Coastal but not littoral: marine resources in Nasca diet

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We examine the contribution of marine resources to the Nasca dietary economy (Early Intermediate Period, circa 100 B.C.–A.D. 600, Peruvian south coast) through ceramic iconography, settlement patterns, maritime subsistence technology, fish and shell remains, and stable isotope analysis. Each data set has limitations but, when combined, a consistent pattern emerges. Although the rich marine biomass of the Peru Current offers potential for huge food surpluses, we conclude that the Nasca use of the littoral zone was minor. This result contrasts with earlier and later subsistence patterns in the same area, and with contemporary dietary systems elsewhere along the Andean coast. This challenge to conventional wisdom on coastal economies highlights the need for new research to understand the full range of Andean adaptations, especially those which appear counterintuitive. This study also questions the notion that percentage frequencies of motifs in the iconography reflect daily realities.

Examinamos la contribución de los recursos marinos a la economía dietética de Nasca (Período Intermedio Temprano, 100 A.C.–600 D.C., costa sur peruana) a través de la iconografía de cerámica, los patrones de asentamiento, restos de subsistencia tecnológica, restos de peces y conchas y análisis de isótopo estable. Una encuesta de tierra sobre el litoral de Ica-Nazca no localizó ocupaciones oceánicas frente a Nasca, aunque los asentamientos desde el Horizonte Temprano y del Período Intermedio Tardío estaban presentes. Aunque resulta evidente por la iconografía que Nasca utilizaba una forma de red de pesca, sin embargo, no se ha encontrado ningún equipo de pesca como anzuelos, sedal, plomos, flotadores, o arpones en el registro arqueológico. Restos de concha son comunes encontrarlos en lugares del interior de Nasca, pero las excavaciones revelan que el componente de concha es menor y disperso, y las espinas de pescado son infrecuentes. Un análisis de isótopo estable se realizó sobre una muestra de restos humanos (n = 75), incluyendo huesos, piel y cabello, desde las tumbas de los Nasca excavadas en siete lugares del interior cerca del río Nazca. Rastros de carbón, nitrógeno y azufre demuestran que los Nasca fueron fundamentalmente agricultores, para quienes la carne terrestre constituía su principal fuente de proteínas, mientras que los recursos marinos desempeñaron un papel menor en la economía dietética. Aunque la iconografía de cerámica tomada de temas marinos ha sido citada como evidencia de un enfoque marítimo, una gran muestra de cerámica excavada (n = 447 vasijas pintadas) muestra temas marinos

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como motivos principales apareciendo en un 10,6% de las vasijas de la época del Nasca Temprano, pero sólo aparecieron un 0,7% de piezas pertenecientes al Nasca Tardío, aunque los datos de isótopos indican un consumo pequeño pero constante de recursos marítimos a lo largo del Período Intermedio Temprano. Sorprendentemente el maíz, cuyo análisis de isótopo aparece identificado como principal cultivo, rara vez se hace referencia como motivo principal en la cerámica Nasca. Concluimos que la iconografía no refleja las realidades económicas y que las clasificaciones iconográficas que distinguen entre temas sagrados y seculares forzaron interpretaciones sujetas a una determinada cultura. Cada uno de los conjuntos de datos anteriores tiene limitaciones, pero si se combinan emerge un patrón consistente. Aunque la biomasa marina rica del Perú actual ofrece un potencial enorme para excedentes de alimentos, concluimos que el uso de la cultura Nasca de su zona litoral era temporal, transitorio y oportunista. Este resultado contrasta con los patrones de subsistencia anteriores y posteriores realizados en la misma zona y con sistemas dietéticos contemporáneos en otros lugares a lo largo de la costa andina. Este desafío a la sabiduría convencional en las economías costeras subraya la necesidad de nuevas investigaciones para entender toda la gama de adaptaciones andinas, especialmente aquellas que aparecen contra-intuitivas.

The cold upwelling of the Peru Current endows Peru with one of the world's richest marine biomasses. Archaeology has long recognized the importance of fishing and littoral gathering throughout Peruvian prehistory (Marcus 1987; Rostworowski 1981; Sandweiss et al. 1989), and maritime resources figure prominently in models of cultural transformation (Feldman 2009; Moseley 1975; Quilter and Stocker 1983; Quilter et al. 1991; Sandweiss 2009). As coastal Peru is a hyper-arid desert in which agriculture depends on unpredictable water supplies from seasonal river flooding, an emphasis or partial reliance on marine resources provides an obvious means of augmenting protein and coping with uncertain conditions.

In this study we examine the role of marine resources in Early Intermediate Period (EIP) Nasca culture (circa 100 B.C.–A.D. 600) of the Peruvian south coast (Figure 1). While the Nasca are considered to be a coastal people—in that they inhabited a coastal desert—they are known primarily from inland valley sites situated 40–60 km from the ocean (Kroeber and Collier 1998; Orefici 2012; Proulx 2007; Reindel 2009; Schreiber 1999, Silverman 2002). Elsewhere on the Peruvian coast, rivers running down from the Andes have floodplains funneling outward to the sea. In such locales fishing and farming are easily integrated pursuits. In a pattern going back to the Late Preceramic and Initial periods in the Casma Valley, Pozorski and Pozorski refer to a "complementary coastal-inland subsistence pattern" or "economic symbiosis" between settlements on the coastline and those in riparian ecological zones (2012: 367–369). This makes good sense and, for their examples, they have good evidence. Our question is whether the Nasca engaged in a similar economic symbiosis and, if so, to what extent? For some archaeologists the answer is obvious. The Nasca provide us with iconographic depictions of sea creatures and fishermen, and many researchers have inferred that fishing was an important part of the economy (Allen 1981: 43; Blasco and Ramos 1980: 128; Carmichael 1988: 34; Lumbreras 1983: 125; Proulx 1983: 100; Silverman 1986: 11; Townsend 1985: 125). We present several lines of evidence which converge to challenge this traditional view.[1]

In southern Peru, the coastal desert reaches it maximum width in the regions of Ica and Nazca. Here, Andean rivers are separated from the ocean by a wide desert plain and range of seafront hills. In the Río Grande de Nazca Basin (hereafter "Nazca Basin") all ten principal rivers merge inland, and only the Río Grande itself continues to the sea (Figure 1). These rivers have erratic seasonal flows, and their channels are dry most of the year, although sub-surface water may be present 4 m or more below the surface. The region also experiences the most extreme sun and wind regimes on the entire Peruvian coast (on hydrology and climate see

