The Archaeology of Andean Pastoralism

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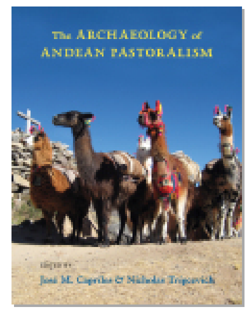

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Chapter 5

Gifts from the Camelids

ARCHAEOBOTANICAL INSIGHTS INTO CAMELID PASTORALISM THROUGH THE STUDY OF DUNG

Maria C. Bruno and Christine A. Hastorf

As archaeobotanists we query the archaeological plant record to understand ancient wild plant gathering, agriculture, and foodways: the quintessential components of human interactions with the plant world. When working with macrobotanical records from the high Andes, however, we confront the reality that most of the wild plant remains we encounter in archaeological settings are the direct result of a human-animal interaction via the use of camelid dung for fuel (Winterhalder et al. 1974). Because only carbonized plant remains preserve in the seasonally wet environments of the Andean mountains, the plants we see are those that were burned. Camelids provide the most important source of fuel in the largely treeless environment, and thus are the primary contributors to the archaeological plant record (Browman 1989; Hastorf and Wright 1998).

The results of an ethnobotanical survey conducted by Bruno (2008) on the Taraco Peninsula, Bolivia, illustrates the fact that domesticated animals are important mediators between the human and plant worlds in the Andes. A collection of 55 pressed wild plants from the peninsula were compiled in a portable booklet. Thirty-one peninsula residents examined each plant and were asked to provide a name for the plant and describe how it was used. Sixty percent (N = 33) of the plants were described as food for grazing animals. Many times the respondents did not know a name for the plant but they would say, "The sheep eat it." While some of these wild plants had additional uses as medicines, infusions, or *matés*, most of them were only recognized based on their contribution to the animals' well-being.

In this chapter, we consider what the patterns in the archaeobotanical record of the southern Lake Titicaca basin can tell us about the ancient camelids themselves, and the plants they interacted with as they grazed. This, in turn, provides insight into several important processes related to past pastoral behaviors rooted in both environmental and sociopolitical processes. In order to accomplish this, we examine a large dataset of botanical remains from two ecologically distinct regions of the southern Lake Titicaca basin: the Taraco Peninsula and the Tiwanaku Valley (Bolivia) (Figure 5.1). While these two neighboring regions have broadly similar botanical compositions, differences in elevation and proximity to water result in notable differences in the plant species upon which camelids can graze. This, in turn, can provide us with data on differential use of the landscape in past camelid pastoralism.

ECOLOGICAL ZONES OF THE TARACO PENINSULA AND TIWANAKU VALLEYS

To initiate this analysis we start with two basic assumptions: (1) people were using camelid dung for their fires,

Figure 5.1. Map showing location of the Taraco Peninsula and Tiwanaku Valley in the Lake Titicaca basin. Modified from Bruno (2008).

and (2) the herds providing the dung were primarily grazed locally, thus eating the plant species in the immediate vicinity or within a day's walk. Based on these assumptions, we would expect the dung-derived plant remains from each site to reflect the local plant ecology. Derivations from these assumptions would indicate nonlocal grazing patterns and/or the introduction of dung from another region.

To establish our baseline inventory of what plant species would be expected in each region, we utilize the vegetation description and distribution maps published by Navarro and Ferreira (2007). This is a system created for all of Bolivia and provides general descriptions of the vegetation communities in the region. To get at some of the more specific species in these zones, we also integrate the ecological zones that archaeologist Juan Albarracin-Jordan utilized for his survey of the lower Tiwanaku Valley (Albarracin-Jordan 1996). His designations correspond quite well with the zones provided by Navarro and Ferreira and provide more specific information on plant species within our study area. In Table 5.1, we summarize the common plant species in each zone and list the specific taxa that we identify archaeologically.

