

Wari's imperial influence on local Nasca diet: The stable isotope evidence

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Abstract

The highland Wari Empire established a presence within the Nasca region of south coastal Peru during the Middle Horizon period. To clarify the nature of this interaction, we analyzed stable carbon and nitrogen isotope ratios of human bone collagen from individuals living in the Southern Nasca Region (SNR) before (1–750 AD) and during (750–1000 AD) imperial influence. The stable isotope data do not indicate that the Wari Empire transformed maize agricultural labor in the Las Trancas Valley of the SNR. In fact, during both time periods, Nasca people had access to a wide range of food items.

During the imperial period, however, dietary breadth increased, with greater inter-individual differences in meat consumption and C₃ foods. During a time of probable population increase, some high status individuals consumed more meat and maize than others. Other individuals consumed less meat and more C₃ foods such as beans, potatoes, huarango, or *quinoa*, which may reflect less meat availability for some individuals within the population. There is, however, no average difference in diet between the sexes, which is consistent with a similar consumption of maize. This suggests that maize consumed in the form of beer (*chicha*), in contrast to ethnographic reports of feasting, was not differentially distributed between males and females. Apparently, the Wari interest in the Las Trancas Valley of the SNR was focused on resources other than maize.

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Introduction

Wari of south central Peru (750–1000 AD, see Fig. 1) was one of the first expansive states to develop in the New World, yet we know less about its rise and expansion than we do about the slightly earlier Teotihuacan state in Mexico (Cowgill, 1997; Manzanilla, 2002) or the contemporaneous Andean Tiwanaku state centered in the Lake Titicaca region (Bermann, 1997; Kolata, 1993; Goldstein, 2005; Janusek, 2004; Stanish, 2002). Recently, however, Wari studies have increased substantially, focused not only on consolidation in the imperial heartland (Cook and Glowacki, 2003; Finucane et al., 2006; Isbell, 2004) but also on peripheral regions such as Beringa in the Majes Valley (Tung, 2007), Tenahaha in the Cotahuasi Valley (Jennings

and Alvarez, 2001), Pikillacta in the Cuzco region (Glowacki and McEwan, 2001; McEwan, 2005), Sonay in the Camaná Valley (Malpass, 2001), Jincamocco in the Sondondo Valley (Schreiber, 1992), and Cerro Baúl, the Wari enclave in the Moquegua Valley (Moseley et al., 2005; Williams, 2001; Fig. 1). The present work extends such studies of peripheral regions by focusing on the Nasca (1–750 AD) of the south coast of Peru, where Wari influence is known (Schreiber, 1999, 2000), although its specific nature is uncertain.

The similarities between Wari and Nasca ceramic technology and iconography suggest a close relationship between the two societies (Menzel, 1964). Wari interest in Nasca may have been economic as the region is well-suited for maize production and two Wari sites are built near areas that today support cotton and coca production (Schreiber, 2005b). Alternatively, it may have involved trade in other material goods such as cotton or ceramics (Clarkson, 1990;

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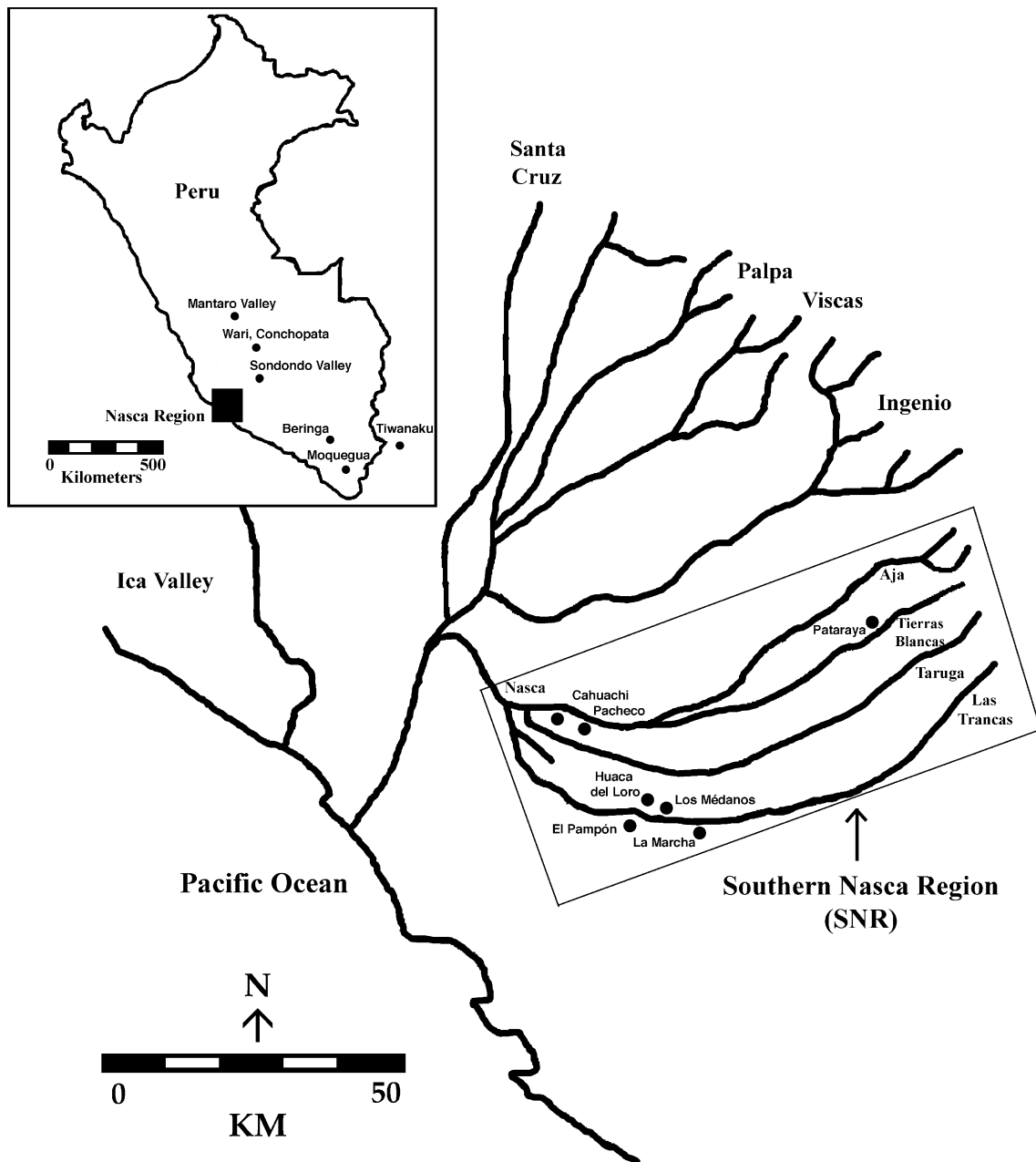


Fig. 1. (Above) Map of Peru with the Nasca region (black square) and relevant Middle Horizon sites discussed within the text identified. (Below) Map of the Río Grande de Nasca drainage system with the relevant valleys and archaeological sites specified (adapted from Schreiber and Lancho Rojas, 2003). The three valleys within the Southern Nasca Region (SNR) are inside the box (adapted from Vaughn, 2005, Figure 7.1).

Conklin et al., 1996). Wari presence in the Nasca region, however, is not as intensive as other areas such as the Sondondo Valley near Ayacucho, where Wari affect extensive changes in settlement location (Schreiber, 1987, 1992) or in areas with massive imperial constructions such as Pikillacta or Viracochapampa (McEwan, 2005; Topic, 1991).

We focus on diet because imperial strategies often involve dramatic shifts in subsistence regimes within peripheral societies (Costello and Walker, 1987; D'Altroy and Hastorf, 2001; Larsen et al., 2001; Smith et al., 2003; Walker et al., 1989; Wilkinson, 2003). A thorough understanding of food production and consumption should explicate the “form, structure, and extent of state power-

[on]. . .the daily lives of people in their domestic activities” (Hastorf, 1990, 262). Access to foodstuffs and labor is crucial to the functioning of any society, but states often extract these commodities from populations under their influence to a greater extent than chiefdoms do (Danforth, 1999). For example, during the Spanish Empire’s settlement of Florida and California in the New World, the state relied on essentially captive indigenous labor to extract foodstuffs for the maintenance of the state’s presence in the region. In doing so, local diet shifted significantly to focus on these foods (Larsen et al., 2001). Nasca, a region with Wari imperial sites yet without a motive for imperial incursion provides a unique opportunity to test imperial

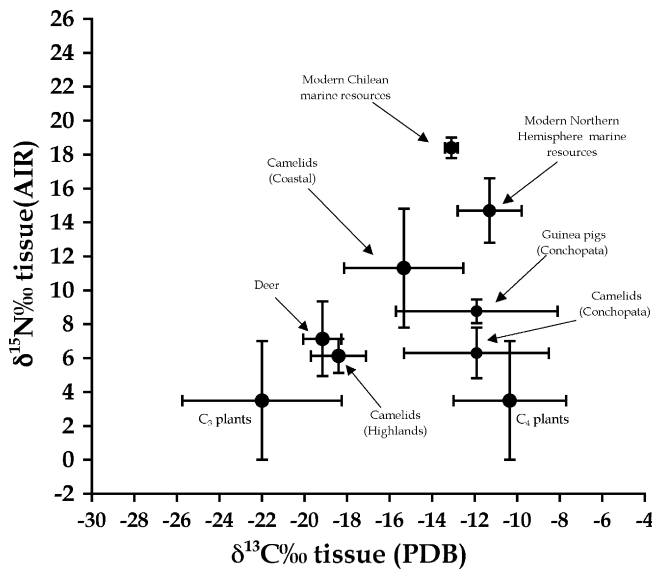


Fig. 2. Archaeological and modern stable isotope average values of the foodstuffs most likely consumed by the Nasca people (whiskers are ± 1 SD). 1.5‰ is added to the actual $\delta^{13}\text{C}$ values of modern plants and animals in this figure to offset the ^{12}C -enrichment of today's atmosphere and permit direct comparison with archaeological remains (data from: DeNiro, 1988; Isla, 1992; Orefici and Drusini, 2003; Rodriguez de Sandweiss, 1993; Schoeninger and DeNiro, 1984; Silverman, 1993; Tieszen and Chapman, 1992).

strategies related to the extraction of foodstuffs in a peripheral society. Toward that end, we use carbon and nitrogen stable isotope data in human bone collagen to assess human diet in the Nasca region just prior to and during Wari imperial influence.

Background

Stable isotopes

Bone collagen exhibits carbon and nitrogen stable isotope ratios (represented as $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ in per mil notation: ‰)¹ that are correlated with the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ of an individual's diet (see Katzenberg, 2000). The most common use of the $\delta^{13}\text{C}$ values in human bone collagen is to determine the relative dependence on plants that use the C_3 or C_4 photosynthetic pathway or on animals that feed on these plants. As seen in Fig. 2, C_3 and C_4 plants show no overlap in $\delta^{13}\text{C}$ values. C_3 plants, which have low (more negative) $\delta^{13}\text{C}$ values, consist of trees, herbaceous plants, cool season grasses, and the vast majority of other plants. C_4 plants, which have higher (less negative) $\delta^{13}\text{C}$ values, include many grass species such as maize. A third photosynthetic pathway, i.e., CAM, includes cacti and other suc-

culents. These plants exhibit $\delta^{13}\text{C}$ values that can fall between C_3 and C_4 plants although several overlap with C_4 plants. Fauna eating either C_3 or C_4 plants or some mixture of the two record those diet sources in their tissues (DeNiro and Epstein, 1978) but have bone collagen $\delta^{13}\text{C}$ values about 3–4‰ higher than their diets (see data in Kellner and Schoeninger, 2007). Marine animals have $\delta^{13}\text{C}$ values in their flesh that are higher than most C_3 plants and can overlap the values for C_4 plants (Schoeninger and DeNiro, 1984). Therefore, in regions where humans eat maize and have access to marine foods, human bone collagen $\delta^{13}\text{C}$ values are not useful in reconstructing the amount of marine food in diet (Schoeninger et al., 1990).

Nitrogen stable isotope ratios in plants vary widely based on their source of nitrogen and metabolic factors (Shearer and Kohl, 1986). Terrestrial plants have $\delta^{15}\text{N}$ values ranging from ‰ to +7‰ (Virginia and Delwiche, 1982). With few exceptions, legumes have $\delta^{15}\text{N}$ values in the lower end of this range whereas other plants fall at the higher end (see data in Schoeninger et al., 1997) because legumes depend to a varying extent on fixation of atmospheric nitrogen, which has the value zero (by definition). The vast majority of plants, however, obtains its nitrogen from soil, and, on average, have $\delta^{15}\text{N}$ values around 3–7‰. Herbivorous animals have bone collagen $\delta^{15}\text{N}$ values that are approximately 3‰ higher than those of the plants on which they feed and there is a 3‰ offset, on average, between the bone collagen $\delta^{15}\text{N}$ values of herbivores and carnivores (Schoeninger and DeNiro, 1984). It is less clear how accurately omnivory (i.e., some meat in the diet) is recorded although because meat contains relatively more nitrogen per unit weight than does the majority of plant material, meat intake should be reflected in bone collagen $\delta^{15}\text{N}$ values (Phillips and Koch, 2002; Schoeninger, 1985). Marine animals exhibit higher $\delta^{15}\text{N}$ values in their bone collagen and other tissues than do terrestrial ones (Schoeninger and DeNiro, 1984), and human diets that include marine foods have higher $\delta^{15}\text{N}$ values than those with only terrestrial foods. Further, marine diets high in secondary carnivores (e.g., carnivorous mammals and fish) have higher $\delta^{15}\text{N}$ values than do diets with marine invertebrates due to trophic level effects (e.g., Schoeninger et al., 1983; Little and Schoeninger, 1995). In regions where prehistoric human populations had access to both marine and maize, which confound the use of $\delta^{13}\text{C}$ values, bone collagen $\delta^{15}\text{N}$ values identify dependence on marine foods (Schoeninger et al., 1990).