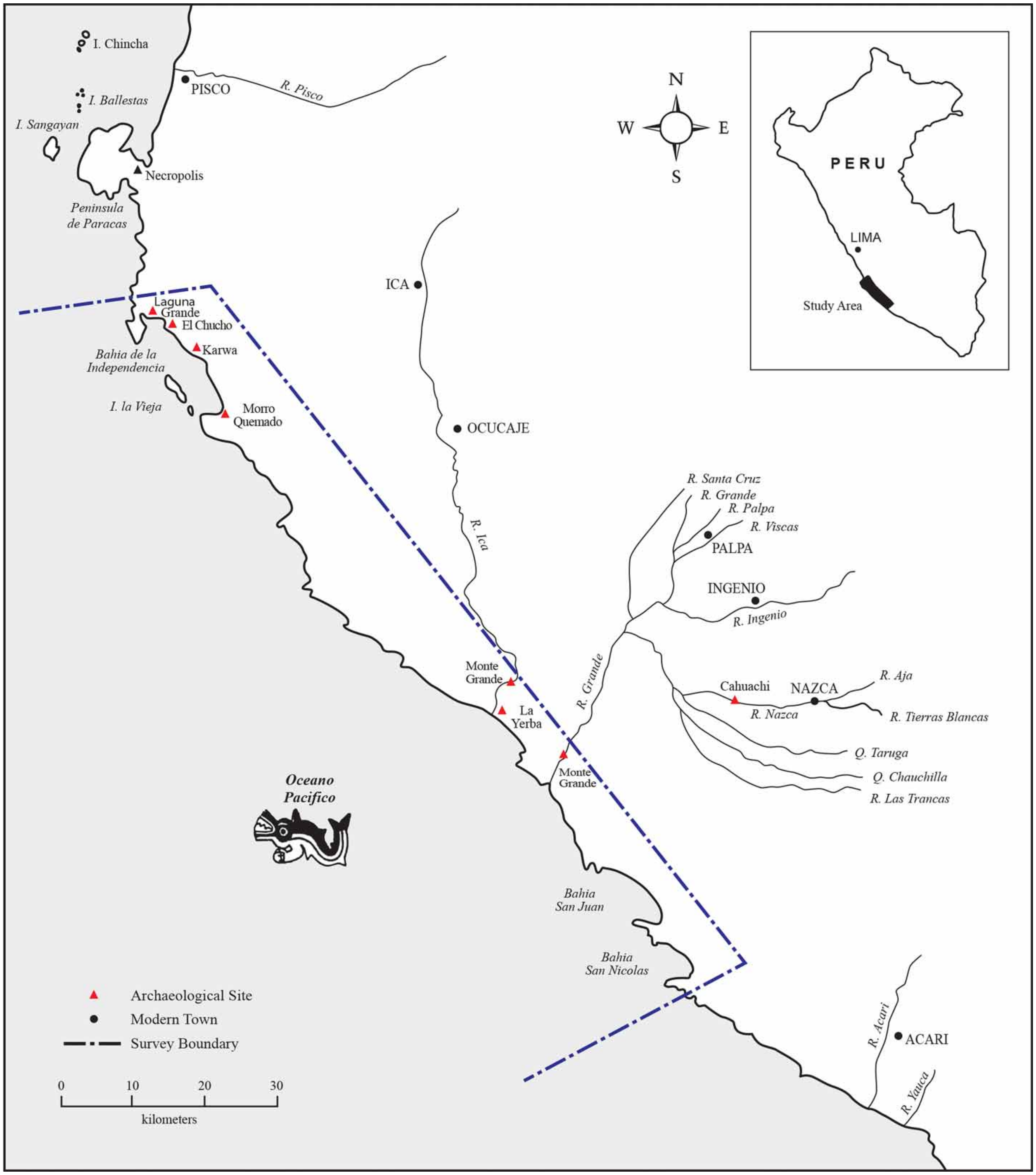

Figure 1. South coast of Peru showing Carmichael's (1998) survey boundaries, archaeological sites, towns, and river valleys as mentioned in the text.

Beresford-Jones 2011: 9–28; Schreiber and Lancho 2003: 24–30). The lower reaches of the Ríos Ica and Grande trace much of their route through deep, narrow gorges which occasionally widen into small basins like verdant oases in the midst of an arid desert landscape. The river mouths are meager, anticlimactic effluents. Back from the oceanfront hills and away from the rivers the terrain is open, rolling country, characterized by stony pampas with rocky outcrops punctuating the horizon. In this environment agriculture is highly circumscribed, being confined to the river margins and oases, and entirely dependent on seasonal flooding. The annual flood does not always arrive. Even the Río Grande, the largest river in the Nazca Basin, is considered to be one of the driest and most irregular rivers on the entire Pacific coast (ONERN 1971: 197). Ironically, dry periods can be followed by destructive floods (Beresford-Jones et al. 2009: 245). This is a tenuous environment for agriculturalists relying primarily on varieties of maize, beans, root crops, fruit, cotton, and gourds (Chiou et al. 2013: 43; Kellner and Schoeninger 2008: 232; Silverman 1993: 289–292; Vaughn 2009: 58). It is only logical for the Nasca to have supplemented their diet with nearby marine protein. The 40 km of desert separating the coastline from inland valleys was not a serious obstacle, being only a one-day walk for local inhabitants. At the time this study was first conceived (1988), some researchers assumed Nasca fishing towns subject to inland urban centers contributed substantial food surpluses, which buffered the effects of periodic drought and supported dense populations including craft and military specialists, and a nobility organized in a stratified, state-level society. It was a model based on logical assumptions, but what did the archaeology say?

This study summarizes the evidence for Nasca marine exploitation from iconography, settlement patterns, subsistence technology, fish and shell remains, and stable isotope analysis of human remains. In the past, isotopic studies have concentrated on the importance of maize in the pre-Columbian diet (e.g., Burger and van der Merwe 1990; Ericson et al. 1989), with more recent isotope studies of Nasca diet focusing on identifying foreigners in the population (Conlee et al. 2009; Knudson et al. 2009), dietary shifts between time periods (Kellner and Schoeninger 2008), residence mobility (Webb et al. 2013), and general isotopic signatures for a region (Cadwallader et al. 2012; Horn

PERIODS AND EPOCHS		ABSOLUTE TIME
	Colonial	
	Late Horizon	AD 1476-1534
8, 7, 6, 5, 4, 3, 2, 1	Late Intermediate Period	AD 1000 - 1476
4, 3, 2, 1	Middle Horizon	AD 700 - 1000
8, 7, 6, 5, 4, 3, 2, 1	Early Intermediate Period	AD 1 - 700
10, 9, 8, 7, 6, 5, 4, 3, 2, 1	Early Horizon	700 BC - AD 1
	Initial Period	1800 - 700 BC
	Preceramic	Prior to 1800 BC

Figure 2. Traditional south-coast chronology (Pisco–Acari) adapted from Rowe and Menzel (1973). Numbers denote epochs (units of time) and corresponding style phases. Absolute dates are those used for Carmichael's survey of the Ica-Grande littoral (1998: 7).

et al. 2009). Results from these studies pertaining to the current topic are considered below, our work is focused exclusively on the issue of marine resource exploitation.

The chronology referenced in this article is the traditional south-coast framework set out by Rowe and Menzel (1973) (Figure 2), which was used when the original field and lab work was undertaken in 1990 (see Note 1). For comparison, the recent chronology advocated by Carmichael (2013) for the Southern Nasca region is shown in Figure 3. In the new chronology, Carmichael moved the original Nasca style phase 8 (EIP Epoch 8) to the Middle

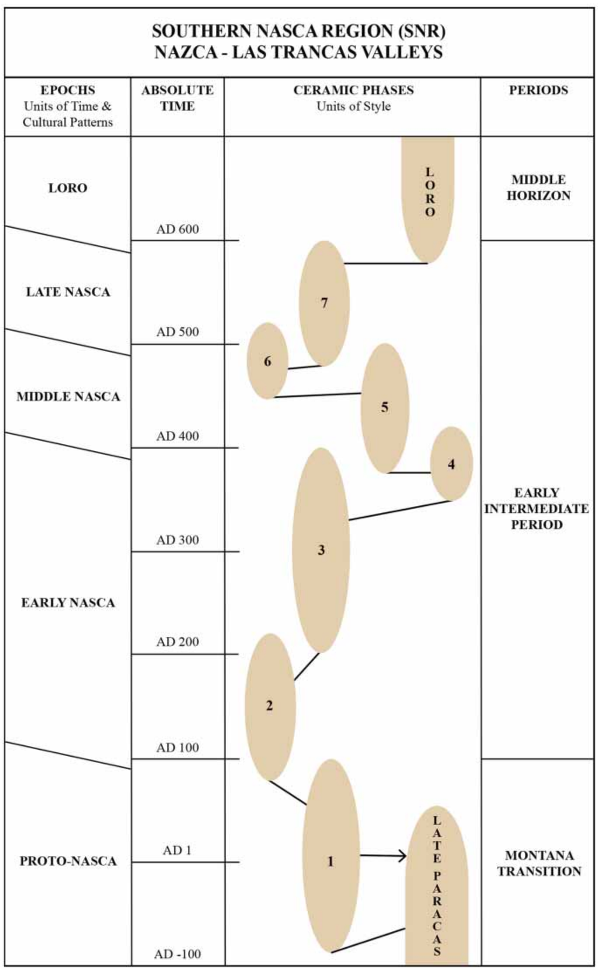

Figure 3. Current chronology for the southern Nasca region (Nasca–Las Trancas valleys). For discussion see Carmichael (2013: Appendix: Revised Chronology).