Upper Colluvial / Intermountaine Zone

These zones encompass the highest elevations (higher than 3,840 m above sea level [asl]) of the Taraco Peninsula Mountains to the north and the Quimsachata Mountains to the south. We combine them because their vegetation is similar (Figure 5.2). The soils of this zone are quite thin and rocky, supporting woody shrubs, bunch grasses, a few herbaceous species, and cacti. While the cacti could have been human food, llamas are also known to eat them (Hastorf and Wright 1998). Archaeologically we can specifically identify the woody bush *Tetraglochin cristatum*, several species of Cactaceae, and members of the grass family. We have not identified every species of grass in the archaeobotanical record and generally just identify them to the family-level (Poaceae). The species *Festuca* sp., however, is easily recognized and separately quantified in this study as it is also a common camelid food source.

Table 5.1. Ecological zones present in the study area and the major corresponding plant species.

Navarro and Ferreira (2007)	Albarracin-Jordan (1996)	General Vegetation Description	Archaeologically Identifiable Species
High Andean grassland over "glacis" and peidmont, deep soils/Bofedales/Anthropogenic	Upper Colluvial Zone / Intermountaine Zone	Primarily shrubs, Few grasses, herbs	Cactaceae, *Festuca* sp., Poaceae, *Tetraglochin cristatum*
High Andean grassland over "glacis" and peidmont, deep soils/Anthropogenic	Lower Colluvial Zone	Grasses, fewer shrubs, herbs	Cactaceae, Fabaceae, *Festuca* sp., Malvaceae, Poaceae, *Verbena* sp.
Higrofitic grassland dominated by grasses and Cyperaceae, tuft grasses (amacolladas)	Spring and Grass Zone	Grasses, sedges	Cyperaceae, Fabaceae, Malvaceae, *Plantago* sp., Poaceae, *Verbena* sp.
High Andean aquatic vegetation	Lake/River Zone	Sedges, aquatic species	Cyperaceae, *Potamogeton* sp., *Ruppia* sp.

Lower Colluvial Zone

This zone is along the foothills of the mountain ranges north and south (~3,810–3,840 m asl) (Figure 5.2). This area has slightly deeper, well-drained soils and is an important area for agriculture. For these reasons, this zone has fewer shrubs than the Upper Colluvial/Intermountain Zone and more grasses, including *Festuca* sp., and several herbaceous species, many of which thrive as agricultural weeds such as the malvas and wild legumes. There are also a few cacti that grow in the rockier areas.

Spring and Grass Zone

These lower elevations of the peninsula (3,810–3,820 m asl) and valley contain the spring and grass zone (Figure 5.2). This is at the break in the slope of the hills and mountains, as they flatten out onto the plain. Here, grasses dominate, and where there are small springs, water-loving species such as sedges and *Plantago* sp. grow. There are no particularly diagnostic grasses that we identify archaeologically here but *Festuca* sp. should be absent. We identify at least three types of sedges or Cyperaceae but have not yet identified them to species. We discuss this family further in the next segment.

Lake and River Zone

The lake zone is dominated by aquatic species particularly within the Cyperaceae family (Figure 5.2). This is the flat lakeshore and its associated plain. While grasses and sedges grow where the lake waters recede on a seasonal basis (Bruno 2011), the shallow waters of the small lake support many aquatic plant species (Iltis and Mourguiart 1992; Raynal-Roques 1992). The most important for human use is the totora reed (*Schoenoplectus tatora*) as it provides materials for housing, mats, boats, basketry, and food (Levieil and Orlove 1992; Orlove 2002). Today, residents of the peninsula intensively harvest the totora reeds to feed their herds of cattle and sheep. In addition to totora, people collect the submerged aquatic plants, particularly *lima* (*Elodea potamogeton* and *Myriophyllum elatinoides*) but also *Potamogeton* sp., to feed animals (Bruno 2008). Sadly, there are no camelid herds on the peninsula today, only a few lone animals, and we do not know if these are also fed with the lake plants. In fact, a major question regarding ancient Andean pastoralism is whether foddering was practiced in the past anywhere. Scholars such as Duccio Bonavia (1996) view foddering as a European practice because the introduced animal species were more particular grazers than llamas, who are known to eat whatever is available to them. Alpacas are more particular grazers and require more water than llamas; yet the ethnographic record suggests these herds were moved to the better grazing areas, rather than humans harvesting and bringing food to them (Flannery et al. 1989; Franklin 1982). Whether or not foddering occurred in the past is something we will consider here.

