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EDITED BY
Jon McVey Erlandson,
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REVIEWED BY
Peter Veth,
University of Western Australia, Australia
Ruth Gruhn,
University of Alberta, Canada

*CORRESPONDENCE
Tom D. Dillehay,
tom.d.dillehay@vanderbilt.edu

†These authors have contributed equally to this work

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Emergent consilience among coeval fishing and farming communities of the middle holocene on the North Peruvian coast

Tom D. Dillehay[1,2†]*, Teresa Rosales Tham[3†], Victor Vázquez[4†], Steve Goodbred[5†], Elizabeth Chamberlain[6†] and Gabino Rodríguez[7]

[1]Department of Anthropology, Vanderbilt University, Nashville, TN, United States, [2]Escuela de Arqueología, Universidad Austral de Chile, Puerto Montt, Chile, [3]Departamento de Antropología, Universidad Nacional de Trujillo, Trujillo, Peru, [4]Centro de Investigaciones Arquebiológicas y Paleoecológicas Andinas ARQUEBIOS, Trujillo, Peru, [5]Department of Earth Sciences, Vanderbilt University, Nashville, TN, United States, [6]Department of Soil Geography and Landscape Research, Wageningen University, Wageningen, Netherlands, [7]Departamento de Antropología, Pontifícia Universidad Católica del Perú, Lima, Peru

Coasts are dynamic, constantly changing ecosystems offering rich and varied foods and other resources. Compared with the monistic structure of crop production in many terrestrial parts of the world, some coastlines reflect a dualistic structure with complementary maritime and agricultural economies beginning in early prehistoric times. In particular, the Pacific coast of the Central Andes offers one of the world's most abundant and diverse supplies of marine resources. The late Pleistocene to middle Holocene (~14,500–4,000 BP) cultural sequences from south Ecuador to north Chile vary appreciably from one region to the next, but all reveal varying degrees of mixed diets of maritime and terrestrial foods. By at least ~7,000 BP, a diversity of seafood and domesticated crops were mutually exchanged to form varied specialized and unspecialized economies in a few Andean areas. This study reports on interdisciplinary data from a complex of archaeological sites with mixed economies along the desert coast of the Chicama Valley in north Peru, specifically the Huaca Prieta area dating between ~14,500 and 3,800 BP. Around 7,500–7,000 BP, intensified maritime and agriculture economies developed simultaneously with social differentiation between public ritual monuments and outlying domestic support sites in an environment of rich marine resources and fertile estuarine wetlands in the valley. This and other coastal areas played an important and persistent early role in human population growth, community formation, and the consilience of different but complementary technologies and principles of socio-economic organization to establish the foundations for later state development along the Central Andean coast.

KEYWORDS

huaca prieta, paredones, dual economy, peruvian coast, early complexity

Introduction

Coastal and marine ecosystems are unique habitats formed by animals and plants that thrive at the borders between ocean and land. Throughout human history these ecosystems have offered a wide range of resources and services, many of which have provided material benefits such as reliable and abundant food supplies and human dwelling habitats and benefits of a non-material nature that affected people in their spiritual, social, and cultural dimensions (Barbier et al. 2011; Blair 2016). By supporting spiritual and religious values, and providing a wide variety of food and non-food resources, including food production in fertile wetlands, coastal ecosystems substantially contributed to the sustainability and well-being of both past and present peoples and to the convergence of different resources, technologies and organizational principles of early sedentary and later proto-state societies in parts of the world (Bailey and Milner 2002).