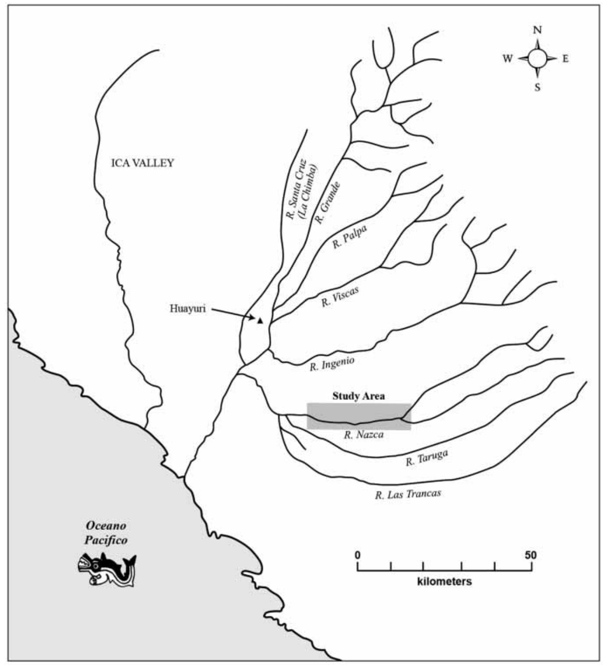

Figure 4. Location of the cemeteries from which Carmichael (1992) drew his pottery sample for motif analysis (Table 1), and also Kroeber's Nasca sites from which specimens were obtained for isotope analysis (Kroeber and Collier 1998).

Horizon (MH), and Nasca 1 (EIP 1) to the transition between the Early Horizon (EH) and EIP, while the estimated time allotments were moved down a century. These adjustments do not seriously impinge on the findings reported herein which, as already stated, follow the traditional Rowe and Menzel (1973) chronology. To date, our work is still the only study designed specifically to address the question of maritime input to Nasca diet. In the interests of clarity, Nasca will be spelled with a "z" when referring to toponyms and geography, and with an "s" when referencing the archaeological culture.

Iconography

Depictions of sea creatures on Nasca pottery have been used to infer economic importance from maritime resources (Blasco and Ramos 1980: 128; Carmichael 1988: 34; Proulx 1983: 100; Silverman 1986: 11). Fishermen with nets, fish, shellfish, aquatic plants, and littoral birds are depicted, and some Nasca deities are based on marine creatures (Proulx 2006: 83–85, 134–135, 149–156, 169). Piscine geoglyphs and petroglyphs are also documented in interior regions (Nieves 2010: 28; Proulx 2007: 67–68). It is evident the Nasca were well acquainted with marine life and, given the tremendous food potential of ocean resources, it is reasonable to hypothesize that the littoral zone played an important role in the regional dietary economy.

A perusal of museum collections and the illustrated literature gives the impression that marine motifs are extremely common. However, the majority of collections lack secure provenience, and the question of collector bias remains an unknown factor. In order to objectively assess motif frequencies, Carmichael (1992) assembled a large sample of excavated Nasca pottery (*N*=447 painted vessels). The pots came from 138 documented burials which could be confidently assigned to specific style phases according to the Dawson Seriation (Carmichael 1988: 461–464), and derive from sites along the Nazca River (Figure 4). Following Roark's (1965: 57) motif classification system (which is still widely used today, e.g., Proulx 2006), the sample was divided into three groups based on primary motifs as follows:

- Referential—subject matter depicting life forms or objects in the real world (birds, plants, animals, fish and shellfish, and humans) and assumed to represent secular or daily reality.
- Conceptual—subject matter that is not identifiable with beings or objects in the real world (spirits or deities) and therefore sacred.
- Abstract—designs for which no referent can be identified (geometric, abstract, and decorative designs) and meaning, if any, is unknown.

The results are shown in Table 1, where the frequency of marine themes is noted under the referential category (adapted from Carmichael 1992: 189). As shown in Table 1, marine themes account for 10.6 percent of the EIP 2–4 sample, and only 0.7 percent of the EIP 5–8 sample (see chronology in Figure 2 compared with Figure 3). If it is assumed motif frequencies reflect economic importance, then it must be concluded that fishing was virtually abandoned in the later epochs. This seems unlikely as climate studies indicate that, beginning in the fifth century A.D. (EIP 5, Figure 2; Middle Nasca, Figure 3), the south coast experienced a period of protracted desiccation (Kevin Vaughn provides an excellent summary of several recent climate studies incanted in Kanter and Vaughn (2012: 75–76); also see Mächtle and Eitel 2013). At the same time, riparian woodlands were significantly reduced to increase farmland, thereby altering soil and wind conditions which created an environment of ever-increasing aridity and fragility, and culminated in the collapse of agricultural production (Beresford-Jones et al. 2011: 290). These conditions do not favor a reduction in fishing activity during Late Nasca times.

Table 1. Carmichael Nazca Basin Sample: Motif Frequencies for EIP

	Early (EIP 2–4)	*Late (EIP 5–8)*
Referential		
Marine	20 = 10.6%	2 = 0.7%
Birds	32 = 16.9%	2 = 0.7%
Plants	34 = 18.0%	5 = 1.9%
Artifacts	2 = 1.0%	5 = 1.9%
Trophy heads	6 = 3.2%	22 = 8.5%
Animals	5 = 2.6%	12 = 4.6%
Human	7 = 3.7%	16 = 6.2%
Warriors	0 = 0.0%	4 = 1.5%
Conceptual	32 = 17.0%	111 = 43.0%
Abstract	51 = 27.0%	79 = 31.0%
Totals	189	258

Note: Sample consists of 61 Early gravelots with 189 vessels and 77 Late gravelots with 258 vessels from the Nazca River Valley = 138 gravelots with 447 vessels. Carmichael (1988): 461–464, Figure 4.

If marine iconography is not documenting economic concerns, what is being expressed? Another perspective is gained by taking a contextual approach, which places the question within an indigenous Andean context. The indigenous context is reconstructed from all possible sources, being informed by environment and ecology, archaeology, art history, ethnography, and ethnohistory. Previously, Carmichael noted that in traditional Andean thought the ocean was believed to be the source of all water (1992: 188–189). The female sea deity, Mama Cocha, was also "mother of lakes and water," and springs were worshipped as her daughters (Cobo 1990 [1653]: 33, 117). On a conceptual level no distinction was drawn between fresh water and salt water; rather, all water originated from the sea. The Inca placed Mama Cocha at the center of their world by covering the Haukaypata plaza in Cuzco with sea sand (Polo de Ondegardo 1916 [1571]: 109–110; Sherbondy 1982: 16 cited in Hyslop 1990: 37–38). Archaeological evidence demonstrates that seashells were used in Cuzco offerings (Delgado González 2013: 89-90).

Symbols of the sea are still used in rain ceremonies near Nazca today. In times of drought a man is sent to the coast at night to collect foamy sea water in a jug from a place where the waves crash against the rocks. The water is later sprinkled on the summit of a hill above Nazca in the belief this offering will cause rain in the mountains within two weeks (Urton 1982: 11). In another account, Antunez de Moyolo observed sea water being poured over seaweed near Nazca in order to bring rain (Reinhard 1988: 51). In addition to sea water and seaweed, seashells were also used in the Andes as offerings to ensure continued water supplies (Cobo 1990 [1653]: 117). Any objects or images associated with the sea may have been perceived in a similar manner. Seashells have been found in offering contexts at the Nasca cult center of Cahuachi (Rodríguez de Sandweiss 1993: 298), which is located where water suddenly emerges on the surface after a 15 km underground flow (Silverman 1993: 10, 12–13; Schreiber and Lancho 2003: 29–30). Much of the famous Nasca polychrome pottery, including imagery of fish, shells, and water birds, was produced near Cahuachi (Vaughn and Neff 2004: 1583). Although the Nasca are too far removed in time and space to claim any direct connection with historical accounts, nonetheless they were part of the greater Central Andean Tradition. In this context, Nasca marine motifs need not be read as specific references to sea life, but rather as general references to water/fertility concepts—understandable preoccupations for farmers dependant on inconsistent water supplies in a rainless, hyper-arid desert (Carmichael 1992: 188–189).[2]

The Late Nasca reduction in depictive marine themes need not be read as a lack of concern for water; as Table 1 shows, in EIP 5–8 there is a greater than two-fold increase in conceptual (supernatural) themes, which include piscine motifs such as the "Mythical Killer Whale" and water-related forms of the "Anthropomorphic Mythical Being" (Carmichael 1992: Figures 7–8, 18; Proulx 2006: Figures 5.3, 5.9, 5.10, 5.47–5.52, 5.54).

