

## Pacopampa and Kuntur Wasi : Regional Variations in the Process of Llama (Lama glama) Introduction

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## 12. Pacopampa and Kuntur Wasi: Regional Variations in the Process of Llama (*Lama glama*) Introduction

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### 1. Introduction

Extensive research has been conducted on the domestication of South American camelids (Bonavia 2009). In the Central Andean region, primarily Peru, early studies focused on the relationship between camelid domestication and social development. Researchers have considered the modern pastoralism of llamas (*Lama glama*), which are used as pack animals and meat sources, and the alpacas (*Vicugna pacos*), which are a source of high-quality fleece (Wing 1972). However, archaeological data of the Andes, which has been accumulated over the past quarter of a century, indicate that camelid domestication occurred independently in several regions of Central and South-Central Andes. In addition, camelids played different roles in each region (Wheeler 2012; Yacobaccio 2004, 2007; Yacobaccio and Vilá 2016).

The validity of prehistoric camelids, based on their bones and hair, raises skepticism regarding the classification of the llamas and the alpacas and suggests the existence of diverse clades (Barreta et al. 2013; Shimada and Shimada 1985; Wheeler et al. 1995). As the quality and quantity of available information from the broader Andean region increases, the spread of early camelid livestock and its impact on society can be understood through the differences in each region's ecological and social environments.

We investigated the use of camelids at two major temple sites, Kuntur Wasi and Pacopampa, in the northern highlands of Peru (Takigami et al. 2020; Uzawa 2010, 2019). Both sites utilized domesticated camelids in the Late Formative Period, that is, around 500 BCE, which was confirmed by previous studies. However, the sites had certain differences, such as Pacopampa witnessed a rapid introduction of camelids, while, at Kuntur Wasi, the use of the animal was slow and deer hunting continued (Uzawa 2010).

Recent analyses have shown that, at Pacopampa, llamas were used primarily for ritual consumption and there was no evidence of the pastoral practices, such as agro-pastoral complexes and vertical control, otherwise observed in the southern part of the Central Andean region (Uzawa et al. 2021). As llama use in the northern highlands of Peru is closely linked to ritual activities at the ceremonial center, interpreting its spread

and introduction from a socioeconomic perspective alone is insufficient. It is important to understand the adaptation and acceptance of the new subsistence technology in each society when llamas spread from their place of origin to surrounding areas, following a geographical gradient. By elucidating the introduction process of domesticated camelids at different sites, we hope to deepen our understanding of the interrelationship between the development of the Formative Period society and the synchronous spread of the llamas.

We conducted research at Kuntur Wasi from 2001 to 2006 and at Pacopampa from 2007 to 2019. Although several reports have been published, camelid materials from the two sites have not been compared in detail and the site differences regarding camelid use have not been examined. In this study, we reanalyzed the Kuntur Wasi data and compared it with the Pacopampa data.

## 2. Materials

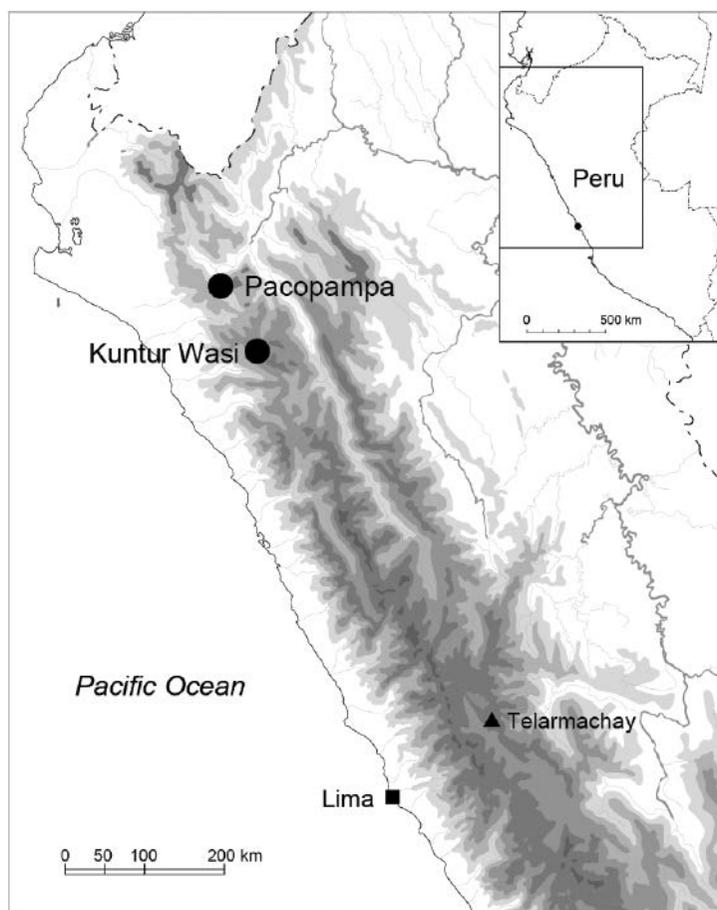
### 2.1 Kuntur Wasi

Kuntur Wasi is built on top of a hill at 2,300 meters above sea level, near the upper reaches of the Jequetepeque River, which flows down the western slopes of the Andes (Figure 12-1). This region is the boundary between the *Yunga* and the *Quechua* zones and has a relatively arid and moderate climate (Pulgar Vidal 1981). At present, the site is surrounded by farmlands containing maize, cotton, and other crops. With the exception of the livestock raised by the villagers, the most common animal in this area is the white-tailed deer (*Odocoileus virginianus*), and wild camelids such as guanaco and vicuña are not distributed.

