	2.21
“	Prox Depth (b’)	48	18.8	17	16.0471	13.66	18.71	1.56530	**9.75**	16	20.5731	18.98	22.53	1.15329	5.60
forelimb	Prox Depth (b’)	13	18.8	3	17.6733	16.24	18.71	1.28189	7.25	10	20.3950	19.12	22.53	1.18553	5.81
hindlimb	Prox Depth (b’)	8	18.8	5	15.5100	13.66	16.78	1.26353	**8.15**	3	21.5067	20.39	22.13	0.96924	4.51

Bone	Metric Code[1]	N	Dec. Rule	Small Camelids				S_x	CV	Large Camelids				S_x	CV
				N	X	Min	Max			N	X	Min	Max		
Scapula	Coronoid Ht (c)	5	47.0	1	41.1100	41.11	41.11	-	-	4	56.2075	53.08	58.57	2.5648	4.56
	Glenoid Ht (d)	12	32.5	5	27.8000	20.77	32.15	4.36763	**13.58**	7	35.8714	32.78	38.35	2.10755	5.87
Humerus	Dist Width (e)	4	43.6	2	38.5600	38.54	38.58	0.02828	0.07	2	47.1600	45.71	48.61	2.05061	4.35
	Dist Depth (h)	11	39.6	4	35.5425	32.20	39.00	2.78099	**7.82**	7	42.7886	40.20	47.01	2.69013	6.29
Radio-ulna	Prox Width (c’)	5	40.7	2	34.4350	34.40	34.47	0.03500	0.10	3	48.6200	47.83	49.53	0.49440	1.76
	W SI Notch (b’)	11	15.4	6	14.0633	13.30	15.14	0.66277	4.71	5	17.6720	16.20	18.77	1.13131	6.40
	Dist Width (f’)	6	41.5	3	29.9200	24.47	33.98	4.90501	**16.39**	3	47.1333	41.82	54.49	6.57751	**13.95**
	Dist Depth (f)	6	30.0	5	34.5680	30.73	37.55	2.44710	7.08	1	25.7100	25.71	25.71	-	-
Metacarpal	Prox Depth (a)	5	24.0	3	20.8867	20.59	21.19	0.30006	1.44	2	31.8150	25.47	38.16	8.97319	**28.20**
	Prox Width (a’)	4	31.6	3	30.0200	29.32	30.87	0.78581	2.62	1	35.2000	35.20	35.20	-	-
	Dist Depth (e)	6	20.0	2	16.0700	15.84	16.30	0.32527	2.02	4	22.5150	21.58	23.36	0.87793	3.90
	Dist Width (e’)	6	40.0	2	35.8500	35.34	36.36	0.72125	2.01	4	47.9250	44.70	49.46	2.24423	4.68
Femur	Head (k’)	1	29.0	1	28.1400	28.14	28.14	-	-	0	-	-	-	-	-
Tibia	Distal W (e)	13	39.8	5	33.2180	29.42	38.44	4.46007	**13.43**	8	45.0763	40.00	48.56	3.01124	6.68
	Distal D (e’)	9	29.5	3	24.4400	23.55	26.05	1.39689	5.71	6	32.3633	29.79	35.76	2.56091	**7.91**
Metatarsal	Prox Depth (a)	6	28.5	3	25.5600	23.50	27.46	1.98484	**7.76**	3	32.4200	30.05	34.46	2.22344	6.86
	Prox Width (a’)	9	31.0	6	27.3067	24.80	29.43	1.94108	7.11	3	35.3100	31.48	37.96	3.39734	**9.62**
	Prox Facet (h)	11	15.5	6	13.8717	10.94	15.02	1.56562	**11.29**	5	17.6640	15.62	19.35	1.82392	**10.32**

<u>Note (Abbreviations)</u>:

Dec. Rule = decision rule (value used to define small vs. large camelids), X = mean, Min = minimum measurement, Max = maximum measurement, S_x = standard deviation, CV = coefficient of variation (Miller and Burger 1995)

<u>Metric codes</u>: Elizabeth Wing metric = lower case letter, Katherine Moore metric = capitalized letter

Table B-2: Pukara Univariate Camelid Metric Data Summary (Continued next page)

Bone	Metric	N	Dec. Rule	Small Camelids				S_x	CV	Large Camelids				S_x	CV
				N	X	Min	Max			N	X	Min	Max		
Scaphoid	Length (A)	3	22.0	0	-	-	-	-	-	3	25.8033	24.72	27.69	1.63989	6.35
	Greatest H (B)	3	18.0	2	16.9150	16.46	17.37	0.8559	5.06	1	18.1700	18.17	18.17	-	-
	Least H (C)	3	14.0	2	12.7650	12.10	13.43	0.94045	**7.37**	1	16.3100	16.31	16.31	-	-
Unciform	Length (A)	4	28.0	3	25.3467	23.44	26.45	1.65802	6.54	1	29.2800	29.28	29.28	-	-
	Width (B)	5	19.0	1	16.2100	16.21	16.21	-	-	4	20.9800	19.53	22.49	1.39805	6.66
Navicular	Length (A)	13	26.0	8	23.6012	19.73	25.77	2.10325	**8.91**	7	28.8140	26.46	30.44	1.53420	5.32
	Width (B)	13	17.0	7	14.5300	11.52	16.11	1.54874	**10.66**	6	18.3617	17.41	19.71	1.06612	5.81
Cuboid	Length (B)	9	31.0	3	32.3933	32.12	32.85	0.39804	1.23	6	29.2283	26.75	30.63	1.59779	5.47
Astragalus	Width (a)	15	25.4	2	22.6400	22.16	23.12	0.67882	3.00	13	29.1915	25.50	33.42	2.12309	**7.27**
	Short L (c)	13	30.8	3	28.3467	26.27	29.50	1.80212	6.36	10	35.0830	32.52	39.18	2.07519	5.91
	Length (c’)	12	41.1	2	36.7950	35.63	37.96	1.64756	4.48	10	45.7550	42.42	49.99	2.46634	5.39
Calcaneus	Length (xy)	2	83.0			-		-	-	2	87.0300	83.96	90.10	4.34164	4.99
	Depth (a)	2	39.1	1	39.2600	39.26	39.26	-	-	1	36.9000	36.90	36.90	-	-
	Width (b’)	2	26.0	1	21.7300	21.73	21.73	-	-	1	26.5900	26.59	26.59	-	-
Lat. Mal.	Length (A)	5	22.0	1	20.7400	20.74	20.74	-	-	4	24.2000	22.63	25.97	1.38480	5.72
	Width (B)	6	18.5	4	17.4583	13.32	19.84	2.37257	**13.59**	2	19.7350	19.63	19.84	0.14849	0.75
1st Phalanx	Length (xy)	5	66.5	4	61.1625	59.25	64.66	2.54533	4.16	1	67.6300	67.63	67.63	-	-
forelimb	Length (xy)	2	66.5	2	63.0500	61.44	64.66	2.27688	3.61	0	-	-	-	-	-
hindlimb	Length (xy)	3	66.5	2	59.2750	59.25	59.30	0.03536	0.06	1	67.6300	67.63	67.63	-	-
“	Prox Width (b)	14	19.5	5	17.8300	16.53	19.47	1.31021	7.35	9	21.0267	19.90	22.78	0.81956	3.90
forelimb	Prox Width (b)	2	19.5	0	-	-	-	-	-	2	20.9200	20.48	21.36	0.62225	2.97
hindlimb	Prox Width (b)	5	19.5	4	17.4200	16.53	18.98	1.08083	6.20	1	19.9000	19.90	19.90	-	-
“	Prox Depth (b’)	22	18.8	13	17.2838	14.94	18.80	1.25430	7.26	9	20.4100	19.16	23.91	1.42362	6.97
forelimb	Prox Depth (b’)	3	18.8	0	-	-	-	-	-	3	20.4033	19.45	21.85	1.27379	6.24
hindlimb	Prox Depth (b’)	5	18.8	5	16.5800	15.64	17.92	0.93688	5.65	0	-	-	-	-	-
Scapula	Coronoid Ht (c)	10	47.0	5	41.2240	39.07	42.90	1.41811	3.44	5	54.3780	51.66	58.64	2.88104	1.84
	Glenoid Ht (d)	20	29.1	13	28.5785	21.50	32.05	3.04591	**10.66**	6	34.3767	32.86	36.24	1.21260	3.53
Humerus	Dist Width (e)	4	43.6	2	38.5600	38.54	38.58	0.02828	0.073	2	47.1600	45.71	48.61	2.05061	4.35
	Dist Depth (h)	11	39.5	4	35.5425	32.20	39.00	2.78099	**7.82**	7	42.7886	40.20	47.01	2.69013	6.29
Radio-ulna	Prox Width (c’)	6	40.7	2	37.9900	37.42	38.56	0.80610	2.12	4	43.8675	42.03	47.37	1.24253	2.83
	W SI Notch (b’)	11	15.4	2	14.1350	13.34	14.93	1.12430	**7.95**	9	16.3211	15.44	18.18	0.92853	5.69

Bone	Metric	N	Dec. Rule	Small Camelids				S $_x$	CV	Large Camelids				S $_x$	CV
				N	X	Min	Max			N	X	Min	Max		
Radio-ulna	Dist Width (f')	3	41.5	-				-	-	3	45.3333	42.86	49.89	3.95100	**8.71**
	Dist Depth (f)	2	30.0	2	28.6200	27.74	29.50	1.24451	4.35	0	-	-	-	-	-
Metacarpal	Prox Depth (a)	5	24.0	2	22.6350	22.20	23.07	0.61518	2.72	0	-	-	-	-	-
	Prox Width (a’)	4	31.6	0	-	-	-	-	-	4	35.3975	31.79	38.18	2.65546	**7.50**
Femur	Head (k’)	10	29.0	3	26.9367	26.37	27.60	0.62067	2.30	7	31.2171	29.50	32.42	1.22297	3.92
Tibia	Distal Width (e)	9	39.8	6	35.6833	30.58	39.57	3.35220	**9.39**	3	42.0567	40.86	44.05	1.73782	4.13
	Distal Depth (e’)	8	29.5	8	26.7825	24.77	28.94	1.69063	6.31	0	-	-	-	-	-
Metatarsal	Prox Depth (a)	4	28.5	3	26.1133	24.22	27.43	1.68090	6.44	1	30.9500	30.95	30.95	-	-
	Prox Width (a’)	13	31.0	5	29.3220	25.56	30.94	2.22984	**7.60**	8	33.0525	31.16	35.76	1.81164	5.48
	Distal Depth (e)	5	20.0	3	18.3767	17.46	19.31	0.92511	5.03	2	21.8550	21.74	21.97	0.16263	0.74
	Distal Width (e’)	3	40.0	1	34.3400	34.30	34.30	-	-	2	44.2350	41.18	47.29	4.32042	**9.77**
	Prox Facet (h)	13	15.5	10	14.2910	13.67	15.29	0.53931	3.77	3	17.1633	15.68	19.50	2.04798	**11.93**

Note (Abbreviations):

Dec. Rule = decision rule (value used to define small vs. large camelids), X = mean, Min = minimum measurement, Max = maximum measurement, S_x = standard deviation, CV = coefficient of variation (Miller and Burger 1995)

Metric codes: Elizabeth Wing metric = lower case letter, Katherine Moore metric = capitalized letter

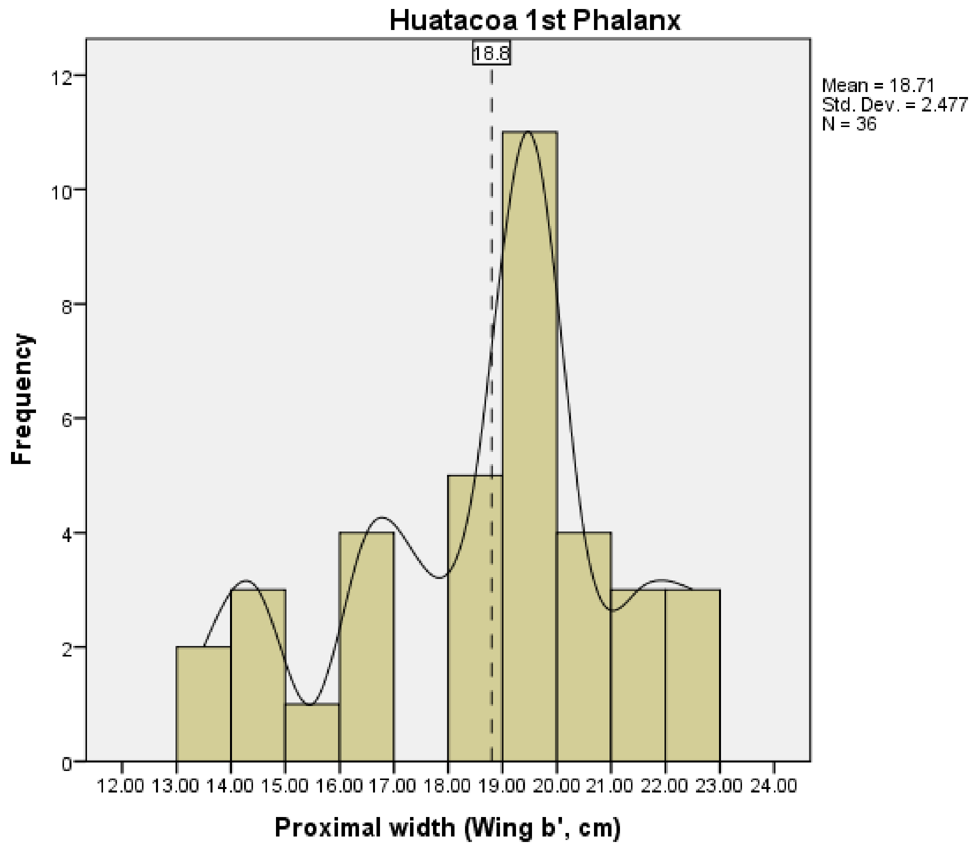
Table B-2: Modern Camelid 1st Phalanx, Proximal Depth (Wing b)

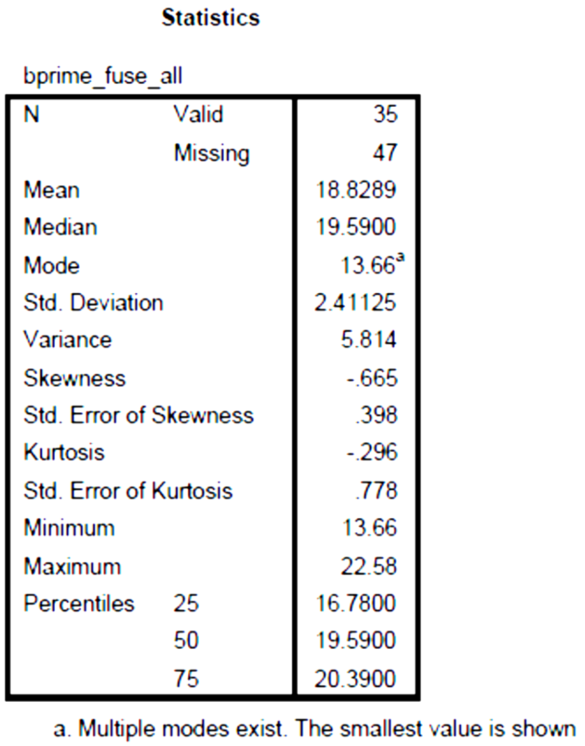
Sample	N	Mean	SD	Range	V
Alpaca, comparative	54	17.68	1.34	16.30 – 19.80	7.60
Kent forelimb mean	80	17.60			6.35
Kent hindlimb mean	84	16.90			6.74
Vicuña, comparative	16	15.50	0.87	15.00 – 16.00	5.60
Kent forelimb mean	28	15.53			3.98
Kent hindlimb mean	12	15.30			4.11
Llama, comparative	22	21.30	1.19	20.80 – 21.90	5.60
Kent forelimb mean	28	22.16			4.30
Kent hindlimb mean	36	20.33			2.94
Guanaco, comparative [1]	9	20.63	1.17	18.67 – 22.20	1.36
Izeta forelimb mean	5	21.33	0.98	19.65 – 22.20	0.96
Izeta hindlimb mean	4	19.77	0.73	18.67 – 20.20	0.54

Note: Alpaca, vicuña, and llama metrics (from La Raya collection) from Miller (2003:Table 1.4); fore- and hindlimb means from Kent (1982: Appendix IV.2).

[1] Argentine guanacos metrics compiled from Izeta et al. (2009).

Note: 1) guanaco hindlimb phalanx range falls below decision rule and 2) overlaps with upper alpaca size range. Forelimb phalanx range overlaps with the low values of modern llamas.