Imperial strategies and indigenous subsistence

Empires use various strategies for conquering or influencing peripheral communities (Menzel, 1959). Expansive states in prehistory, facing daunting transport costs and without recourse to dominant militaries and wide-ranging economic systems of later imperial powers usually “tailored their approaches to the sociopolitical and natural circumstances of each region” (D’Altroy et al., 2000, 1) as

¹ The ratios of carbon and nitrogen ($^{13}\text{C}/^{12}\text{C}$ and $^{15}\text{N}/^{14}\text{N}$) in bone collagen are reported relative to PDB (PeeDee Belemnite) for carbon and AIR (atmospheric nitrogen) for nitrogen in parts per mil (‰) using delta (δ) notation (Hoefs, 2004). $\delta^{15}\text{N}$ is calculated as: $(\frac{^{15}\text{N}/^{14}\text{N}}{\text{sample}} / \frac{^{15}\text{N}/^{14}\text{N}}{\text{standard}} - 1) \times 1000$, while $\delta^{13}\text{C}$ is calculated as: $(\frac{^{13}\text{C}/^{12}\text{C}}{\text{sample}} / \frac{^{13}\text{C}/^{12}\text{C}}{\text{standard}} - 1) \times 1000$.

well as the myriad needs of the empire (Schreiber, 1992). The core-periphery model (Kohl, 1987; Wallerstein, 1974) describes the *asymmetrical* political and social relationships between states and associated peripheral societies but may not take into account the variation of imperial ties to their various peripheries (Stanish, 1997).

Imperial influence is not monolithic. Local groups also shape the imperial experience, whether resisting or complying with imperial strategies (e.g., Taylor and Pease, 1994; Wells, 1999). Local response can differ across regions, but often centers on the control of the production of foodstuffs. Various examples from around the world (albeit concentrating on the Andes) serve to outline a range of possible outcomes for Wari influence on Nasca diet.

In North America, the southwestern Pueblos (Reff, 1995), the coastal California Chumash (Beebe and Senkewicz, 1996), and the coastal southeastern Guale (Larsen et al., 2001) all revolted against the Spanish largely over forced conscription for ever-increasing agricultural production for the empire. In all these regions, aspects of health worsened during imperial rule (e.g., higher rates of carious lesions, enamel hypoplasia, porotic hyperostosis, and osteoperiostitis); due, at least in part, to the missions' crowded living conditions and a decrease in diet quality (El-Najjar, 1976; El-Najjar et al., 1976; Hooton, 1930; Larsen et al., 2001; Walker, 1985; Walker et al., 1989).

Diets also changed. Among the southeastern Guale, stable isotope data show that those living in the Spanish missions shifted significantly to a diet including more maize and less marine protein during Spanish rule than they enjoyed previously (Schoeninger et al., 1990). Additionally, this monotonous mission diet led to a similar diet between the sexes, a change from pre-Spanish dietary patterns (Hutchinson et al., 1998). Similarly, among the California Chumash, botanical, faunal, and human stable isotope data show that a diverse indigenous diet was supplanted by a monotonous agricultural diet and a decrease in marine protein (Costello and Walker, 1987; Walker et al., 1989). At some southwestern pueblos, carbon stable isotope data remain constant during Spanish hegemony, and other lines of evidence suggest that maize protein replaced meat protein of similar $\delta^{13}\text{C}$ values (e.g., bison, see Kellner et al., 2007). In contrast to these examples, the Caribbean Taino, devastated by disease after the Spanish invasion, appear to have maintained some aspects of their indigenous diet as botanical, faunal, and ceramic data did not change appreciably during this time (Deagan, 2004, 261). In addition, California Chumash who remained outside of the mission system managed to continue exploiting wild terrestrial resources even after Spanish conquest (King, 1982). This variability in diet regimes highlights both the resourcefulness of local people during imperial influence and the limits of imperial power.

Imperial strategies and subsistence regimes in ancient Peru

Wari, contemporary Tiwanaku, and later Inka (1476–1532 AD) cultures delineate a range of indigenous imperial

strategies in the ancient Andes, illustrating the many ways that local diet and agricultural labor can be influenced by state power. The Wari Empire consolidated power over much of Peru during the Middle Horizon (750–1000 AD; see Fig. 1). It came to dominate the inhabitants of the Sondondo Valley (Fig. 1) during the early part of the Middle Horizon (600 AD) and dramatically shifted the valley's subsistence base to intensify maize production (Schreiber, 1987, 1992, 2005b). New villages were established, settlements were located at elevations slightly lower than those in the pre-imperial period, allowing for more extensive maize production, terracing for maize production was introduced, and a road was constructed connecting the area with the imperial heartland (Schreiber 1987, 278; 1992). This increased production may have supplied inhabitants in the Wari heartland where recent stable isotope data from the coeval city of Conchopata reveals a diet heavy in maize and maize-consuming animals including domestic camelids and guinea pigs (Finucane et al., 2006). To oversee this system, the Wari constructed a large administrative core, Jincamocco, and three other administrative centers (Schreiber 1987, 278; 1992, 161). The Wari also established a shrine close to pre-existing local Sondondo Valley shrines suggesting manipulation of "local belief systems in order to express its power and legitimate its domination" (Schreiber, 2005a, 131).

The Tiwanaku state (600–1000 AD), largely contemporaneous with Wari and centered approximately 400 km to the southeast near Lake Titicaca (Fig. 1), provides another example of state influence on dietary regimes. Tiwanaku colonized the lower parts of the Moquegua Valley; but its settlers seem to have had few links with the earlier inhabitants of the valley (Goldstein, 2003; Owen and Goldstein, 2001, 175). The new Tiwanaku settlers, accompanied by a precipitous rise in grinding stones, had higher $\delta^{13}\text{C}$ values than earlier Moquegua Valley inhabitants, suggesting higher maize production, processing, and consumption by the settlers compared to earlier people (Goldstein, 2003; Sandness, 1992). Lower $\delta^{15}\text{N}$ values also characterized the Tiwanaku settlers in comparison to earlier people in the valley, suggesting that they consumed a diet with fewer marine resources and/or terrestrial animals (Goldstein, 2003; Sandness, 1992). The population of Cochabamba valley in Bolivia was also influenced by the Tiwanaku state, as Tiwanaku ceramics are found in habitation and cemetery sites. The lack of evidence for regional reorganization, however, argues against direct Tiwanaku control in the valley (Higueras, 2001).

The later Inka Empire (1430–1533 AD) used different strategies. Within the Sondondo Valley, they co-opted the existing political and social structures, rather than employing intensive imperial investment as had the Wari before them (Schreiber, 1987, 282). The region was more densely populated and more complex politically than during pre-Wari times (Schreiber 1987; 1992, 282–283), making such co-optation economically viable. In terms of major administrative centers, the imperial footprint is far less than that

which characterized the earlier Wari; and no evidence exists for radical shifts in the subsistence base or in settlement patterns. The presence of Inka storehouses, however, “implies that tribute was being paid, also in the form of labor, to produce maize” (Schreiber, 1987, 278). Ethnohistoric sources name the local Sondondo ethnic group the “litter bearers of the Inka” (Guaman Poma de Ayala, 1936, 333).

In the Upper Mantaro Valley of central Peru (Fig. 1), the Inka behaved more similarly to the Wari in the Sondondo Valley by changing the subsistence strategy and political system of the local Xauxa people (Hastorf, 1990; D’Altroy and Hastorf, 2001). Previous to the Inka incursion, Xauxa settlements were located near the valley edge in order to take advantage of pasturage for camelids and tuber production. Much of the population resettled to lower elevations conducive to intensive maize production at the time of Inka influence, and ethnohistoric documents detail the region’s production of maize for the Inka state (Vega, 1965). Stable isotope data in human bone collagen showed that consumption of maize increased significantly with Inka imperial incursion, a finding supported by household botanical data (Hastorf, 2001, 176). Less variation in nitrogen stable isotope values during the imperial period suggests less inter-individual difference in access to meat than during the pre-imperial period (Hastorf, 2001, 176).

Apparently the Inka also used *chicha* production as part of their overall imperial strategy in the Mantaro Valley, co-opting long-standing community feasting and “provisioning” men with *chicha* during labor service (Earle, 2001, 307). Men consumed more maize and meat than women, implying that newly imposed Inka state political structures stimulated inequality between the sexes in the consumption of maize beer (*chicha*) and camelids (Hastorf, 1991, 151). The Wari may also have co-opted long-standing community practices from their peripheral regions as proposed for the Inka and in other regions as well (Bray, 2003; Costin, 2001, 235; Cook and Glowacki, 2003). Wari ceramic assemblages in the imperial heartland and some of their provinces exhibit characteristics of feasting, and include material remains similar to those mentioned in ethnohistoric and ethnographic reports from other regions (Anders, 1991; Brewster-Wray, 1990; Cook and Glowacki, 2003; Glowacki and McEwan, 2001; Isbell, 1977; Moseley et al., 2005). Among these remains are large wide mouthed jars used in *chicha* production as well as decorated urns and cups used by the nobility and small non-descript bowls used by commoners for *chicha* consumption (Cook and Glowacki, 2003, 183; Weismantel, 1988).

In present-day Peru, Bolivia, and Ecuador, feasting involves copious quantities of food and drink, usually with *chicha* as the major focus (Jennings, 2005; Orlove and Schmidt, 1995; Weismantel, 1988); archaeological evidence suggests the same is true throughout Andean prehistory. Ethnographic and archaeological evidence (Jennings, 2005; Moore, 1989; Morris, 1979) shows that *chicha* production was within the purview of household communities

that pooled resources. Today, local elites distribute meat and *chicha* to the general public as part of their obligation during community and labor feasts (Jennings, 2005; Weismantel, 1988). Ethnohistoric evidence and ethnographic reports indicate that women usually brewed the *chicha* while men consumed most of it (Jennings, 2005, 248; Weismantel, 1988; but see Rostworowski de Diez Canseco, 1977). Tupu pins usually worn by elite women have been found near the brewing area at the Wari outpost of Cerro Mejía in Moquegua suggesting that brewing *chicha* was a female activity among the Wari as well (Moseley et al., 2005). Additionally, ethnographic data from the Colca Valley suggest that women consume less *chicha* than men (Jennings, 2005, 248).

Alternatively, Wari imperial strategies could have focused on goods other than foodstuffs in some peripheral regions. For example, obsidian from the Alca source, close to the Wari influenced site of Tenahaha in the Cotahuasi region of the south central highlands is found in copious amounts at the Wari outpost of Cerro Baúl in Moquegua (Jennings and Alcock, 2002). Nasca ceramics have been found in the Wari heartland and at the peripheral Wari site of Pikillacta (Glowacki and McEwan, 2001; Menzel, 1964), Jincamocco (Schreiber, 1992, 234), and in the Moquegua Valley (Goldstein, 2000). Wari imperial monocropping of cotton in the Nasca region is also a possibility. Wari textiles found on the south coast are made with a mix of camelid fiber and cotton (Conklin et al., 1996) and cotton is common in Nasca middens (Orefici and Drusini, 2003; Silverman, 1993). Cotton favors more tropical climates with a low chance of frost (McBride, 1920) and may not have been grown in great quantities in the Wari heartland. Additionally, Pataraya, the small Wari outpost in the uppermost Tierras Blancas valley is situated at an altitude that is amenable to the cultivation of coca; terraces near the site may have been used for this purpose (Schreiber, 2005b).

Nasca archaeological background

During the Early Intermediate Period (ca. 1–750 AD) in Peru, the Nasca culture flourished on the arid south coast of Peru. The culture area of the Nasca is usually recognized as the Río Grande de Nasca drainage system, bordered by the Ica drainage to the northwest and the Las Trancas valley to the south (Fig. 1). Most archaeological work on Nasca settlement pattern analysis (e.g., Schreiber and Lancho Rojas, 2003; Vaughn, 2004), however, has been focused on the Southern Nasca Region (SNR), or the three valleys of Nasca, Taruga, and Las Trancas (Fig. 1). Wari imperial influence in the drainage system seems to be circumscribed to the SNR, with two imperial sites located in the Nasca Valley. Because of this evidence, our discussion of Nasca will focus on developments within the SNR.

The Nasca are famous for their expertise in textile and ceramic art (Carmichael, 1998; Menzel, 1964; Proulx, 1968), the construction of hydraulic technology (Schreiber and Lancho Rojas, 2003), the early ceremonial center of

Cahuachi (Silverman, 1993; Fig. 1), and the Nasca lines, geoglyphs that dot the desert (Aveni, 1990). Their advanced hydraulic technology, ‘*puquios*’ or underground filtration galleries constructed during 400–500 AD, made available more arable land in the SNR on which to grow comestibles such as maize, beans, squash, and peppers (Orefici and Drusini, 2003; Schreiber and Lancho Rojas, 2003; Silverman, 1993; Vaughn, 2004). Based on the distinctive and wide-ranging Nasca ceramic style, the Nasca culture was once thought to be a state-level society, but is now considered, at most, to be a complex chiefdom (Carmichael, 1995; Schreiber and Lancho Rojas, 2003; Silverman, 1993; Vaughn, 2004). Mortuary analyses support this conclusion, as the Nasca exhibited ranked (fluid social status) instead of stratified (hierarchical social classes) differences in such tomb characteristics as ceramics, other offerings, and tomb structure (Carmichael, 1995; but also see Isla and Reindel, 2006). Late in the Nasca sequence (650–750 AD) after the construction of the *puquios*, there was a shift in settlement patterns in the SNR towards urbanism. During this time, concentrated populations lived in a limited number of towns centered near the *puquios* in newly arable lands (Schreiber, 2001; Schreiber and Lancho Rojas, 2003, 17). This shift towards urbanism was accompanied by more differences in burial treatment between individuals suggesting greater differences in social status (Carmichael, 1995; Isla and Reindel, 2006).