Kuntur Wasi is one of the largest ceremonial centers in the district. The site is composed of four terraces, constructed from the hillside to the top. The uppermost terrace is a flat platform of about one hectare, where the plazas and major architectural features are located. Tello first studied the site in 1946 and it was later excavated in detail by a team from the University of Tokyo from 1988 to 2002. The latter established its architectural transition and chronology (Onuki 1995). The site comprises four phases – the Ídolo phase (950–800 BCE), the Kuntur Wasi phase (800–550 BCE), the Copa phase (550–250 BCE), and the Sotera phase (250–50 BCE). The first and the last phases correspond to the Middle and Final Formative Periods, respectively. In the intervening period, that is, the Late Formative Period, construction activities witnessed a rise and inter-regional exchanges expanded. In particular, artifacts, such as pottery and metal products, indicate a connection with the coastal region (Inokuchi 2019).

### Bone Samples

Bone samples were collected by careful hand-picking from the uppermost platform, which is the core of the site. The amount of animal bone remains excavated was unevenly distributed among the phases, with less material from the Ídolo phase and more from the Kuntur Wasi and Copa phases, reflecting the difference in the stratum volume. We observed approximately 10,000 mammal bone specimens and identified 3,854 at the



**Figure 12-1** Map of the northern highland of Peru (produced by Kazuhiro Uzawa)

species, genus, and family levels. A wide range of taxa, across 13 families, was identified in the bone material, including marsupials, rodents, and carnivores. The composition of the taxa varied by period; however, throughout all the periods, artiodactyls, consisting of white-tailed deer and camelids, were most dominant and comprise about 80% of the sample.

Of the diverse animal material, this study focuses on the camelid. There were 214 NISP (number of identified specimens) of camelids and 14 MNI (minimum number of individuals) found in the Late Formative Period, which was a combination of the Kuntur Wasi and Copa periods. The Sotera phase, in the Final Formative Period, had 244 NISP and 7 MNI.

## 2.2 Pacopampa

Pacopampa is located 90 km north of Kuntur Wasi, at 2,500 meters above sea level, on the bank of the Chotano River, which is a tributary of the Marañon River that flows on

the eastern slope of the Andes (Figure 12-1). The mountains have lower altitudes in this area, providing an east-west passage between the Pacific Ocean and the Amazon. The site is situated in the area connecting the *Quechua* and the warmer temple zone (Pulgar Vidal 1981). The humid environment helps modern villagers grow soybeans, maize, and other root vegetables around the site.

Pacopampa comprises three platforms, covering an area of four hectares. The central architectural features are concentrated on the third platform, which is the uppermost part of the site. After several surveys by different archaeologists (Fung 1975; Morales 1980; Rosas and Shady 1970), the Pacopampa Archaeological Project, a joint project by the National Museum of Ethnology in Japan and the National University of San Marcos (*Universidad de Nacional major de San Marcos*) in Peru, began excavating the site in 2005. This project established the following chronology – Pacopampa Phase I (1200–700 BCE) corresponds to the Middle Formative Period and Pacopampa Phase II (700–400 BCE) corresponds to the Late Formative Period (Seki 2014; Seki et al. 2019). Although Phases I and II are subdivided into sub-phases, IA and IB and IIA and IIB, respectively, the <sup>14</sup>C dates for the sub-phases remain unavailable. This study, therefore, compiled and analyzed the samples for the Pacopampa I and II periods.

### Bone Samples

We analyzed mammalian skeletal remains unearthed from the third platform, the core of the Pacopampa site. The bone remains found on the floor surface and mixed in the cover soil were collected by careful hand-picking. The faunal remains observed so far comprise approximately 20,000 specimens and 6,246 NISP. Deer and camelids account for about 80% of the total bone material. Excluding these artiodactyls, the major taxonomic groups recovered from Pacopampa I and II include the cotton-tailed rabbit (*Silivilagus andinus*), guinea pig (*Cavia porcellus*), and opossum (*Didelphis* sp.). In addition to these taxa, capuchin monkey (*Cebus* sp.), pacarana (*Dinomys branickii*), and small feline were identified in the Pacopampa II assemblage. There were 22 NISP of the analyzed camelid remains and 4 MNI for Pacopampa I and 1,331 NISP and 25 MNI for Pacopampa II (Uzawa et al. 2021).

## 3. Methods

Camelid use at the two sites was examined based on the following aspects – temporal changes in the domesticated camelid ratio in the assemblages, consumption processes, indicated by the body parts' occurrence frequency and distribution of the butchering marks, and differences in livestock management strategy and purpose of use, based on the animal's age structure. The Pacopampa data was obtained from our recent analysis (Uzawa et al. 2021). For comparison purposes, we reanalyzed the Kuntur Wasi data collected on-site between 2002 and 2008.

### 3.1 Camelid's Composition Ratio

The percentage of camelid remains, among the animal skeletal remains at the two sites,

was calculated concerning the white-tailed deer, which is the common artiodactyl taxa inhabiting the northern highlands of Peru. Since Kuntur Wasi and Pacopampa are located outside the natural distribution range of the guanaco and vicuña, camelids found in the archaeological assemblages can be considered domestic animals (Uzawa 2010). Therefore, the change in camelid composition is a quantitative indicator of livestock utilization.

### 3.2 Osteometry

We performed a discriminant analysis, using bone measurements, to distinguish between the llamas and the alpacas. The maximum width (BFp) and depth (DFp) of the proximal facet of the proximal phalanges, which are the most commonly used measures to classify South American camelids taxa, were used in this study, following the method of Mondini and Muñoz (2017). Data on modern llamas and alpacas were obtained from extant literature (Cartajena 2009; Gasco and Marsh 2015; Izeta et al. 2009; Kent 1982). These data included the comparative specimens collected in Peru, Bolivia, Chile, and Argentina.

### 3.3 Body Parts Frequency

The relative occurrence frequency of camelids' skeletal elements was compared to examine the body's selective transportation. Some vertebrae and rib fragments were undistinguishable between the two animals and were, thus, identified as artiodactyl and excluded from the analyses. Each element's occurrence frequency was calculated using %MNI, which indicated, for each bone element, the number of animals found in the material, relative to the maximum MNI calculated in the assemblage.