Statistics

bprime_fuse_all

N	Valid	35
	Missing	47
Mean		18.8289
Median		19.5900
Mode		13.66[a]
Std. Deviation		2.41125
Variance		5.814
Skewness		-.665
Std. Error of Skewness		.398
Kurtosis		-.296
Std. Error of Kurtosis		.778
Minimum		13.66
Maximum		22.58
Percentiles	25	16.7800
	50	19.5900
	75	20.3900

a. Multiple modes exist. The smallest value is shown

Figure B-3: Huatacoa First Phalanx (Wing b')

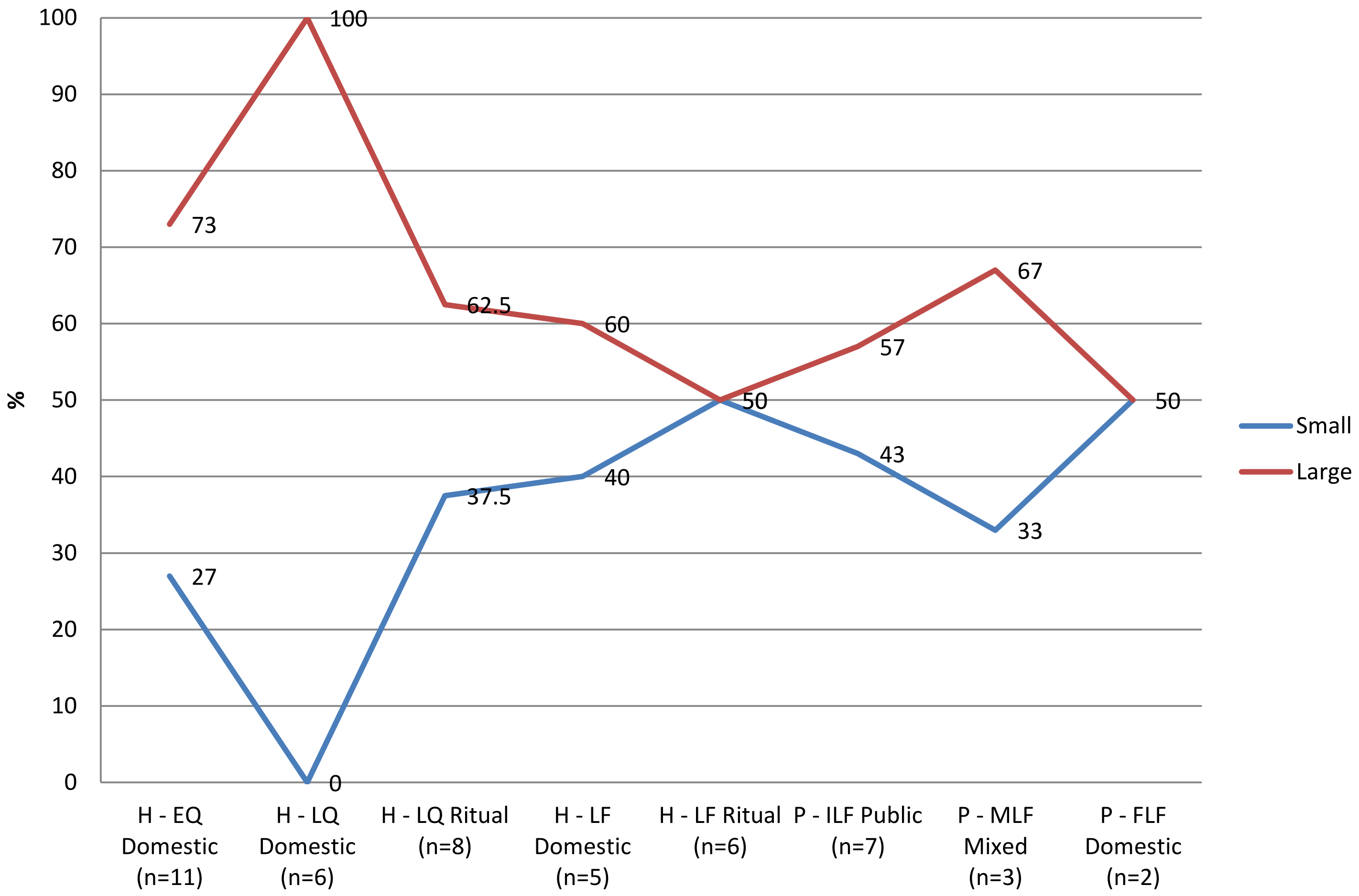
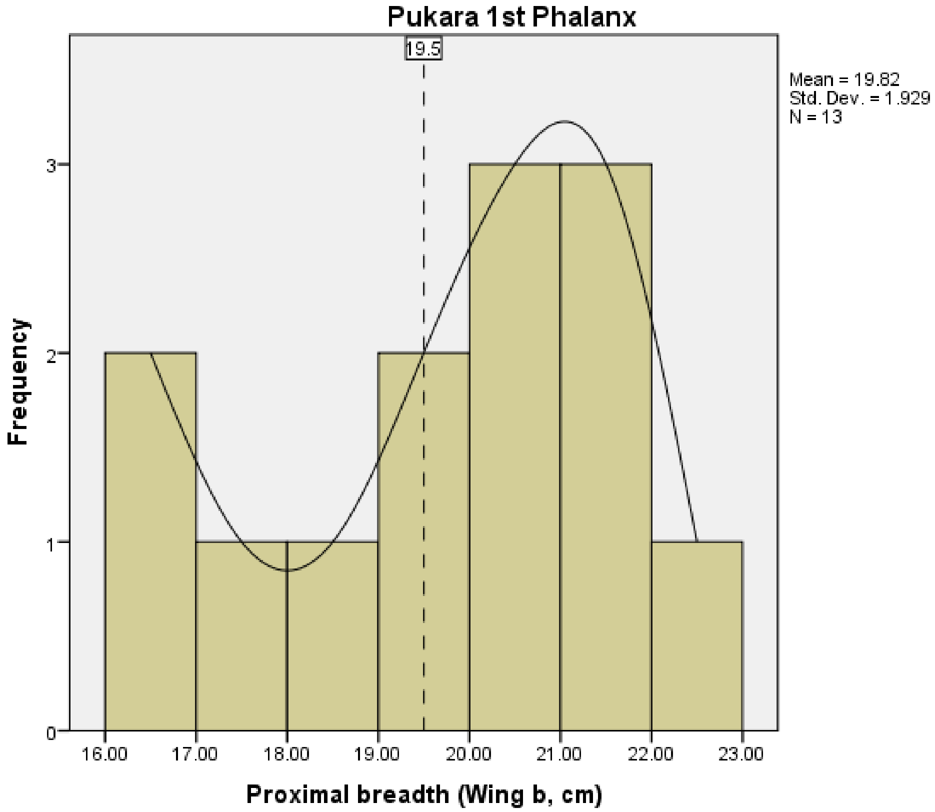


Figure B-4: Pukara Valley Phalanx (Wing b) – Proportions of Small vs. Large Camelids by Time and Context

<u>Note</u>: Pukara LF sample overall: Large form (n=7, 58%) and Small form (n=5, 42%)



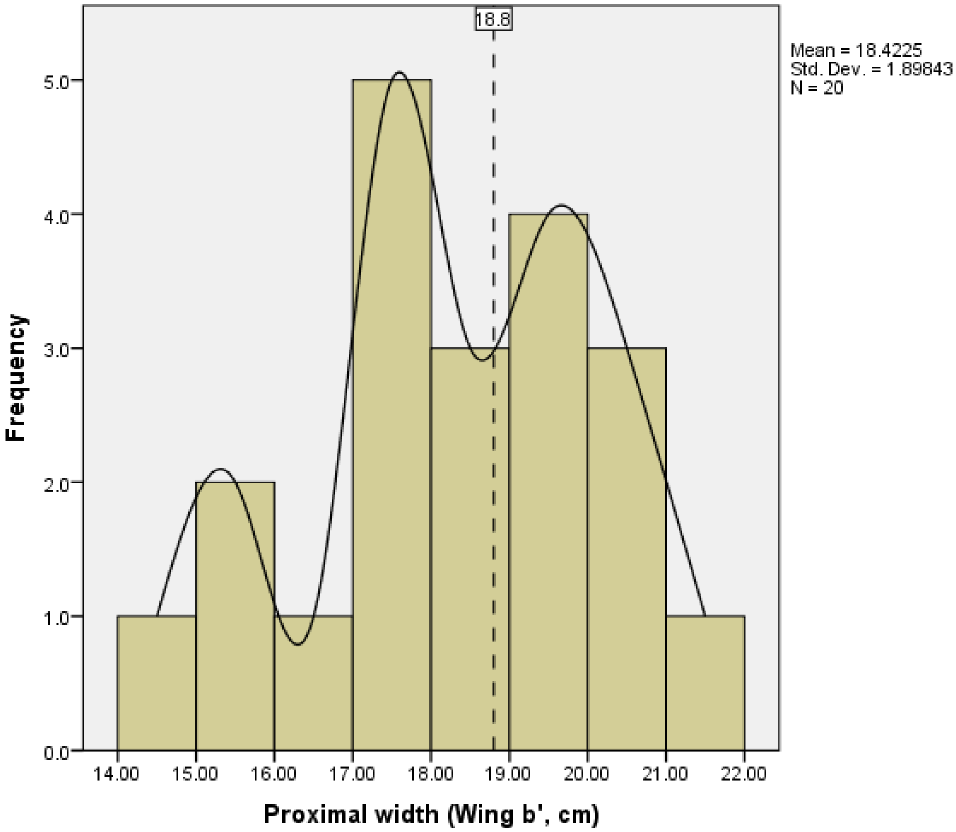
Statistics

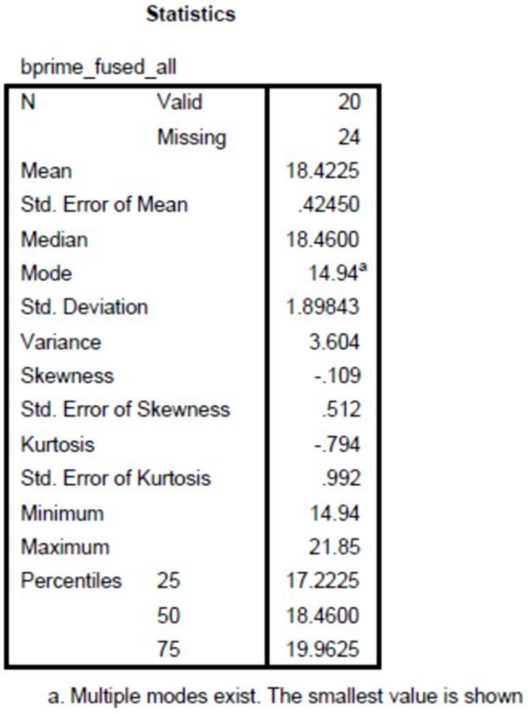
b_fuse_all

N	Valid	13
	Missing	31
Mean		19.8185
Std. Error of Mean		.53499
Median		20.3200
Mode		16.53[a]
Std. Deviation		1.92894
Variance		3.721
Skewness		-.520
Std. Error of Skewness		.616
Kurtosis		-.644
Std. Error of Kurtosis		1.191
Minimum		16.53
Maximum		22.78
Percentiles	25	18.1150
	50	20.3200
	75	21.2500

a. Multiple modes exist. The smallest value is shown

Figure B-5: Pukara First Phalanx (Wing b)



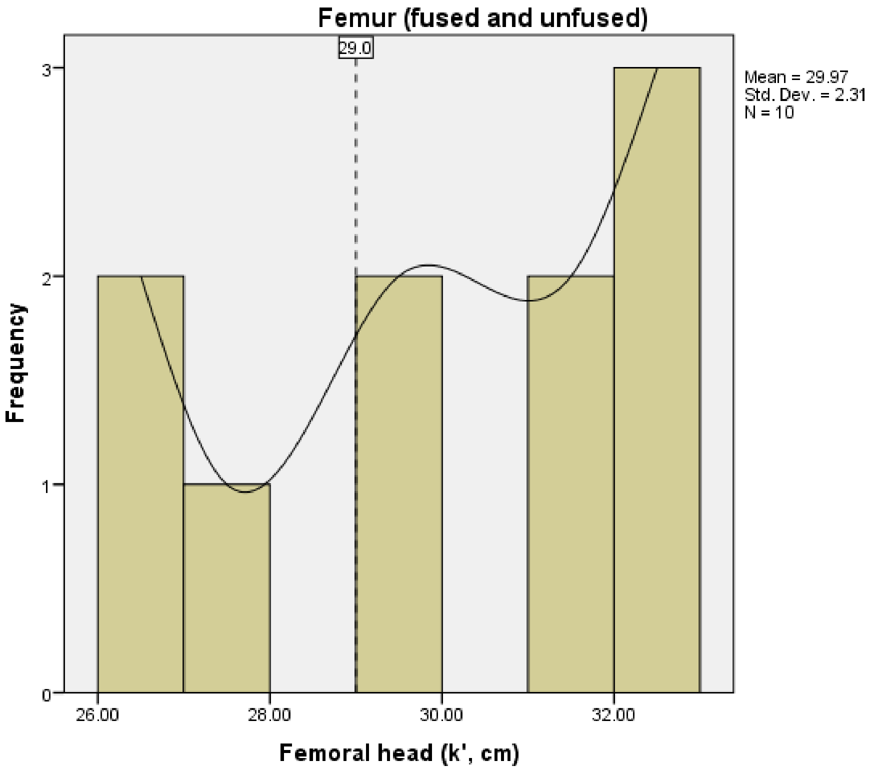

Statistics

bprime_fused_all

N	Valid	20
	Missing	24
Mean		18.4225
Std. Error of Mean		.42450
Median		18.4600
Mode		14.94[a]
Std. Deviation		1.89843
Variance		3.604
Skewness		-.109
Std. Error of Skewness		.512
Kurtosis		-.794
Std. Error of Kurtosis		.992
Minimum		14.94
Maximum		21.85
Percentiles	25	17.2225
	50	18.4600
	75	19.9625

a. Multiple modes exist. The smallest value is shown

Figure B-5: Pukara First Phalanx (Wing b')



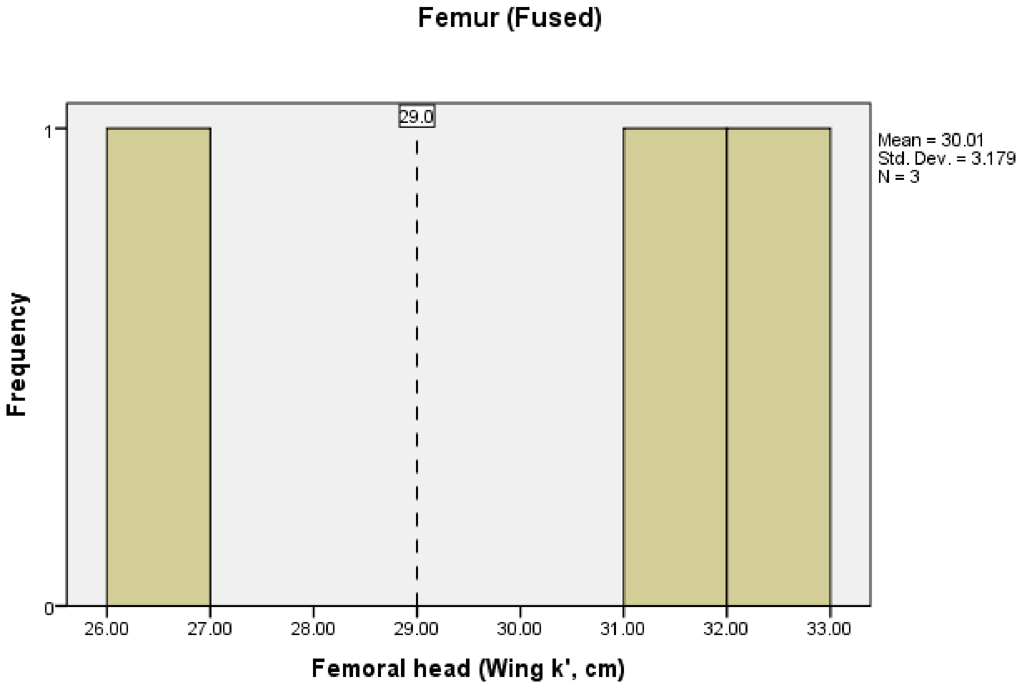
Note: Kent (1982: Appendix IV.2) mean La Raya values (vicuña=25.07 cm, alpaca= 26.66 cm, llama= 31.72 cm

Statistics

		Wing_kprime	Wing_kprime_ fuse	Wing_kprime_ unfused
N	Valid	10	3	7
	Missing	0	7	3
Mean		29.9680	30.0133	29.9514
Median		30.5200	31.4500	29.8500
Mode		26.37[a]	26.37[a]	26.84[a]
Std. Deviation		2.31009	3.17862	2.14938
Variance		5.337	10.104	4.620
Skewness		-.551	-1.618	-.359
Std. Error of Skewness		.687	1.225	.794
Kurtosis		-1.378		-1.330
Std. Error of Kurtosis		1.334		1.587
Minimum		26.37	26.37	26.84
Maximum		32.42	32.22	32.42

a. Multiple modes exist. The smallest value is shown

Figure B-6: Pukara Femora: Fused and Unfused Specimens (Wing k')