Aside from marine themes, our isotope study (see below) provides another curious finding in regard to motif frequencies: approximately 50 percent of bone carbon was ultimately derived from C_4 plants (either directly or through animals eating them) with maize being the most probable candidate, and yet, as a primary motif on pottery, maize was entirely absent in the plant category (Table 1). A similar study of Proulx's (1968) Ica pottery samples for EIP 3–4 found maize comprised 4 percent of plant motifs (Carmichael 1992: 188). The critical question here is whether depictions which can be identified with objects in the real world are "mundane" or "secular" images of daily life as stated by Roark (1965: 57), or have interpretations fallen subject to classification? Carmichael has argued that Nasca iconography is a symbolic, interrelated system from which components cannot be isolated and treated as accurate reflections of ordinary reality (1992, 1994). But a different view is presented by Donald Proulx (2006: 18, 140, 205). We should remain cautious in using iconography to reconstruct subsistence. Nonetheless, iconography unequivocally demonstrates the Nasca engaged in some fishing involving nets. The question is the extent to which this activity underpinned the regional dietary economy.

Settlement Patterns

Nasca sites are well documented in the inland valley areas of Ica and the Nazca Basin (Browne and

Baraybar 1988; Cook 1994; Massey 1986; Proulx 2007; Reindel 2009; Schreiber 1998; Silverman 2002). These inland regions are separated from the ocean by 40–60 km of desert plain, transected by the Ica and Grande rivers which trace their routes through coastal hills to the shores of the Pacific. Little systematic research had been done in the littoral zone before Carmichael's 1989–1990 survey (Carmichael 1998 [and see Engel 1966, 1981, 1991]).

Carmichael's study area encompassed the coastal region opposite the inland centers of Ica and Nazca (Figure 1). While sites from all time periods were recorded, the main objective was to document Nasca fishing villages, which informants insisted were abundant and huge. After six months of field work, no oceanfront Nasca sites were found (EIP 2–8). Settlements dating to the EH and Late Intermediate Period (LIP) are present in the littoral zone, but EIP and Middle Horizon (MH) sites were not documented on the seafront. They occur in the oases several kilometers inland from the mouths of the Ica and Grande Rivers (both called Monte Grande), and it would be surprising if, eventually, a few sherds are not found on the shores, but remains indicative of permanent oceanfront habitation from these periods are thus far lacking.

Here, and hereafter in this article, a qualification is required: Carmichael's survey findings reflect surface evidence as it appeared in 1989–1990. As previously noted, regional chronologies are currently in flux, and researchers' definitions can vary by area. The reader is again directed to the chronology used in this article, shown in Figure 2 (Carmichael 1998: 7).

At the sites of El Chucho (Cerro Chucho; Chucchio) and Karwa (Karwas; Carhua) in the Bahía de la Independencia at the northern end of the study area (Figure 1), occupation continued from the EH through the Necrópolis phase (EH 10–EIP 2) according to Engel (1981: 28–29) and Paul (1991: 18) (also see García Soto and Pinilla Blenke 1995 for an excellent discussion of the Bahía during this time). The smaller site of Morro Quemado, located at the south end of the Bahía, also corresponds to this phase (Carmichael 1998: 82; García Soto and Pinilla Blenke 1995). Carmichael did not find pottery dating to EIP 1–2 at these locales. His evidence suggests El Chucho and Karwa were reoccupied in the LIP (Carmichael 1998: 73, 75). Evidently, earlier and later peoples faired quite well in this littoral environment.

Large and small villages from the LIP were encountered throughout the study area, and represent a more extensive use of the shoreline than any previous period in prehistory (Carmichael 1998: 29). Here we deal only with the LIP site of La Yerba, located at the mouth of the Rio Ica (Figure 1), which provides a good example of what a permanent fishing village looks like (Carmichael 1998: 87–88). The site has been known since the beginning of the last century when it was first described (colorfully) by Max Uhle;[3] Engel refers to it as 15b VII-30 and 15b VII-35 (1981: 20), or Max Uhle I and Max Uhle II (1991: 157), and Cook designates it as PV-62-L-3 (1994: 223). La Yerba covers two large, adjacent, shell-strewn hills facing the ocean on the south side of the Rio Ica, about 700 m in from the beach line, at the north end of La Yerba dune field (for which Carmichael named the site). Surface remains cover an area approximately 200 × 120 m, mounded to a height of 15 m or more. In and around these hills are exposed sections of reed walls, foundation segments of silt-stone blocks, and adobes with mud plaster. Note that these more permanent materials are not available on the beachfront, and must have been hauled from some distance. Midden deposits contain thick, rich organic layers full of charcoal and ash. In addition to a great variety of shellfish, maize and gourd fragments are plentiful. Sea lion, whale, camelid, and canine bones are also present, as are pieces of coarse cloth, string, and netting. Fragments of large cooking and storage vessels are found over the entire site, and painted fine-ware sherds are plentiful. A nearby cemetery dates to the same period. At La Yerba, we have clear evidence of year-round occupation demonstrated not just by the amount of debris, but by the energy investment in durable construction materials and abundance of both utilitarian and fine-ware pottery, which had to be carried across the desert. A corresponding cemetery demonstrates territorial permanency. It is fair to suggest that La Yerba participated in an economic symbiosis with its inland neighbors.

The EH-Necropolis sites of El Chucho and Karwa contain similar midden deposits, but very little pottery was visible on the surface in 1989–1990, and was mainly eroded or undecorated utilitarian ware. However, where LIP La Yerba consists of two, roughly circular mounds, the EH mounds are linear. El Chucho has 18 linear mounds, the larger ones estimated to be 100–150 m in length by 20 m wide and 2–4 m high (Carmichael 1998: 73). The survey by Cordy-Collins at Karwa in 1980 (1998: 37) identified nine major mounds ranging from 31–234 m long, 10–47 m wide, and 1–6 m high. Modest human burials were observed at both sites. These villages were important fishing communities of their era, and possibly year-round occupations. They may have engaged in economic symbiosis with agrarian settlements, probably in the Ica Valley rather than the Paracas Peninsula according to García Soto and Pinilla Blenke (1995: 65).

Since we have major examples of oceanfront villages in the EH and LIP, why is the record blank for the EIP and MH? Here we will concentrate on the EIP, although the same considerations apply to the MH. First, the littoral zone is not a uniform environment. The coastline includes sand beaches, gravel beaches, rocky beaches, and sheer rock cliffs, with shoreline depths ranging from waist deep to a 10 m plunge. Varieties of shellfish, fish, birds, and sea mammals inhabit these various microenvironments, so that particular resources are concentrated in given stretches. Access to potable water is a major problem today, although a few seeps are reported along the Bahía de la Independencia, and brackish water can be found below the dry river beds of the Ica and Grande rivers behind the shore. Seasonal storms lash the coast making cliffs dangerous for deep water fishing and egg gathering. Unpredictable events such as El Niños and red tides (toxic algal blooms) shut down fisheries. In spite of such challenges, EH and LIP villages flourished on this coastline for centuries.

The common factor shared by the large EH sites of El Chucho and Karwa with LIP La Yerba is location—they are situated on (or immediately adjacent to) extensive sandy beaches. The principal constituents of the midden (mound) deposits at all three sites are species of clams harvested in abundance from the sandy sub-littoral. These sites also contain gastropods and bivalves from the rocky sub-littoral in addition to sea mammal bones and domesticated plant foods, but the bulk of the deposits are composed of clam shells. Why were El Chucho and Karwa abandoned at the beginning of the EIP? Were the clam beds exhausted due to environmental disasters or over-harvesting, did the fresh water seeps fail, or fish migrations shift? Why did a permanent village the size of La Yerba not appear at the mouth of the Río Ica before the LIP?[4] Whatever factors may have been involved (and human agency must be considered among them), the settlement pattern data demonstrate that, for the Nasca, the return on harvesting marine resources did not warrant the energy investment required to maintain permanent shoreline occupations. Nonetheless, a considerable amount of protein can be obtained and preserved during short-term, seasonal visits.

Marine Subsistence Technology

The apparent absence of permanent, year-round Nasca fishing villages along the oceanfront suggests fishing and littoral gathering activities—both of which undeniably occurred—were conducted during temporary visits to the shore. Another approach to estimating the importance of these pursuits is to examine the archaeological evidence for marine subsistence technology. Fishing gear requires maintenance, which is best undertaken where repair materials are plentiful, and when free time allows. Prized implements are more likely to be kept with the owner rather than abandoned in a distant cache. Such considerations, combined with the fact that the ocean is a one to two-day walk from most Nasca villages, suggests the possibility that gear accompanied its owners back to their villages after a fishing trip.