### 3.4 Butchering Mark

We recorded seven types of butchering marks to determine the consumption process for an animal. Cut marks, chop marks, and peeling marks indicated dismembering and filleting, the percussion pit and striae reflect bone cracking and marrow extraction, and scrape marks signify skinning or periosteal removal. The occurrence frequency of each mark was calculated for each body part. Each mark was identified following White (1992) and the references therein.

### 3.5 Mortality Profile

The death age of each animal reflected the purpose of livestock management (Greenfield 1988; Yacobaccio 2007). The mortality profile of the camelids was first estimated based on a skeletal fusion schedule determined by Miller (2003). The skeletal fusion process in camelids, typically, completes in five years, while camelids live for 8–10 years (Bonavia 2009). Thus, we conducted an age assessment, based on tooth eruption and wear, to determine older animals' life stages, following Stiner (1994) and Wheeler (1982).

Three age categories – juvenile, prime adult, and old adult – were applied during age assessment, based on their teeth. These categories reflect most artiodactyls' growth processes, although each duration varies with animal species and their lifespan (Stiner 1994). Juvenile, defined by deciduous teeth in the dentition, is the category before

reproductive maturity. Prime adulthood, marked by replacing the dp4 with the P4, corresponds to the stage whereby females are sexually mature and reach childbearing age. The transition from prime adult to old was determined by tooth wear patterns and was bound by 61% to 65% of the maximum lifespan. This study set the boundary between prime and old adults at six years.

### 3.6 Sacrifice of Camelid

At archaeological sites, animal remains consumed as food are usually found crushed and scattered on the floor or soil and mixed with other animal species. However, in certain cases, whole bodies or body parts have been found in anatomical positions. Based on the archaeological context, such cases are identified as sacrifices. Several llama sacrifices were detected at Pacopampa. We searched excavation records for similar examples at Kuntur Wasi.

### 3.7 Data Analysis and Statistics

To distinguish between the llamas and the alpacas, discriminant analysis was conducted, using Mahalanobis distance, which does not require normal data distribution. A test of independence was conducted for skeletal elements' occurrence and mortality composition in the different samples, using Fisher's exact test. All analyses were performed using R (R 4.0.3). The  $p$ -values are indicated in the text and  $p < 0.05$  was considered a statistically significant difference.

## 4. Results

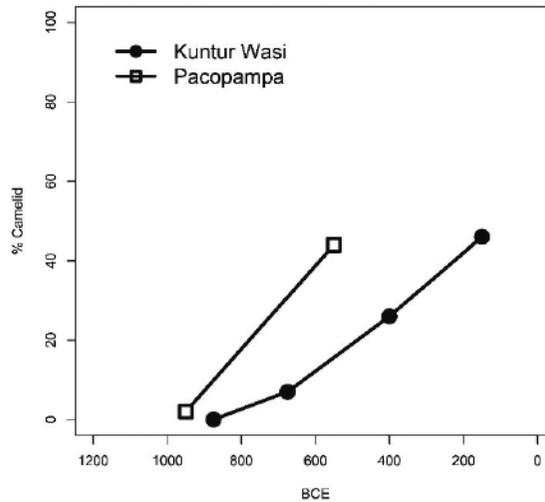
### 4.1 Camelid Composition

The chronological changes in the percentage of camelids, expressed as a relative ratio to deer in the assemblages, are shown in Figure 12-2. In both sites, camelids first appeared in the Late Formative Period. However, only 7% of the camelids were in Kuntur Wasi during the Kuntur Wasi phase. This percentage increased slowly during the Late Formative Period. The percentage of occurrence of the animal was 26% at Kuntur Wasi, which is notably lower than that of Pacopampa during the same period. At Kuntur Wasi, deer continued to be an important animal long after the introduction of the camelids. The slow pace of camelid introduction at Kuntur Wasi is distinctly different from Pacopampa, where camelids increased rapidly in the Late Formative Period. Even in the Sotera phase, which is the Final Formative Period, Kuntur Wasi had similar proportions of camelids and deer, indicating that deer hunting continued to be a significant activity.

### 4.2 Osteometry

In the Late Formative Period, nine specimens were measured at Kuntur Wasi, combining the Kuntur Wasi and Copa phases, and six Final Formative Period materials from the Sotera phase (Table 12-1). There is no difference in size between the phalanges from the two periods. The values of 15 Kuntur Wasi specimens were compared with the value of the comparative materials of the Pacopampa samples (Figures 12-3-a and 12-3-b).

Discriminant analysis identified 14 specimens as llamas and one as an alpaca. The material in Pacopampa was identified as llama (Uzawa et al. 2021) and the sizes for most specimens of the Kuntur Wasi material overlapped. Although one specimen was identified as an alpaca, llamas were used at both Kuntur Wasi and Pacopampa.

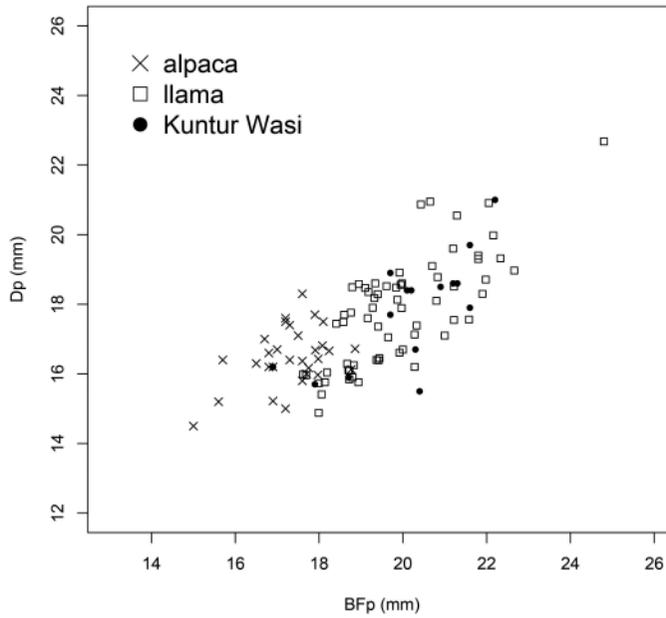


**Figure 12-2** The chronological changes in the percentage of camelids in the Kuntur Wasi and Pacopampa bone assemblages (produced by Kazuhiro Uzawa)