Archaeobotanical Records of the Taraco Peninsula and Tiwanaku Valley

With these basic vegetation patterns of the broad zones established, we now consider the particular ecologies of

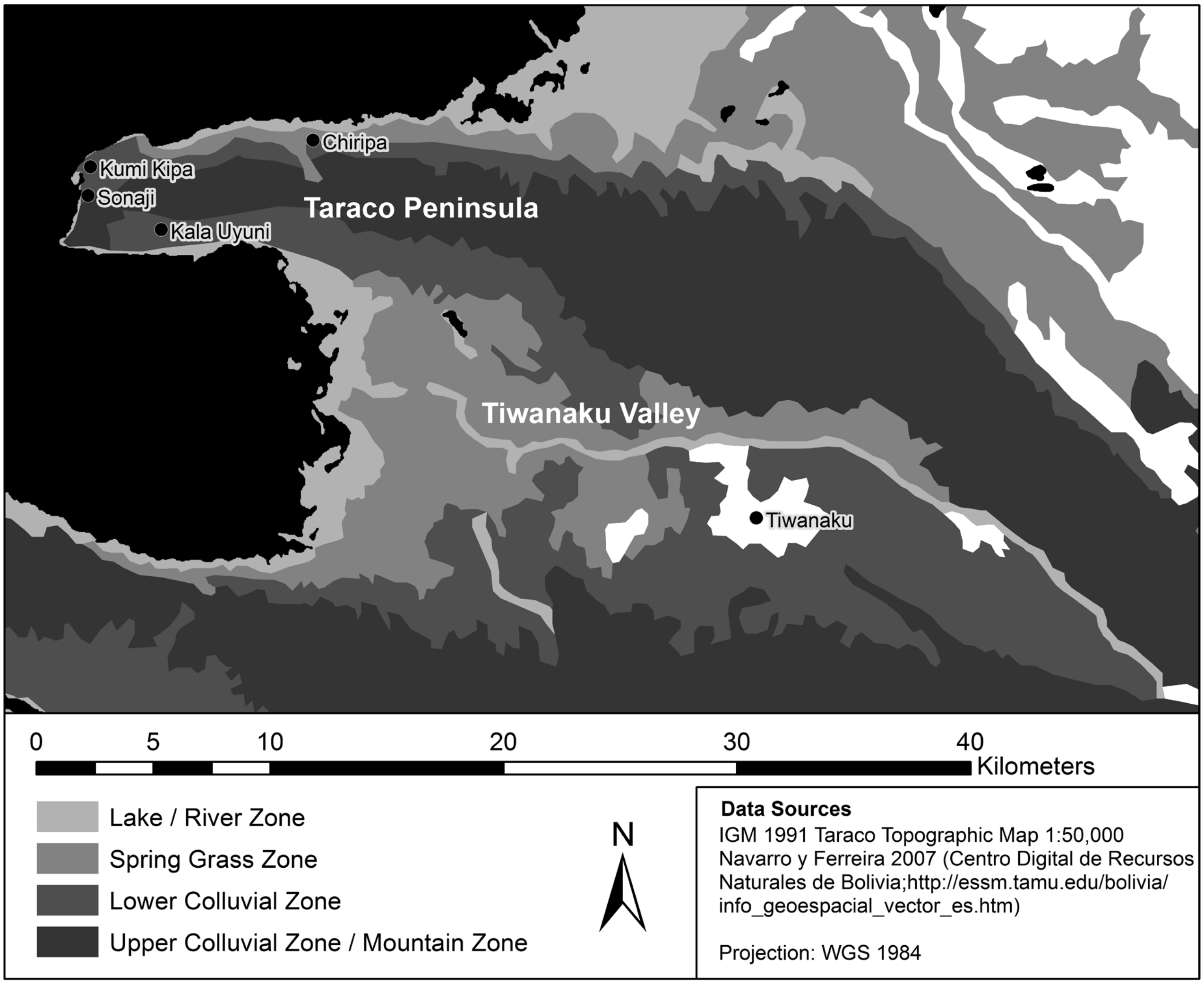

Figure 5.2. Study area with locations of the ecological zones and sites mentioned in the chapter. Based on Navarro and Ferreira (2007).