On the Peruvian coast from Preceramic times onwards, fishing technology included cotton nets, stone weights, gourd floats, cotton line, and fishhooks fashioned from shell, bone, and cactus-spines (Bird and Hyslop 1985: 224–225; Pozorski and Pozorski 1987: 14–15; Quilter and Stocker 1983: 548). If fishing was an important activity for the EIP Nasca, some evidence of such artifacts might be expected. However, none has been reported from excavated habitation sites, and no fishing gear (nets, sinkers, gourd floats, hooks, fish line, or harpoons) was present among the contents of 213 Nasca tombs documented by Carmichael (1995). Nasca graves often contain utilitarian items such as spear-throwers and darts, obsidian knives and points, cactus-spine needles, yarn, spindles and spindle whorls, combs, gourd bowls, baskets, and clothing (Carmichael 1988: 483–499). The absence of artifacts associated with fishing is notable. Fragments of netting have been reported as surface finds (Proulx 2007: 9), including knotted and looped netting (Proulx 2006: 176), but it is not clear whether these are hand-sized pieces of net bags or parts of full-size fishing nets. Ceramic iconography graphically illustrates the presence of fish nets (Lapiner 1976: 214; Proulx 2006: 177), perhaps as large as the traditional Peruvian *atarraya* or circular cast net (Marcus 1987: 16–17). Marcus (1987: 17) provides an example of one found in a LIP tomb. We anticipate similar nets will be found eventually in secure Nasca contexts; however, there is no suggestion in the iconography of larger hanging nets (*red de cortina*) which require floats on the surface and weights on the bottom. Historically, hanging nets were strung between two rafts (Marcus 1987: 18). Nasca watercraft have never been identified archaeologically. Iconography suggests the use of one-man floats, perhaps made from an inflated animal skin (Proulx 2006: 123).

Shell and Fish Remains

Shell remains from crabs, chitons, sea urchins, barnacles, mussels, clams, and many other mollusks from both sandy and rocky littoral habitats frequently dot the surface of inland sites in the Ica-Nazca region. One might assume shellfish were a constant and important dietary element throughout prehistory, but recent field work documents variations in shell densities through time, with EIP Nasca sites containing sparse remains compared to deposits from earlier and later periods (Beresford-Jones 2011: 92; Cook and Parrish 2005: 140). Controlled excavations at EIP sites consistently reveal the shell component to be minor and scattered (Beresford-Jones et al. 2011: 280; Cook and Parrish 2005: 140; Van Gijseghem 2004: 298; Vaughn 2009: 133; Vaughn and Linares 2006: 602). Some specimens are found to be edge-worn, cut, perforated, or with traces of red pigment on exterior and interior surfaces (Rodríguez de Sandweiss 1993: 295). Mussel shells appear to have been used as spoons. Mollusks were also used to make beads for necklaces and bracelets, which were worn by men, women, and children (Carmichael 1988: 485–486). Rodríguez de Sandweiss concluded that, in some features excavated at Cahuachi, shell remains were not a byproduct of subsistence, but rather represent ritual offerings (1993: 298). While shell remains are present at many inland sites, there is no evidence to suggest shellfish played a significant role in the Nasca diet.

Tangible evidence of fish at inland sites is more equivocal, as fish bones are delicate, may be boiled down, and on small species like anchovies can be entirely consumed. Fish remains are sometimes mentioned in the literature as present at excavated sites, but seldom quantified. Van Gijseghem (2004: 297) included fish bone in a list of faunal recoveries from La Puntilla (Late Paracas, Nasca 1), and Rodríguez de Sandweiss (1993: 296) lists several species found at Cahuachi. Neither researcher calculated MNIs, indicating minor representation. Valdez alone reports abundant fish heads in some excavations at Cahuachi, which he identifies as *Odontesthes regia regia* (*pejerry*), a small fish known to school periodically at river mouths (1988: 148, 150). Apparently these finds were localized, as Silverman's excavations (1993) did not encounter significant fish remains. Cahuachi is well known as the preeminent center for Early Nasca ceremonial feasting (Orefici 2012; Silverman 1993; Valdez 1994), but fish bone is not mentioned at village sites of the period such as Upanca (Vaughn and Linares 2006) or Marcaya (Vaughn 2009). We are left pondering the extent to which fish may or may not have contributed to the Nasca diet.

The evidence summarized thus far does not support a strong reliance on marine resources. It may be argued that the paucity of fishing gear and limited shellfish and fish remains at inland sites is due to sampling error or differential preservation, and large food surpluses can be generated from temporary seashore encampments. If only the meat from mollusks and fish was transported inland (having been sun-and-wind dried on the beach) there would be few tangible traces in the archaeological record. For these reasons we have investigated another avenue of inquiry: the stable carbon, nitrogen, and sulfur isotope values of the Nasca people themselves.

Isotope Evidence

Stable isotope analysis can provide extremely useful dietary information, but application of the technique is limited to situations in which subsistence issues involve isotopically distinct food groups. Stable light isotopes such as carbon, nitrogen, and sulfur have been used in the past to explore two main issues surrounding dietary choice: (1) relative reliance on C_3 versus C_4 plants, especially maize, and (2) relative reliance on marine versus terrestrial resources.

Carbon isotopes can be used to distinguish between three groups of plants because of the different photosynthetic pathways used. C_3 plants include most trees, shrubs, temperate-zone grasses, and the majority of domesticated Andean plants (potatoes, squash, quinoa, and beans) and have $\delta^{13}C$ values in the range of −33 to −23 permille (O'Leary 1988; Sharp 2007; Tieszen 1991; Tieszen and Boutton 1989). C_4 plants are characterized by growing in arid, warm conditions and include many grasses as well as maize and kiwicha (a pseudo-cereal similar to quinoa) with $\delta^{13}C$ values ranging typically from −16 to −9 permille, although the values can be as low as −21 permille (Hatch and Slack 1966; O'Leary 1988; Sharp 2007; Tieszen 1991). Crassulacean acid metabolism (CAM) plants, notably cacti and succulents, can have $\delta^{13}C$ values that span the range of C_3 and C_4 plants, although their isotope value often will reflect the type of environment in which they grow, for example, CAM plants in arid hot environments will have a $\delta^{13}C$ value similar to C_4 plants (Cadwallader et al. 2012; Eickmeier and Bender 1976). There is a slight fractionation of carbon isotopes as the food chain is ascended of approximately +1 permille (DeNiro and Epstein 1978).

Nitrogen isotope values are useful in distinguishing between different trophic levels, with the $\delta^{15}N$ value increasing due to fractionation as the food chain is ascended by approximately 3–5 permille at each step (Bocherens and Drucker 2003; O'Connell et al. 2012). Thus herbivores, omnivores, and carnivores can be distinguished, and the degree of carnivory estimated (Ambrose 1993, 2000; O'Connell and Hedges 1999). It is important to note that $\delta^{15}N$ values can be elevated in plants as a response to aridity or can be artificially raised due to the addition of fertilizer (Ambrose 1991). Thus it is important to have faunal isotope values to act as a baseline when interpreting human data in order to account for these possible effects.

Together, carbon and nitrogen are useful in distinguishing between the consumption of marine and freshwater resources. While the $\delta^{15}N$ value will be elevated for both of these diets (allowing its identification from terrestrial resources) a more enriched $\delta^{13}C$ value (similar to those of a C_4 diet) will identify it as a marine diet as opposed to a freshwater diet which has much lower values (Schoeninger and DeNiro 1984).

Sulfur isotope ratios ($\delta^{34}S$) are used as another potential indicator of marine resource consumption. $\delta^{34}S$ values of the marine environment are typically in the region of 15–20 permille (Hoefs 2004; Zhao et al. 2003), while terrestrial sources are ^{34}S depleted and in the range of 2–8 permille (Macko et al. 1999; Privat et al. 2007; Schwarcz 1991). Sulfur isotopes do not fractionate as they ascend the food chain and thus the values in human tissues should be directly equivalent to the foods consumed (González-Martín et al. 2001; Kennedy and Krouse 1989; Richards et al. 2003). However, the sea-spray effect means that terrestrial plants grown near the coast can have sulfur isotope values similar to marine resources (Richards et al. 2003). Thus sulfur isotopes also can indicate proximity to the sea. There have been few Andean archaeological studies which have incorporated $\delta^{34}S$ analyses (Aufderheide et al. 1994; Horn et al. 2009; Kelley et al. 1989; Macko et al. 1999), largely due to the fact that the sample of choice is hair or soft tissue, since the sulfur content of bone is very low.