Arguably one of the most impacting events in world history—food production and its consequences—led to economic surpluses and significant changes in landscapes, eventually supporting human population growth, the spread of sedentism and the rise of diverse social complexities. Yet, food production was more than just a matter of subsistence and landscape changes (e.g., Bender 1993; Hayden 1995; Graham and Goucher 2015; Redman 2019). It also led to dramatic shifts in social, ideological and demographic practices, including challenges such as the maintenance of cohesion in the face of variable community formations, increased social scale and differentiation, agency and identity, new technologies to meet new economic demands, and the need for different ways of developing new institutions to manage the changing nature of uncertainty and risk (e.g., Sterelny and Watkins 2015; Sanz 2018). Food technologies, mortuary patterns, domestic and public sites, burial patterns, organizational strategies, and symbolic iconographies reflect much of the archaeological evidence of the initial practices and institutions that were formed to deal with those challenges. Managing these changes through growing collective actions, coalescing technologies and knowledges, new strategies and "communities of practice" (e.g., Wenger 1998; Knappett 2013; Bogaard 2015; Dillehay 2019) may have been as problematic as arriving at successful food production, especially when societies combined different food strategies (i.e., fishing, animal husbandry, agriculture), which required different means of negotiation and organization to deal with challenges beyond those of a primary mode of production (i.e., agriculture). In recent years, there has been a renewed interest in examining these challenges and their consequences, especially the relationship between mixed food strategies and multiple pathways of emergent community development (Costin 2011; Robb 2013; Graham and Goucher 2015; Scarry et al. 2022).

While we can document the challenges and consequences of new developments in the archaeological record and acknowledge that in broad terms social interaction, symbols, ideas, and ritual practices had some role in shaping mixed or primary food producing communities, it is harder to find specific databases to explain how and why they succeeded or failed (e.g., Yoffee 2019). Although much more is known of the differing community lives of early agriculturalists (e.g., Bowles and Choi 2013; Graham and Goucher 2015; Spataro and Furholt 2020), less is known of closely interacting communities of farmers and herders and even less of co-existing coastal farmers and maritime fishers (e.g., fishing, shellfish and seaweed gathering) and their distinct or shared experiences. Reported here is a synopsis of an ongoing, long-term interdisciplinary research on the emergence of social complexity and the consilience of coeval Preceramic sedentary communities of specialized and unspecialized farmers and fishers in the Huaca Prieta area (Figure 1) of the lower Chicama Valley on the north coast of Peru from ~7,500 to 3,800 BP (All ages are radiocarbon calibrated). This area consists of two neighboring public mounds or ritual centers at Huaca Prieta and Paredones and their outlying, sustaining domestic sites (Dillehay and Bonavia 2017a-b; Dillehay 2017). Although different in size and purpose, with Huaca Prieta (Figure 2) mainly associated with a maritime economy and Paredones primarily with farming (Figure 3), the two mounds are contemporaneous and their activities complementary. The outlying domestic sites supporting these mounds reflect a mixture of different specialized and unspecialized food strategies. This research examines the people who occupied the mounds and domestic sites in the dynamic littoral and wetland habitats of the lower valley and their food strategies, boundary and identity formations, domestic and public activities, social differentiation and inequality, and economic organizations. Also examined is the long-term relationship between the "dominant culture" (Lohse 2007) of early ritual centers and their support communities. In the Andes, there is a long tradition of believing that if we understand ritual or ceremonial centers as the perceived apex of society, then by extension, we comprehend their subordinate sectors, the outlying domestic communities, which is not necessarily the case. We place this early coastal society within the conceptual space of complementary food producing communities and their joint multi-complex socio-cultural practices and seek to better understand the interaction among Preceramic fishers, wetland hunter-gatherers, and incipient agriculturalists, based on their respective uses of a changing Pacific seascape and the coastal landscape subject to shifting sea

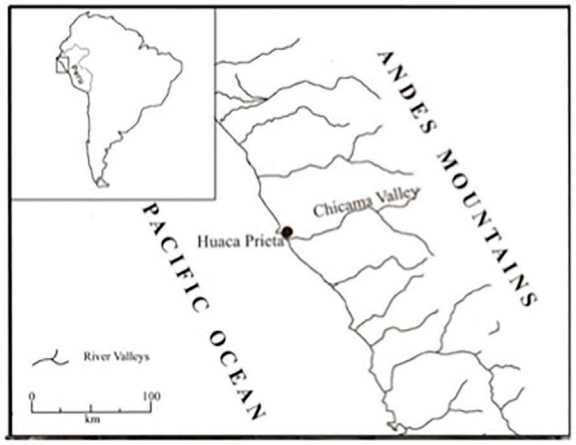

FIGURE 1
Location map showing northern Peru and major coastal river basins and the Huaca Prieta study area near the mouth of the Chicama River.