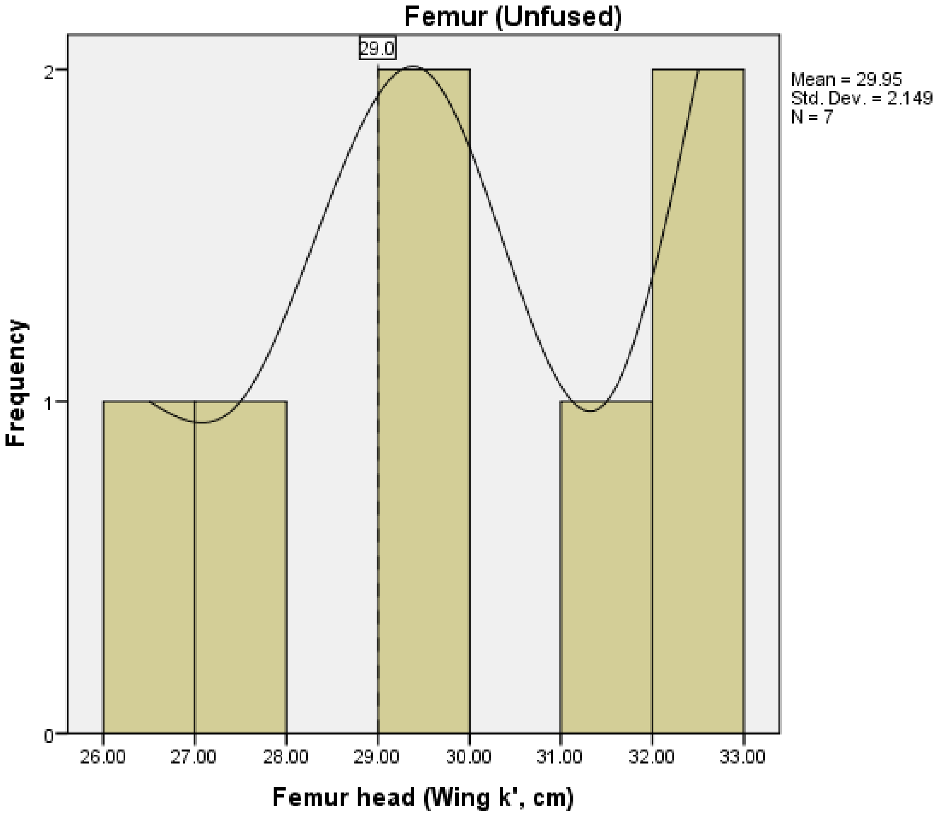


Figure B-6: Pukara Femora: Fused and Unfused Specimens (Wing k' Cont'd)

Table B-4: First Phalanx, Forelimb (FP) and Hindlimb (BP) Multivariate Results

Site	Area / Strata	Cat. #	FP 1V1	FP 1VP2	FP 1PV3	FP 1VP4	FP 1VP5	Guanaco Coef.	Llama Coef.	Alpaca Coef.	Vicuña Coef.t	Diff.	Taxa Assigmed	Miller L/S
P	2 / ILF	2011	64.65	21.64	-	17.66	16.27	250.57	273.38	267.79	253.76	5.59	Llama	L
H	A / LQ	2514	70.54	20.89	19.14	18.13	16.06	278.89	294.19	286.57	279.08	7.62	Llama	L
H	A / LQ	4641	81.79	22.96	20.47	20.06	18.66	369.40	369.99	350.48	344.68	**0.59**	**Llama**	L
H	A / LQ	4713	73.02	21.05	19.62	18.84	16.95	280.06	298.40	290.04	280.62	8.36	Llama	L
H	A / LQ	5174	77.82	23.34	21.33	19.27	18.23	364.11	363.37	344.61	338.00	**0.74**	**Guanaco***	L
H	A / LQ	5328	61.51	16.80	16.07	13.03	13.55	203.83	210.77	223.56	230.34	6.78	Vicuña	S
H	A / LQ	4647	67.77	20.88	18.07	17.80	16.57	250.20	272.32	268.22	256.82	4.10	Llama	L
H	B / LF	2676	73.02	22.73	19.57	18.95	17.78	314.09	325.69	312.20	300.98	11.50	Llama	L
H	B / LF	2677	65.86	22.35	19.99	18.51	17.79	243.39	273.21	266.95	247.16	6.25	Llama	L
H	A / LF	3071	73.46	20.96	19.63	17.61	16.12	316.42	318.27	308.54	307.45	**1.85**	**Llama**	L
H	A / LF	3307	80.89	23.49	22.53	20.20	19.43	361.68	365.98	346.70	337.19	4.30	Llama	L
H	A / LF	3407	82.02	25.08	22.10	20.14	19.33	421.60	410.75	383.73	377.28	10.85	Guanaco*	L
H	B / LF	3956	66.68	19.96	18.71	17.12	14.98	250.49	268.07	265.18	259.04	2.89	Llama	L

Site	Area/ Strata	Cat.	BP 1V177	BP 1V178	BP 1V179	BP 1V180	BP 1V181	Guanaco Coef.	Llama Coef.	Alpaca Coef.	Vicuña Coef.	Diff.	Taxa Assigmed	Miller L/S
P	3/ILF	16.1	60.56	16.92	15.96	14.45	13.32	315.47	321.45	323.86	324.91	**1.05**	**Vicuña**	**S**
P	2/MLF	1339	60.19	16.53	16.23	14.35	13.89	297.89	306.50	311.90	311.65	**0.25**	**Alpaca**	**S**
P	2 /MLF	1705	68.00	19.90	17.92	15.89	14.58	418.47	412.88	402.31	400.96	5.588	Guanaco*	L
H	B / LF	1824	64.90	21.67	16.78	16.37	15.37	359.81	362.67	305.66	305.40	2.86	Llama	L
H	A / LF	1423	67.42	15.87	14.80	13.32	12.74	306.24	306.45.	311.25	326.30	15.05	Vicuña	S
H	A / LF	3103	48.73	15.02	13.66	12.40	12.47	153.53	177.87	198.67	193.87	4.80	Alpaca[1]	S
H	A / LF	3308	60.00	17.38	16.24	15.06	14.23	306.55	315.90	318.63	316.71	1.92	Alpaca	S
H	A / LF	4565	54.79	15.20	14.63	13.33	12.60	234.66	249.63	261.88	262.63	**0.75**	**Vicuña**	**S**
H	A / LF	4992	72.64	22.50	20.39	18.96	17.51	503.17	495.35	473.21	464.96	7.82	Guanaco*	L

Table B-5: Second Phalanx Multivariate Results

Site	Area/ Strata	Cat.	P2V6	P2V7	P2V8	P2V9	P2V10	Guanaco Coef.	Llama Coef.	Alpaca Coef.	Vicuña Coef.	Diff.	Taxa Assigmed
P	2/ILF	3917	25.93	13.73	12.92	12.79	12.16	98.35	120.83	131.07	124.52	6.55	Alpaca
P	2/MLF	1957	26.92	15.85	14.17	13.95	14.64	147.64	169.83	171.90	160.30	2.07	Alpaca
P	2/MLF	3737	31.95	13.63	14.38	13.63	14.03	104.74	126.65	136.27	129.44	6.83	Alpaca
P	2/MLF	3944	29.62	15.85	14.17	13.95	14.64	147.64	169.83	171.90	160.30	2.07	Alpaca
H	B/EQ	2736	41.67	18.84	14.82	15.36	14.97	204.02	202.99	199.25	201.43	**1.03**	**Guanaco***
H	B/EQ	2787	35.01	17.36	13.52	15.49	14.35	216.65	221.56	214.42	210.25	4.91	Llama
H	B/EQ	5119	41.21	19.67	16.31	20.97	18.10	-49.36	26.09	-	-	75.45	Llama
H	B/LQ	93	39.33	19.40	15.76	16.57	14.55	-77.31	1.36	-	-	75.95	Llama
H	A/LQ	2516	35.82	17.43	15.45	16.27	15.19	-73.40	-0.95	-	-	72.45	Llama
H	A/LQ	5246	17.54	15.59	15.59	20.11	16.12	-46.89	20.40	-	-	67.29	Llama
H	A/LQ	4650	37.74		16.43	18.43	14.51	-61.40	11.37			72.77	Llama
H	A/LF	3617	30.80	14.58	12.12	12.40	11.10	154.94	159.03	162.30	165.47	3.17	Vicuña

Pathological Specimens

Figure B-7: Pukara first phalanx# 3213 – Stress, Cargo Markers

Note: Dorsal, Ventro-Proximal Close-up, Medial View

Figure B-9: Pukara first phalanx# 2011 – Stress, Cargo Markers

<u>Note</u>: Dorsal, Medial, and Proximal Views

Figure B-9: Huatacoa Specimen #2122 - 11th Thoracic Vertebra: Osteoarthritis

Note: Lateral, Posterior, Lateral Views – Eburnation, Porosity, Osteophytes

Figure B-10: Pukara Metacarpal - Spavin, Polydactl Specimen?

Note: AnteriorView: Extosis ridge below articular surface.
Dorsal close-up: Polydactyl articular surface. Additional specimen noted in midden deposit fill within abandoned Late Formative Huatacoa sunken court.

Figure B-11: Pukara #504 Rib – Trauma: Healed Fracture

Figure B-12: Pukara Femur #4493 – Trauma, Infection

<u>Note:</u> Anterior, Posterior, Medial Views: Irregular Extoses, Remodeled femoral head (osteoarthritis: eburnated, pitted, grooved)

Figure B-12: Huatacoa first phalanx#2579: Infection

<u>Note</u>: Dorsal, Lateral, Ventral Views: Note sinus drainage canal on lateral view.

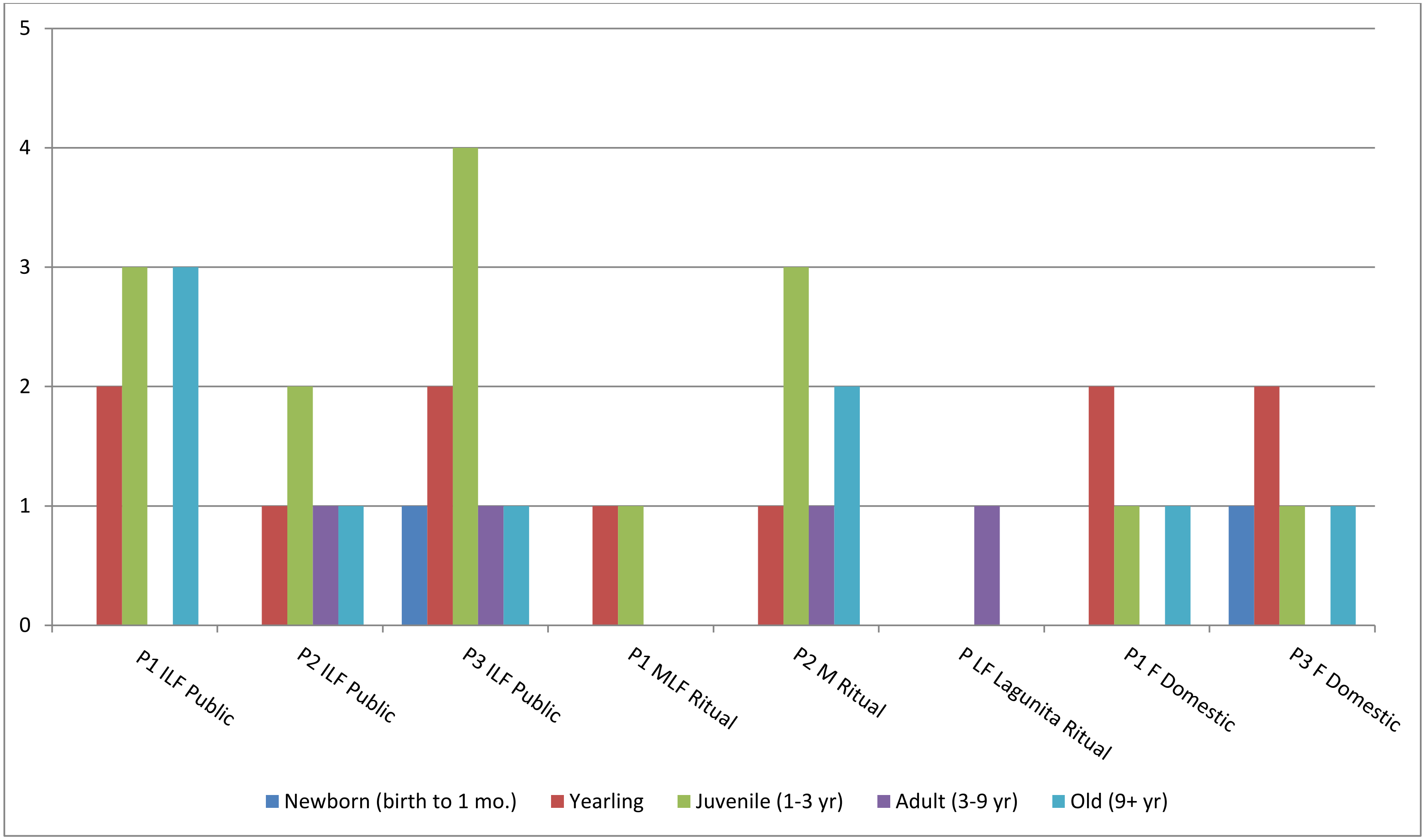


Figure B-13: Pukara - Detailed Mortality Profile by Context

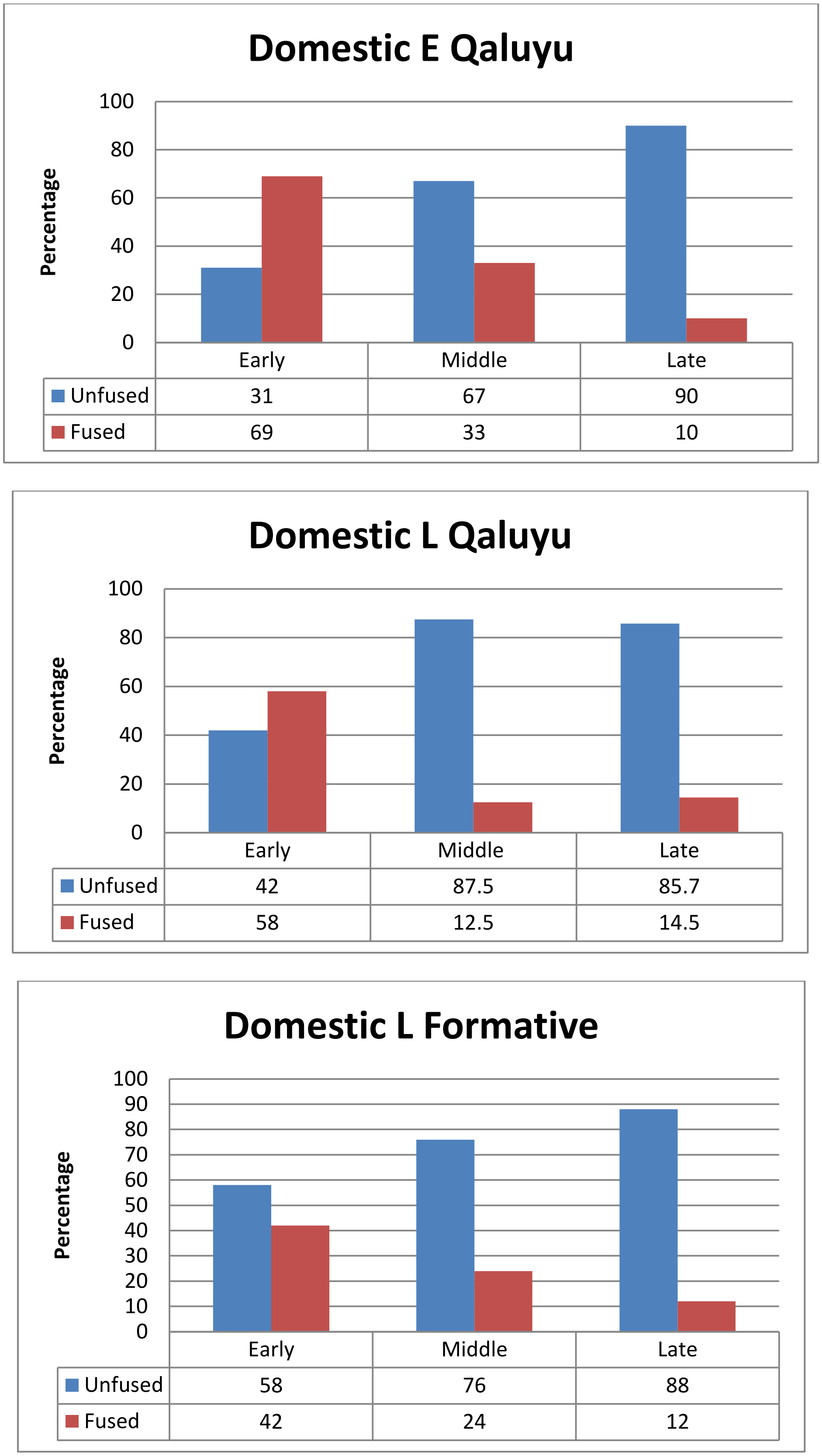
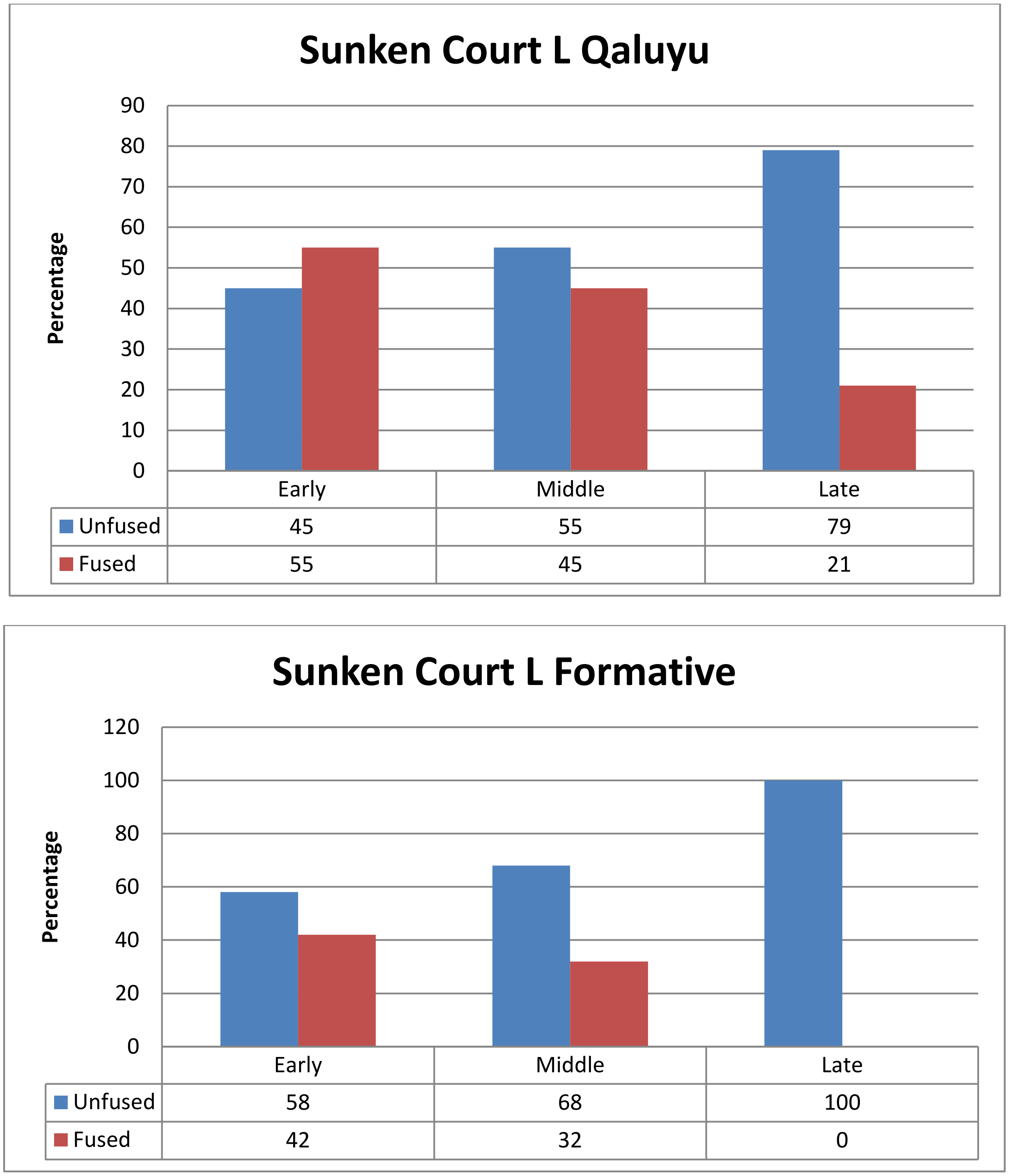