both the Taraco Peninsula and the Tiwanaku Valley and how these zones are distributed in each area. We use these basic ecological patterns to create hypotheses about which zones might have been exploited in the past for camelid grazing and derive several expectations for how they would be reflected in the archaeobotanical records of each area.

We also briefly discuss the archaeological contexts, particularly the time periods and sociopolitical contexts, for the archaeobotanical samples considered in the study.

The Taraco Peninsula

The Taraco Peninsula is a low-lying eroded range that juts into the small lake basin, Lago Wiñaymarka (Figures 5.1 and 5.2). This geography provides the full range of microenvironmental zones discussed here, except for the highest intermountain reaches. Shrubs and cacti dominate the Taraco hilltops with just a few stands of hearty grasses. The gentle upper slopes become grassier, but the relatively flat areas between the slope and lakeshore are moist and sustain lush grasses as well as clusters of small sedges. While grasses and sedges fill in where the lake waters recede, the shallow waters of the small lake support many aquatic plant species. The Taraco Peninsula is a fairly restricted area of land and all four vegetation zones are accessible on foot within about 30–45 minutes from any of the archaeological settlements; thus, camelid herds could have potentially grazed in all of these zones at various times of the year. Based on these observations, we would expect the dung of animals grazing across the Taraco Peninsula to have a mix of dryland grasses, herbaceous plants, as well as lacustrine species. Given the proximity to the lake, we might even expect there to be a higher frequency of lacustrine species if the herders were taking advantage of this high-quality source of food, harvesting it and feeding it to their animals.

The Taraco plant samples derive primarily from Formative period (1500 BC–AD 500) contexts (Bruno 2008; Langlie 2008; Whitehead 2007). This was a time of local population growth and internal sociopolitical developments (Bandy 2004; Hastorf 2003, 2008). Most of our current models assume that food production including farming, fishing, and herding were local practices (Browman 1989; Capriles et al. 2008; Moore 2011; Moore et al. 2010). While herders may have spent part of the year in other areas to find forage for their animals or to obtain goods from distant areas, no larger political system of production specialization was in place in the Formative Period to bring camelid dung from these other areas. Thus, our expectation for these samples is that they should represent the local vegetation. We are, however, uncertain as to whether herders would have harvested the lake plants to feed their herds.

Tiwanaku Valley

The ancient city and center of the Tiwanaku state is located about 20 km southeast of the Taraco Peninsula in the middle Tiwanaku Valley (Figure 5.2). It sits in the midst of expansive grassland with abundant grasses and herbaceous plants upon which to graze. This valley primarily consists of the Lower Colluvial and Spring and Grass Zones. The Upper Colluvial zones are several kilometers away from the city center, a half-day's journey in one direction to the northwest toward the Taraco Range and over 10 km to the higher Quimsachata Mountains to the south. While the Tiwanaku River and scattered springs support some of the smaller water-loving sedges, it is a half-day's walk to the nearest totora reed beds and other aquatic species of the Lake Zone. There are, however, remnants of *qochas*, or human-made ponds, near the city; when filled with water the ponds may have supported stands of totora and other aquatic plants seasonally (Albarracin-Jordan 1996; Flores Ochoa 1987).

Based on these observations, we would expect the dung of animals grazing within the general proximity of Tiwanaku itself to contain primarily grasses as well as herbaceous species. There may be a few sedges, but the lake species would not be present or at least they would be present in lower quantities than from those animals living near the lake associated within the Taraco Peninsula settlements. Upper Colluvial Zone species would also be rare.