levels and major tsunami, El Nino and other physical events (Goodbred et al. 2017, 2020). It was the consilient linking together of different, technologies, foodways, community patterns, and ritual practices that contributed to the emergence of social complexity in this area of north coastal Peru.

To address the changing dynamics of these interactions and the relationship between communities and changing environments, our research focused primarily on three research questions. First, what was the nature of the shared or separate domestic communities of fishers and agriculturalists in the study area? That is, to what extent did these communities differ by food procurement, diet, isotope, dental, settlement, technology, mortuary, artifactual, and other patterns? Were there physical boundaries formed within and across them and socio-economic identities defined between them? Although the burial, dental and isotope data from the Huaca Prieta and Paredones mounds indicate a dual population of fishers and farmers, respectively (Tung et al. 2020), there also are indications of an unspecialized mixed dietary orientation in a few domestic communities, with some groups equally exploiting all resource habitats. Second, how different or similar are the co-existing communities of fishers and farmers, not only with regard to each other, but with respect to their ritual and burial practices at the ritual mounds and domestic sites? Did ritual activity at the mounds promote parity among specialized and possibly unspecialized domestic communities and foster a sense of harmony? Or was cohesion and harmony expressed primarily at the mounds and not in the domestic communities, which would suggest marked social distinctions between the public and domestic sectors? And three, how did these communities adapt to the changing coastal ecosystem over time?

Materials and methods

The methodology applied to these research questions is a combination of paleo-ecological research, archaeological survey and multi-site excavation in ritual and household sites across different maritime and terrestrial habitats, and a wide variety of

FIGURE 2
The Huaca Prieta mound situated on the south tip of the Sangamon Pleistocene terrace. Note excavation areas underway. The Pacific Ocean lies approximately 150 m west of the mound.

FIGURE 3
The Paredones mound in the foreground located about 600 m north of Huaca Prieta. In the background is a large Moche pyramid dated from ~1,500 to 1,200 years ago.

other interdisciplinary techniques including isotope, dental and genetic analyses. In studying different fishing and farming communities, we focused on several variables: 1) household and community variability in site organization in different locations along the littoral and in the immediate interior; 2) networks within and across sites and communities, especially in comparison to burial contexts and offerings, to quantification and qualification of food remains from different house and community forms, and to isotope and genetic data of human skeletons (Dillehay 2017; Tung et al. 2020); 3) new technologies evidenced by the appearance and diversification of weaving and decorative techniques in textiles and baskets, symbolic motifs on gourds and painted stones, irrigation canals and raised agricultural fields, and their differential associations with various site types; and 4) reconstruction of the paleo-ecology through time.

In specific regard to the present study, the research involved an interdisciplinary group studying the development of coastal and riverine landscapes and the change of ecological and environmental dynamics through time. Among the specific methods used in the work, the application of stable isotopes on diverse sample sets (e.g., carbonate shells and sediments, organic and carbonate plant remains, and human and animal bones and teeth) allowed common links between the human, environmental, and climatic records preserved in the lower Chicama Valley. Newly studied sedimentary deposits in wetlands have yielded high-resolution climate records from the littoral and deltaic lowlands, which have helped to constrain what the climate was like at the coast where early farming and maritime communities existed, and when coupled with the archaeological data, has permitted a direct correlation with human activities including culture, diet, and economy. In addition to the use of stable carbon and nitrogen isotopes to help interpret human diets, dental microwear analyses have allowed human diets to be analyzed using three-dimensional texture analysis.