Some Nasca cemeteries and, more rarely, habitation sites include carefully prepared, isolated human heads, referred to as “trophy” heads. Head-taking was common in prehistoric Andean iconography, and depictions of isolated heads are a basic theme in Nasca iconography. No ancient Peruvian cultures, however, match the prolific nature and meticulous preparation that characterizes Nasca “trophy” head production, which was an integral and endemic cultural practice dating back to the earlier Paracas culture (~700–100 BC) (Proulx, 2001). Such heads have been recovered in caches (e.g., Browne et al., 1993), as well as in tombs and sacred constructions (see Drusini and Baryabar, 1991; Kellner, 2002, 2006; Proulx, 2001; Williams et al., 2001; Verano, 2001). Young to middle aged males make up the vast majority of these individuals leading many researchers to suggest that individuals represented as “trophy” heads were those of combatants taken in social conflicts (Proulx, 2001; Verano, 2001). These conflicts may have taken the form of raids or ritualized battles similar to modern day examples in the Andes (Gorbak et al., 1962; Orlove, 1994; but see Arkush and Stanish, 2005), as we have no evidence of Nasca armies. Iconographic depictions of these heads become more common later in time in concert with the shift to larger, denser settlements in the Late Nasca period of the SNR (~550–750 AD; Proulx, 2001). The association between these two phenomena is consistent with aspects of social conflict (Browne et al., 1993; Roark, 1965, 56) although alternative explanations for the iconography involve ritual sacrifice and ancestor veneration (Baraybar, 1987; Coehlo, 1972;

Drusini and Baryabar, 1991; see Proulx, 2001 for a more nuanced position). The narrow demographic profile of Nasca individuals represented as “trophy” heads strongly suggests that they are the consequence of social conflict and not ancestor veneration. Their careful preparation and prominent placement in Nasca iconography, however, signifies that taking human heads was important in Nasca ideology (Proulx, 2001).

Feasting, probably including the ingestion of maize beer, was another integral and endemic cultural practice among the Nasca. At the early Nasca ceremonial site of Cahuachi (~1–450 AD; Vaughn, 2005, Table 7.1), maize and beans were recovered in a non-domestic setting in conjunction with camelid bones, feathers, and panpipes (Silverman, 1993; Valdez, 1994). These materials are associated with decorated bowls and dishes, ovens, and large vessels for the brewing of *chicha* beer or hallucinogenic drinks (Silverman, 1993; Strong, 1957; Valdez, 1994). Feasting also occurred at the household level. At the early Nasca site of Marcaya, in the same valley as the later Wari site of Pataraya, bowls and fancy decorated polychromes suggest that feasting was likely relegated to household units, as there are no clearly demarcated communal feasting areas (Vaughn, 2004). It is not known whether feasting patterns remained constant or changed during the time of Wari’s impact on the region.

With the advent of the Middle Horizon (ca. 750–1000 AD), the Wari Empire came to influence the Nasca in the SNR. While the exact nature of their relationship with the Nasca is ambiguous, Wari highland ceramics of the Chakipampa style are found in Nasca cemeteries and habitations in the SNR, along with the local Loro style (Menzel, 1964; Schreiber, 2000; Strong, 1957). A road, ostensibly built by the empire, links the SNR, the Sondondo Valley, and the Wari imperial center (Schreiber, 1991). In contrast to the situation in the Sondondo Valley, however, the Wari built no overt administrative center in the SNR although the large Wari site, Pacheco (Fig. 1), may have been used in this manner (Schreiber, 2000). In addition, a small site, Pataraya, was built according to rigid imperial rectilinear plans (Schreiber, 1999, 2000), which may imply that it was built and occupied by a colony of emissaries from the imperial heartland. The practice of “trophy” head taking continued into the Wari period (Kellner, 2006; Ubbe-lohde-Doering, 1958), but it is unclear if those taken were of Wari migrants, Nasca warriors, or some other category of individuals. Feasting also continues; but it is not certain that the Wari co-opted Nasca feasting for imperial purposes, as the later Inka Empire did in certain regions.

During this period, there seems to have been a depopulation of the northern SNR tributaries (Conlee and Schreiber, 2006; Schreiber, 2001; Schreiber and Lancho Rojas, 1993; Silverman, 2002). A local center, Huaca del Loro, emerges in the southernmost Las Trancas Valley, and becomes the largest settlement in the SNR (Strong, 1957; Schreiber and Lancho Rojas, 2003). Wari ceramics have not been found at Huaca del Loro, either on the surface

or in excavations suggesting that the town was not an imperial outpost (Schreiber, 2001; Schreiber and Lancho Rojas, 2003, 18; Strong, 1957; cf. Paulsen, 1983). In contrast, Wari ceramics are found on a few smaller habitation sites in the valley and elsewhere in the SNR, in cemeteries throughout the SNR and on the imperial sites of Pacheco (Menzel, 1964) and Pataraya (Schreiber, 2000).

The motivation for Wari presence in the SNR and the impact on local populations is under debate. Archaeological research has shown that Wari imperial investment in the Nasca region is much lower than in other areas with Wari administrative centers (Schreiber, 1992, 2000), however, it is unclear what imperial needs the Nasca region may have served. Because the Wari impacted the Nasca at a similar time as the Wari co-opted maize agriculture in the Sondondo Valley, it is suggested that a grand expansion of Wari imperial power occurred at this time (Menzel, 1964; Schreiber, 1987, 2000). To some, similarities in Nasca and Wari ceramics suggest long-standing interaction and perhaps shared aspects of ideology (Menzel, 1964; Schreiber, 1992). Based on these similarities, some believe that Nasca may have held a “special privileged position [within the Wari Empire]... similar to Greece within the Roman Empire” (Menzel, 1964, 148; see also Conlee, 2005, 214). Yet to others, local depopulation of the northern SNR near the Wari site of Pacheco and a population rise in the southern valleys in the SNR suggests a more hostile relationship between the two (Conlee and Schreiber, 2006; Schreiber, 1999, 168). High rates of skeletal pathology in the Nasca Valley during this time suggest declining health under imperial influence, possibly due in part to major changes in diet (Orefici and Drusini, 2003). During the imperial period in the Las Trancas Valley, individuals buried with Wari imperial ceramics at the cemeteries discussed in this paper exhibit a significantly higher rate of cranial trauma (23.5%, $\chi^2 = 5.08$, $p = 0.03$) than those buried with local Loro style ceramics (6.2%, Kellner, 2002), suggesting violence was directed at those affiliated with the Wari. Overall, however, the low rate of cranial trauma (9.3%) during the imperial period in these Las Trancas Valley cemeteries implies that this valley had a relationship with the Wari other than one of military conquest. In contrast to the overall average of 9% exhibited at the three cemeteries near Huaca del Loro during the imperial period, 33% of the total population at Beringa in the Majes Valley to the south, a site unrelated to Nasca, suffered from cranial trauma during a period of Wari influence (Fig. 1; Tung, 2007). Based on archaeological evidence, Nasca was an important peripheral society to the Wari, perhaps providing the Empire with food, agricultural labor, ceramic technology, cotton, and/or coca.

Archaeological evidence of Nasca diet

Botanical and faunal remains from the excavation of sites in the SNR indicate that Nasca diet centered on the cultivation of a great variety of foodstuffs and on wild

and domestic animals, with some marine resources (Isla, 1992; Orefici and Drusini, 2003; Roque et al., 2003; Sejuro, 1990; Silverman, 1993). Maize was the staple cultigen of the region, and it probably was important for feasting (as mentioned above) as well as a basic food. In addition to maize, various C₃ plants, such as potatoes, legumes (peanuts and beans), squash, manioc, achira, jicama, ají, paca, lúcuma, avocado, huarango and guava were also recovered in excavations of different Nasca sites.² Human coprolites and botanical remains at the site of Cauhuachi attest to the importance of huarango fruit (*Prosopis* sp., a nitrogen-fixer) in the Nasca diet; only maize is present in larger quantities (Silverman, 1993, 293). Further, excavations in the Nasca Valley report quinoa, suggesting that this highland C₃ cereal crop, was introduced during the Wari imperial period (Orefici and Drusini, 2003, 109). Two CAM plants, San Pedro cactus represented on ceramics (Carmichael, 1995; Lothrop, 1964; Proulx, 2006: Plate 8) and *Opuntia ficus-indica* represented by floral remains (Sejuro, 1990), were also available. Of the cultivated and collected plants, peanuts, beans, and huarango fruit, plentiful in archaeological middens and Nasca iconography (Orefici and Drusini, 2003; Silverman, 1993, 2002), are leguminous and could, therefore, have low $\delta^{15}\text{N}$ values.

The majority of animal meat was most likely in the form of wild and domestic camelids (llama, alpaca, and guanaco), domestic guinea pig and dog, and wild deer, birds, and foxes (Isla, 1992; Orefici and Drusini, 2003; Silverman, 1993, 2002). Deer from the highlands and coast of Peru have bone collagen $\delta^{13}\text{C}$ values indicative of a diet of wild C₃ plants (see Fig. 2). If the Nasca people consumed much of their protein from this source, the $\delta^{13}\text{C}$ values in their bone collagen should reflect a mixture of C₃ from the deer and C₄ from maize. In contrast to the deer, domestic animals in Peru ate foodstuffs with a range of $\delta^{13}\text{C}$ values. In some highland sites (Pucara), camelids apparently ate mainly C₃ plants (DeNiro, 1988) whereas camelids and guinea pigs from the Wari heartland site of Conchopata exhibit high $\delta^{13}\text{C}$ values that suggest fodder rich in maize (Finucane et al., 2006). At the north coast Moche site of Pampa Grande, archaeological evidence suggests that camelids were fed a diet of huarango or algarrobo seeds (*Prosopis* sp., a C₃ plant) and maize (Shimada and Shimada, 1985). Other camelids, from archaeological sites along the central coast (Chilca and La Paloma), have high average $\delta^{15}\text{N}$ values combined with intermediate $\delta^{13}\text{C}$ values that imply a diet that included marine plants (DeNiro, 1988).

² Achira (*Canna edulis*), ají (*Capsicum* spp.), avocado, (*Persea americana*), beans (*Phaseolus lunatus* and *vulgaris*), guava (*Psidium guajava*), huarango (*Prosopis chilensis* or *pallida*), jicama (*Pachyrrhizus tuberosus*), lúcuma (*Lucuma obovata*), maize (*Zea mays*), manioc (*Manihot esculenta*), paca (*Inga feuillei*), peanut (*Arachis hypogaea*), potatoes (*Ipomoea* and *Solanum* spp.), San Pedro cactus, (*Echinopsis pachanoi*) and quinoa (*Chenopodium quinoa*) (Isla, 1992; Orefici and Drusini, 2003; Sejuro, 1990; Silverman, 1993; Valdez, 1994).

Although not numerous, marine vertebrates and invertebrates are found at sites in the SNR (Orefici and Drusini, 2003; Isla, 1992; Rodriguez de Sandweiss, 1993; Silverman, 2002). Nasca sites are located 40–60 km from the coast and no survey has uncovered permanent Nasca littoral settlements; therefore obtaining marine foods probably required a significant investment. Marine iconography is common on their ceramics (Carmichael, 1995); but the significance of such foods in human diet is uncertain. Stable isotope data from the northern portion of the SNR (Fig. 1) suggest that marine resources were not an important part of Nasca diet in either the pre-imperial or imperial periods (Carmichael and Kennedy, 1998) although the sample size for the latter period is quite small ($n = 3$). Freshwater shrimp (*camarones del río*) has been found in Nasca middens suggesting use of riverine resources (Orefici and Drusini, 2003).

No one has yet analyzed the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of the flora and fauna from the Nasca region. Thus far, we have been unable to extract usable bone collagen from fauna associated with Nasca remains. Even so, archaeological carbonized Peruvian plants from the highlands exhibit $\delta^{15}\text{N}$ values similar to modern specimens and $\delta^{13}\text{C}$ values that are approximately 1.5‰ higher than today's plants due to the relative ^{13}C depletion of today's atmosphere (DeNiro and Hastorf, 1985; Friedli et al., 1986). In addition, the ranges of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of modern plants and animals from the nearby Atacama desert (included in the ranges reported in Fig. 2; Tieszen and Chapman, 1992) are similar to those reported for other regions (Schoeninger and DeNiro, 1984).

Expectations

We undertook stable isotope analyses of individuals buried in cemeteries in the Las Trancas Valley in order to investigate the imperial impact, if any, on Nasca food consumption. If the Wari had intensified the production of Nasca maize agriculture for imperial needs, we expected $\delta^{13}\text{C}$ values to increase, which would indicate an increased consumption of maize, as it did among the Guale of southeastern U.S.A. (Larsen et al., 1992) and the Xauxa of the Mantaro Valley (Hastorf, 1990, 2001). If, on the other hand, the Wari did not intensify maize agriculture among the Nasca, we expected no significant change in $\delta^{13}\text{C}$ values. If the Wari manipulated local Nasca agricultural labor as the Spanish did among the Chumash (Walker et al., 1989) and the Guale (Larsen et al., 1992), we expected a decrease in the range of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values, which would in turn indicate a decrease in dietary diversity. If, however, the Wari did not manage Nasca agricultural labor in this way, we expected no change in the range of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values.

If the imposition of Wari imperial hierarchy intensified Nasca nascent status roles (Carmichael, 1995), we expected those with higher social status (more ceramic pieces in tombs, see discussions below) to consume more meat or

less common foods (marine resources) during the imperial period. If a closer relationship with the Wari Empire meant higher social status during the imperial period, those buried with fancy imperial ceramics may also have had the ability to garner more meat or marine resources than did those buried only with local ceramics. Both instances should be indicated by higher $\delta^{15}\text{N}$ values. If, however, the Wari did not affect Nasca status roles, or if the presence of imperial ceramics is not indicative of status, we expected no such differences in $\delta^{15}\text{N}$ values between groups.

If the Wari used similar strategies to consolidate agricultural labor as they did for the Xauxa (Hastorf, 2001), we expected Nasca men to consume more meat and maize than Nasca women during the imperial period. Nasca men would then exhibit higher $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values than the Nasca women during this time period. If, however, the Wari did not manage Nasca agricultural labor in this manner, we expected the same pattern of gender differences or similarities in diet during both the pre and imperial periods.