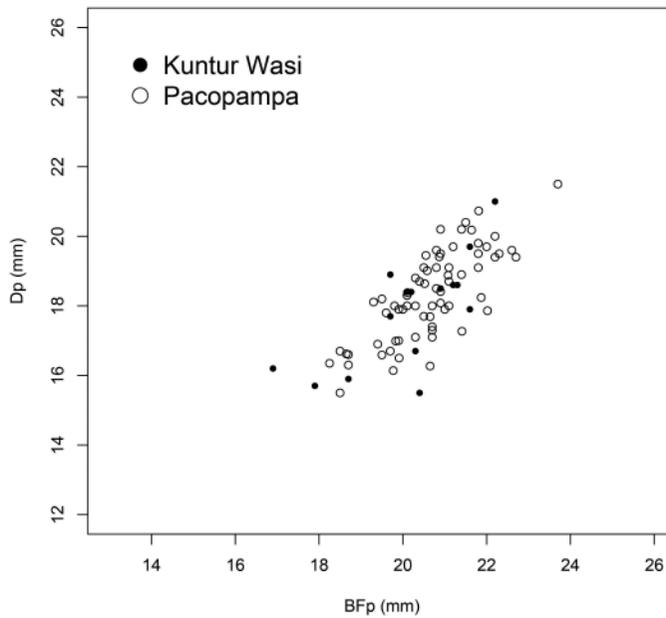
**Table 12-1** The measurements of maximum width (BFp) and depth (DFp) of the proximal facet of the proximal phalanges from Kuntur Wasi

Sample No.	Phase	Period	BFp (mm)	DFp (mm)
94KW-B-119	<i>Kuntur Wasi</i>	Late Formative	16.9	16.2
94KW-B-166	<i>Kuntur Wasi</i>	Late Formative	20.3	16.7
94KW-B-1068	<i>Kuntur Wasi</i>	Late Formative	21.6	19.7
96KW-A-127	<i>Copa</i>	Late Formative	20.4	15.5
96KW-A-140	<i>Copa</i>	Late Formative	19.7	17.7
96KW-A-129	<i>Copa</i>	Late Formative	20.2	18.4
97KW-A-130	<i>Copa</i>	Late Formative	20.1	18.4
97KW-A-240	<i>Copa</i>	Late Formative	20.9	18.5
94KW-B-1545	<i>Copa</i>	Late Formative	19.7	18.9
01KW-R-17	<i>Sotera</i>	Final Formative	18.7	15.9
01KW-R-24	<i>Sotera</i>	Final Formative	21.3	18.6
01KW-R-81	<i>Sotera</i>	Final Formative	21.6	17.9
01KW-R-95	<i>Sotera</i>	Final Formative	21.2	18.6
01KW-R-414	<i>Sotera</i>	Final Formative	17.9	15.7
01KW-R-215	<i>Sotera</i>	Final Formative	22.2	21.0

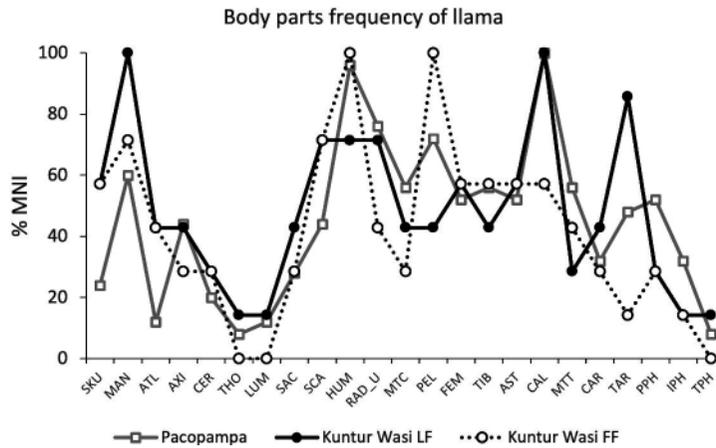
(produced by Kazuhiro Uzawa)



**Figure 12-3-a** Size distribution of camelids. Data for modern llamas and alpacas were taken from different researchers (Cartajena 2009; Izeta et al. 2009; Kent 1982) (see text) (produced by Kazuhiro Uzawa)



**Figure 12-3-b** Size distribution of camelids in Kuntur Wasi and Pacopampa (produced by Kazuhiro Uzawa)



**Figure 12-4** Skeletal frequencies of major elements of artiodactyls remain. The body part frequencies of camelids were plotted by the %MNI of each element. (produced by Kazuhiro Uzawa)

### 4.3 Skeletal Frequency of Camelids

The skeletal elements' frequency is presented in Figure 12-4. The material found in Kuntur Wasi included an animal's entire body, although each skeletal region had variations. The overall skeletal frequency pattern was similar to Pacopampa. Large proximal portions of the limb bones, such as the humerus and the femur, had a high occurrence frequency, while the distal portions of the head, spine, and limbs had a low occurrence frequency. However, the number of vertebrae and ribs may be underestimated because fragments for taxonomic groups, which could not be identified, were excluded from the analysis. For the material in Pacopampa, there was no correlation between the frequency of occurrence of skeletal elements and their strength (Uzawa et al. 2021:  $\rho=0.247$ ,  $p=0.415$ ). The Kuntur Wasi materials were not tested because of the limited quantity.