Lastly, the relative frequency data for faunal and floral food remains at ritual mounds and domestic sites shown in Figure 14 are skewed toward marine food remains due to sampling procedures. All excavated cultural deposits at all sites (totally more than 1280 cubic meters excavated) were screened through three mesh sizes, including 1.0 cm, 0.5 cm and 0.2 cm. During both excavation and screening, visible macro-floral remains were retrieved. As a result, approximately 98% of all faunal remains (e.g., bone, shell) were recovered. Given the cubic meters excavated, it was logistically impossible to float all cultural sediments, thus only ~5% were floated, which resulted in a skewed sample favoring marine remains. Also studied were starch grains and phytoliths from hearth and other features, yet the results of these studies added only a few new floral species. Based on these results, Figure 14 shows approximate ratios of 10.0:0.1–0.2 of faunal to plant foods, respectively, for all site types. If all excavated sediments had been floated, these ratios likely would be closer to 9:1 to 8:2. Although the data are slightly skewed, the comparative frequencies of marine to plant foods between ritual mounds and tiered-domestic sites and among the different domestic sites is relatively accurate.

Results

Central Andean seascapes and landscapes

The offshore waters of the Pacific coast from Ecuador to Chile provide some of the most diverse and abundant marine resources in the world due to the cold Humboldt Current and major upwelling (Miloslavich et al. 2011). The region is one of the most appropriate places to study the socio-economic challenges and interactions that developed between early fishing and farming communities from ~10,000 to 4,000 BP. It is the only place in the world where maritime, agricultural, and pastoral economies coalesced to lay the foundations for the later development of pristine urbanism and state societies (e.g., Quilter 1991; Moore 2005; Piperno and Dillehay 2008; Moseley 1975, 1992; Patterson 1983; Sandweiss 1996). Moseley (1975, 1992) was one of the first archaeologists to conceptually articulate the importance of Preceramic maritime resources along the coast of Peru and how the abundance and predictability of seafood led to early sedentism and increasingly complex societies. He argued that people in large permanent communities, likely managed by part-time leaders, carried out large-scale corporate activities, focused primarily on constructing non-domestic, communal mounds that served as ceremonial

centers in establishing the pre-state foundations of Andean coastal civilization. Since Moseley's initial publication, additional research has revealed that both marine foods and crops were important dietary elements in these early societies (Richardson 1981; Patterson 1983; Quilter 1991; Dillehay et al. 2007, 2009; Sandweiss 2009; Lavallee and Julien 2012; Marquet et al. 2012; Dillehay 2017; Beresford-Jones et al. 2018a, 2022).