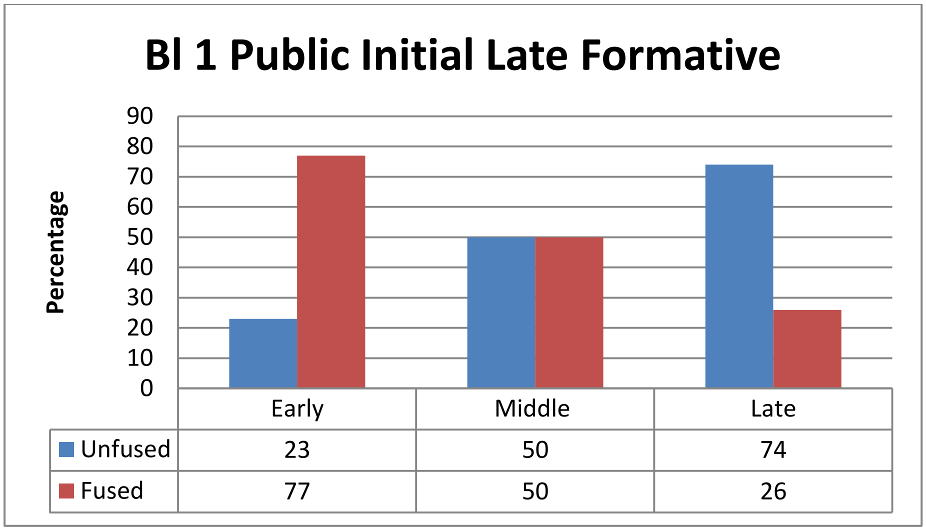
Figure B-14: Huatacoa Domestic Age Profiles



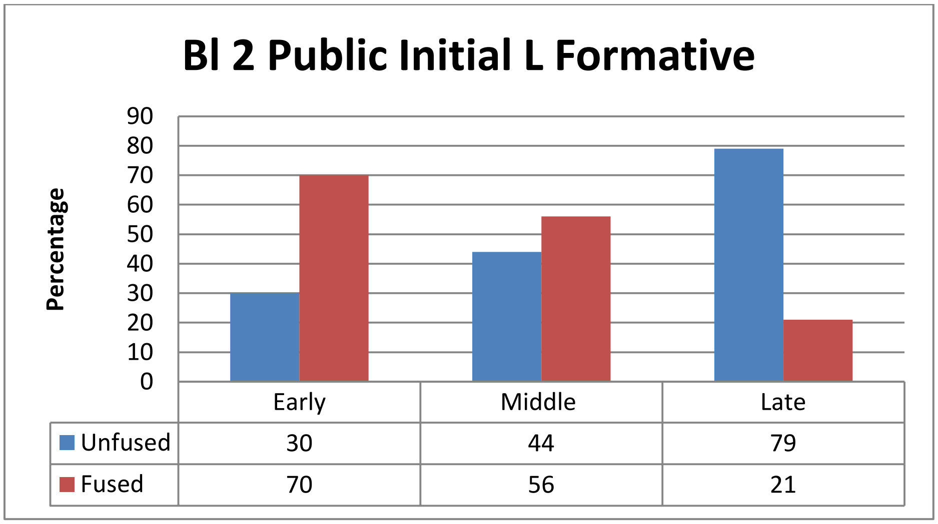
	Early	Middle	Late
🟦 Unfused	45	55	79
🟥 Fused	55	45	21

	Early	Middle	Late
🟦 Unfused	58	68	100
🟥 Fused	42	32	0

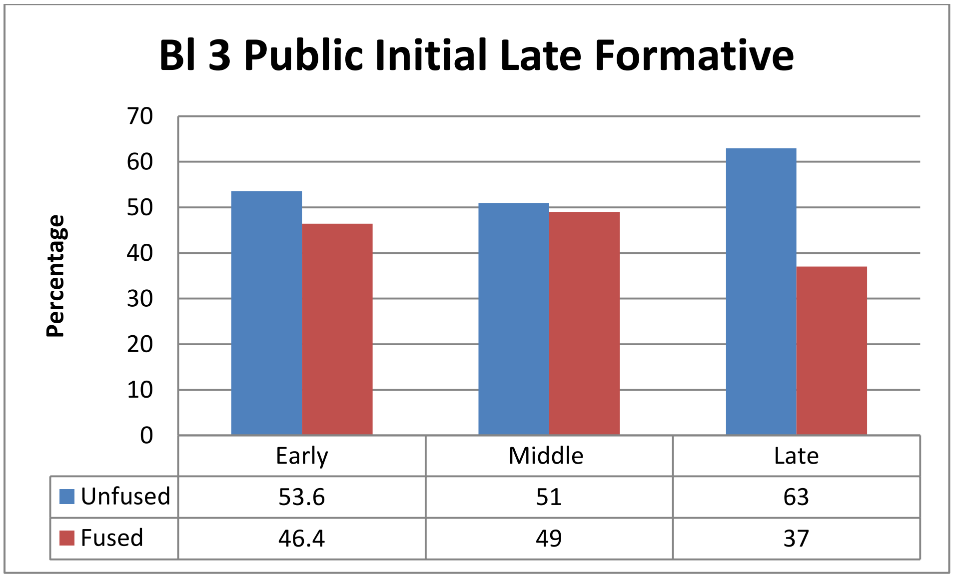
Figure B-14: Huatacoa Sunken Court Age Profiles



	Early	Middle	Late
🟦 Unfused	23	50	74
🟥 Fused	77	50	26

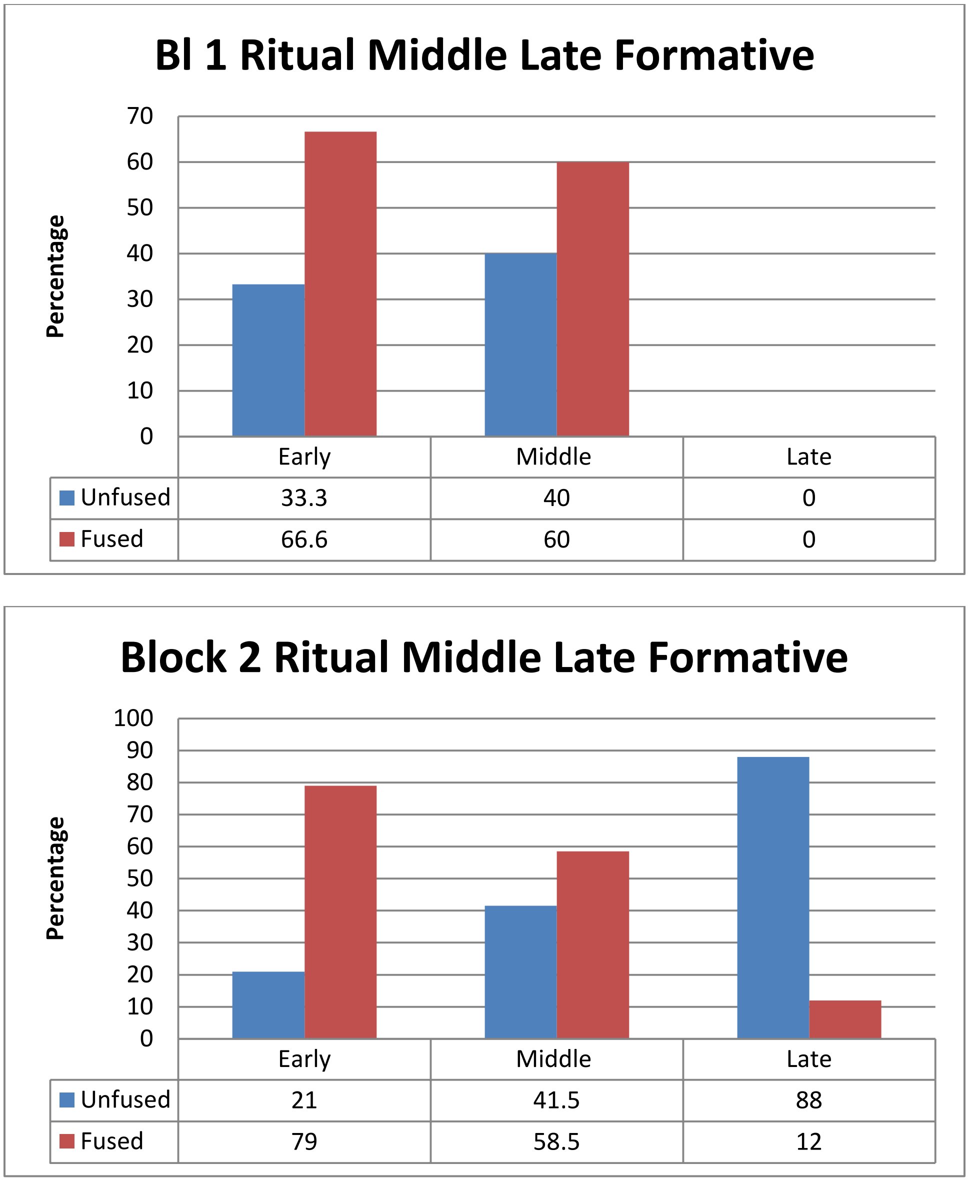


	Early	Middle	Late
🟦 Unfused	30	44	79
🟥 Fused	70	56	21



	Early	Middle	Late
🟦 Unfused	53.6	51	63
🟥 Fused	46.4	49	37

Figure B-15: Pukara Initial Late Formative Public Age Profiles



	Early	Middle	Late
🟦 Unfused	33.3	40	0
🟥 Fused	66.6	60	0

	Early	Middle	Late
🟦 Unfused	21	41.5	88
🟥 Fused	79	58.5	12

Figure B-16: Pukara Middle LF Ritual Age Profiles

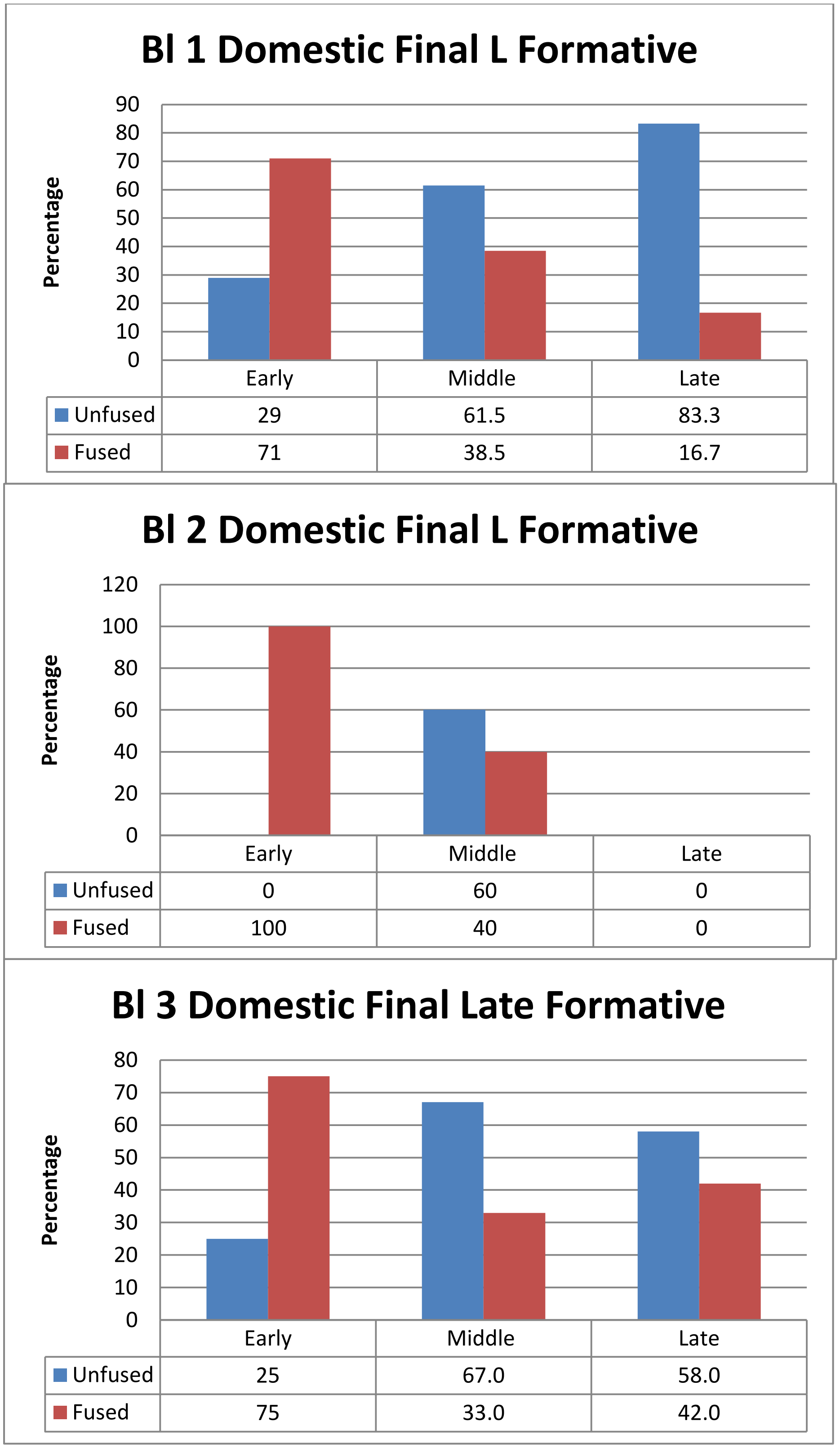


Figure B-17: Pukara Middle LF Ritual Age Profiles

Appendix C: Cutmark Distribution By Site Strata[96]