The sociopolitical and economic dynamics of the Tiwanaku city and its state are quite distinct from those of Formative Period Taraco Peninsula (Hastorf 2003; Janusek 2004; Kolata 1982); thus, several other issues must be considered when deriving expectations for these samples. Perhaps the most pertinent question is whether herds were kept near the outskirts of the city during parts of the year to graze upon the vast grasslands (Vallières 2012), or were always on the move, grazing in distant lands as a meat source or as part of caravans (Browman 1980). While it might be expected that the Formative Period villages on the peninsula could graze their herds near the settlements, the urban center of Tiwanaku may not have supported this type of nearby pastoralism. Were the qochas, such as the large one near the Mollo Kontu mound, used for camelid grazing or possibly for cultivation of totora reeds for camelid food when the herds were visiting the city (Vallières, this volume)? If local herds were left to simply graze on the naturally available vegetation, we would expect the samples to be dominated by local valley grasses and herbs. If, on the other hand, herds were kept far from the city and their dung was transported back to the city for fuel, we would expect their floral composition to be quite distinct from these expectations.

MATERIALS AND METHODS

The 814 Taraco Peninsula flotation samples derive from four sites: Chiripa, Kala Uyuni, Sonaji, and Kumi Kipa, which were excavated by the Taraco Archaeological Project, directed by Christine Hastorf beginning in 1992 with co-director Matthew Bandy, between 2001 and 2005 (Figure 5.2). The 876 Tiwanaku flotation samples derive from various sectors of the site of Tiwanaku itself during excavations of the Wila Jawira Project directed by Alan L. Kolata between 1989 and 1991. The same procedures were used for the recovery, processing, and analysis of all the macro-botanical samples in this study (Wright et al. 2003). In addition to the authors of this chapter, many individuals contributed to the analysis of these samples including Heidi Lennstrom, Melanie Wright, William Whitehead, BrieAnna Langie, and many student volunteers in Hastorf's archaeobotany laboratories in the University of Minnesota and the University of California, Berkeley.

Table 5.2. Wild plant taxa identified in macrobotanical remains by region.

TAXA FOUND IN BOTH REGIONS' SITES	TARACO ONLY	TIWANAKU ONLY
Amaranthaceae (*Chenopodium* sp.)	Apiaceae	Caryophyllaceae
Amaranthus sp.	Capparidaceae	*Oenothera*
Asteraceae	Convolvulaceae	
Brassicaceae Type 1	*Erythroxylum coca*	
Brassicaceae Type 2	Euphorbiaceae	
Cactaceae	*Galium* sp.	
Chenopodium quinoa	*Tetraglochin cristatum*	
Cyperaceae		
Fabaceae (*Trifolium amabile)*		
Festuca sp.		
Kainya		
Lamiaceae		
Malvaceae		
Nicotiana sp.		
Oxalis sp.		
Plantago sp.		
Poaceae		
Polygonaceae		
Portulaca sp.		
Potamogeton sp.		
Relbunium sp.		
Ruppia sp.		
Salvia sp.		
Sisyrinchium sp.		
Solanaceae		
Verbena sp.		

In this study, we focus on the seeds of wild plant species. Based on both ethnobotanical and ethnoarchaeological studies, these seeds most likely entered the charred archaeobotanical record through camelid dung fuel use (Hastorf and Wright 1998). We exclude crop plants, although we recognize that camelids do eat quinoa.

In many cases, we can only identify the seed to genus or family level, although some plants are identified to species-level (Table 5.2). We identified 33 different wild seed taxa in the Taraco samples and 28 in the Tiwanaku samples. The difference in the number of identified taxa between the two areas may not reflect different environments but possibly the fact that more comparative collections were available during the later Taraco analyses and we have not yet had the opportunity to see if any of the newly identified taxa match some of the Unknown seeds from the Tiwanaku analysis.