We examined the differences in the occurrence frequency of materials' parts in Kuntur Wasi and Pacopampa. Skeletons were grouped into four parts – head, trunk, proximal limbs, and distal limbs. The head included the skull and the mandible, while the trunk included the vertebrae, the sternum, and the ribs. The proximal portion of the limb bones comprised the scapula, the humerus, the acetabulum, and the femur and the distal portion of the limb bones comprised the radius, the ulna, the tibia, the metacarpus, the carpus, the tarsus, and the phalanges. Independence tests, using Fisher's exact probability and the MNI values calculated for each body group, showed no significant difference in the intercomparison between the three materials (Tables 12-2-1 and 12-2-2).

### 4.4 Butchering

Bone material from Kuntur Wasi was well preserved, with more than 90% of the specimens showing Behrensmeier's (1978) weathering stage index 1. Therefore,

**Table 12-2** Body parts frequency based on MNI**Table 12-2-1** Results of the independence test for body parts frequency

	Head	Trunk	Upper limb	Lower limb
Kuntur Wasi Late Formative	7	3	5	7
Kuntur Wasi Final Formative	14	3	7	4
Pacopampa	15	11	24	19

(produced by Kazuhiro Uzawa)

**Table 12-2-2** Results of the independence test for body parts frequency

	<i>p</i> value
Kuntur Wasi LF - Kuntur Wasi FF	0.4062
Kuntur Wasi LF - Pacopampa	0.6684
Kuntur Wasi FF - Pacopampa	0.0658

(produced by Kazuhiro Uzawa)

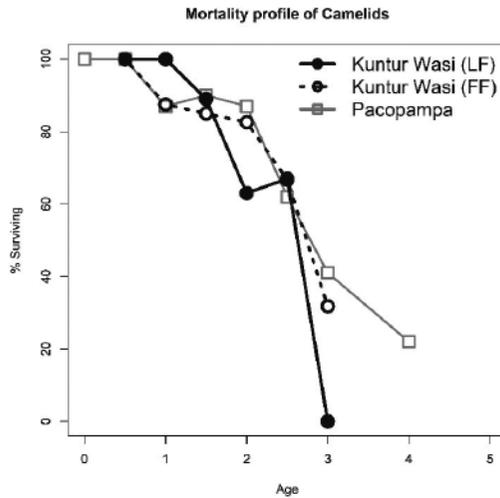
**Table 12-3** Types and distribution frequency of butchering marks

Butchering marks	NISP	Dismembering / Filetting						Marrow extracting						Total			
		Cut		Chop		Peeling		Pit		Striae		Crushing				Scrape	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
<b>Head</b>																	
Kuntur Wasi Late Formative	22	2	9.1	2	9.1	1	4.5	4	18.2	2	9.1	0	0.0	0.0	0.0	5	27.3
Kuntur Wasi Final Formative	26	1	3.8	1	3.8	1	3.8	3	11.5	0	0.0	1	3.8	1.0	3.8	7	26.9
Pacopampa (Late Formative)*	59	6	10.2	1	1.7	2	3.4	3	5.1	1	1.7	1	1.7	0	0.0	13	22.0
<b>Axial</b>																	
Kuntur Wasi Late Formative	24	2	8.3	0	0.0	1	4.2	0	0.0	0	0.0	2	8.3	0.0	0.0	4	16.7
Kuntur Wasi Final Formative	18	1	5.6	1	5.6	0	0.0	1	5.6	0	0.0	1	5.6	0.0	0.0	3	16.7
Pacopampa (Late Formative)	188	7	3.7	8	4.3	4	2.1	11	5.9	6	3.2	10	5.3	0	0.0	32	17.0
<b>Upper limbs</b>																	
Kuntur Wasi Late Formative	53	6	11.3	1	1.9	1	1.9	8	15.1	1	1.9	0	0.0	1.0	1.9	14	26.4
Kuntur Wasi Final Formative	65	6	9.2	0	0.0	2	3.1	2	3.1	0	0.0	1	1.5	1.0	1.5	12	18.5
Pacopampa (Late Formative)	242	20	8.3	11	4.5	2	0.8	33	13.6	8	3.3	10	4.1	3.0	1.2	59	24.4
<b>Lower limbs</b>																	
Kuntur Wasi Late Formative	123	12	9.8	1	0.8	0	0.0	4	3.3	1	0.8	0	0.0	0.0	0.0	10	8.1
Kuntur Wasi Final Formative	97	11	11.3	3	3.1	0	0.0	7	7.2	1	1.0	0	0.0	0.0	0.0	21	21.6
Pacopampa (Late Formative)	764	34	4.5	6	0.8	2	0.3	40	5.2	11	1.4	1	0.1	0.0	0.0	83	10.9

(produced by Kazuhiro Uzawa)

butchering marks were observed in detail. Various dismemberment marks were observed across all body parts – cut marks, chop marks, and peeling were associated with skinning, joint separation, and meat removal and the pit, striae, and scrape were associated with bone marrow removal (White 1992). Hence, the joints were dismembered, the flesh was stripped, and long bones were crushed to extract the marrow.

To compare the distribution pattern of the butchering marks with the Pacopampa material, we divided the entire body into four parts – head, trunk, proximal limbs, and distal limbs (Table 12-3) and classified the four parts following the above-mentioned analysis of the body parts frequency. The Kuntur Wasi material was divided into the Late Formative and the Final Formative Periods.