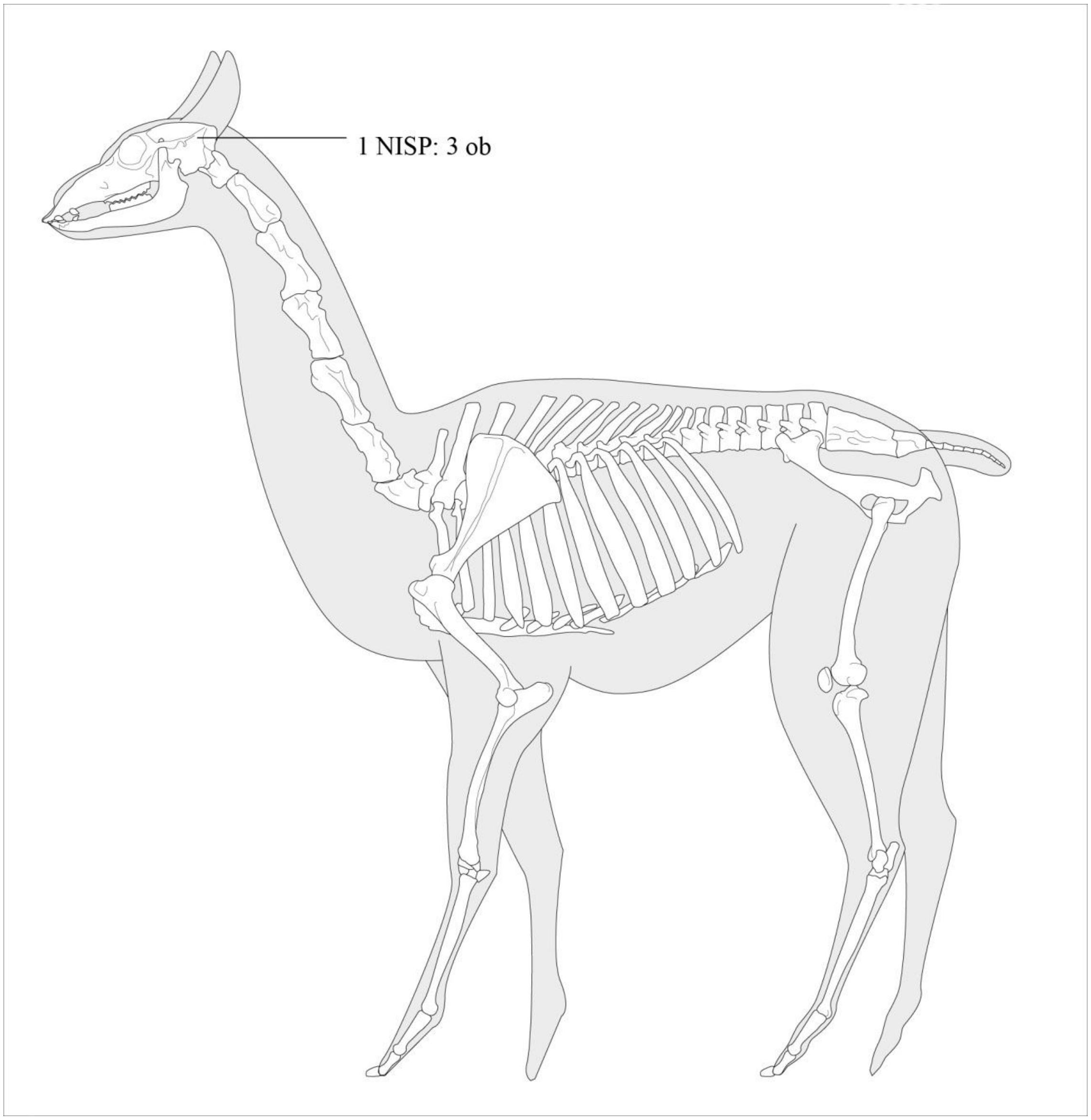


Figure 1: Early Qaluyu Plaza (A1)

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[96] Note: abbreviations describe cutmark orientation (l = longitudinal, ob = oblique, tr = transverse). All recorded cuts occur on ¼” bone.

Caveats: I did not record cuts present on unidentified metapodia. Cutmarks frequency on ribs is grossly underestimated due to: 1) fragmentation, 2) frequency of ribs / carcass, 3) difficulty distinguish cut mark placement upon incomplete blade segments, and 4) ribs were often identifiable only as *Artiodactyla*.

Finally, cutmarks on worked bone or bone tools were not tallied. Cuts often help smooth and shape surfaces or split bone into smaller units.

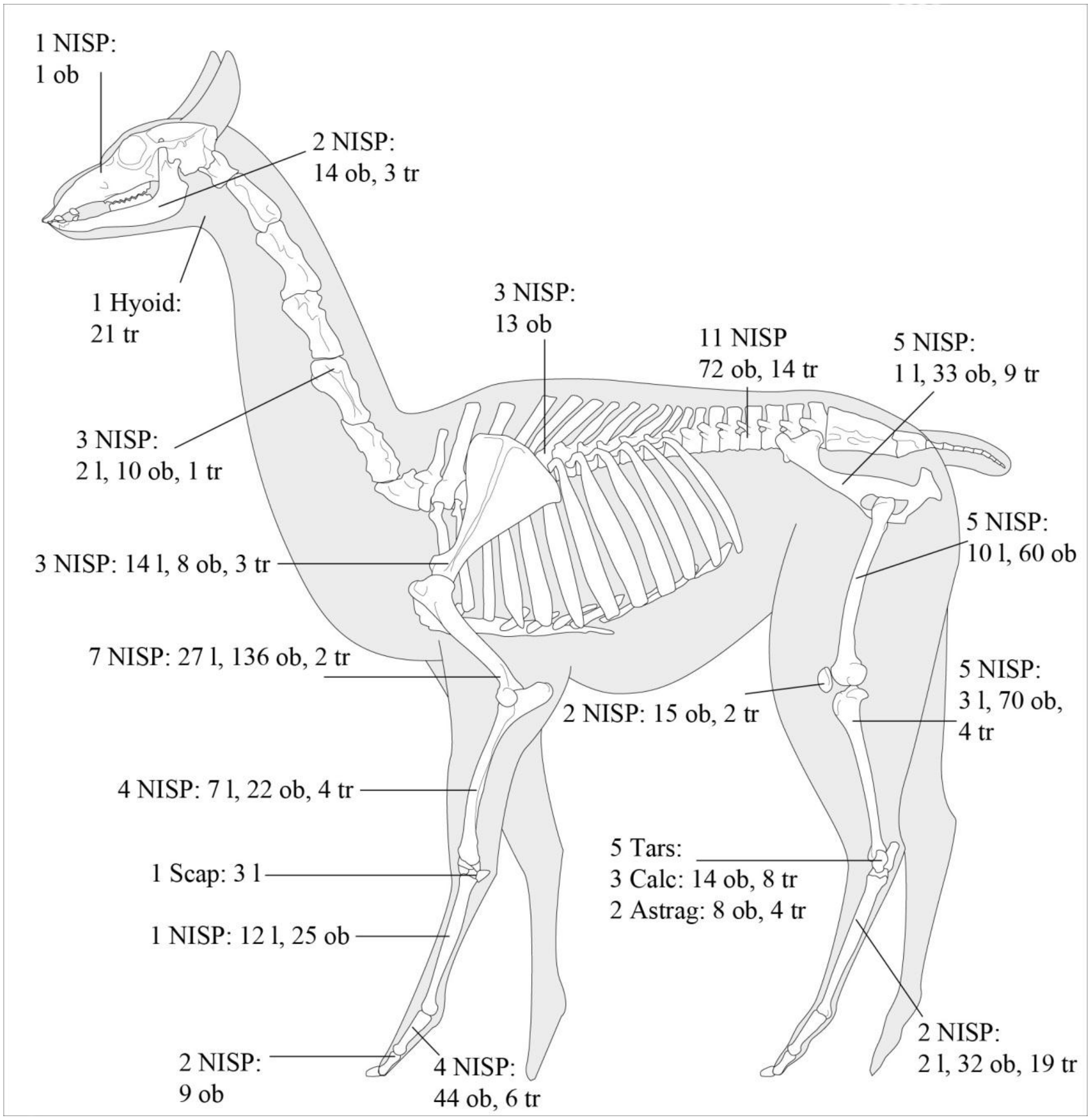

Figure 2: First Late Qaluyu Court (A3)

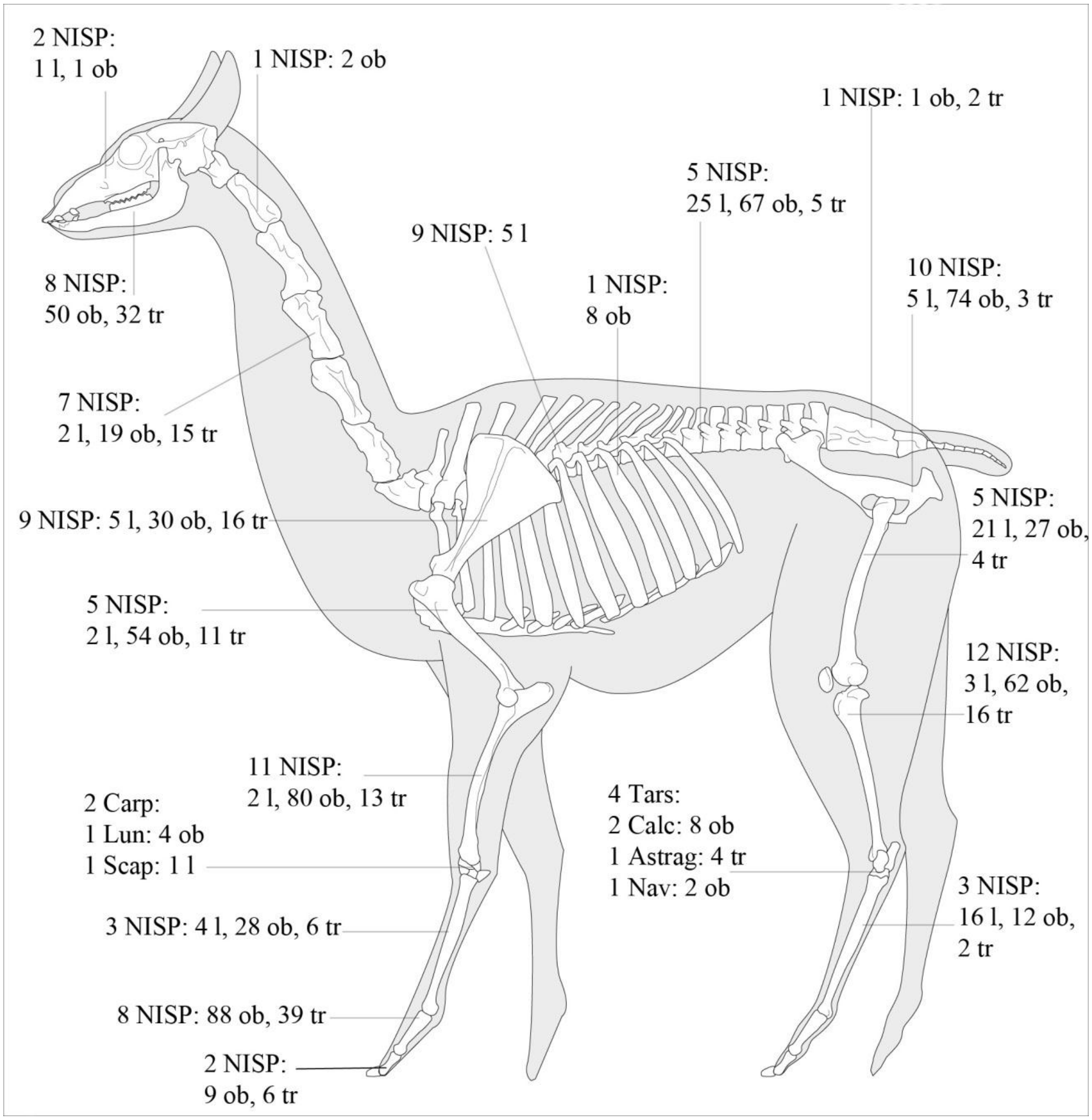

Figure 3: Late Formative Court (A5)

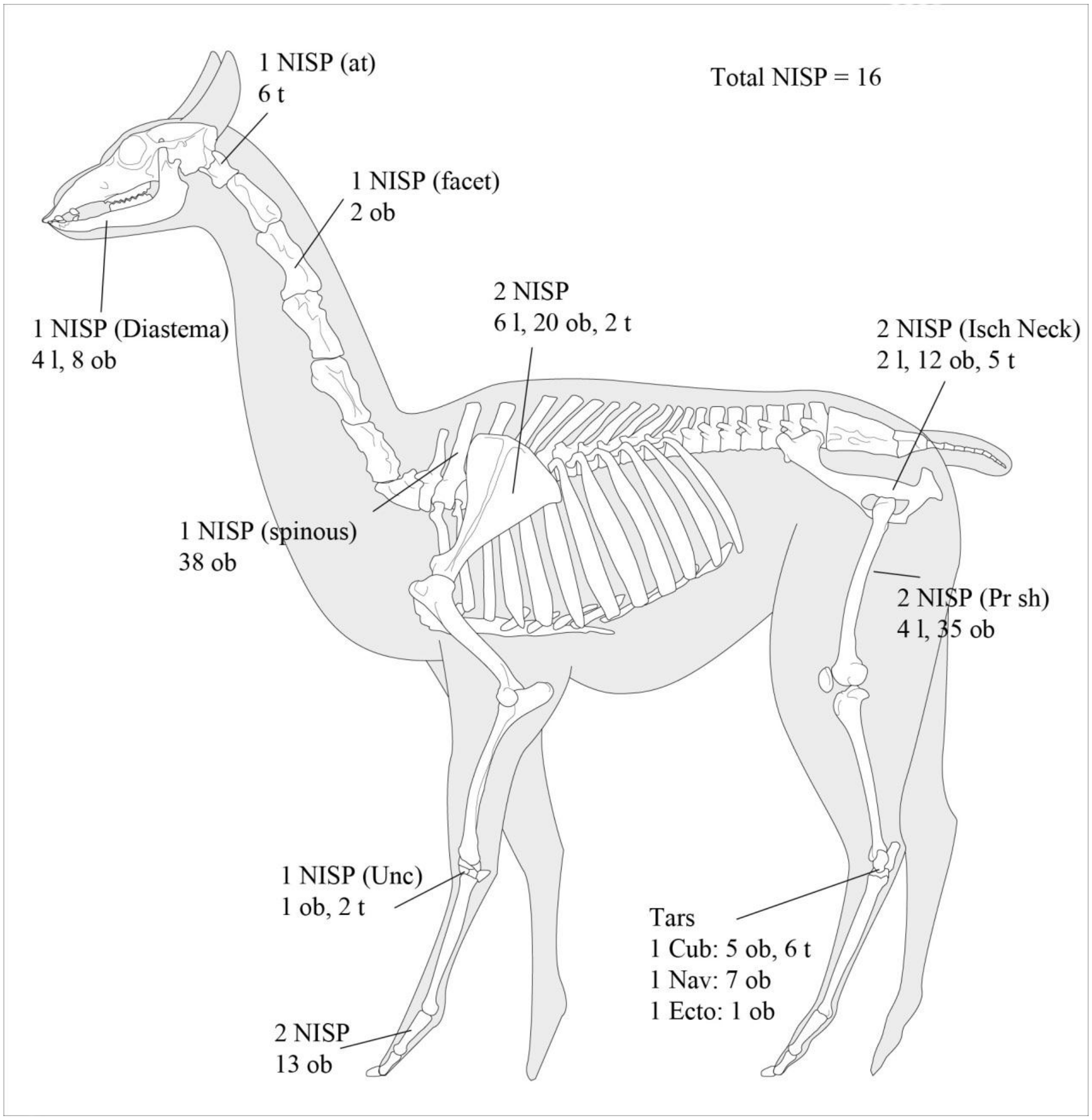

Figure 4: Early Qaluyu Pithouse / Midden Bone (B1)