Materials and Methods

Carbon, nitrogen, and sulfur isotope values were determined for a large sample of human remains ($N = 75$) derived from the Kroeber collection, which was assembled in 1926 and is housed at the Field Museum of Natural History in Chicago. Well-provenienced specimens of bone, hair, and soft tissue (skin) were selected from gravelots recovered from seven sites along the Río Nazca: Agua Santa, Aja, Cahuachi, Cantayo, Majoro Chico, Ocongalla, and Soisongo (Figure 4; and see Kroeber and Collier 1998; Schreiber 1998). The sample spans the EIP and includes a small number of MH and LIP burials (Table 2). It is restricted to adults, but incorporates both males and females and persons of different social status.[5] While bone and soft tissue specimens represent interred individuals, the hair sample also incorporates wigs worn by the deceased and hair bundles included in the grave goods. On the basis of forensic examination, we believe that multiple hair samples found in a single grave can be attributed to different individuals (Carmichael et al. 1991).

Sample preparation techniques used at the University of Calgary followed accepted methods for the various materials analyzed and the isotopes involved. Bone collagen was extracted as per the methods of Sealy and van der Merwe (1986). Hair and skin specimens were washed in acetone (to remove any lipids), followed by distilled water, freeze-dried and analyzed as bulk samples. The hair can be regarded as pure keratin once it has been cleaned in this manner, whereas the skin will be a mixture of collagen, keratin, elastin, and other minor components (Odland 1991; Wenstrup et al. 1991). Due to the different turnover times of the tissues, bone collagen gives approximately a lifetime dietary average (Hedges et al. 2007; Rummel et al. 2007), whereas hair represents the last few months of life (Saitoh et al. 1969; Tobin 2005). The different components in skin turnover at different rates and some have been shown not to turnover at all (Babraj et al. 2005; El-Harake et al. 1998; Ritz-Timme et al. 2003), however, as collagen is the predominant component, the diet represented by the isotope signal is approximately that consumed in the last few months of life.

Table 2. Nasca Diet and Subsistence Project: Human Sample

		Specimens		
Site	*Time Period*	*Bone*	*Hair*	*Soft Tissue*
Kroeber collection				
Aja	EIP	1	—	—
Agua Santa	EIP	1	—	—
Cahuachi	EIP	7	12	8
Cantayo	EIP	3	7	2
	MH	2	—	—
	LIP	1	—	—
Majoro Chico	EIP	9	1	—
	LIP	1	1	2
Ocongalla	EIP	3	2	1
Soisongo	EIP	3	2	1
	MH	1	1	1
Total		27	26	15
Other				
Monte Grande	EIP	13	—	—

Specimens for carbon and nitrogen analysis (all tissue types) were combusted in a Carlo-Erba carbon-nitrogen analyzer, and their isotope ratios assessed in a VG Isogas Prism mass spectrometer. Samples for sulfur isotope analysis were Parr-bombed, with sulfur retrieved as barium sulfate and analyzed in a VG 602 mass spectrometer. Isotope ratios are expressed using the delta (δ) notation in permille (‰) relative to international standards, such as VPDB for carbon and AIR for nitrogen (Hoefs 2004). The original data are now unavailable and, as such, machine precision cannot be given.

During the original analysis in 1990, atomic carbon to nitrogen ratios were used to assess the integrity of the specimens. Carbon and nitrogen values for all tissues were rejected if the C/N ratio of the specimen fell outside the acceptable range of 2.9–3.6 (DeNiro 1985). This value is based on bone collagen and subsequently an acceptable C/N ratio for hair keratin has been published as 3.0–3.8 (O'Connell and Hedges 1999). Given the similarity in the ranges for bone collagen and keratin, we assume here that the keratin results are valid. The C/N ratio of skin collagen—the major component of skin—theoretically should be the same as bone collagen due to the similarities in the collagen composition (Odland 1991; Wenstrup et al. 1991); thus, the use of 2.9–3.6 as a quality control assessment here is regarded as appropriate in the circumstances.

Not all of the human remains yielded useable results. It is unknown whether there are any paired results in the data set.

Results

Only mean stable isotope results and their standard deviations were available and are summarized in Table 3.

Carbon and Nitrogen. The three tissue types are largely comparable, based on the standard deviations and the spread of the data, although the carbon isotope values from the bone collagen are narrower.

Table 3. Results of Stable Isotope Analysis

Tissue	*δ^{13}C (N)*	*δ^{15}N (N)*	*δ^{34}S (N)*
Bone	−13.3 ± 0.8 (14)	+9.8 ± 1.3 (14)	—
Hair	−15.0 ± 1.5 (17)	+7.9 ± 1.2 (16)	+2.1 ± 1.8 (10)
Soft tissue	−15.2 ± 1.6 (5)	+10.9 ± 0.9 (5)	+1.3 ± 1.8 (10)

The means for the bone and hair carbon and nitrogen values are in good agreement when the tissue spacing between collagen and keratin is taken into consideration (O'Connell et al. 2001). The skin ($n = 5$) results are broadly similar to the other tissues and as expected based on tissue spacing studies (DeNiro and Epstein 1978, 1981; Lyon and Baxter 1978; O'Connell et al. 2001; Tieszen et al. 1983; White and Schwarcz 1994). There is no indication that there was a change in diet towards the end of life in general for the population analyzed.

The carbon isotope values suggest that a mixed C_3/C_4 diet was consumed, with a significant reliance on C_4 foods. Without faunal remains it is difficult to know whether this C_4 signal in humans is the result of animals consuming either wild C_4 foods, such as grasses which are abundant on the coast, or domesticated C_4 foods, such as maize or kiwicha (Cadwallader et al. 2012). Again, without a faunal baseline, interpretation of the δ^{15}N values is slightly problematic in terms of defining the types and relative quantities of meat consumed. However, comparing these data to published faunal data from similar sites (Cadwallader 2013; Horn et al. 2009) and to modern studies of marine isotope values (Tieszen and Chapman 1992), our results suggest that terrestrial meat was the main source of protein and marine foods were not consumed in any significant quantity (Figure 5).

Sulfur. The hair and the skin sulfur results ($n = 10$ for both) are broadly similar. These low values can be interpreted as stemming from a terrestrial diet with little or no input from marine resources, especially when viewed in light of resources with known sulfur values from the coast (Horn et al. 2009). They also indicate that no foods were consumed which had been subject to the sea-spray effect (unsurprising given the distance from the sea) nor had any terrestrial meat sources been foddered on marine plants such as seaweed (Figure 6). Thus these results fully support the carbon and nitrogen data.

To assess the possibility of temporal variation in types of foods consumed by the Nasca, we divided

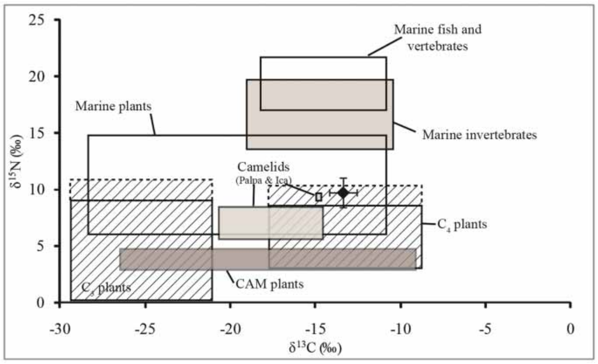

Figure 5. Mean carbon and nitrogen isotope value of bone collagen (black diamond) from the Kroeber collection (n = 14; error bars are to 1σ) plotted against background isotope values for south-coast plants and animals. Data for plant values are based on Cadwallader et al. (2012), DeNiro and Hastorf (1985), Thornton et al. (2011), and Tieszen and Chapman (1992). Animal data are based on Cadwallader (2013), Horn et al. (2009), and Tieszen and Chapman (1992). Modern data have been corrected for the Suess effect using Long et al. (2005). The dashed boxes on top of the C_3 and C_4 plant ranges represent the elevated nitrogen values expected for water stressed plants (modified from Cadwallader (2013)).

our sample into two groups: specimens from EIP 2–4 and EIP 5–8 (Table 4). Carbon and sulfur isotope values for the early material are slightly lower than for later material, while nitrogen values are essentially the same. The difference in carbon collagen values is