Feasting at the site of Cahuachi and at household sites was evident in the Nasca region before Wari imperial influence (Orefici and Drusini, 2003; Valdez, 1994; Vaughn, 2005). What is not clear is if Nasca populations adhered to Andean ethnographic examples showing marked sex differences in the consumption of *chicha*, with higher consumption in men relative to women (e.g., Morris, 1979; Jennings, 2005; Weismantel, 1988; c.f. Rostworowski de Diez Canseco, 1977 for the north coast of Peru). The archaeological $\delta^{13}\text{C}$ stable isotope data of Xauxa people in the Mantaro Valley under Inka occupation show higher maize consumption in men than in women, consistent with men consuming more maize in the form of *chicha* through state-provided labor feasts (Hastorf, 1991). Carbon stable isotope data from the Wari city of Conchopata, however, shows no sex differences in the consumption of maize, suggesting that ingestion of *chicha* may have been similar between the sexes (Finucane et al., 2006). If the Nasca followed the ethnographic model, such behavior should be evidenced by higher $\delta^{13}\text{C}$ values, on average, in men than in women. If, however, the Nasca were more similar to the Conchopata Wari in feasting behavior or if *chicha* ingestion does not affect overall $\delta^{13}\text{C}$ values in collagen, we did not expect any gendered differences in $\delta^{13}\text{C}$ values. It is also possible that sporadic differential consumption of *chicha* between the sexes in a maize-rich diet is not recorded in bone collagen $\delta^{13}\text{C}$ values.

For the people represented as “trophy” heads, we considered several alternative outcomes. If these individuals were taken in social conflict with groups near the Las Trancas valley, they probably ate the same diet as the general Nasca population. If they came from more distant lands (e.g., Mantaro Valley or Conchopata) they could differ in diet from the Las Trancas population. Alternatively, in some places, warriors had differential access to meat (ancient Bohemia, LeHuray and Schutkowski, 2005); the individuals represented as “trophy” heads could have elevated $\delta^{15}\text{N}$ values in comparison with the general Las

Trancas population. Alternatively, if these individuals were singled out for ritual purposes or were of higher status, it is possible that they had access to a diet rich in maize and meat (elevated $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values) as reported for some Inka child sacrifices (Wilson et al., 2007).

Materials and methods

Thirty-eight adult human skeletons from the 1927–1928 Julio C. Tello Nasca skeletal collection were analyzed in this study (Table 1). Curated at the Museo Nacional de Arqueología, Antropología, e Historia del Peru in Lima, Peru, these burials come from three cemeteries located within 10 km of each other in the southernmost Las Trancas valley of the SNR (Fig. 1; Novoa Bollota, 2002). These multicomponent cemeteries, including individuals from the entire Nasca sequence, are not associated with specific

Nasca sites, but are located near the large local site of Huaca del Loro (Fig. 1). Twelve individuals from this sample date to the pre-imperial period (650–750 AD) and 26 come from the period of imperial influence (ca. 750 AD). Of the individuals from the imperial period, 14 are buried with at least one piece of Wari (i.e., “Chakipampa”) style ceramics, and 8 are buried with only the local (i.e., “Loro”) ceramic style. Interred within tombs, seven of the individuals chosen for study are those represented as “trophy” heads. Three of these are entombed with pre-imperial individuals and four are interred with individuals from the imperial period. Three of the imperial period individuals represented as “trophy” heads come from tombs with local ceramics, and one from a tomb with imperial ceramics.

Relative status in prehistoric chiefdom level societies, like the Nasca, can be difficult to ascertain. We assigned status based on tomb ceramic offerings and tomb inclu-

Table 1
Carbon and nitrogen stable isotope values of Nasca individuals from the pre-imperial and imperial periods

$\delta^{13}\text{C}\%$	$\delta^{15}\text{N}\%$	Time period	Ceramic style	Sex ^a	Age ^b	“Trophy” head individual	Relative status ^c	C/N	Yield%	CK#
-13.7	7.7	Pre-imperial	Late Nasca	F	AD	No	High	3.05	23.2	115
-13.7	8.7	Pre-imperial	Late Nasca	F	35–50	No	Mid	2.68	12.8	4
-12.9	10.1	Pre-imperial	Late Nasca	F	20–34	No	Mid	2.87	17.9	5
-12.8	7.4	Pre-imperial	Late Nasca	F	20–34	No	Mid	2.95	11.4	5
-12.4	9.2	Pre-imperial	Late Nasca	F	20–34	No	Mid	2.92	12.6	116
-13.0	10.6	Pre-imperial	Late Nasca	Indet	15–17	Yes	—	2.96	11.4	42
-13.8	7.2	Pre-imperial	Late Nasca	M	35–50	No	Mid	2.65	16.9	2
-13.2	8.1	Pre-imperial	Late Nasca	M	20–34	No	Low	3.58	16.5	3
-13.1	8.6	Pre-imperial	Late Nasca	M	35–50	Yes	—	2.83	14.1	36
-13.1	7.2	Pre-imperial	Late Nasca	M	35–50	Yes	—	3.16	9.5	38
-12.3	8.9	Pre-imperial	Late Nasca	M	35–50	No	Mid	3.08	7.5	1
-11.7	10.7	Pre-imperial	Late Nasca	M	35–50	No	High	3.51	13.2	114
-14.3	7.9	Imperial	Loro	F	40+	No	Mid	2.80	15.3	11
-14.2	7.7	Imperial	Loro	F	35–50	No	Mid	3.01	8.5	12
-12.2	8.1	Imperial	Loro	F	20–34	No	Mid	2.69	9.2	10
-15.0	7.7	Imperial	Loro	M	20–34	Yes	—	2.86	5.8	39
-14.6	7.1	Imperial	Loro	M	20–34	No	Mid	2.69	9.3	7
-14.4	7.3	Imperial	Loro	M	35–50	Yes	—	3.16	20.4	33
-13.6	9.5	Imperial	Loro	M	35–50	No	Mid	2.70	15.1	221
-12.6	10.7	Imperial	Loro	M	35–50	No	High	2.76	18.6	8
-12.1	8.8	Imperial	Loro	M	AD	Yes	—	2.91	6.0	37
-11.9	9.9	Imperial	Loro	M	35–50	No	Low	2.69	16.2	223
-11.2	10.5	Imperial	Loro	M	20–34	No	High	2.67	17.6	9
-13.9	7.5	Imperial	Chakipampa	F	35–50	No	High	2.86	13.0	18
-13.1	7.0	Imperial	Chakipampa	F	20–34	No	High	3.24	17.8	93
-12.9	7.7	Imperial	Chakipampa	F	20–34	No	High	2.92	14.2	85
-12.5	9.2	Imperial	Chakipampa	F	20–34	No	Mid	3.41	15.0	17
-11.8	9.2	Imperial	Chakipampa	F	35–50	No	Mid	2.76	8.1	53
-11.7	10.5	Imperial	Chakipampa	F	35–50	No	High	2.77	10.1	255
-14.3	7.5	Imperial	Chakipampa	M	20–34	No	High	2.79	11.6	14
-13.9	8.6	Imperial	Chakipampa	M	20–34	Yes	—	3.23	16.4	34
-13.3	8.0	Imperial	Chakipampa	M	20–34	No	Mid	2.77	12.2	15
-13.1	8.7	Imperial	Chakipampa	M	35–50	No	Low	2.75	5.3	13
-12.9	10.0	Imperial	Chakipampa	M	20–34	No	High	2.83	15.7	264
-12.8	11.1	Imperial	Chakipampa	M	35–50	No	High	2.65	12.0	52
-12.5	9.6	Imperial	Chakipampa	M	40+	No	High	2.82	11.2	260
-12.1	8.2	Imperial	Chakipampa	M	20–34	No	Low	2.80	14.6	265
-11.7	10.0	Imperial	Chakipampa	M	20–34	No	High	2.79	12.8	262

^a Sex: M = Male, F = Female, Indet.=Indeterminate.

^b Age: AD = Adult, Indeterminate Age, all other numbers in years.

^c Please see text and Table 3 for explanation of relative status used in this analysis (per Carmichael, 1995).

sions such as textiles, feathers, and obsidian following earlier studies of Nasca burials (Carmichael, 1995, 170), with some modifications due to the fragmentary nature of the 1927 field notes (Table 3). This necessarily compresses the number of Nasca status levels and limits the utility of status as a variable. We have, however, sampled individuals interred with a wide variety of ceramic pieces and tomb inclusions. According to the 1927 notes, the range of tomb inclusions in this sample encompasses those buried with less than 5 ceramic pieces ($n = 14$), to those buried with more than 10 ceramic pieces ($n = 14$). A slight positive correlation exists between the number of ceramics and the amount of other tomb inclusions ($r^2 = 0.302$, $p = 0.07$). Many of the tombs with imperial style ceramics housed multiple individuals and were lavishly outfitted, sometimes with 10–12 pieces of decorated ceramics, obsidian points, rich textiles, and llama, bird, and plant offerings. The pre-imperial tombs and those that contained only local ceramics during the imperial period were more variable. Some contained single individuals; very few were as sumptuously appointed as the tombs with imperial style ceramics. There is some indication in the field notes that these tombs were re-used, with various parts of previous burials moved aside for newer offerings or burials (Novoa Bollota, 2002). Individuals with greater numbers of tomb inclusions were more likely than those with fewer inclusions to possess individuals represented as “trophy” heads (often more than one) as burial objects as reported previously (Carmichael, 1995). We cannot know the living status of the individuals represented as “trophy” heads, only the status of the primary burial with whom they are buried; this precludes us from including these burial objects within our status rankings.

All of the samples in this study were prepared for collagen extraction as described previously (see Sealy, 1986 and Schoeninger et al., 1989). Collagen was analyzed in automated fashion on a Thermo-Finnigan Delta XP Plus, Conflow and Costect EA. Samples were evaluated for diagenetic change using the range for C/N ratios (2.6–3.4) and collagen yield percentages (>5 percent <25 percent) (Schoeninger et al., 1989). All samples are within this acceptable range (Table 1). Glycine, our internal laboratory standard, shows precision for both carbon and nitrogen of 0.2‰ ($n = 24$; $\delta^{13}\text{C}$ mean = -35.8‰ , $\pm 0.2\text{‰}$, $\delta^{15}\text{N}$ mean = 11.5‰ , $\pm 0.2\text{‰}$). At least two 1 mg aliquots of each sample were averaged for each reported $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ value with a precision of $\pm 0.3\text{‰}$ in $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$.

Results and discussion

Overall average nasca diet

Within the complete sample (Table 2, Fig. 3), the average $\delta^{13}\text{C}$ value is $-13.0 \pm 0.9\text{‰}$, which indicates inclusion of foods with a C_4 signature such as maize (or maize and CAM plants) or animals that fed on such plants. Although this value overlaps the values for C_4 plants, the value would

Table 2

Average stable isotope values for Nasca individuals during the pre-imperial and imperial periods

Time period	N	$\delta^{13}\text{C}\text{‰}$	STD	$\Delta^{15}\text{N}\text{‰}$	STD
Pre-imperial period	12	-13.0‰	0.6‰	8.7‰	1.3‰
Imperial period	26	-12.9‰	0.7‰	8.8‰	1.2‰
Local (Loro) ceramics	11	-13.3‰	1.3‰	8.7‰	1.3‰
Imperial (Chakipampa) ceramics	15	-12.8‰	0.8‰	8.9‰	1.2‰
Total sample	38	-13.0‰	1.1‰	8.8‰	1.2‰

Table 3

Relative status of Nasca individuals in this sample based on Carmichael's (1988, 1995) categories with revisions from Tello's field notes of 1927 (Novoa Bollota, 2002)

Relative Status	Burial category	N
Low	Urn only, 1–2 pots	4
Mid	Urn with 3–5 pots	14
High	+6 pots	13

As burial offerings, “trophy” head individuals are excluded from this table (see text for explanation).

be closer to -8‰ (given expectations of a 3–4‰ increase over the diet) if they had eaten only these foods. When compared with Pecos Pueblo (Kellner and Schoeninger, 2007), an archaeological group supported by intensive maize agriculture and fauna that ate C_4 plants (bison), it is clear that the Nasca ate far fewer C_4 foods. They also consumed fewer C_4 foods than did the Wari group from Conchopata (Fig. 3), where domestic fauna also ate C_4 foods (Fig. 2). On the other hand, the Nasca average is approximately 7‰ higher than hunter-gatherers from Late Woodland Georgia who consumed mostly C_3 foodstuffs (acorns, nuts, deer, squirrels; Tucker, 2002). In combina-

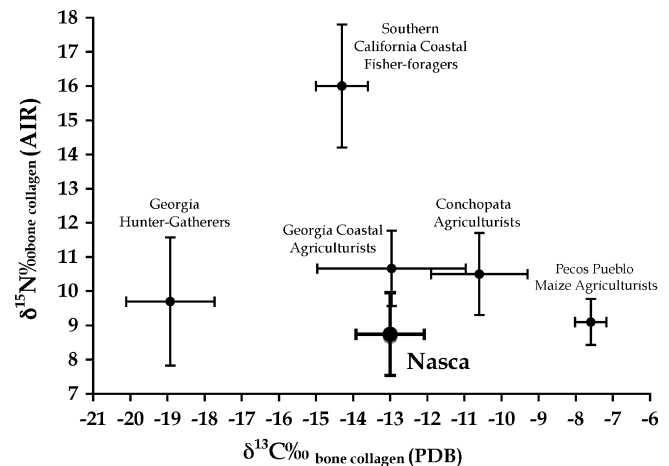


Fig. 3. Average Nasca $\delta^{13}\text{C}$ values (whiskers are ± 1 SD) in comparison with intensive maize agriculturists from the Southwestern U.S.A. (Pecos Pueblo), Early Mississippian Period Georgia hunter-gatherers, Georgia coastal maize agriculturalists, Conchopata (Peru) maize agriculturalists, and fisher-foragers from the southern California coast (data from: Finucane et al., 2006; Kellner and Schoeninger, 2007; Larsen et al., 1992; Tucker, 2002; Walker and DeNiro, 1986).