The vast majority (N = 26) of the taxa identified are present in both regions. This supports the earlier observation that the two regions are quite similar botanically. Despite the similarities in taxa, we would expect to see differences in their relative distributions. To reiterate, based on the available plant species and our knowledge of their ecologies we would expect the Tiwanaku samples to be dominated by the species found in the Lower Colluvial Zone and Spring Grass zones, such as grasses and some sedges, while we would expect to find the full range of species in the Taraco samples, especially species such as Cyperaceae and *Potamogeton* sp. from the Lake zone.

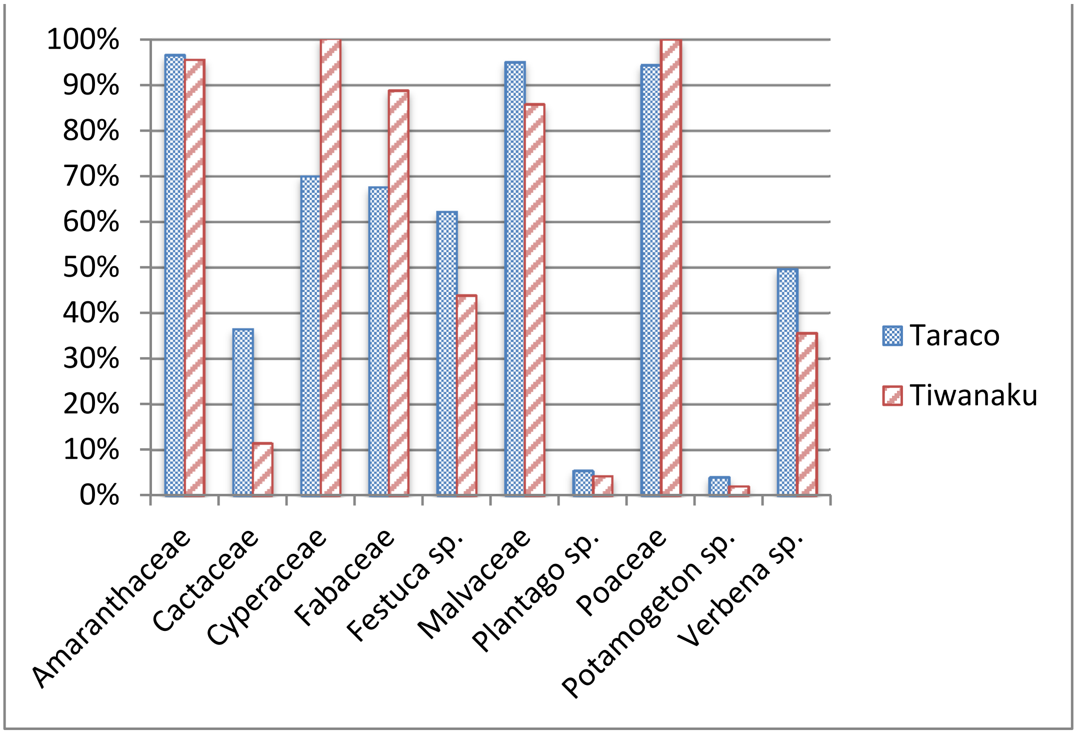

Figure 5.3. Comparison of ubiquity of most common taxa between the Taraco and Tiwanaku plant samples.

Ubiquity

In order to measure the relative differences in the presence or absence of each particular species, without having to worry about differences in preservation or relative abundance, we utilize the ubiquity (percent presence) measure (Popper 1988) (Figure 5.3).