**Figure 12-5** Mortality profile of camelids at Kuntur Wasi and Pacopampa. The survival curves were estimated based on the bone fusion stage, following Miller (2003). (produced by Kazuhiro Uzawa)

**Table 12-4** Age structure estimation by tooth eruption and wear. The age structure of the Late Formative Period of Kuntur Wasi was not significantly different from that in the Final Formative stage ( $p=0.6115$ ) and Pacopampa ( $p=1$ ).

sample	Juvenile	Prime	Old
Kuntur Wasi LF	9	1	1
Kuntur Wasi FF	5	3	0
Pacopampa	12	4	3

(produced by Kazuhiro Uzawa)

The frequency of butchering marks observed in each body segment was high in all three assemblages. This indicated that the llama’s entire body was elaborately butchered and consumed. After comparing the butchering marks by period and body segments, between material from the Final Formative Period of Kuntur Wasi (21.6%) and Pacopampa (10.6%) ( $p=0.0043$ ), a significant difference was noted only in the lower limb. However, the frequency of percussion pits observed on the head differed between the Kuntur Wasi and Pacopampa materials. At Kuntur Wasi, the frequency of head blows was high throughout the Formative Period, while it was low at Pacopampa. Specifically, the Late Formative Period material of Kuntur Wasi was 18%, which was noticeably different from that of Pacopampa ( $p=0.0826$ ). The possibility of having used different slaughtering techniques was considered, although one must be cautious due to the small sample size of Kuntur Wasi.

#### 4.5 Mortality Profile

Age assessment was performed based on the epiphysis fusion status, according to Miller

(2003). For the Late and Final Formative Periods of Kuntur Wasi, 81 and 115 loci, respectively, were observed. The calculated age structure of a camelid is presented in Figure 12-5. Although Kuntur Wasi had a smaller sample size, compared to Pacopampa (525 loci), the overall trend was shared among the three assemblages. Specifically, the mortality curve at the end of the Formative Period at Kuntur Wasi matched that of Pacopampa.

Conversely, at ages one, two, and three years, the mortality curve at the Late Formative Period of the Kuntur Wasi period showed different values from the other two sources, especially at age three. However, only six specimens were used to estimate mortality at age three. Thus, this result should be interpreted with caution. Most camelids at Kuntur Wasi died before reaching adulthood throughout the Late Formative and the Final Formative Periods. Hence, the results of age composition estimation by bone fusion indicate that the camelids used at the site were immature. As the upper age limit, which can be examined using the bone fusion data, is constrained, age assessment by teeth identified the more mature individuals. In the Late Formative Period assemblage at Kuntur Wasi, nine individuals were juvenile (less than three years old), one individual was a prime adult (less than six years old), and one individual was an old adult (more than six years old). During the Final Formative Period, five juveniles, three prime adults, and no old adult were detected (Table 12-4). The age of comparison at Pacopampa was 12 juveniles, four prime adults, and three old adults (Uzawa et al. 2021). In Pacopampa, most juvenile camels were slaughtered; however, those beyond the adult stage were commonly kept longer, while in Kuntur Wasi, the proportion of old camels was lower. Nevertheless, there was no statistically significant difference when the materials of Kuntur Wasi from the Late Formative and the Final Formative Periods were combined and compared with those of Pacopampa ( $p=0.6115$ ).

## 5. Discussion

### 5.1 Time Transition of Llama Use

At Kuntur Wasi and Pacopampa, llamas were mostly introduced in the Late Formative Period. However, the subsequent development of llama use at both sites was different. In Kuntur Wasi, the proportion of llamas did not increase significantly, even in the Copa phase, which was the latter half of the Late Formative Period, and deer was the main resource in use. This is in marked contrast to Pacopampa, where the use of llamas advanced rapidly during the same period.

Various factors may have influenced the different proportions of deer and llamas at the two sites during the same period. While it is possible to focus on the importance of deer hunting in Kuntur Wasi, it is more reasonable to consider the factors that prevented the use of llamas at this ceremonial center, given the widespread use of llamas throughout Central Andes during this period. We propose that the supply of llamas was limited at Kuntur Wasi during the Late Formative Period than it was at Pacopampa. The ecological environment around Kuntur Wasi must be considered here. Llama production is best suited to cool, water-rich highlands and Kuntur Wasi did not have such a terrain.

Further, Kuntur Wasi may not have been incorporated into the routes of transporting llamas during the Formative Period in the northern highlands of Peru, as proposed by Tsurumi (2014). We have commenced a study to reconstruct the life history of the llamas by isotope analysis and preliminary analysis suggests that different features existed in the production and management of Kuntur Wasi and Pacopampa herds (Takigami and Uzawa this volume). Further investigation is necessary.

## 5.2 Camelid Consumption in the Ceremonial Centers

In contrast to the significant difference in the speed of llama introduction, their use in Kuntur Wasi and Pacopampa was similar, in terms of age composition, excavated parts, and traces of consumption. Young individuals were selected and their entire bodies were consumed. Based on the bone data, the llamas were used primarily for their meat.

It is noteworthy that the similarities in the artifacts of the two sites increase for the llama. When llama use began at Pacopampa, during the Late Formative Period, the number of textile-related artifacts, such as spindles and needles, increased rapidly (Arata 2017). Based on this finding, we argued that adult animals were bred to collect hair, although this did not appear in the animal skeletal remains (Uzawa et al. 2021). At Kuntur Wasi, the number of artifacts related to textile production increased in the Late Formative Period (Nishizawa 2015). Although flesh and bones were not brought into the temple's core, the use of hair from adult animals is suggested at Kuntur Wasi.

## 5.3 Sacrifice of Llama

The most striking difference between the use of llamas in Kuntur Wasi and Pacopampa is in the animal's sacrifice. While four llama sacrifices were identified at Pacopampa, no case was recognized at Kuntur Wasi. We reviewed the excavated records of llamas and did not find any possible cases. While the four sacrificed llamas at Pacopampa showed consistency in the use of primarily less than one-year-old animals, their practices were diverse. While some used the entire body, others had rituals involving beheading or only the distal limb bones. The diversity of their styles reflects the differences in the opportunities and motivations for performing sacrifices. For example, we connected the beginning of camelid breeding to the high mortality of newborns, due to the unsanitary condition of enclosures, and determined that yearlings were sacrificed. As such, the idea of llama sacrifice may have been generated by the act of breeding and managing them. In Pacopampa, hunted deer were not sacrificed, suggesting that llama sacrifices were implemented by the people who reared them.