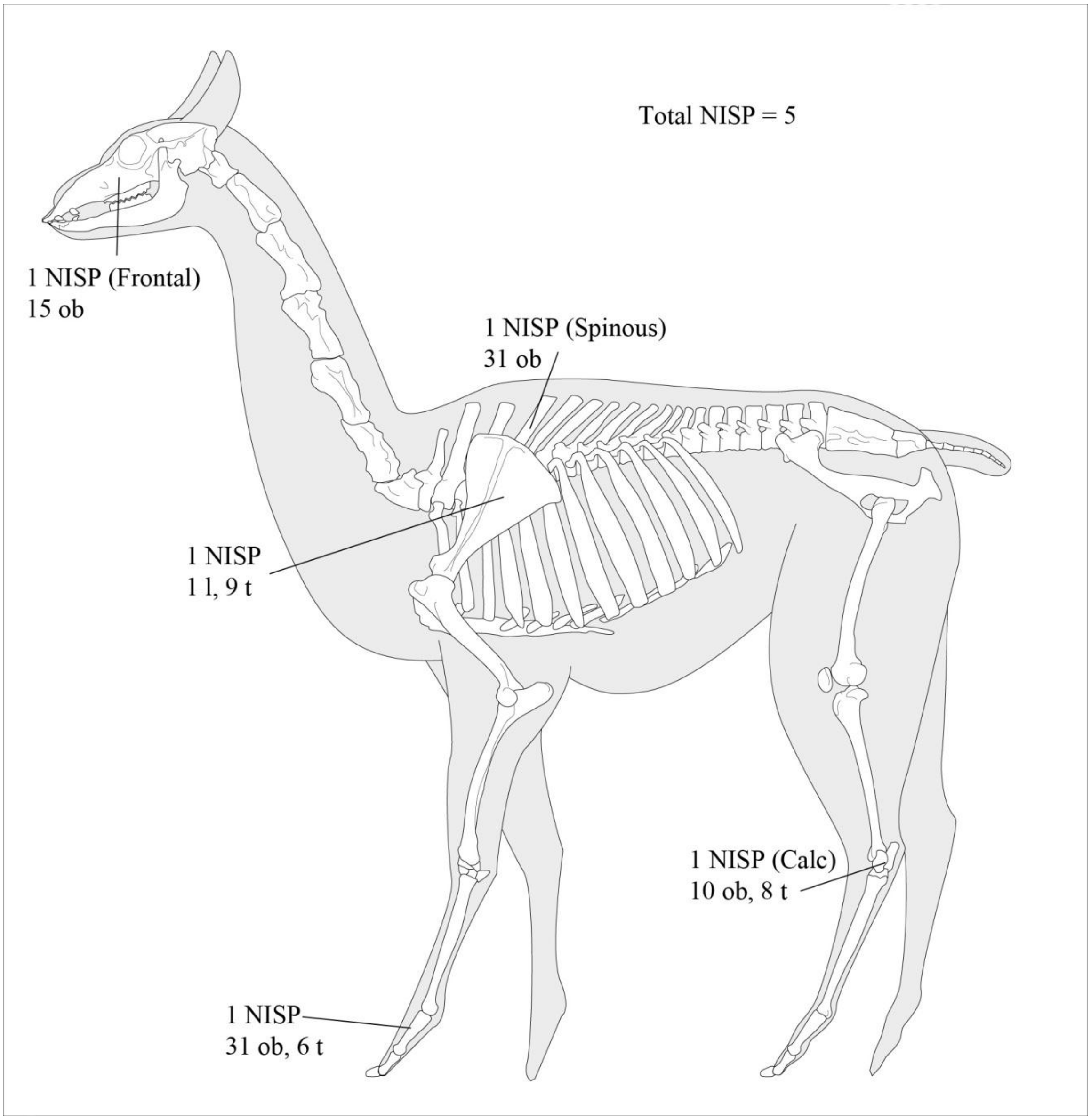

Figure 5: Early Qaluyu Adobe House / Contexts (B2)

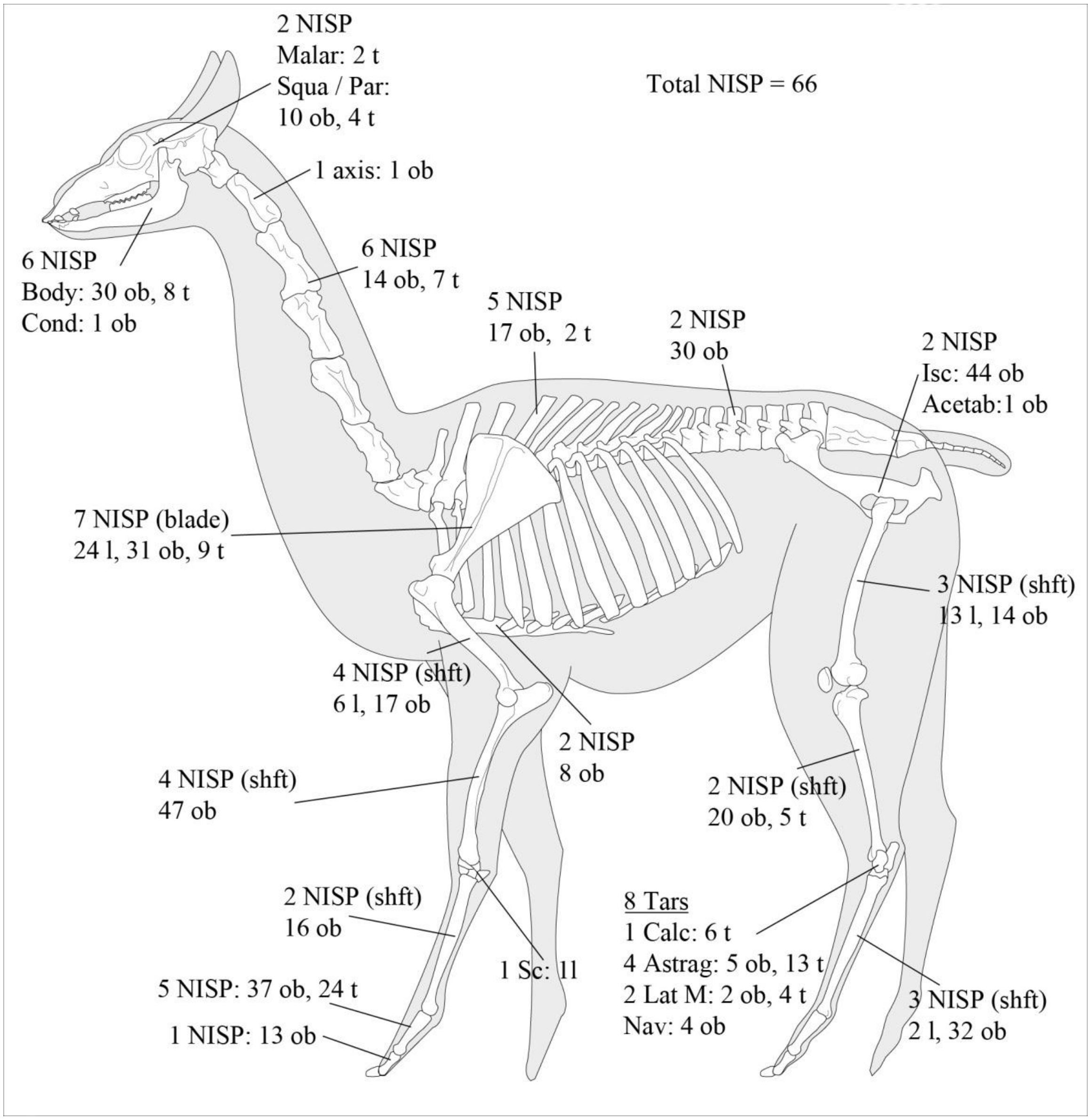

Figure 6: EQ Above Adobe House Domestic Midden (B3)

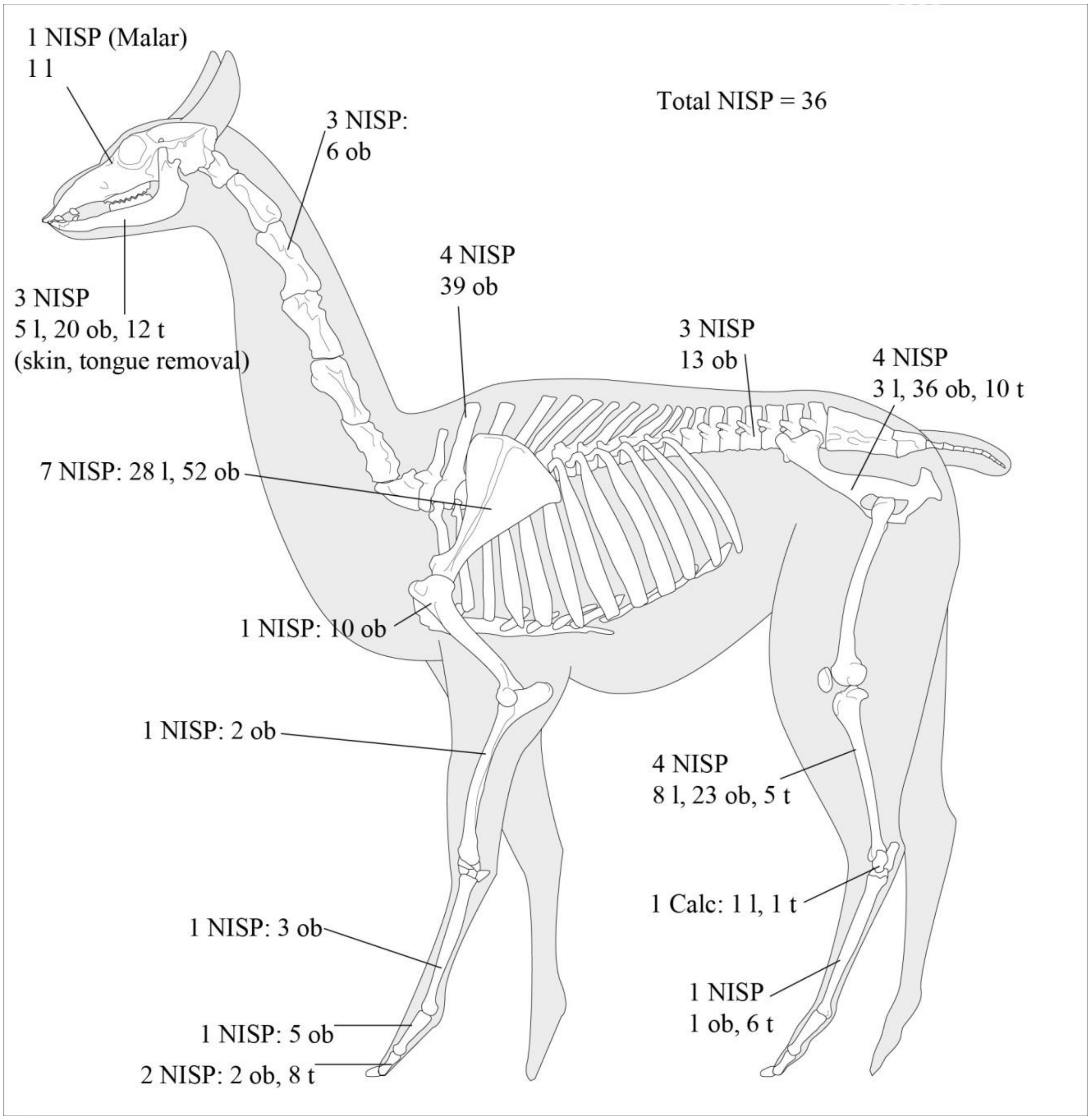

Figure 7: LQ Above Adobe House Domestic Midden (B4)

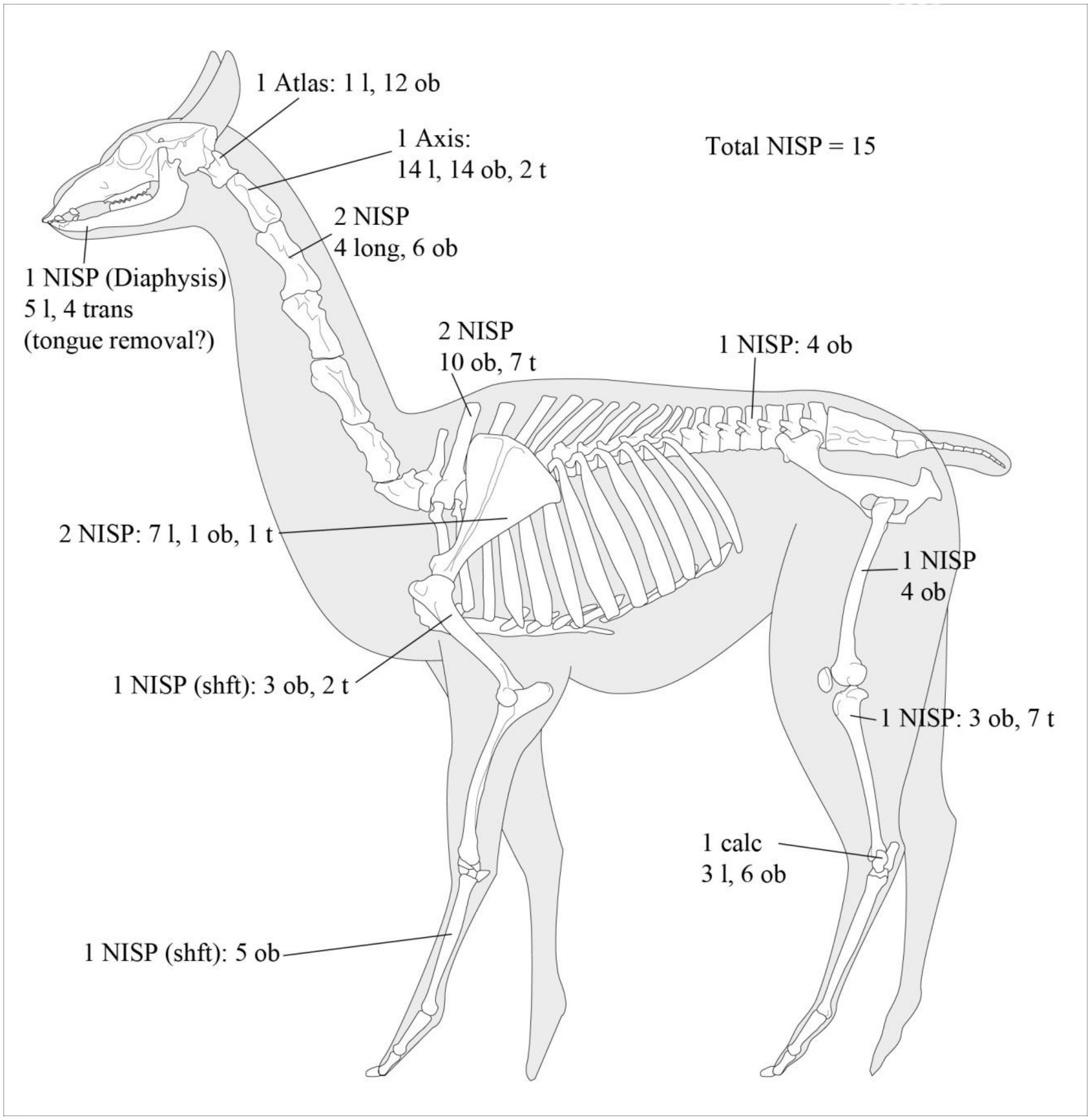

Figure 8: Late Formative Above Adobe House Domestic Midden (B5)

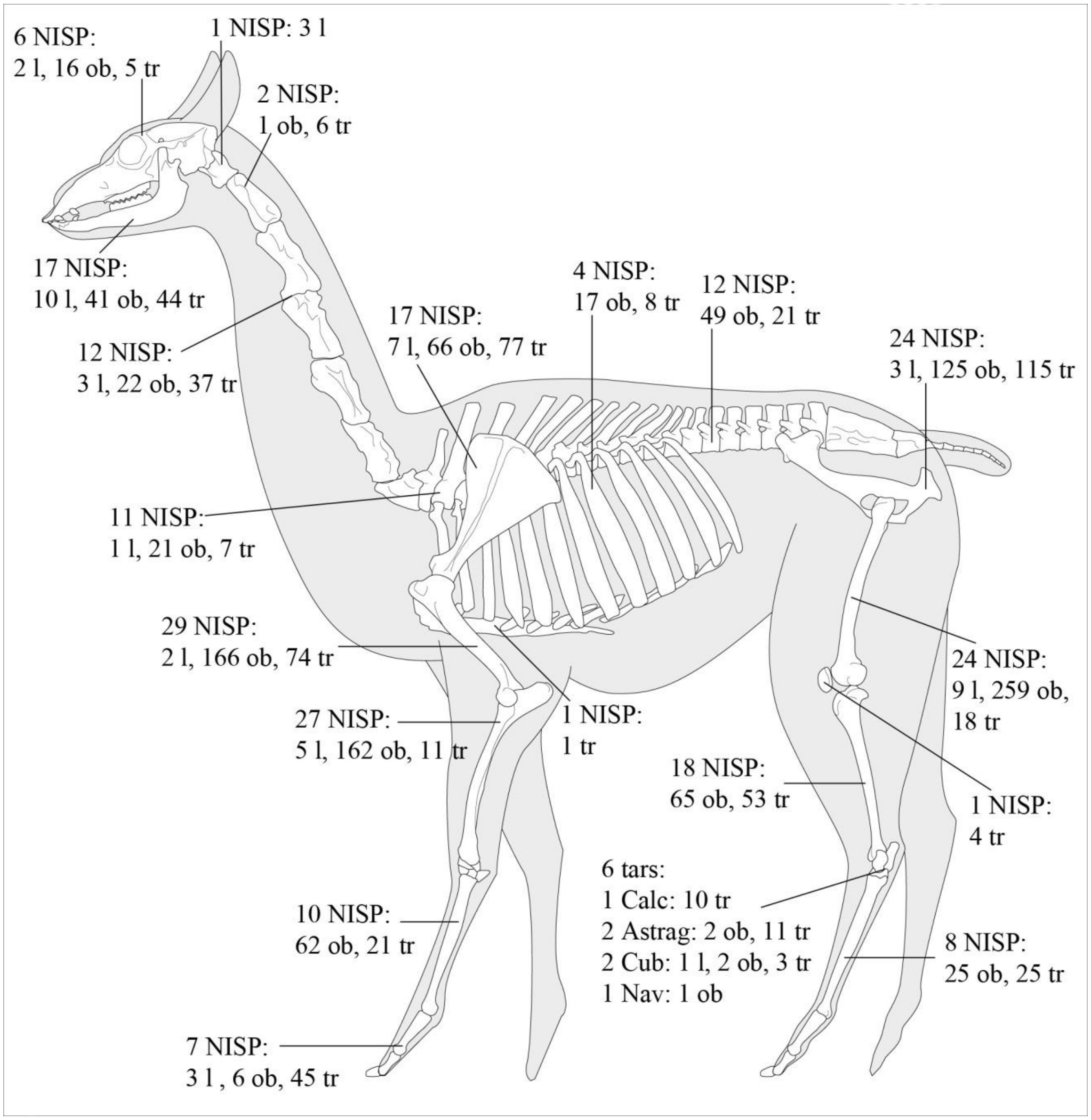

Figure 9: Initial Late Formative Pukara (Block 1)