Table 4
Results of non-parametric Mann–Whitney tests of stable isotope values of carbon and nitrogen between Nasca individuals

Group comparisons	$\delta^{13}\text{C}$	$\delta^{15}\text{N}$
Pre-imperial period vs. imperial period	$z = -0.02, p = 0.99$	$z = -0.14, p = 0.89$
Loro vs. Chakipampa	$z = -1.0, p = 0.31$	$z = -0.42, p = 0.68$
Men vs. women, pre-imperial period	$z = -0.28, p = 0.78$	$z = -0.55, p = 0.58$
Men vs. women, imperial period	$z = -0.30, p = 0.77$	$z = -1.38, p = 0.17$
Men vs. women, Loro	$z = -0.20, p = 0.84$	$z = -0.72, p = 0.47$
Men vs. women, Chakipampa	$z = -0.65, p = 0.52$	$z = -0.89, p = 0.40$
“Trophy” vs. non-“trophy”, pre-imperial period	$z = -0.28, p = 0.78$	$z = -0.19, p = 0.85$
“Trophy” vs. non-“trophy”, imperial period	$z = -1.28, p = 0.20$	$z = 0.23, p = 0.82$

tion, these comparisons are consistent with expectations that the main plant staple consumed by the Nasca was maize. Comparisons with other archaeological groups and with archaeological fauna from the region further suggest that the main sources of terrestrial animal protein are fauna feeding on C_3 plants, rather than on C_4 plants (Table 4).

Given the archaeological evidence attesting to their dependence on maize, the amount of marine foods in the average Nasca diet cannot be assessed from the carbon isotope data alone, as discussed earlier. In fact, Nasca average $\delta^{13}\text{C}$ value is almost identical to both Georgia coastal maize agriculturists (Larsen et al., 1992) and to fisher–hunter–gatherers from the California coast (Walker and DeNiro, 1986) that ate no C_4 foods. The Nasca $\delta^{15}\text{N}$ values, however, suggest that they ate few marine foods. The average value ($8.8 \pm 1.2\text{‰}$) is 7‰ lower than California coastal fisher–hunter–gatherers and almost 2‰ lower than the coastal Georgia maize agriculturists who also obtained marine foods. The two coastal groups (Georgia and California) differ from one another due to the different sources of nitrogen at the base of the trophic systems on each coast plus the differences in trophic level of the fauna taken by humans on each coast. On the east coast nitrogen-fixing organisms (with values close to zero) form the base of the trophic system resulting in lower overall values (Schoeninger and DeNiro, 1984; Wallace et al., 2006). In addition, human groups relied heavily on near shore fauna from lower trophic levels (Little and Schoeninger, 1995). The west coast system is higher overall (Schoeninger and DeNiro, 1984; Tieszen and Chapman, 1992; Wallace et al., 2006) and people regularly consumed fish and mammals that were secondary carnivores (Schoeninger et al., 1983). If the Nasca had consumed significant amounts of marine foods, they should have $\delta^{15}\text{N}$ values comparable to California fisher–hunter–gatherers. Instead, the average Nasca $\delta^{15}\text{N}$ value is within 1‰ of hunter–gatherers from inland Georgia and of southwestern maize agriculturists (Kellner and Schoeninger, 2007). Both of these groups obtained the majority of their dietary protein from terrestrial sources.

Apparently, the Nasca incorporated few marine resources into their diet even though faunal remains and iconography suggest their presence. This finding is similar to that reported from the Nasca Valley in the north SNR

(Fig. 1; Carmichael and Kennedy, 1998). It is also consistent with the inland location of Huaca del Loro (40–60 km from the coast) and the lack of Nasca settlements on the coast (Carmichael, 1998).

The Nasca also exhibit a lower average $\delta^{15}\text{N}$ value than the Wari inhabitants from Conchopata (Finucane et al., 2006), which likely signifies the consumption of less meat, on average. This interpretation is reasonable as the inhabitants of Conchopata, a secondary Wari city, were intermediate elites and were probably from a higher social stratum than Nasca individuals (Isbell and Cook, 2002; Ochatoma and Cabrera, 2002; Tung, 2007).

Comparison of average Nasca diet during the pre-imperial and imperial periods

Average Nasca diet does not change significantly from the pre-imperial period (open symbols) to the imperial period (closed symbols) (Fig. 4). As such, the data do not support an increase in maize consumption during the imperial period, as happened with the Xauxa in reaction to the Inka in the Mantaro Valley (Hastorf, 2001). This finding high-

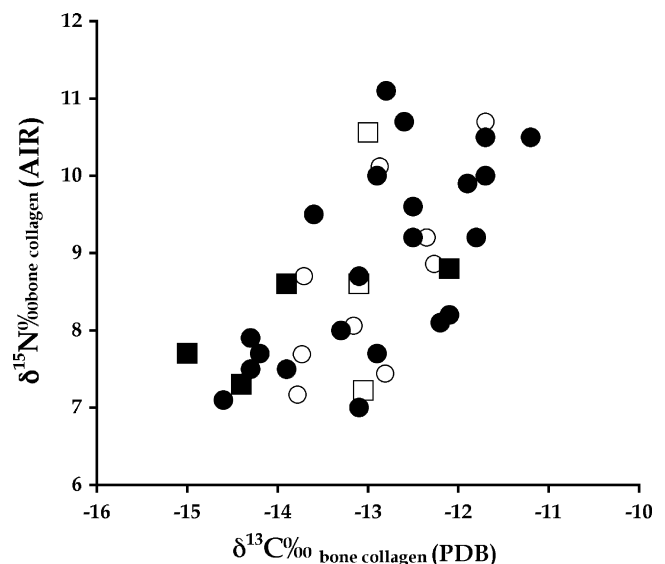


Fig. 4. All Nasca stable isotope values in carbon and nitrogen from the pre-imperial period (open symbols) and the imperial period (closed symbols). ‘Trophy’ head individuals are indicated by squared symbols.

lights the stability of the average Nasca diet in the southernmost Las Trancas valley during a period of social change.

In addition, there are no significant differences in average diet between social strata in either period (Fig. 5a and 5b), implying that food was not a strong mediator for social differences among the Nasca, even during the imperial period or that more subtle differences exist between the status levels. A slight association exists between those of high status and access to meat, which

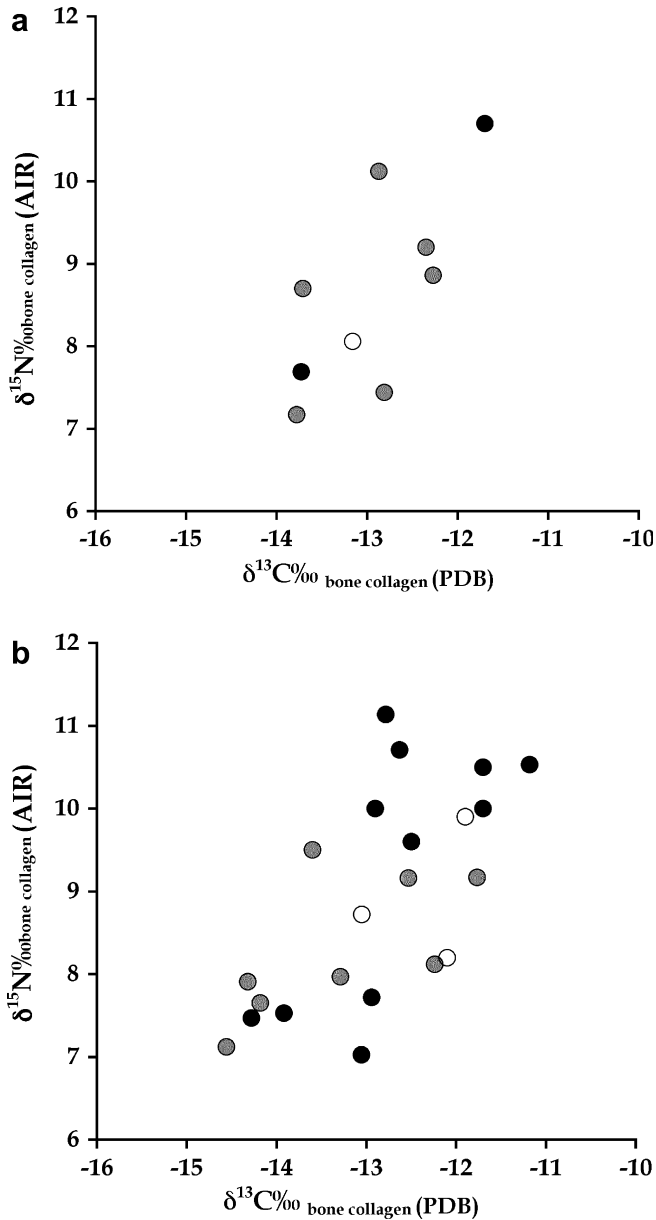


Fig. 5. (a) Nasca stable isotope values in carbon and nitrogen by high (closed symbols), mid-range (grey symbols), and low status (open symbols) individuals during the pre-imperial period. See Table 3 and the text for status groupings. (b) Nasca stable isotope values in carbon and nitrogen by high (closed symbols), mid-range (grey symbols), and low status (open symbols) during the imperial period. See Table 3 and the text for status groupings.

may reflect the lack of sensitivity of our measures both to status differentials and to meat-eating. Further, average diet is not significantly different between those buried with imperial (closed symbols) and local (open symbols) ceramics (Table 2; Fig. 6). This finding suggests that proximity to the Wari through the acquisition of imperial ceramics did not guarantee access to food resources such as meat or marine products.

Additionally, there are no relative changes in $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values between the sexes during the imperial period (Fig. 7a and 7b). This implies that Nasca men and women had similar access to foodstuffs in both time periods. Thus, the Wari Empire did not directly control maize agricultural labor in the Las Trancas valley of the SNR. This is different from the pattern in other areas under Wari influence as well as from the later Inka pattern.

In addition, Nasca men do not exhibit higher $\delta^{13}\text{C}$ values than Nasca women in either time period. These data suggest a pattern of equitable consumption of maize, including that consumed as *chicha*. This pattern is similar to that suggested for the population at the Wari city of Conchopata and contrasts with modern Andean ethnographic reports and that suggested for the inhabitants of the Mantaro Valley during Inka occupation. We cannot, however, reject the possibility that the consumption of *chicha* during the relatively infrequent occurrences of feasting may not be recorded isotopically in collagen when a diet is already rich in maize.

Lastly, individuals represented as “trophy” heads (squares) consumed a similar diet on average to those buried as complete individuals (circles) in both time periods (Fig. 4). Thus, dietary data do not support the conclusion

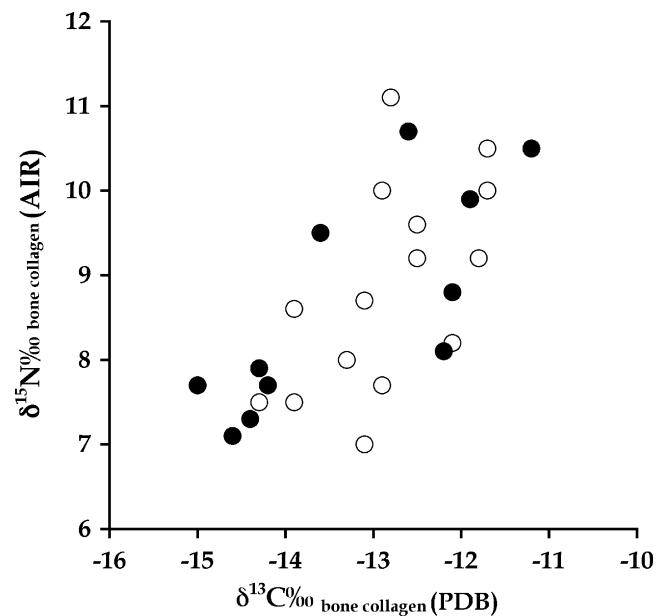


Fig. 6. Nasca stable isotope values in carbon and nitrogen during the imperial period. Individuals buried with imperial ceramics are indicated by closed symbols, while individuals buried with local ceramics are indicated by open symbols.

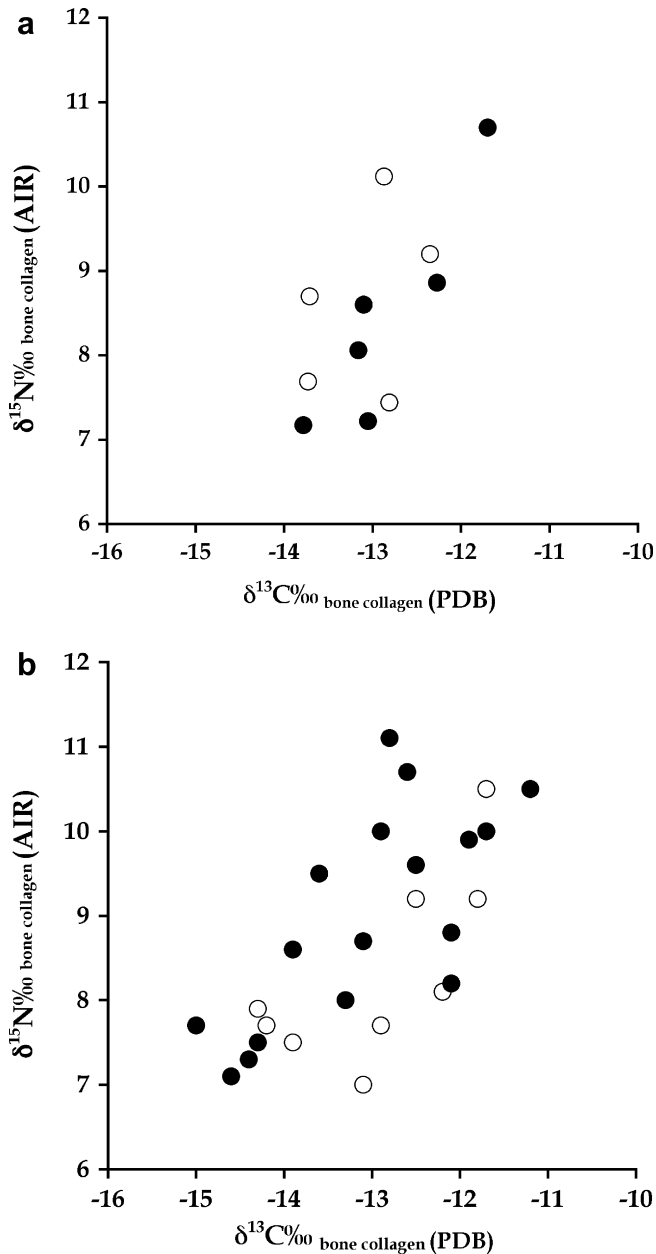


Fig. 7. (a) Nasca stable isotope values in carbon and nitrogen by sex during the pre-imperial period. Men are indicated by closed symbols, while women are indicated by open symbols. (b) Nasca stable isotope values in carbon and nitrogen by sex during the imperial period. Men are indicated by closed symbols, while women are indicated by open symbols.

that Nasca individuals represented as “trophy” heads were of a certain warrior class or high status that had access to more meat than the general population or that they came from a region where the diet was significantly different from that in the Las Trancas valley. Neither do the data suggest that these individuals were fed a diet reserved for sacrificial victims. In addition, although the sample is small, the lack of average dietary differences between individuals represented as “trophy” heads from either time period suggests little imperial interference in this Nasca cultural practice.