Based on ubiquity, we can observe several interesting patterns. First, the most common taxa in *both* regions appear to be Amaranthaceae,[1] Malvaceae, and Poaceae. This could reflect their general presence across both landscapes, but could also suggest that camelids particularly prefer these species. The Taraco samples have greater ubiquities of *Verbena* sp., Cactaceae, *Festuca* sp., Malvaceae (by a slight margin) as well as *Potamogeton* sp., and *Plantago* sp. The greater presence of Cactaceae, *Festuca* sp., *Potamogeton* sp., and *Plantago* sp. meet the expectations in which camelids on the peninsula would have greater access to species in the Upper Colluvial and Lake Zones. It is also worth mentioning that another species associated with the Upper Colluvial Zone, *Tetroglochin christatum*, was only present in the Taraco assemblage. As might be expected if camelids were grazing primarily in the Lower Colluvial and Spring/Grass zones, the Tiwanaku samples have higher ubiquities of Fabaceae and Poaceae. It is very unexpected to find a high ubiquity of Cyperaceae in the Tiwanaku samples however, as the city is not near extensive wetlands. While some of these species could come from the wet areas around springs, qochas, and river, without the nearby presence of lake plants we would not expect to see Cyperaceae so common in the Tiwanaku valley samples, yet they are even more common than in the Taraco samples.

Percent of Taxa in Total Sample

We next consider the frequency with which these taxa appear in the samples, or their contribution to the total seed assemblage (Figure 5.4). Overall we can see that while many of these taxa are present in all of the samples (high ubiquity), some of them appear in fairly small quantities (*Potamogeton* sp. and *Plantago* sp. are excluded because they are less than one percent of the entire sample for both regions). Cyperaceae is a case in point: while it is found in 100 percent of the Tiwanaku samples, it only represents 1 percent of the assemblage, telling us that while it is not abundant it was widely distributed across the settlement. Poaceae is a bit more frequent, representing 15 percent of the total assemblage.

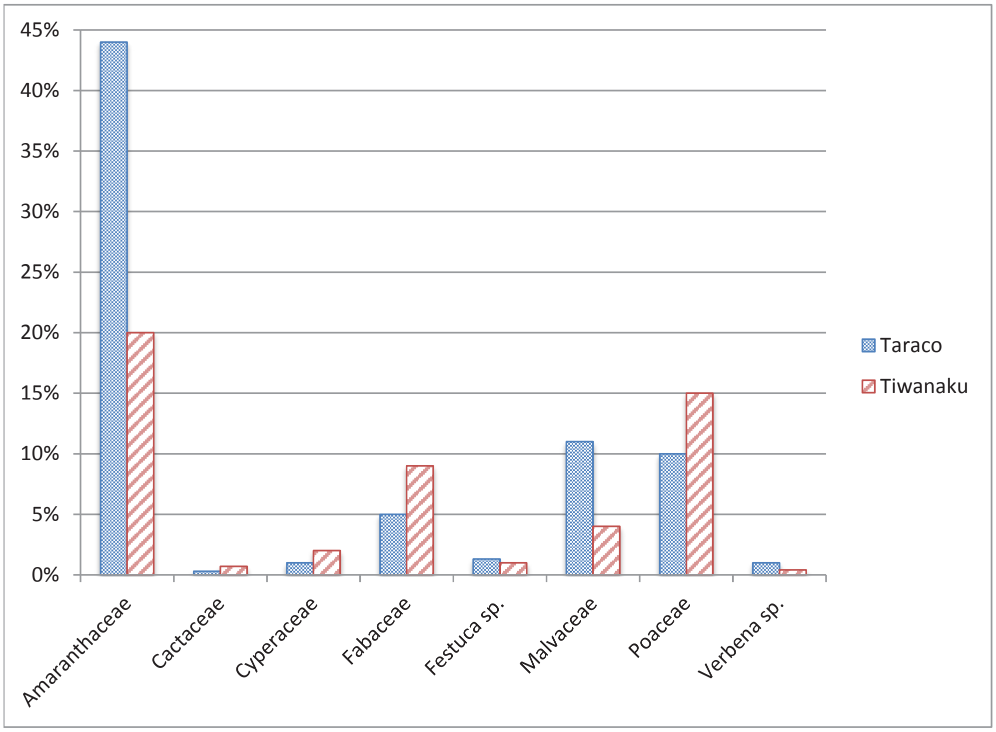

Figure 5.4. Relative frequency of each taxon between the Taraco and Tiwanaku assemblages.