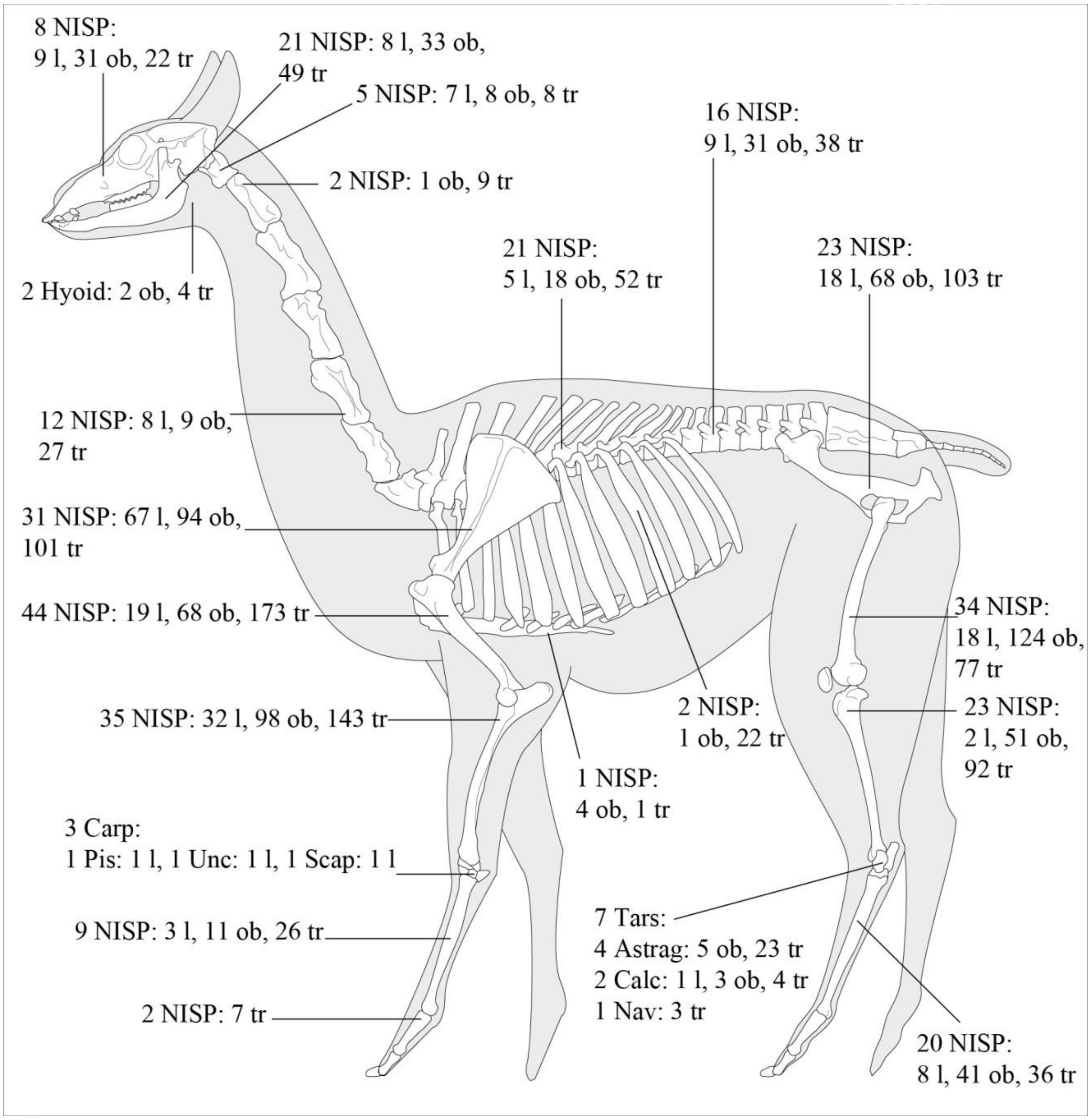

Figure 10: Initial Late Formative Pukara (Block 2)

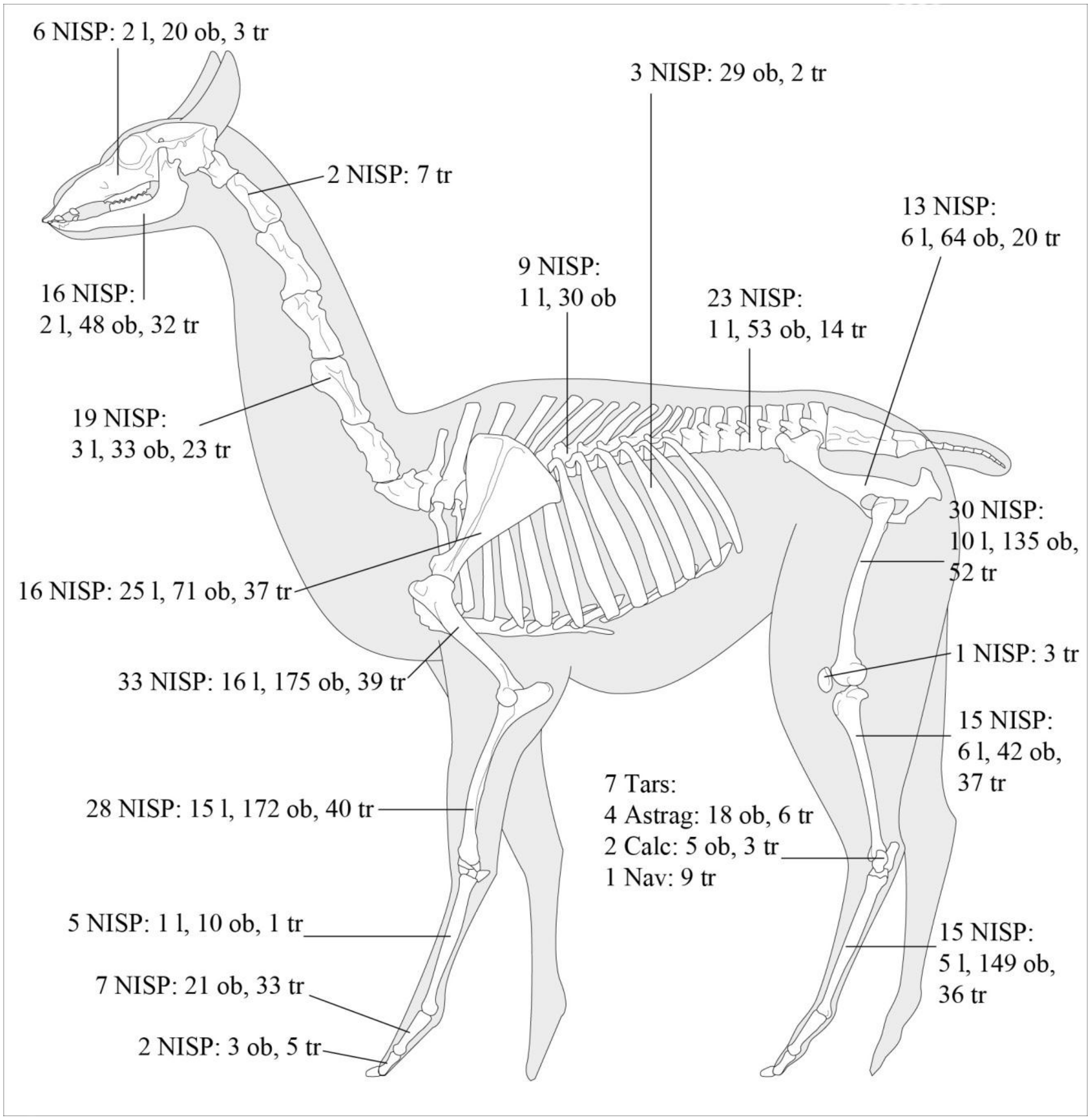

Figure 11: Initial Late Formative Pukara (Block 3)

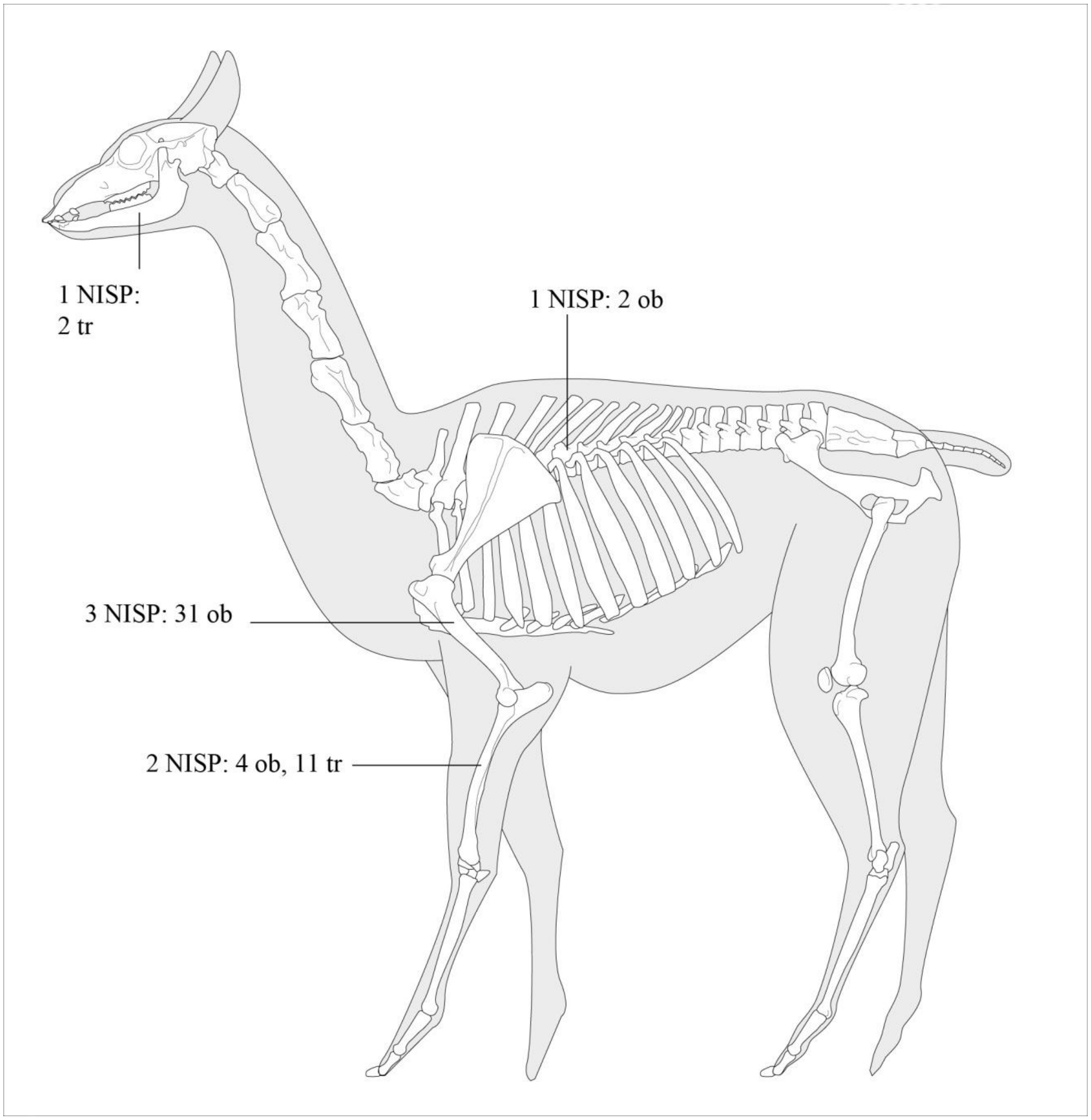

Figure 12: Middle Late Formative Pukara (Block 1)

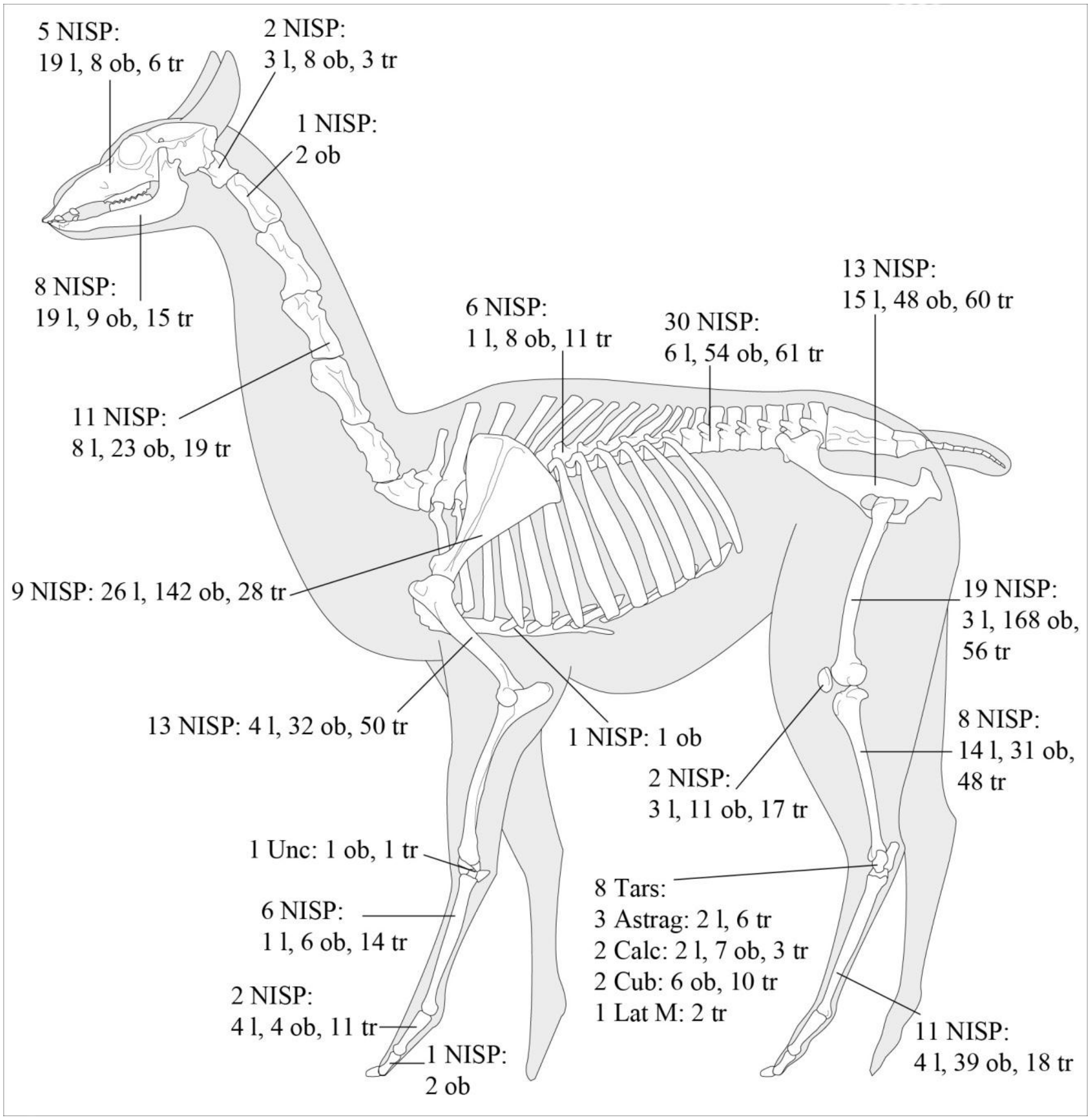

Figure 13: Middle Late Formative Pukara (Block 2)