Nasca dietary range during the pre-imperial and imperial periods

Notably, however, the overall range in $\delta^{13}\text{C}$ values (3.8‰) and $\delta^{15}\text{N}$ values (4.1‰) indicate significant inter-individual differences in diet. The ranges in both $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ greatly exceed that found in animals fed monotonous diets ($\delta^{13}\text{C} = 1\text{‰}$, $\delta^{15}\text{N} = 2\text{‰}$, DeNiro and Schoeninger, 1983). The $\delta^{15}\text{N}$ range exceeds the expected 3‰ average difference between herbivores and carnivores among free-range animals (Schoeninger and DeNiro, 1984). The range in values suggests that there are differences between individuals in the consumption of meat, maize and other foods. Even though these differences do not sort clearly along status or sex lines, as discussed previously, some combination of these variables or of other variables may be at play in determining access to different foods among the Nasca in the Las Trancas Valley. Alternatively, it is possible that this great variation in diet is due to migration of people from areas where the subsistence strategy differed from that of the Las Trancas Valley.

During the pre-imperial period, the range in $\delta^{13}\text{C}$ values (2.1‰) values and $\delta^{15}\text{N}$ (3.5‰) values indicate that these inter-individual differences in diet were present well before the Wari Empire entered the Nasca region (Fig. 4). A high-status man exhibits the highest $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values for this time period. While marine resources are probably not a large part of this individual’s diet, as his $\delta^{15}\text{N}$ value falls well below that of marine resources (compare Fig. 3), the value is more than one standard deviation above that of the average Nasca diet. This suggests that his diet was not common for the pre-imperial Nasca. The combination of high-status and diet may indicate a trend toward more social stratification within pre-imperial Nasca society (e.g., Carmichael, 1995). A larger sample from earlier periods would clarify this possibility. The data, however, indicate that among high status individuals, some had access to more meat than others did (Fig. 5a).

During the imperial period, the range of $\delta^{13}\text{C}$ values (3.8‰) and $\delta^{15}\text{N}$ (4.1‰) values (closed symbols) increases rather than decreases (Fig. 4). This finding implies that access to food types expanded for the Nasca during the imperial period, in contrast to the situation in Spanish Florida and California. This dietary breadth could be the result of the Nasca needing to exploit more varied food resources during a time of population increase, a relative increase in exploitation of certain extant plants over others, the introduction of new foodstuffs, and/or more expansive regional sampling of people, representing different subsistence strategies, interred in the cemeteries.

A small subgroup of individuals exhibits lower $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values than any seen in the pre-imperial period (Fig. 4). The low $\delta^{13}\text{C}$ values indicate less maize ingestion and the low $\delta^{15}\text{N}$ values indicate a diet relatively low in meat protein, as they are within or lower than the range of $\delta^{15}\text{N}$ values for domestic fauna and wild deer (Fig. 2). Foods found in Nasca middens that are consistent with a

diet of this combination include beans, squash (with seeds), huarango and *quinoa*. *Quinoa*, higher in protein and the amino acid lysine compared to maize and potatoes (Mahoney et al., 1972; Ruales and Nair, 1992) may have been introduced into the Las Trancas Valley during this time as it was in the Nasca valley to the north (Orefici and Drusini, 2003, 109). These individuals may also have consumed a diet that included plants with low $\delta^{15}\text{N}$ values, such as beans and peanuts, both of which are high in protein, or huarango fruit. This is a period of probable population increase in the Las Trancas Valley and it is possible that meat products became unavailable for a portion of the population.

This subgroup is eclectic (Figs. 5b, 6, 7b). It includes both men and women, those buried with imperial and with local ceramics, both middle and high status individuals, and some individuals represented as “trophy” heads, which makes the reasons for the emergence and maintenance of this dietary subgroup difficult to discern at present. While it is tempting to ascribe family lineage to this group, these individuals are not buried in the same tombs; in fact only three share membership in the Los Médanos cemetery and the others are buried within the cemeteries of La Marcha and El Pampón. Perhaps these individuals represent an influx of migrants into the Nasca region during the imperial period. It is possible that strontium and oxygen analysis (planned in the future) will help delineate migration patterns in the Nasca region as they have elsewhere in the Andes (Knudson and Price, 2007).

Another Nasca subgroup consumed a diet that included more meat than the majority of the population (Fig. 5b). These individuals exhibit the highest $\delta^{15}\text{N}$ values during the imperial period and consist mainly of high status individuals. Both sexes are included and they are buried with local as well as imperial ceramics. They probably ingested terrestrial animals that fed on C_3 plants as their $\delta^{15}\text{N}$ values fall well below all marine resources as well as groups consuming marine resources (compare Fig. 3). Perhaps these individuals represent herding specialists with greater access to animal products from animals raised primarily for their wool.

Conclusions

Unsurprisingly, the main plant staple consumed by the Nasca was maize although the level of dependence is far lower than that observed among Pueblo populations in the southwest U.S.A. Both pre-imperial and imperial populations exhibit significant dietary variation. The most likely sources of animal protein are camelids and guinea pigs; there is little evidence for marine foods in anyone's diet. There is no association between particular diets and any of our measures of status or with sex differences either in the pre-imperial or imperial periods.

Overall the stable isotope data support a conclusion that the Wari did not manage Nasca agricultural labor in order to intensify maize agriculture, as occurred elsewhere. The

larger range of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values during the imperial period relative to the pre-imperial period suggests the ability (or necessity) of the Nasca to access a wider variety of foodstuffs than was believed previously. Apparently, the Wari did not manage local Nasca labor for maize production as occurred under Spanish rule in North America (Larsen et al., 1992; Walker et al., 1989) or in other regions of Peru. It appears that no overarching authority governed access to foodstuffs. In sharp contrast, the presence of an imperial power north of Huaca del Loro may have required a population wide dietary expansion among these peripheral Nasca.

This interpretation is further supported by a lack of difference in the average diet of people living in the pre-imperial and imperial periods unlike nearby Mantaro and Sondondo Valleys in Peru and in California and Florida. Notably, the lack of change in average diet occurred at a time of probable population increase in the Las Trancas Valley (Schreiber, 1999, 2001). This suggests that some intensification of maize production occurred in order to maintain the same amount of maize in the diet. Combined with the low levels of skeletal pathology in both periods (Kellner, 2002), these data indicate that people living near Huaca del Loro succeeded in producing the food necessary for this larger population base in the absence of direct control by the Wari Empire. This implies local initiative in the intensification rather than maize monocropping for the Empire. The lack of average dietary difference between the sexes also supports a conclusion of a less direct imperial footprint in the region. This contrasts with the Mantaro Valley where the Inka practiced imperial co-optation of agricultural labor by sex.

The lack of consistent status differences in Nasca diet indicated by our data is not surprising given the absence of imperial control. Hypothetically, in middle range societies or chiefdoms, like the Nasca, the “elite must still share (food) resources, whether directly or indirectly” (Danforth, 1999, 18). During both periods, however, some high status Nasca individuals were apparently able to afford more maize and meat than other individuals. Alternatively, our method of assigning status may have compressed much of the complexity of Nasca status levels and possible relationships to dietary regimes.

Feasting behavior among the Nasca may have been unlike that which occurred in the Inka or modern people. Our data provide no support for a marked male/female difference in access to *chicha*. While this is a small data set, it suggests that use of ethnographic analogy in describing feasting behavior in cultures earlier than the Inka Empire requires re-examination. The lack of dietary difference between individuals represented as “trophy” heads and other Nasca individuals suggests that the former had no differential access to particular food resources and that they lived in regions with cuisines similar to that of the Las Trancas valley. These dietary data in conjunction with the age distribution of the individuals represented as “trophy” heads (young to middle aged adult males) support the

contention that these individuals were taken as a result of social conflict and that the prepared heads may have been used in a ritual manner. Both practices are represented iconographically on Nasca ceramics.

In combination, these dietary data suggest that the motivation for Wari interest in the southernmost Nasca region did not involve maize production. Perhaps the Wari Empire was attracted to the Nasca for ceramic technology (Menzel, 1964) or for non-food crops such as cotton for imperial textiles (Clarkson, 1990) or coca (Schreiber, 2005b). Some Nasca people may have been merchants or ceramic specialists who traded with the Empire, gaining imperial ceramics, meat (or camelids), *quinoa*, or other trade items for local products. In turn, this suggests that the Nasca in the SNR retained a level of independence from the Empire unlike that observed when the Spanish settled in North America.

This diet reconstruction revealed aspects that the relationship between the Wari Empire and the southernmost Nasca, a peripheral society, that were not obvious from more traditional methods of analysis. The Wari must have lacked unlimited power because the relationship in the Las Trancas valley differs from that in the Sondondo Valley. The Wari imperial footprint may also have varied within the Nasca region, and dietary studies of Nasca remains from more of the valleys in the region would augment our nascent understanding of the variation in Wari imperial strategies (Conlee and Schreiber, 2006).

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References

Anders, M.B., 1991. Structure and function at the planned site of Azángaro: cautionary notes for the model of Huari as a centralized

- secular state. In: Isbell, W.H., McEwan, G.F. (Eds.), *Huari Administrative Structure: Prehistoric Monumental Architecture and State Government*. Dumbarton Oaks, Washington, DC, pp. 165–197.
- Arkush, E., Stanish, C., 2005. Interpreting conflict in the ancient Andes. *Current Anthropology* 46, 3–17.
- Aveni, A., 1990. *The Lines of Nasca*. American Philosophical Society, Philadelphia.
- Baraybar, J.P., 1987. Cabezas trofeo Nasca: nuevas evidencias. *Gaceta Arqueológica Andina* 4, 6–10.
- Beebe, R.M., Senkewicz, R.M., 1996. The end of the 1824 Chumash Revolt in Alta California: Father Vicente Sarria's account. *The Americas* 53, 273–283.
- Bermann, M., 1997. Domestic life and vertical integration in the Tiwanaku Heartland. *American Antiquity* 8, 93–112.
- Brewster-Wray, C., 1990. *Moraduchayauq: An Administrative Compound At the Site Of Huari, Peru*. Ph.D. dissertation, State University of New York, Binghamton. University Microfilms, Ann Arbor.
- Bray, T., 2003. Inka pottery as culinary equipment: food, feasting and gender in imperial state design. *Latin American Antiquity* 14, 3–28.
- Browne, D., Silverman, H., García, R., 1993. A cache of 48 Nasca trophy heads from Cerro Carapo, Peru. *Latin American Antiquity* 4, 274–294.
- Carmichael, P., 1995. Nasca burial patterns: social structure and mortuary ideology. In: Dillehay, T. (Ed.), *Tombs for the Living: Andean Mortuary Practices*. Dumbarton Oaks, Washington, DC, pp. 161–187.
- Carmichael, P., 1998. Nasca ceramics: production and social context. In: Shimada, I. (Ed.), *Andean Ceramics: Technology, Organization, and Approaches*. MASCA Research Papers in Science and Archaeology, University of Pennsylvania Museum of Archaeology and Anthropology, pp. 213–231.
- Carmichael, P., Kennedy, B.V., 1998. The role of marine resources in Nasca diet. In: Carmichael, P. (Ed.), *Prehistory of the Ica–Nasca Coast, Peru*. Manuscript in possession of the authors.
- Clarkson, P.B., 1990. The archaeology of the Nazca Pampa: environmental and cultural parameters. In: Aveni, A.F. (Ed.), *The Lines of Nazca*. The American Philosophical Society, Philadelphia, pp. 117–172.
- Coelho, V.P., 1972. *Enterramentos de cabeças da cultura Nasca*. Tese de Doutorado apresentada ao Departamento de Comunicações e Artes da Universidade de São Paulo.
- Conklin, W.J., Rowe, A., Cook, A., Frame, M., 1996. Nasca/Huari and other south coast textiles. In: Boone, E.B. (Ed.), *Andean Art at Dumbarton Oaks*, vol. 2. Dumbarton Oaks Research Library and Collection, Washington, DC, pp. 413–422.
- Conlee, C.A., 2005. The expansion, diversification, and segmentation of power in Late Prehispanic Nasca. In: Vaughn, K.J., Ogburn, D., Conlee, C.A. (Eds.), *Foundations of Power in the Prehispanic Andes*. American Anthropological Association, Arlington, Va, pp. 211–223.
- Conlee, C.A., Schreiber, K.J., 2006. The role of intermediate elites in the Balkanization and reformation of post-Wari society in Nasca, Peru. In: Elson, C.M., Covey, R.A. (Eds.), *Intermediate Elites in Pre-Columbian States and Empires*. University of Arizona Press, Tucson, pp. 94–111.
- Cook, A., Glowacki, M., 2003. Pots, politics, and power: Huari ceramic assemblages and imperial administration. In: Bray, T.L. (Ed.), *The Archaeology and Politics of Food and Feasting in Early States and Empires*. Kluwer Academic/Plenum Publishers, New York, pp. 173–202.
- Costello, J.G., Walker, P.L., 1987. Burials from the Santa Barbara Presidio Chapel. *Historical Archaeology* 21, 3–17.
- Costin, C.L., 2001. Production and exchange of ceramics. In: D'Altroy, T.N., Hastorf, C.A. (Eds.), *Empire and Domestic Economy*. Kluwer Academic/Plenum Publishers, New York, pp. 203–242.
- Cowgill, G.L., 1997. State and society at Teotihuacan, Mexico. *Annual Review of Anthropology* 26, 129–161.
- D'Altroy, T.N., Hastorf, C.A. (Eds.), 2001. *Empire and Domestic Economy*. Kluwer Academic/Plenum Publishers, New York.
- D'Altroy, T.N., Lorandi, A.M., Williams, V.I., Calderari, M., Hastorf, C.A., DeMarrais, E., Hagstrum, M.B., 2000. Inka rule in the Northern Calchaqui Valley, Argentina. *Journal of Field Archaeology* 27, 1–26.