As might be expected based on the similar ubiquities, the Taraco samples have higher percentages of *Festuca* sp., Malvaceae, and *Verbena* sp. Amaranthaceae seeds are much more abundant in the Taraco samples than the Tiwanaku ones. Either this species was very abundant and preferred by the camelids on the peninsula or they were able to graze in fallow fields. It is also possible that we are seeing humans select for this plant for other purposes (Bruno 2008:306–312). Although the cacti were more common in the Taraco samples, they have just a slightly higher percentage at Tiwanaku. Cacti are quite low in both populations indicating a fairly low occurrence in the diets of camelids and also possibly humans. As with the ubiquity values, the Tiwanaku samples have higher percentages of Cyperaceae, Fabaceae, and Poaceae.

DISCUSSION

Based on this small study, a few very interesting patterns emerge regarding the eating habits of the camelids whose dung was an essential fuel for the ancient people on the Taraco Peninsula and at Tiwanaku. Overall, we argue that the Taraco samples conform to an expected pattern of camelids grazing in the various, easily accessible zones of the peninsula, and their dung being used to fuel local hearths. We find the species present in the samples typical of all local zones, although it does appear that Amaranthaceae, Malvaceae, and Poaceae are among the most commonly consumed by the animals. There is no suggestion in the plant data that these animals were foddered.

While aspects of the Tiwanaku sample suggest local grazing in the nearby grasslands as well, with Poaceae, Malvaceae, Fabaceae very common and few Upper Colluvial Zone species, the higher than expected ubiquity of Cyperaceae, plants associated with the wetter zones, was unexpected and requires us to consider scenarios in which animals were taken to moist environments to graze, or that they received moist lake plants as fodder while at Tiwanaku.

Whereas Cyperaceae seeds do not comprise a large percentage of the samples, its regular ubiquity across the Tiwanaku samples suggests that these plants, and therefore wet zones, were readily available to the animals whose dung was being burned at Tiwanaku. There are a few explanations to explore for this seed pattern. One is that the herds were periodically grazing where water-loving species were available. This could have been due to animals regularly traveling through the wetter highland qochas, or regularly residing in lakeshore locations, perhaps Iwawi or Lukurmata, in areas of the valley where springs or qochas were available, along the Rio Desaguadero to the south, or higher up in the mountains. Dung produced by these animals was then brought to the city for fuel, and either distributed by the state or provisioned by rural households themselves. The other possibility is that these plants were transported from the lake to the valley and were fed to the local camelids as fodder. There are accounts of people today traveling several kilometers with harvested totora reeds to feed animals (Levieil and Orlove 1992). It is difficult to determine which scenario is valid with the current data but is something that might be answered in the future. What we can say is that the Tiwanaku camelids had regular access to plants from moist zones, more so than the Taraco Peninsula animals did.

CONCLUSIONS

New herding insights can be gained by considering what the archaeobotanical record can reveal about the camelids themselves; or, rather, about the herding practices of the people who were raising them. This study suggests that the earlier and more rural context of the Taraco Peninsula indicates highly localized herding practices that utilized all local ecological zones. While the presence of Cyperaceae and other water-loving species suggest herds did have access to the zones with these plants, the relatively low ubiquity and frequency, especially compared to the Tiwanaku samples, suggest people were probably not harvesting lake plants to feed their herds, nor taking the animals far away on a regular basis. In contrast, the Tiwanaku samples suggest more specific management of what the herds were eating. While there are the plants we might expect to find in the expansive grasslands of the altiplano, the high ubiquity and relatively higher frequency of Cyperaceae in these samples suggests that herders were purposefully providing them water-loving species, either by grazing them in areas where they are available or possibly harvesting them as fodder. This study provides yet another example of how the Tiwanaku state intensified the economies of the southern Lake Titicaca basin, in this case influencing how camelids were maintained.

ACKNOWLEDGMENTS

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NOTE

1. This category includes a wild species of this family that is likely a chenopod, possibly a wild *kañawa* (*Chenopodium pallidicaule*).

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