Table 4. Temporal Variation in Stable Isotope Values of Human Bone Collagen and Hair

Time Period	$\delta^{13}C$ *(N)*	$\delta^{15}N$ *(N)*	$\delta^{34}S$ *(N)*
Bone collagen			
EIP (1–4)	−13.8 ± 0.7 (6)	+9.7 ± 1.8 (6)	—
EIP (5–8)	−12.8 ± 0.6 (8)	+9.9 ± 0.7 (8)	—
EIP (All)	−13.3 ± 0.8 (14)	+9.4 ± 1.3 (14)	—
MH	−13.5 ± 0.4 (3)	+9.4 ± 0.5 (3)	—
LIP	−11.0 (1)	+10.6 (1)	—
Hair			
EIP (1–4)	−14.9 ± 1.4 (14)	+7.9 ± 1.3 (13)	+2.4 ± 1.6 (7)
EIP (5–8)	−15.8 ± 1.4 (3)	+8.1 ± 0.9 (3)	+1.3 ± 1.9 (3)
EIP (All)	−15.0 ± 1.5 (17)	+7.9 ± 1.2 (16)	+2.1 ± 1.8 (10)
MH	−14.4 (1)	+7.7 (1)	+1.1 (1)
LIP	−14.2 (1)	+8.4 (1)	—

statistically significant for the early versus late EIP ($t(12) = -2.8$ $P < 0.05$),[6] although actually this increase could be attributed to natural variation within the background isotopic resources, especially as the early material derives from different sites than the later sample.

Several MH and LIP specimens were also included in our Field Museum sample. MH values are in the same range as those from Nasca sites, while LIP values are slightly enriched, suggesting a somewhat greater importance of maize and possibly marine resources as has been seen elsewhere (Cadwallader 2013), although this result is based on only one sample (Table 4).

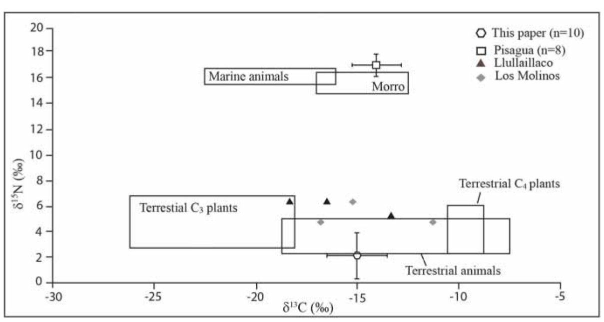

Figure 6. Sulfur and carbon isotope values from hair samples compared against marine and terrestrial resources. Plant and animal data are taken from Horn et al. (2009) and Macko et al. (1999). Comparative human hair samples are taken from Aufderheide et al. (1994)—Pisagua mummies (northern Chile); Horn et al. (2009)—EIP mummies (Palpa, Peru); Macko et al. (1999)—Morro mummies (northern Chile); and Wilson et al. (2007)—Llullaillaco mummies (highland Argentina).

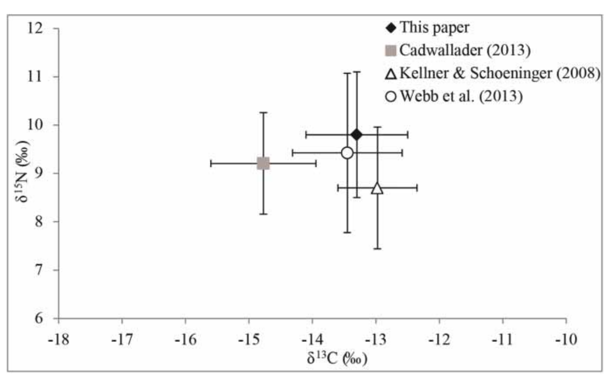

Figure 7. Comparison of carbon and nitrogen bone collagen isotope data with other EIP south-coast sites.

Finally, we can ask how the Nazca Valley data compare with those from other south-coast valleys during the EIP. Figure 7 plots our bone collagen data against other contemporaneous populations from the south-coast region. There is a striking similarity between all the data, although the Ica Valley population is less enriched in $\delta^{13}C$ (Cadwallader 2013). Importantly for this study none of the populations shows any sign of reliance on marine resources based on the isotopic data.

Discussion

Isotope data demonstrate the Nasca subsistence economy was firmly based on agriculture with maize probably being the principal crop. Marine resources played a minor role in the regular diet, a finding confirmed in other isotope studies (Cadwallader 2013: 187; Horn et al. 2009: 192; Kellner and Schoeninger 2008: 236; Webb et al. 2013: 133–135). However, seafood could have provided relief during prolonged droughts, and mollusks may have been a seasonal source of protein (Erlandson 1988), which would not be identified in bulk analyses of bone collagen. The isotopic analysis suggests that terrestrial animal protein was somewhat frequently eaten, although there is a paucity of faunal isotopic evidence for this period and region. This is in contrast to faunal analyses which suggest it played a minor dietary role.

The results of the isotope study complement other lines of evidence. The absence of Nasca sites on the oceanfront, the thin and scattered nature of marine remains at inland sites, and the paucity of fishing gear beyond fragments of netting no longer can be assumed to reflect preservation or sampling biases, but accurately indicate the limited dietary importance of marine resources. While the frequency of marine motifs in the iconography parallels the seafood component of the diet in EIP 2–4, isotope data indicate marine input remained relatively constant throughout the EIP (Table 4). In EIP 5–8, depictive, primary motifs showing fish and fishermen are rare (Table 1). Hence, the iconographic and isotopic data do not agree. In addition, isotope values suggest that maize comprised a significant portion of the Nasca diet, although an indirect dietary route (i.e., humans eating camelids with a C_4 signal) cannot be ruled out without future faunal isotopic analyses (Cadwallader et al. 2012). Horn et al. (2009: 192) also found that maize played a major role in subsistence, while Kellner and Schoeninger refer to it as the main plant staple (2008: 236). Maize also has been found in significant quantities in the archaeobotanical record (Beresford-Jones et al. 2011; Piacenza 2005; Silverman 1993; Valdez 1994). However, as primary motifs on pottery, depictions of maize were absent from the plant category in Carmichael's sample of 447 vessels (Table 1 and see Carmichael 1992: 188). In Proulx's (1968) Ica sample of EIP 3–4 pottery they represent only 4 percent of plant motifs. Other plants such as beans, peppers, and fruits are more than five times as common. We argue motif frequencies have no relation to economic reality, and do not reflect mundane or daily experience.

The Nasca were familiar with the ocean. They certainly gathered mollusks and engaged in some form of net fishing. How might these activities be envisaged? While encamped at the mouth of the Rio Ica in October and November 1989, Carmichael observed trucks dropping off groups of fisherman from inland areas (Ocucaje, the cities of Ica and Pisco, and even a few from the sierra). They set up small, reed-mat huts, or *ramadas*. In mid-October there were about 20 of these ramadas, sheltering 50–60 people, mostly adult males, but a few wives and children among them. There were a few commercial teams of six or eight men, but most were independents, and spent more time enjoying the beach than working it. These people brought the barest necessities—a sweater, blanket, and a plastic bowl, cup, and spoon for each, along with a few tin cooking pots (unlike the ancient inhabitants of nearby La Yerba who brought their best serving ware and large ceramic storage vessels—investments in permanent residency). The modern fishermen stayed for several weeks, harvesting macha (*Mesodema donacium*) on the sandy shores, steaming open the shells, and sundrying the meat for transport inland. Many sacks of dried clams were prepared and loaded on returning trucks. Further north in the Bahía de la Independencia, Carmichael occasionally encountered teams of net fishermen from Ica who camped for a week or two, patiently waiting for schooling fish to come close to sandy shores. Carmichael's survey study concluded that the Nasca likely favored small, temporary, seashore encampments of a similar nature to those erected by fishermen today (1998).

Earlier studies which assumed fishing to be an integral part of the Nasca economy relied heavily on the maritime potential argument. But proximity to the ocean (or any resource for that matter) does not mean it will be maximally exploited. The data presented here lead us to concur with Alfred Kroeber's assessment that, while Nasca was a coastal culture, the Nasca were not a littoral people (1944: 24). There is no evidence of an "economic symbiosis" between littoral and inland communities. The Nasca were an agrarian-based coastal society in which marine resources played a relatively minor role in the dietary economy, despite apparent opportunity, subsistence logic, and iconographic indicators. We conclude that Nasca use of the littoral was seasonal, transitory, and opportunistic. But the sea was a powerful force in Nasca mythology, the abode of fierce divinities and, as Mama Cocha—mother of all water—the most basic necessity of life in a desert.