- Danforth, M.E., 1999. Nutrition and politics in prehistory. *Annual Review of Anthropology* 28, 1–25.
- Deagan, K., 2004. Reconsidering Taino social dynamics after Spanish conquest: gender and class in culture contact studies. *American Antiquity* 69, 597–626.
- DeNiro, M., 1988. Marine food sources for prehistoric Coastal Peruvian Camelids: evidence and implications. In: Wing, E.S., Wheeler, J.C. (Eds.), *Economic Prehistory of the Central Andes*. British Archaeological Reports International Series 427. Oxford, England, pp. 119–129.
- DeNiro, M.J., Epstein, S., 1978. Influence of diet on the distribution of carbon isotopes in animals. *Geochimica et Cosmochimica Acta* 45, 341–351.
- DeNiro, M., Hastorf, C.A., 1985. Alteration of $^{15}N/^{14}N$ and $^{13}C/^{12}C$ ratios of plant matter during the initial stages of diagenesis: studies utilizing archaeological specimens from Peru. *Geochimica et Cosmochimica Acta* 49, 97–115.
- DeNiro, M., Schoeninger, M.J., 1983. Stable carbon and nitrogen isotope ratios of bone collagen: variations within individuals, between sexes, and within populations raised on monotonous diets. *Journal of Archaeological Science* 10, 199–203.
- Drusini, A., Baryabar, J., 1991. Anthropological study of Nasca trophy heads. *Homo* 41, 251–265.
- Earle, T.K., 2001. Exchange and social stratification in the Andes: the Xauxa case. In: D'Altroy, T.N., Hastorf, C.A. (Eds.), *Empire and Domestic Economy*. Smithsonian Institution Press, Washington, DC, pp. 297–324.
- El-Najjar, M.Y., 1976. Maize, malaria, and the anemias in the pre-Columbian New World. *Yearbook of Physical Anthropology* 20, 329–337.
- El-Najjar, M.Y., Ryan, D.J., Turner II, C.G., Lozoff, B., 1976. The etiology and porotic hyperostosis among the prehistoric and historic Anasazi Indians of Southwestern United States. *American Journal of Physical Anthropology* 44, 477–487.
- Finucane, B., Agurto, P.M., Isbell, W.H., 2006. Human and animal diet at Conchopata, Peru: stable isotope evidence for maize agriculture and animal management practices during the Middle Horizon. *Journal of Archaeological Science* 33, 1766–1776.
- Friedli, H., Löttscher, H., Oeschger, H., Siegenthaler, U., Stauffer, B., 1986. Ice core record of $^{13}C/^{12}C$ ratio of atmospheric CO_2 in the past two centuries. *Nature* 324, 237–238.
- Glowacki, M., McEwan, G., 2001. Pikillacta, Huaro, y la gran region del Cuzco: nuevas interpretaciones de la ocupación de la sierra sur. In: Kaulicke, P., Isbell, W.H. (Eds.), *Boletín de Arqueología PUCP No. 5 Huari y Tiwanaku: Modelos vs. Evidencias, Segunda Parte*. Pontificia Universidad Católica de Peru, Lima, Peru, pp. 31–49.
- Goldstein, P.S., 2000. Exotic goods and everyday chiefs: long-distance exchange and indigenous sociopolitical development in the south central Andes. *Latin American Antiquity* 11, 335–361.
- Goldstein, P.S., 2003. From stew-eaters to maize-drinkers: The *Chicha* economy and the Tiwanaku expansion. In: Bray, T.L. (Ed.), *The Archaeology and Politics of Food and Feasting in Early States and Empires*. Kluwer Academic/Plenum, New York, pp. 143–172.
- Goldstein, P.S., 2005. *Andean Diaspora: The Tiwanaku Colonies and the Origins of South American Empire*. University of Florida Press, Gainesville.
- Gorbak, C., Lischetti, M., Munoz, C.P., 1962. Batallas rituales del Ciaraja y del Tocto de la Provincia de Kanas (Cuzco-Peru). *Revista del Museo Nacional* 31, 293–304.
- Guaman Poma de Ayala, F., 1936. *Nueva Crónica y Buen Gobierno*. Institut d'Ethnologie, Paris.
- Hastorf, C.A., 1990. The effect of the Inka State on Sausa agricultural production and crop consumption. *American Antiquity* 55, 262–290.
- Hastorf, C.A., 1991. Gender, space, and food in prehistory. In: Gero, J., Conkey, M. (Eds.), *Engendering Archaeology*. Basil Blackwell, Oxford, pp. 132–159.
- Hastorf, C.A., 2001. Agricultural production and consumption. In: D'Altroy, T., Hastorf, C.A. (Eds.), *Empire and Domestic Economy*. Kluwer Academic/Plenum Publishers, New York, pp. 155–178.
- Higueras, A., 2001. El período intermedio (Horizonte Medio) en los valles de Cochabamba: una perspectiva del análisis de asentamientos humanos y uso de tierras. In: Kaulicke, P., Isbell, W.H. (Eds.), *Boletín de Arqueología PUCP No. 5 Huari y Tiwanaku: Modelos vs. Evidencias, Segunda Parte*. Pontificia Universidad Católica de Peru, Lima, pp. 625–646.
- Hoefs, J., 2004. *Stable Isotope Geochemistry*. Springer-Verlag, Berlin.
- Hooton, E.A., 1930. *The Indians of Pecos Pueblo: A Study of Their Skeletal Remains*. Publications for the Department of Archaeology, Yale University Press, Andover, Massachusetts.
- Hutchinson, D.L., Larsen, C.L., Schoeninger, M.J., Norr, L., 1998. Regional variation in the pattern of maize adoption and use in Florida and Georgia. *American Antiquity* 63, 397–416.
- Isbell, W.H., 1977. *The Rural Foundation for Urbanism: Economic and Stylistic Interaction Between Rural and Urban Communities in Eighth-Century Peru*. University of Illinois Press, Urbana, Illinois.
- Isbell, W.H., 2004. Mortuary preferences: a Wari culture case study from Middle Horizon Peru. *Latin American Antiquity* 15, 3–32.
- Isbell, W.H., Cook, A.G., 2002. A new perspective on Conchopata and the Andean Middle Horizon. In: Silverman, H., Isbell, W.H. (Eds.), *Andean Archaeology II: Art, Landscape, and Society*. Kluwer/Plenum, New York, pp. 249–305.
- Isla, J.C., 1992. La Ocupación Nasca en Usaca. *Gaceta Arqueológica Andina* 12, 8–11.
- Isla, J., Reindel, M., 2006. Burial patterns and sociopolitical organization in Nasca 5 society. In: Isbell, W.H., Silverman, H. (Eds.), *Andean Archaeology III: North and South*. Springer-Verlag, New York, pp. 374–400.
- Janusek, J.W., 2004. Tiwanaku and its precursors: recent research and emerging perspectives. *Journal of Archaeological Research* 12, 121–183.
- Jennings, J., 2005. La Chichera y El Patron: *Chicha* and the energetics of feasting in the prehistoric Andes. In: Vaughn, K.J., Ogburn, D., Conlee, C.A. (Eds.), *Foundations of Power in the Prehispanic Andes*. American Anthropological Association, Arlington, Va, pp. 241–259.
- Jennings, J., Alcock, M.D., 2002. Description and method of exploitation of the Alca obsidian source, Peru. *Latin American Antiquity* 13, 107–118.
- Jennings, J., Alvarez, W.Y., 2001. Architecture, local elites, and imperial entanglements: the Wari Empire and the Cotahuasi Valley of Peru. *Journal of Field Archaeology* 20, 143–159.
- Katzenberg, M.A., 2000. Stable isotope analysis: a tool for studying past diet, demography, and life history. In: Katzenberg, M.A., Saunders, S.R. (Eds.), *Biological Anthropology of the Human Skeleton*. Wiley-Liss, New York, pp. 305–327.
- Kellner, C.M., 2002. Coping with environmental and social challenges in Prehistoric Peru: bioarchaeological analyses of Nasca populations. Ph.D. Dissertation, University of California, Santa Barbara.
- Kellner, C.M., 2006. Wari imperial influence on Nasca head-taking practices. In: Bonogofsky, M. (Ed.), *Skull Collection, Decoration, and Modification*. British Archaeological Reports, International Series 1539. Oxford, England, pp. 101–112.
- Kellner, C.M., Spielmann, K., Moore, K.M., Schoeninger, M.J., 2007. Stable isotope data show temporal stability in diet at Pecos Pueblo and diet variation among Southwest pueblos. In: Morgan, M. (Ed.), *Revisit Pecos Pueblo*. Papers of the Peabody Museum of Archaeology and Ethnology. Harvard University, Boston.
- Kellner, C.M., Schoeninger, M.J., 2007. A simple carbon isotope model for reconstructing prehistoric human diet. *American Journal of Physical Anthropology* 133, 1112–1127.
- King, C. (Ed.), 1982. *Archaeological investigations at Telepop (LAN-229)*. Office of Public Archaeology. University of California, Santa Barbara.
- Knudson, K.J., Price, T.D., 2007. Utility of multiple chemical techniques in archaeological residential mobility studies: case studies from Tiwanaku- and Chiribaya-affiliated sites in the Andes. *American Journal of Physical Anthropology* 132, 25–39.