If these considerations are valid, llamas' sacrifice would reflect the relationship between the llama-producing group and the society, which built the ceremonial center. The new religious practice of killing and offering livestock, according to specific rules, was accepted in Pacopampa. In contrast, llama sacrifices in Kuntur Wasi were not incorporated into the temple rituals, which may be due to the differences in the relationships between the llama-herding groups. In addition, the geographical and social distance of llama production bases may have influenced their use in Kuntur Wasi and Pacopampa.

#### 5.4 Periodic Changes in Camelid Use at Kuntur Wasi

It is essential to understand whether llama use at Kuntur Wasi changed from the Late Formative Period to the end of the period, thus, understanding the early process of llama introduction. Even after combining the Kuntur Wasi and the Copa phases, the llama data from the Late Formative Periods remain scarce. Considering the limitation of sample size, the changes in the occurrence frequency of body parts, butchering marks, and mortality profile are not remarkable. However, based on llama usage and consumption patterns, their supply may have gradually increased.

### 6. Conclusion

Llama breeding occurred during the Late Formative Period in the northern highlands of Peru; however, its importance varied from one region to another. The use of llamas in Kuntur Wasi and Pacopampa was similar, primarily for ritual consumption. Conversely, the difference in the proportion of llamas in the total animal use, and their sacrifice, may reflect differences in geographic and social ties to llama-supplying areas.

Domestic camelids were produced in the central and southern parts of the Central Andes and spread to the northern highlands of Peru by 500 BCE. However, the phenomenon was not similar to the progress of the “llama front line,” which moved northward at a constant rate. Instead, a “hub and spoke” type spread is suggested, whereby, the spread happened from a source site, established in an appropriate environment for camelid breeding, in the surrounding area. The rapid progress of llama breeding and the early acceptance of religious practices, including sacrifices, occurred at Pacopampa before Kuntur Wasi. This may have been due to its close geographical and/or social relationship with the hub base of llama breeding. Further, the base area that supplied llamas to each site must be examined. It is necessary to estimate the place of origin through isotope analysis of excavated camels and examine the regional exchange during the Late Formative Period from the aspect of material culture.

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### References

Arata, Megumi

- 2017 Production, Consumption, and Disposal at the Pacopampa Site: An Analysis of Lithic, Bone and Antler Objects, Clay Objects and Metal Objects. In Y. Seki (ed.) *Andean Civilization: The World of Power through the Analysis of the Archaeological Data Recovered from the Temple*, pp. 133–160. Kyoto: Rinsen-Shoten. (in Japanese)

Barreta, Julia, Beatriz Gutiérrez-Gil, Volga Iñiguez, Valentina Saavedra, Roberto Chiri, Etel Latorre, and Juan Arranz

- 2013 Analysis of Mitochondrial DNA in Bolivian Llama, Alpaca and Vicuna Populations: A Contribution to the Phylogeny of the South American Camelids. *Animal Genetics* 44(2): 158–168.

Behrensmeyer, Anna K.

- 1978 Taphonomic and Ecologic Information from Bone Weathering. *Paleobiology* 4(2): 150–162.

Bonavia, Duccio

- 2009 *The South American Camelids: An Expanded and Corrected Edition* (Monograph 64). Los Angeles: Cotsen Institute of Archaeology Press, University of California, Los Angeles. (Retrieved from <https://escholarship.org/uc/item/7xs9j2zs>)

Cartajena, Isabel

- 2009 Explorando la variabilidad morfológica del conjunto de camélidos pequeños durante el Arcaico Tardío y el Formativo Temprano en quebrada Tulán, norte de Chile. *Revista del Museo de Antropología* 2(1): 199–212.

Fung, Rosa P.

- 1975 Excavaciones en Pacopampa, Cajamarca. *Revista del Museo Nacional* 41: 129–207.

Gasco, Alejandra V. and J. Erik Marsh

- 2015 Hunting, Herding, and Caravanning: Osteometric Identifications of Camelid Morphotypes at Khonkho Wankane, Bolivia. *International Journal of Osteoarchaeology* 25(5): 676–689.

Greenfield, Haskel

- 1988 The Origins of Milk and Wool Production in the Old World: A Zooarchaeological Perspective from the Central Balkans. *Current Anthropology* 29(4): 573–587.

Inokuchi, Kinya

- 2019 Socioeconomic Transformations at the Ceremonial Center of Kuntur Wasi: Raw Material, Craft Production, and Leadership. In R. L. Burger, L. C. Salazar, and Y. Seki (eds.) *Perspectives on Early Andean Civilization in Peru: Interaction, Authority, and Socioeconomic Organization during the First and Second Millennia BC* (Yale University Publications in Anthropology 94), pp. 83–95. New Haven: Department of Anthropology, Yale University and Yale Peabody Museum of Natural History.

Izeta, Andrés D., Clara Otaola, and Alejandra Gasco

- 2009 Osteometría de falanges proximales de camélidos sudamericanos modernos: Variabilidad, estándares métricos y su importancia como conjunto comparativo para la interpretación de restos hallados en contextos arqueológicos. *Revista del Museo de Antropología* 2(1): 169–180.

Kent, Jonathan D.

- 1982 The Domestication and Exploitation of the South American Camelids: Methods of Analysis and Their Application to Circum-Lacustrine Archaeological Sites in Bolivia and Peru. Ph.D. Dissertation, Washington University, St. Louis.

Miller, George R.