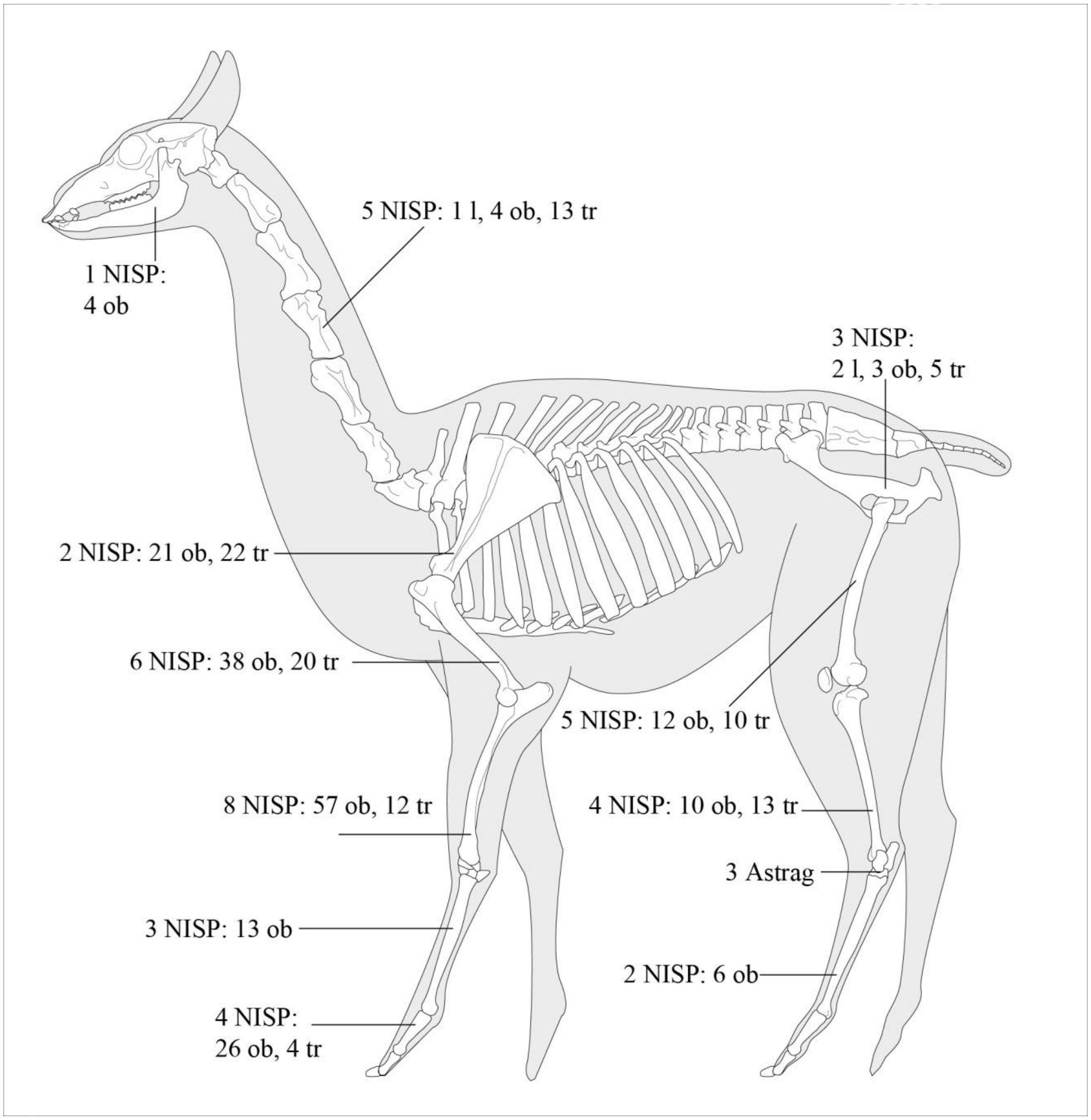

Figure 14: Final Late Formative Pukara (Block 1)

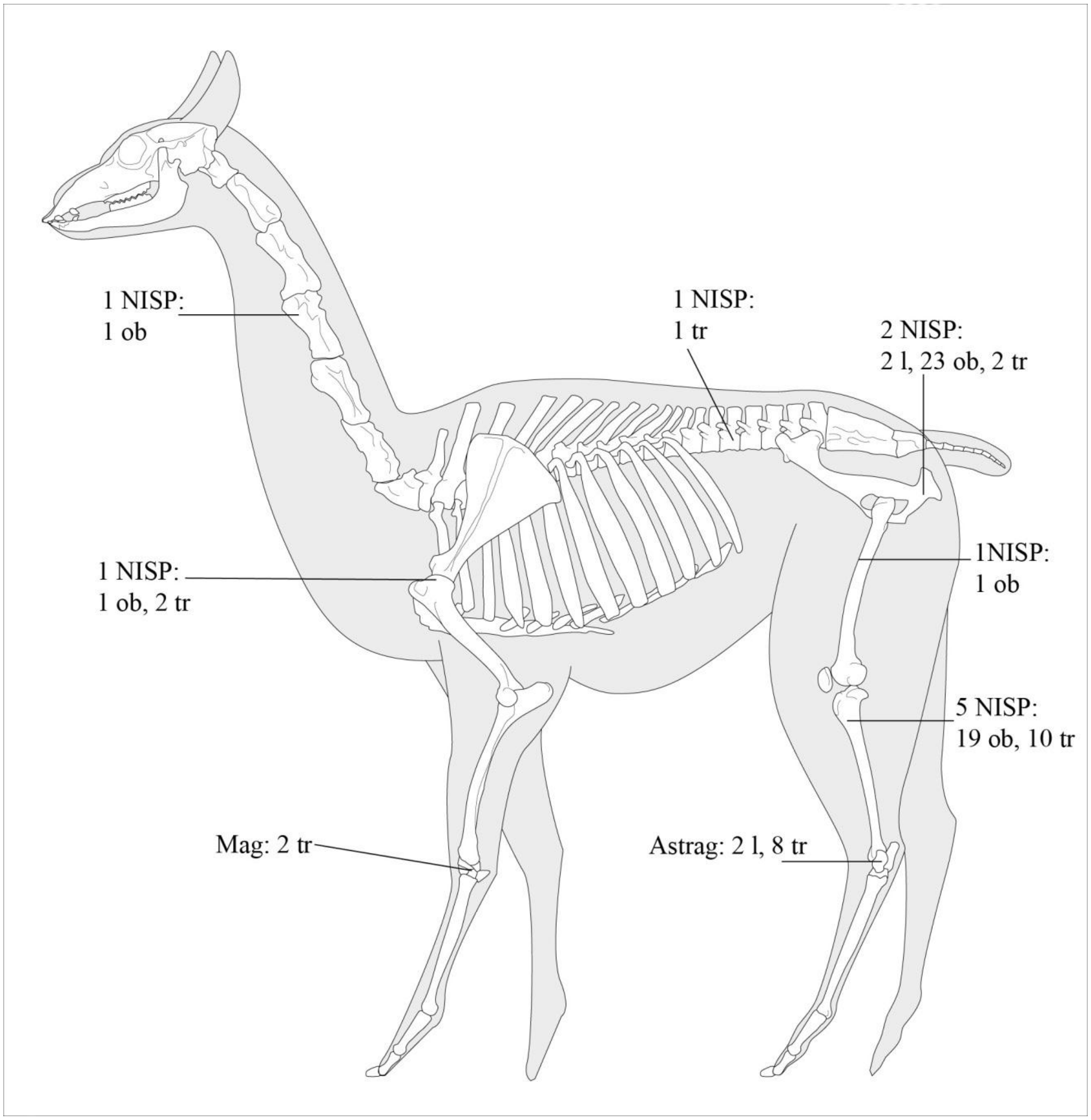

Figure 15: Final Late Formative Pukara (Block 2)

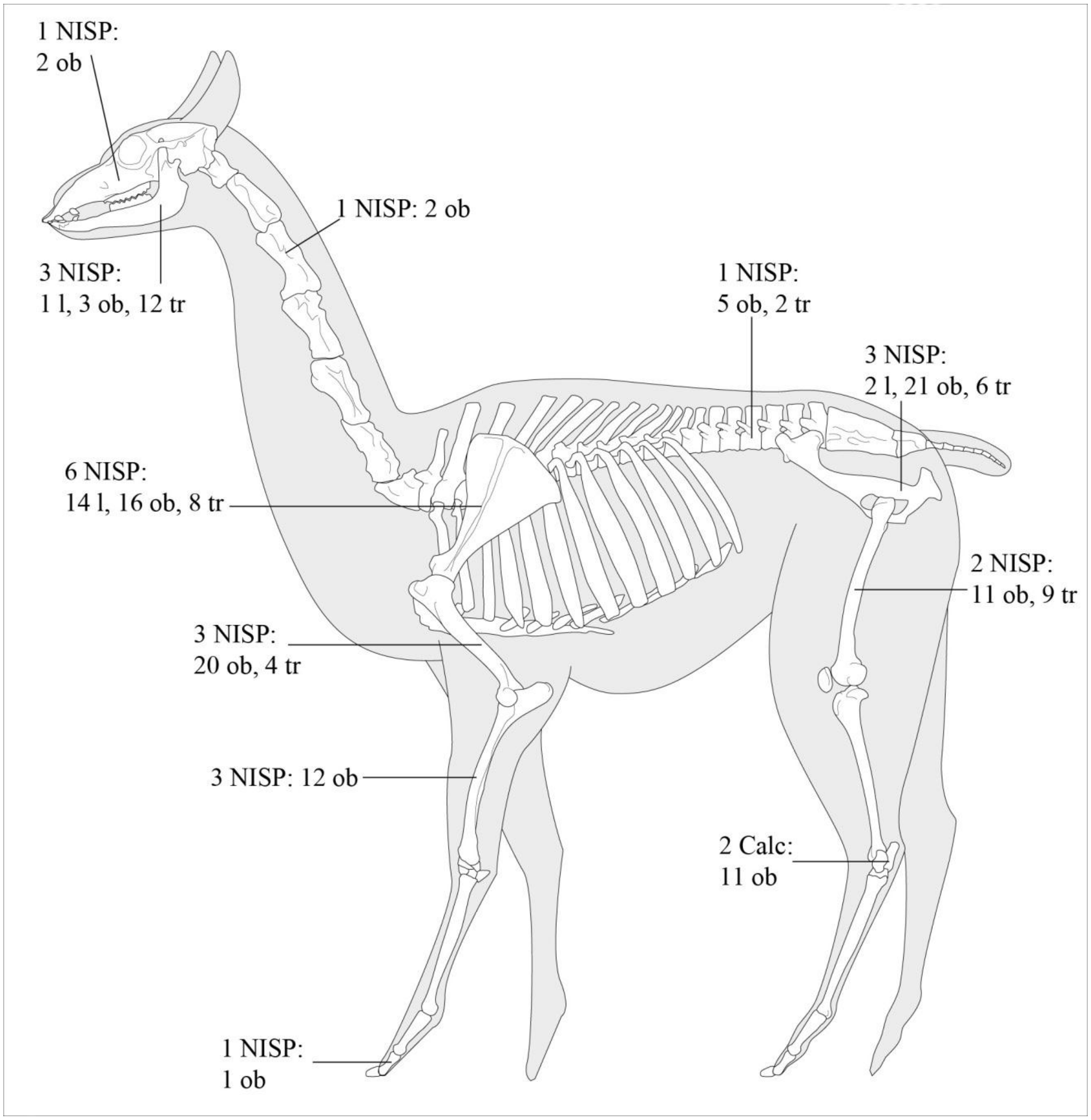

Figure 16: Final Late Formative Pukara (Block 3)

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December 2012

Education:
B.A., University of Minnesota—Moorhead, May 1999
Major: Anthropology
M.S., University of Wisconsin—Milwaukee, December 2002
Major: Anthropology
Ph.D., University of Wisconsin—Milwaukee, December 2012
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M.S. Title: A Diachronic Study of Animal Exploitation at Aztalan, A Late Prehistoric Village in Southeast Wisconsin

Teaching Experience:

2004-2005	Adjunct Instructor, Department of Anthropology, University of Wisconsin—Milwaukee
2002-2000	Teaching Assistant, Department of Anthropology, University of Wisconsin—Milwaukee

Research Experience (Laboratory):

2006-2008	Pukara Valley Archaeology Project. Asociación Collasuyu, Puno, Peru
2003	La Cantera and Cancha de Yacango sites, Museo Contisuyo, Moquegua, Peru
2002	San-Bartolomé-Wiscachani site, Museo Contisuyo, Moquegua, Peru
2001-2002	Aztalan, WI site, University of Wisconsin, Milwaukee
1999	Khirbet Hammam, Jordan site, University of Wisconsin, Milwaukee

Professional Experience:

2009-2011	Project Archaeologist, Commonwealth Cultural Resources Group, Jackson, MI
2010	Assistant Supervisor, University of Minnesota—Moorhead, Swift County, MN Survey (summer)
2009	Project Assistant, “Evaluating Early Urbanism at Pukara, Peru”, University of California, Los Angeles Field School / Wenner Gren International Collaborative Research Grant (summer)
2007-2008	Field Director, Rockies Express Pipeline, Commonwealth Cultural Resources Group
2006	GPS Technician, Rockies Express / Enbridge Pipelines, Commonwealth Cultural Resources Group
2002-2003, 2005	Field Technician, Historic Resource Management Services (summers)
1999	Hemisphere Field Services, Minneapolis, MN (summer)

Awards:

2009	Dissertation Fellowship, University of Wisconsin—Milwaukee
2008	Wenner-Gren Dissertation Fieldwork Grant
2007-2006	Sigma Xi Grants-in-Aid-of-Research Fellowship
2006	University of Wisconsin, Milwaukee Graduate Student Travel Award
2006	Center for Latin American / Caribbean Studies Travel Award
2006-2005	Graduate Fellowship, University of Wisconsin—Milwaukee
2003-2004	Center for Latin American / Caribbean Studies Travel Award
2002-2003	Center for Latin American / Caribbean Studies Travel Award
2001	University of Wisconsin, Milwaukee Graduate Student Travel Award

Publications:

Warwick, Matthew and Robert J. Jeske

2000 Middle and Late Archaic Study Unit. In *Southeastern Wisconsin Archaeology Program 1999- 2000*, edited by Robert J. Jeske, pp. 107-122. Report of Investigations No. 145, Archaeology Research Laboratory, University of Wisconsin—Milwaukee.

Presentations:

2012 "Camelids as Social Intermediaries: Suprahousehold and Ritual Practices of the Formative Period, North Titicaca Basin". Invited paper for session, "Recent Anthropological Perspectives on Past and Present Andean Pastoralism". 111th Annual Meeting of American Anthropological Association, San Fransisco. Nov. 14-18.

2011 "Zooarchaeology of the Rio Pukara Valley: New Data from the Northern Lake Titicaca Basin Formative". Presentation to Michigan Archaeological Society, Upper Grand Valley, Oct. 19.

2011 "Camelid Domestication in the South Andes". Presentation to Michigan State University Anthropology 362 course, "The Archaeology of Foragers to Farmers". Oct. 3.

2010 "The Camelid and the Toad: Zooarchaeology of the Pukara Valley Formative." Society for Amazonian and Andean Studies, 2nd Biennial Meeting, Gainesville, Nov. 5-6.

2010 "Zooarchaeology of the Rio Pukara Valley: New Data from the Northern Lake Titicaca Basin Formative."75th Annual Meeting of Society for American Archaeology, St. Louis, April 13-18.

2009 "Shepherding the Household Herd into the Political Arena: Formative Herding in the Lake Titicaca Basin." 74th Annual Meeting of the Society for American Archaeology, Atlanta, April 22-26.

2006 "For Hearth and Home or a Political Party?: Camelid Husbandry and Use at Pukara, Peru". 10th Conference of the International Council of Archaeozoology, Mexico City, Mexico, August 23-28.

2003 "Diachronic Study of Animal Exploitation at Aztalan."49th Annual Midwest Archaeological Conference, Milwaukee, Oct. 16-19.

2003 Session chair / co-organizer with Jean L. Hudson, Session Title: Zooarchaeological Approaches to Archaeological Questions. Paper title: "Leftovers: Faunal Evidence of Feasting." SAA 68th Annual Meeting, Milwaukee, April 9-13.

2001 Paper title: "Antlers, Aves, and Fish Up the Yingyang:A Zooarchaeological Analysis of

Subsistence Change at the Aztalan site, Wisconsin". SAA 66th Annual Meeting, New Orleans, April 18-22.

Professional Societies:
American Anthropological Association (AAA)
Society for American Archaeology
Midwest Archaeological Conference
International Council for Archaeozoology
Sigma Xi, the Scientific Research Society
Anthropology Student Union, University of Wisconsin—Milwaukee

University Service:

2003-2004	Treasurer, Anthropology Student Union, UW-Milwaukee
2000-2001	Vice President, Anthropology Student Union, UW-Milwaukee

Languages:

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