- Kohl, P., 1987. The ancient economy, transferable technologies, and the bronze age World-system: a view from the North Eastern Frontier of the Ancient Near East. In: Larsen, M., Rowlands, M., Kristiansen, K. (Eds.), *Centre and Periphery in the Ancient World*. Cambridge University Press, Cambridge, pp. 13–24.
- Kolata, A., 1993. *The Tiwanaku: Portrait of an Andean Civilization*. Blackwell, Cambridge, Massachusetts.
- Larsen, C.S., Schoeninger, M.J., Van der Merwe, N.J., Lee-Thorp, J.A., 1992. Carbon and nitrogen stable isotopic signatures of human dietary change in the Georgia bight. *American Journal of Physical Anthropology* 89, 197–214.
- Larsen, C.S., Griffin, M.C., Hutchinson, D.L., Noble, V.E., Norr, L., Pastor, R.F., Ruff, C.B., Russell, K.F., Schoeninger, M.J., Schultz, M., Simpson, S.W., Teaford, M.F., 2001. Frontier of contact: Bioarchaeology of Spanish Florida. *Journal of World Prehistory* 15, 69–123.
- LeHuray, Jonathan D., Schutkowski, H., 2005. Diet and social status during the La Tene period in Bohemia: carbon and nitrogen stable isotope analysis of bone collagen from Kutna Hora-Karlovo and Radovesice. *Journal of Anthropological Archaeology* 24, 135–147.
- Little, E.A., Schoeninger, M.J., 1995. The Late Woodland Diet on Nantucket Island and the problem of maize in Coastal New England. *American Antiquity* 60, 351–368.
- Lothrop, S.K., 1964. *Treasures of Ancient America*, Skira, New York.
- Mahoney, A.W., Lopez, J.G., Hendricks, D.G., 1972. An evaluation of the protein quality of Quinoa. *Journal of Agricultural Food Chemistry* 23, 190–193.
- Malpass, M., 2001. Sonay: a Wari orthogonal cellular center in the Camaná Valley, Peru. In: Kaulicke, P., Isbell, W.H. (Eds.), *Boletín de Arqueología PUCP No. 5 Huari y Tiwanaku: Modelos vs. Evidencias, Segunda Parte*. Pontificia Universidad Católica de Peru, Lima, Peru, pp. 51–68.
- McBride, G.M., 1920. Cotton growing in South America. *Geographical Review* 9, 35–50.
- McEwan, G.F. (Ed.), 2005. *Pikillacta: The Wari Empire in Cuzco*. University of Iowa Press, Iowa City.
- Manzanilla, L., 2002. Living with the ancestors and offering to the gods: domestic ritual at Teotihuacan. In: Plunket, P. (Ed.), *Domestic Ritual in Ancient Mesoamerica*. Cotsen Institute of Archaeology Monograph No. 46, Los Angeles, California, pp. 43–52.
- Menzel, D., 1959. The Inca conquest of the south coast of Peru. *Southwestern Journal of Anthropology* 15, 125–142.
- Menzel, D., 1964. Style and time in the Middle Horizon. *Nawpa Pacha* 2, 1–105.
- Moore, J.D., 1989. Pre-Hispanic beer in Coastal Peru: technology and social context of prehistoric production. *American Anthropologist* 91, 682–695.
- Morris, C., 1979. Maize beer in the economics, politics, and religion of the Inca Empire. In: *Fermented Foods in Nutrition*. Academic Press, New York, pp. 21–34.
- Moseley, M.E., Nash, D.J., Williams, P.R., deFrance, S., Ana Miranda, A., Ruales, M., 2005. Burning down the brewery: establishing and evacuating an ancient imperial colony at Cerro Baul, Peru. *Proceedings of the National Academy of Sciences* 102, 17264–17271.
- Novoa Bollota, P., 2002. Arqueología de la cuenca del río Grande de Nasca: Cuadernos de investigación del Archivo Tello; no. 3. Museo de Arqueología y Antropología de la Universidad Nacional Mayor de San Marcos, Lima, Peru.
- Ochatoma, J., Cabrera, M., 2002. Religious ideology and military organization in the iconography of a D-shaped ceremonial precinct at Conchopata. In: Silverman, H., Isbell, W.H. (Eds.), *Andean Archaeology II: Art, Landscape, and Society*. Kluwer/Plenum, New York, pp. 225–247.
- Orefici, G., Drusini, A., 2003. *Nasca: Hipótesis y Evidencias de su Desarrollo Cultural*. BresciaLima: Centro Italiano Studi e Ricerche Archeologiche Precolombiane, Lima, Peru.
- Orlove, B.S., 1994. Sticks and stones: ritual battles and play in the Southern Peruvian Andes. In: Poole, D. (Ed.), *Unruly Order: Violence, Power, and Cultural Identity in the High Provinces of Southern Peru*. Westview Press, Boulder, Colorado, pp. 133–164.
- Orlove, B.S., Schmidt, E., 1995. Swallowing their pride: indigenous and industrial beer in Peru and Bolivia. *Theory and Society* 24, 271–298.
- Owen, B., Goldstein, P.S., 2001. Tiwanaku in Moquegua: regional interactions and collapse. In: Kaulicke, P., Isbell, W.H. (Eds.), *Boletín de Arqueología PUCP No. 5 Huari y Tiwanaku: Modelos vs. Evidencias, Segunda Parte*. Pontificia Universidad Católica de Peru, Lima, Peru, pp. 169–188.
- Paulsen, A., 1983. Huaca del Loro revisited: the Nasca–Huarpa connection. In: Sandweiss, D. (Ed.), *Investigations of the Andean Past. Papers from the First Annual Conference on Andean Archaeology and Ethnohistory*. Cornell University, Ithaca, New York, pp. 98–121.
- Phillips, D.L., Koch, P.L., 2002. Incorporating concentration dependence in stable isotope mixing models. *Oecologia* 130, 114–125.
- Proulx, D.A., 1968. *Local Differences and Time Differences in Nasca Pottery*. University of California Press, Berkeley, California.
- Proulx, D.A., 2001. Ritual uses of trophy heads in ancient Nasca society. In: Benson, E.A., Cook, A. (Eds.), *Ritual Sacrifice in Ancient Peru*. University of Texas Press, Austin, pp. 119–136.
- Proulx, D.A., 2006. *A Sourcebook of Nasca Ceramic Iconography: Reading a Culture Through its Art*. University of Iowa Press, Iowa City, Iowa.
- Reff, D.T., 1995. The “Predicament of Culture” and Spanish Missionary accounts of the Tepehuan and Pueblo Revolts. *Ethnohistory* 42, 63–90.
- Roark, R., 1965. From monumental to proliferous in Nasca pottery. *Nawpa Pacha* 3, 1–92.
- Rodriguez de Sandweiss, M., 1993. Malacological analysis. In: Silverman, H. (Ed.), *Cahuachi in the Ancient World*. University of Iowa Press, Iowa City, pp. 294–299.
- Roque, J., Cano, A., Cook, A., 2003. Restos vegetales del sitio arqueológico Casa Vieja, Callango (Ica). *Revista Peruana de Biología* 10, 33–43.
- Rostworowski de Diez Canseco, M., 1977. *Etnia y Sociedad: Costa Peruana Prehispanica*. Instituto de Estudios Peruanos, Lima, Peru.
- Ruales, J., Nair, B.M., 1992. Nutritional quality of the protein in quinoa (*Chenopodium quinoa*, Wild) seeds. *Plant Foods for Human Nutrition* 42, 1–11.
- Sandness, K.L., 1992. Temporal and spatial dietary variability in the prehistoric Lower and Middle Osmore drainage: the carbon and nitrogen stable isotope evidence. M.A. Thesis, University of Nebraska, Lincoln, Nebraska.
- Schoeninger, M.J., 1985. Trophic level effects on $^{15}\text{N}/^{14}\text{N}$ and $^{13}\text{C}/^{12}\text{C}$ ratios in bone collagen and strontium levels in bone mineral. *Journal of Human Evolution* 14, 515–525.
- Schoeninger, M.J., DeNiro, M.J., 1984. Nitrogen and carbon stable isotope ratios of bone collagen reflect marine and terrestrial components of prehistoric human diet. *Geochimica et Cosmochimica Acta* 48, 625–639.
- Schoeninger, M.J., DeNiro, M.J., Tauber, H., 1983. $^{15}\text{N}/^{14}\text{N}$ ratios of bone collagen reflect marine and terrestrial components of prehistoric human diet. *Science* 220, 1381–1383.
- Schoeninger, M.J., Moore, K.M., Murray, M.L., 1989. Detection of bone preservation in archaeological and fossil samples. *Journal of Applied Geochemistry* 4, 281–292.
- Schoeninger, M.J., van der Merwe, N.J., Moore, K., Lee-Thorp, J., Larsen, C.S., 1990. Decrease in diet quality between the prehistoric and contact periods. In: Larsen C.S. (Ed.), *The Archaeology of Mission Santa Catalina de Guale: 2. Biocultural Interpretations of a Population in Transition*. Anthropological Papers of the American Museum of Natural History, vol. 68, Washington, DC, pp. 78–93.
- Schoeninger, M.J., Iwaniec, U.T., Glander, K.E., 1997. Stable isotope ratios monitor diet and habitat use in New World monkeys. *American Journal of Physical Anthropology* 103, 69–83.
- Schreiber, K.J., 1987. Conquest and consolidation: a comparison of the Wari and Inka occupations of a highland Peruvian Valley. *American Antiquity* 52, 266–284.

- Schreiber, K.J., 1991. The association between roads and polities: evidence for Wari roads in Peru. In: Trombold, C.D. (Ed.), *Ancient Road Networks and Settlement Hierarchies in the New World*. Cambridge University Press, Cambridge, pp. 243–252.
- Schreiber, K.J., 1992. Wari Imperialism in Middle Horizon Peru. University of Michigan Museum, Ann Arbor.
- Schreiber, K.J., 1999. Regional approaches to the study of prehistoric Empires: examples from Ayacucho and Nasca. In: Billman, B.R., Feinman, G.M. (Eds.), *Settlement Pattern Studies in the Americas: Fifty Years Since Viru*. Smithsonian Institution Press, Washington, DC, pp. 160–171.
- Schreiber, K.J., 2000. Los Wari en su contexto local: Nasca y Sondondo. In: Kaulicke, P., Isbell, W.H. (Eds.), *Boletín de Arqueología PUCP No. 4 Huari y Tiwanaku: Modelos vs. Evidencias, Primera Parte*. Pontificia Universidad Católica de Peru, Lima, Peru, pp. 425–447.
- Schreiber, K.J., 2001. The Wari Empire of Middle Horizon Peru: the epistemological challenge of documenting an empire without documentary evidence. In: Alcock, S.E., D'Altroy, T.N., Morrison, K.D. (Eds.), *Empires*. University of Cambridge Press, Cambridge, pp. 70–92.
- Schreiber, K.J., 2005a. Sacred landscapes and imperial ideologies: the Wari Empire in Sondondo, Peru. In: Vaughn, K.J., Ogburn, D., Conlee, C.A. (Eds.), *Foundations of Power in the Prehispanic Andes*. American Anthropological Association, Washington, DC, pp. 131–150.
- Schreiber, K.J., 2005b. Imperial Agendas and local agency: Wari colonial strategies. In: Stein, G.J. (Ed.), *The Archaeology of Colonial Encounters: Comparative Perspectives*. School of American Research Press, Santa Fe, New Mexico, pp. 237–262.
- Schreiber, K.J., Lancho Rojas, J., 2003. *Irrigation and Society in the Peruvian Desert: the Puquios of Nasca*. Lexington Books, Lanham, Maryland.
- Sealy, J., 1986. Stable carbon isotopes and prehistoric diets in the Southwestern Cape province, South Africa. *British Archaeological Reports*, No. 293, Oxford, England.
- Sejuro, O., 1990. Plantas medicinales utilizadas por los curanderos de Nasca. *Boletín de Investigación en Tecnologías Nativas* 5. Lima, Peru.
- Shearer, G., Kohl, D.H., 1986. N₂-fixation in field settings: estimations based on natural ¹⁵N abundance. *Australian Journal of Plant Physiology* 13, 699–756.
- Shimada, M., Shimada, I., 1985. Prehistoric llama breeding and herding on the North coast of Peru. *American Antiquity* 50, 3–26.
- Silverman, H., 1993. *Cahuachi in the Ancient Nasca World*. University of Iowa Press, Iowa City.
- Silverman, H., 2002. *Ancient Nasca Settlement and Society*. University of Iowa Press, Iowa City.
- Smith, M.E., Wharton, J.B., Olson, J.M., 2003. Aztec feasts, rituals, and markets: political uses of ceramics vessels in a commercial economy. In: Bray, T.L. (Ed.), *The Archaeology and Politics of Food and Feasting in Early States and Empires*. Springer-Verlag, New York, pp. 235–268.
- Stanish, C., 1997. Nonmarket imperialism in the Prehispanic Americas: the Inka occupation of the Titicaca basin. *Latin American Antiquity* 8, 195–216.
- Stanish, C., 2002. Tiwanaku political economy. In: Isbell, W., Silverman, H. (Eds.), *Andean Archaeology I: Variations in Sociopolitical Organization*. Kluwer Academic, New York, pp. 169–198.
- Strong, W.D., 1957. Paracas, Nasca, and Tihuanacoid cultural relationships in South Coastal Peru. *Memoir No. 13*. Society for American Archaeology, Menasha, Wisconsin.
- Taylor, W.B., Pease, F.G.Y., 1994. *Violence, Resistance, and Survival in the Americas: Native Americans and the Legacy of Conquest*. Smithsonian Institution Press, Washington DC.
- Tieszen, L., Chapman, M., 1992. Carbon and nitrogen isotopic status of the major marine and terrestrial resources in the Atacama desert of northern Chile. In: *Proceedings of the First World Congress on Mummy Studies*, Museo Arqueológico y Etnográfico de Tenerife, Cabildo de Tenerife, Canary Islands, pp. 409–425.
- Topic, J.R., 1991. Huari and Huamachuco. In: Isbell, W.H., McEwan, G.F. (Eds.), *Huari Administrative Structure: Prehistoric Monumental Architecture and State Government*. Washington, DC, Dumbarton Oaks, pp. 141–164.
- Tucker, B.D., 2002. Culinary confusion: using osteological stable isotopic evidence to reconstruct paleodiet for the Ocmulgee/Blackshear Cord-marked people of south central Georgia. M.A. Thesis, Louisiana State University. Manuscript in possession of the authors.
- Tung, T.A., 2007. Trauma and violence in the Wari empire of the Peruvian Andes: warfare, raids, and ritual fights. *American Journal of Physical Anthropology* 133, 941–956.
- Ubbelohde-Doering, H., 1958. Bericht über archäologische Feldarbeiten in Peru. *Ethnos* 23, 67–99.
- Valdez, L.M., 1994. Cahuachi: new evidence for an Early Nasca ceremonial role. *Current Anthropology* 35, 675–679.
- Vaughn, K.J., 2004. Households, crafts, and feasting in the ancient Andes: the village context of Early Nasca craft consumption. *Latin American Antiquity* 15, 61–88.
- Vaughn, K.J., 2005. Crafts and the materialization of chiefly power in Nasca. In: Vaughn, K.J., Ogburn, D., Conlee, C.A. (Eds.), *Foundations of Power in the Prehispanic Andes*. American Anthropological Association, Arlington, Va, pp. 113–130.
- Vega, A. de., 1965[1582]. La descripción que se hizo en la provincia de Xauxa por la instrucción de Su Majestad que a la dicha provincia se invio de molde. In: Jimenez de la Espada, M., (Ed.), *Relaciones Geográficas de Indias*. Ediciones Atlas, Madrid, pp. 166–175.
- Verano, J., 2001. The physical evidence of human sacrifice in ancient Peru. In: Benson, E.A., Cook, A. (Eds.), *Ritual Sacrifice in Ancient Peru*. University of Texas Press, Austin, pp. 165–184.
- Virginia, R.A., Delwiche, C.C., 1982. Natural ¹⁵N abundance of presumed N₂-fixing and non-N₂-fixing plants from selected ecosystems. *Oecologia* 54, 317–325.
- Walker, P.L., 1985. Anemia among the prehistoric Indians of the American southwest. In: Merbs, C.F., Miller, R.J. (Eds.), *Health and disease in the prehistoric Southwest*. Arizona State University Anthropological Research Papers No. 34, pp. 139–164.
- Walker, P.L., DeNiro, M.J., 1986. Stable nitrogen and carbon isotope ratios in bone collagen as indices of prehistoric dietary dependence on marine and terrestrial resources in southern California. *American Journal of Physical Anthropology* 71, 51–61.
- Walker, P.L., Lambert, P.M., DeNiro, M., 1989. The effects of European contact on the health of the California Indians. In: Thomas, D.H. (Ed.), *Columbian Consequences: Archaeological and Historical Perspectives on the Spanish Borderlands*, Vol. 1. Smithsonian Institution, Washington, DC, pp. 349–364.
- Wallace, B.P., Seminoff, J.A., Kilham, S.S., Spotila, J.R., Dutton, P.H., 2006. Leatherback turtles as oceanographic indicators: stable isotope analyses reveal a trophic dichotomy between ocean basins. *Marine Biology* 149, 953–960.
- Wallerstein, I., 1974 *The Modern World-System*, vol. 1. Academic Books, New York.
- Weismantel, M.J., 1988. *Food, Gender, and Poverty in the Ecuadorian Andes*. University of Pennsylvania Press, Philadelphia.
- Wells, P.S., 1999. Production within and beyond imperial boundaries: goods, exchange, and power in roman Europe. In: Kardulias, P.N. (Ed.), *World-Systems Theory in Practice*. Rowman and Littlefield Publishers, Inc., Lanham, Massachusetts, pp. 85–102.
- Wilkinson, T.R., 2003. *Archaeological Landscapes of the Near East*. University of Arizona Press, Tucson.
- Williams, P.R., 2001. A Wari center on the Tiwanaku frontier. *Latin American Antiquity* 12, 67–83.
- Williams, S., Forgey, K., Klarich, E.A., 2001. An osteological study of Nasca trophy heads collected by A.L. Kroeber during the Marshall field expeditions to Peru. *Fieldiana* 33, 1–132.
- Wilson, A.S., Taylor, T., Ceruti, M.C., Chavez, J.A., Reinhard, J., Grimes, V., Meier-Augenstein, W., Cartmell, L., Stern, B., Richards, M.P., Worobey, M., Barnes, I., Gilbert, M.T.P., 2007. Stable isotope and DNA evidence for ritual sequences in Inca child sacrifice. *Proceedings of the National Academy of Sciences* 104, 16456–16461.