Why do we find variation over time in the intensity of littoral exploitation along the south coast, and what does this tell us about the cultures of this region? We cannot assume the factors which favored large EH settlements like El Chucho and Karwa in the Bahía de la Independencia were necessarily the same for LIP La Yerba at the Ica River mouth. From one perspective, all three sites have immediate access to sand beaches, and the shell middens appear to be composed primarily of corresponding clam species (shell type ratios should be verified through formal malacological analysis from strata cuts). However, settlement patterns actually vary significantly, from bayside (El Chucho) to peninsula (Karwa) and estuary (La Yerba) locations, and from a series of linear mounds (El Chucho and Karwa) to a few roughly circular mounds (La Yerba). Does mound shape and number reflect the organization of social groups in these societies? Why are clusters of linear mounds not found south of the Bahía? What is the relationship of permanent littoral villages to inland communities?

Large oceanfront sites represent significant energy expenditure in long-term, if not year-round, habitation. Clearly, the littoral zone provided significant return on labor investment during the EH and LIP. Therefore, the littoral zone could yield abundant food resources when environmental and cultural conditions are favorable.

During the EIP and MH the shores were not abandoned. Traffic continued, but there was less of it and for shorter times than in earlier and later periods. We predict that solid evidence of EIP and MH littoral activities will be found (the Ica River estuary is a strong candidate). Our point here is not the simple presence/absence of a few sherds or radiocarbon dates, but the extent to which people of these periods exploited maritime resources. Construction of sedentary villages with materials and artifacts lugged across the desert is a strong measure of economic importance, or social imperative if valley politics were adverse. Absence of such investments turns our attention back to the social and economic arrangements of inland dwellers.

Use of the littoral zone is a reflection of interior conditions. We cannot fully illuminate the prehistory of the south coast without taking both regions into account. The immediate mystery—Why was the littoral more important in some periods than in others?—is answerable. An agenda for future research should explore both natural and cultural environments. We need deep excavation at the Bahía and Ica estuary sites. Quantitative malacological analysis may reveal changes in species composition indicative of fluctuating sea temperatures, bottom structure, or economic specialization. Natural marine deposits in the immediate area of these sites should be cored for baseline standards. Archaeobotanical and faunal analyses will be essential in isolating the marine component, and documenting shore/inland interactions.

It will be instructive to compare archaeological remains at the estuaries of the Río Ica and Río

Grande de Nazca, and in their nearby oases (both named Monte Grande). La Yerba should be compared with other LIP sites along the coast, especially the large village mound of Laguna Grande (Figure 1) at the north end of the Bahía (Carmichael 1998: 29, 72; Engel 1981: 71). For the Bahía EH sites, we need to know if El Chucho and Karwa are sequential, overlapping, or contemporary occupations, and a formal comparison of site layouts, construction methods, midden constituents, and artifacts would be a major contribution. García Soto and Pinilla Blenke (1995) made an excellent start in setting Bahía archaeology in its regional context, and we eagerly await the results of new studies currently underway by the Paracas Archaeological Project (Dulanto et al. 2013).

Answers to the foregoing questions and approaches will shed light on the factors—both environmental and cultural—which favored permanent villages in the littoral zone. Conversely, such findings will highlight elements not present during periods when littoral use was transitory. This is a form of indirect evidence reflecting on inland settlements during the EIP, which narrows the parameters of our inquiries into Nasca society.

From the first native colonists to the Inca, Andean peoples continue to surprise us with their diversity of life-ways and organizational patterns. In the current example, relatively slight use of marine resources during the EIP along the Ica-Nazca littoral contrasts with earlier and later subsistence systems in the same area, and with earlier, contemporary, and later patterns elsewhere along the Peruvian coast. All forms represent adaptations to the physical and social environments of a given place and time. These conditions are dynamic on micro as well as macro levels. Static models applied diachronically and synchronically mask the highly nuanced tapestries of Andean cultures.

Acknowledgments

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Notes

1. Carmichael and Kennedy were members of the Department of Archaeology, University of Calgary, when this study was originally undertaken (1990). They presented the results at the Institute for Andean Studies Annual Conference, Berkeley (Kennedy and Carmichael 1991). The paper was later prepared for a monograph, which remains unpublished (Carmichael 1998). The current, updated version has benefited from a much expanded literature in the intervening years, and from the input of our co-author, Lauren Cadwallader, who brought the isotope section up to date. However, in spite of numerous independent studies and enhanced methods of analysis, our basic conclusions remain unchanged.
2. There are obvious limitations to the contextual approach, but by making the effort we are taken a step closer to the indigenous Andean perspective, as opposed to a literal, culture-bound, Eurocentric view. The contextual approach frames the question only within broad parameters of space and time, but they are Andean parameters. Ultimately, we are not answering specific questions (let alone claiming proof), rather, we are developing perspectives—useful perspectives that take us further than reasoned, culture-bound assumptions (Carmichael 1992: 187, 193, 196; Carmichael 1994: 81, 85).
3. "Near the mouth of Ica river, five minutes' walk from the sea, there are two splendid sambaquis or shellmounds, each about 180 m long from east to west, 100 m wide, 50 m high. These appear to be the first discovered on the Peruvian coast, and to resemble those of the southern Brazilian coast. Their bases may be low natural elevations, but probably 40 m or more of their depth is almost pure shell kitchen-midden, only slightly mixed with sand. About a dozen varieties of marine mollusks are distinguishable. On these mounds I found erect house posts, insignificant adobe wall remains, fragments of textiles and wooden [*sic*] slings, a stone ax fragment, chips of stones, llama bones, whale vertebrae, and seaweeds, all well preserved on the surface. Also there were strewn about broken human leg bones, suggesting that they had been

cracked for marrow. Potsherds indicated the civilization of the surface as the last pre-Inca one. On account of the expense of digging mounds as large as these, dynamiting to their interior was considered but given up as unfeasible" (Uhle 1924: 123). Proulx (1970: 31) dates Uhle's observations to February 1901, citing a letter written at Ocucaje in the same month of that year in which Uhle also relates he only abandoned the dynamite idea because some acquaintances convinced him the soil was too soft for good results. Uhle made a small collection of artifacts at the mouth of the Ica River, which is now maintained at the Phoebe A. Hearst Museum of Anthropology, University of California, Berkeley. In a footnote to Uhle's report above, Kroeber and Strong (1924: 123) describe a sherd sample from the shell mounds and a nearby cemetery, stating: "There are about a dozen sherds in the Museum (4-4671, 4673). Some of these are Late Ica; some almost certainly Middle Ica; and one or two suggest Proto-Nazca influence. One is incised." Carmichael's examination of Uhle's handwritten Field Catalogue III, p. 48 [28] (Phoebe A. Hearst Museum of Anthropology, University of California, Berkeley, Microfilm 65-11043), adds the following from the shell mounds at the river mouth:

- 4673a: broken leg bones
- 4673b: kinds of shell and crayfish represented there
- 4673c: sea-weed etc.
- 4673e, f, g, h, i: five woolen slings, probably used for catching sea-birds
- 4673k: ball of woolen yarn [letter j not used in catalogue]
- 4673l: fragments of pottery, proving that the remains found on the surface of the Sambaquis belonged to the later Chincha Period
- 4673 [m]: fragment of stone axe.

4. There is a large Preceramic site called Morro La Gringa on the north side of the Ica River mouth, across from La Yerba. It was excavated by Engel (1981: 19–20) who defined three separate areas and a series of occupations. At the south end, Engel encountered dwellings encircled by posts held in place by split rocks and cobbles, with walls formed of mats. This is the same area where he discovered part of a log raft yielding a radiocarbon date corrected to circa A.D. 1000, and Carmichael (1998: 86–87) found LIP sherds on the surface. Morro La Gringa appears to have been a village seasonally reoccupied over a long period (Preceramic remains are definitely present), with some reuse roughly contemporary with La Yerba on the south bank.
5. These data are no longer available and therefore age and sex comparisons of the results are not possible.
6. This assumes the data to be parametric; however, the original data are not available, so this assumption cannot be tested nor can non-parametric statistical tests be applied.

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