- 2003 Food for the Dead, Tools for the Afterlife: Zooarchaeology at Machu Picchu. In R.

- Burger and L. Salazar (eds.) *The 1912 Yale Peruvian Scientific Expedition Collections from Machu Picchu: Human and Animal Remains* (Yale University Publications in Anthropology 94), pp. 1–63. New Haven: Department of Anthropology, Yale University and Yale Peabody Museum of Natural History.
- Morales, Daniel C.  
 1980 *El dios felino en Pacopampa*. Lima: Seminario de Historia Rural Andina, Universidad Nacional Mayor de San Marcos.
- Mondini, Mariana and A. Sebastián Muñoz  
 2017 Osteometrics of South-Central Andean Wild Camelids: New Standards. In M. Mondini, A. Sebastián Muñoz, and P. M. Fernández (eds.) *Zooarchaeology in the Neotropics: Environmental Diversity and Human-Animal Interactions*, pp. 177–188. Cham: Springer.
- Nishizawa, Hiroe  
 2015 Andean Civilizations from a Perspective through the Analysis of Clay Objects from Kuntur Wasi. *Chaski* 51: 16–17. (in Japanese)
- Onuki, Yoshio (ed.)  
 1995 *Kuntur Wasi y Cerro Blanco: Dos sitios del Formativo en el norte del Perú*. Tokyo: Hokusensha.
- Pulgar Vidal, Javier  
 1981 *Geografía del Perú: Las ocho regiones naturales del Perú*. Lima: Editorial Universo.
- Rosas, L. N. Hermilio and Ruth Shady S.  
 1970 *Pacopampa: Un centro formativo en la sierra nor-peruana*. Lima: Seminario de Historia Rural Andina, Universidad Nacional Mayor de San Marcos.
- Seki, Yuji  
 2014 La diversidad del poder en la sociedad del Período Formativo: Una perspectiva desde la sierra norte. In Y. Seki (ed.) *El centro ceremonial andino: Nuevas perspectivas para los períodos Arcaico y Formativo* (Senri Ethnological Studies 89), pp. 175–200. Osaka: National Museum of Ethnology.
- Seki, Yuji, Diana Alemán P., Mauro Ordoñez L., and Daniel Morales C.  
 2019 Emergence of Power during the Formative Period at the Pacopampa Site. In R. L. Burger, L. C. Salazar, and Y. Seki (eds.) *Perspectives on Early Andean Civilization in Peru: Interaction, Authority, and Socioeconomic Organization during the First and Second Millennia BC* (Yale University Publications in Anthropology 94), pp. 107–127. New Haven: Department of Anthropology, Yale University and Yale Peabody Museum of Natural History.
- Shimada, Melody and Izumi Shimada  
 1985 Prehistoric Llama Breeding and Herding on the North Coast of Peru. *American Antiquity* 50(1): 3–26.
- Stiner, Mary C.  
 1994 *Honor Among Thieves: A Zooarchaeological Study of Neandertal Ecology*. Princeton: Princeton University Press.
- Takigami, Mai, Kazuhiro Uzawa, Yuji Seki, Daniel Morales C., and Minoru Yoneda  
 2020 Isotopic Evidence for Camelid Husbandry during the Formative Period at the Pacopampa Site, Peru. *Environmental Archaeology* 25: 262–278.

Tsurumi, Eisei

- 2014 Subsequent Report on the Survey in Northern Peru: New Data from Huancay, Huaraday and Lacramarca Valleys. *América Antigua* 17: 101–118. (in Japanese)

Uzawa, Kazuhiro

- 2010 La difusión de los camélidos domesticados en el norte del Perú durante el Periodo Formativo. *Boletín de Arqueología PUCP* 12: 249–259.
- 2019 A Shift in the Use of Animals in the Northern Highlands Formative Period: Climate Change or Social Adaptation? In R. L. Burger, L. C. Salazar, and Y. Seki (eds.) *Perspectives on Early Andean Civilization in Peru: Interaction, Authority, and Socioeconomic Organization during the First and Second Millennia BC* (Yale University Publications in Anthropology 94), pp. 97–105. New Haven: Department of Anthropology, Yale University and Yale Peabody Museum of Natural History.

Uzawa, Kazuhiro, Yuji Seki, and Daniel Morales C.

- 2021 Ritual Consumption and Sacrifice of Llama (*Lama glama*) at the Pacopampa Site in the Northern Highlands, Peru. *Anthropological Science* 129(2): 109–119.

Wheeler, Jane

- 1982 Aging Llamas and Alpacas by Their Teeth. *Llama World* 1982: 12–17.
- 2012 South American Camelids - Past, Present and Future. *Journal of Camelid Science* 5: 1–24.

Wheeler, Jane C., Joanne Russel, and Hilary Redden

- 1995 Llamas and Alpacas: Pre-Conquest Breeds and Post-Conquest Hybrids. *Journal of Archaeological Science* 22(6): 833–840.

White, Tim D.

- 1992 *Prehistoric Cannibalism at Mancos 5MTUMR-2346*. Princeton: Princeton University Press.

Wing, Elizabeth

- 1972 Utilization of Animal Resources in the Peruvian Andes. In S. Izumi and K. Terada (eds.) *Andes 4: Excavations at Kotosh, Peru*, pp. 327–352. Tokyo: University of Tokyo Press.

Yacobaccio, Hugo D.

- 2004 Social Dimensions of Camelid Domestication in the Southern Andes. *Anthropozoologica* 39(1): 237–247.
- 2007 Andean Camelid Herding in the South Andes: Ethnoarchaeological Models for Archaeozoological research. *Anthropozoologica* 42(2): 143–154.

Yacobaccio, Hugo D. and Bibiana L. Vilá

- 2016 A Model for Llama (*Lama glama* Linnaeus, 1758): Domestication in the Southern Andes. *Anthropozoologica* 51(1): 5–13.