Some of the most elaborate Preceramic maritime societies in the Central Andes include the Chinchorro culture of north Chile and south Peru (~8,000–4,500 BP; e.g., Arriaza 1995), and the slightly later mound cultures from southern Ecuador to central Peru that subsisted on mixed economies, whether fishing and farming or maritime and terrestrial foraging (e.g., Huaca Prieta, Paloma, Huaynuna, Aspero, Alto Salaverry, Los Morteros: see Alva Meneses 2008; Benfer 1984; Bird et al. 1985; Bonavia 1982, 1993; Cárdenas 1999; Dillehay et al. 1999; Feldman 1985; Fung 1988; Lanning 1963; Lavallée and Julien 2012; Llagostera 1992; Maldonado 1992; Mauricio et al. 2021; Moore 2007; Pearsall 2008; Power et al. 2021; Pozorski and Pozorski 1977; Quilter 1989; Shady 1983; Stothert 1985). These societies developed during the Central Andean "Neolithic" or "Andean Boom" (*sensu* Lavallee 2000) when social networks and resource sharing of small-scale maritime fishers and foragers adjusted to new organizational and institutional needs to deal with increased adoption of crops, co-residency with farmers, monument building, new community duties, competition and cooperation, social cohesion and occasionally economic and occupational specialization. Besides sites like Huaca Prieta and Paredones, many of these developments are featured at other places along the Peruvian coast, for instance, Bandurria on the north-central coast, where Chu (2011) excavated a public platform mound and a sedentary domestic area dated to ~5,200 BP. The domestic component was associated with a broad-spectrum economy focused on fishing, cultivation, and the exploitation of reeds in wetlands for manufacturing balsas, mats, walls, baskets, and others. Fishing, capturing of birds and collection of their eggs were practiced as well as cultivation of cotton, pepper, and gourds. In the delta wetlands of the Chao Valley on the north-central coast, the Los Morteros site was occupied between 7,000 and 3,100 BP (Cárdenas 1999; Mauricio et al. 2021). From ~5,700 to 3,900 BP, in particular, the site is characterized by public and domestic sectors with a mixed diet similar to contemporaneous localities elsewhere along the Peruvian coast. Farther south in the coastal areas of the Ica and Nazca valleys, Beresford-Jones (Beresford-Jones et al. 2018; 2022) analyzed lomas vegetation (in the Andean foothills) and shell middens, discovering increased sedentism between 7,000 and 5,000 BP. In addition to marine foods, he documented a wide variety of roots and fruits of wild plants from the lomas. In the nearby Palpa Valley at the Pernil Alto site (Gorbahn 2020), an alleged diversity of food crops was introduced between 5,900 and 4,800 BP, with hunting and gathering appearing as minor subsistence practices. These and other Preceramic sites represent various aspects of the socio-cultural "boom" from roughly 7,500 to 4,000 BP that established some of the basic socio-economic organizational principles that eventually led to greater cultural complexity in the Central Andean region.

Environmental setting

The physical setting of the lower Chicama Valley at ~14,500 BP, the earliest known period of human occupation along the littoral, was a broad, shallowly incised alluvial plain of sand and gravel sediments delivered by the Chicama River. These deposits are not unlike those found in the modern braided river channel or the exposed channels or washes to the north. The shoreline at ~14,500 BP was located ~16 km seaward and transgressed to ~10 km seaward by ~10,000 BP (Dillehay et al. 2012; Goodbred et al. 2017; Iriarte and Watling 2017). There is no evidence for persistent, aggrading wetlands at this time, although small, ephemeral ones probably existed along the alluvial corridor.

Beginning ~7,500 years ago, coastal plain sediments began to accrete over the sandy alluvial surface as the rising base level and groundwater table intersected incised areas of Chicama Valley. These flooded depressions formed the first persistent lagoons and wetlands near Huaca Prieta and the Sangamon terrace (Figure 4). The development of dunes and gravel beach ridges under the slowing sea-level rise further trapped surface runoff and groundwater in the back-dune areas, extending the lagoons and wetlands along the coast. The emergence of such habitats is widely recorded in valley-wide stratigraphic profiles by a 1–2 m thick sequence of interbedded fluvial muds, fine sand, peat, and freshwater carbonates (Goodbred et al. 2017). These early Holocene lagoon deposits have been mapped to at least 200–300 m in width and to have extended at least 12 km north along the coast from the modern river past the Sangamon or El Brujo terrace (Figures 4–6). Radiocarbon ages from the upper parts of these lagoon deposits average ~6,500 BP, after which the extensive peats and carbonate sediments associated with these settings disappear, or at least considerably contract in their extent.

Ephemeral (paludal) wetlands persisted from ~6,500 to 5,000 BP. The interpretation as ephemeral wetlands is consistent with the lack of peat formation or macro floral remains, as seasonal drying allowed plant matter to be remineralized and thus not well preserved. Beginning ~4,500 BP, a second phase of wetland and lagoon expansion took place and persisted to ~3,500 years ago (Goodbred et al. 2017). Renewed formation of peats and freshwater carbonates, interbedded with fluvial muds, reflects a return to active river discharge and sediment delivery, presumably driven by a wetter highland climate. These soil characteristics reflect diagenesis

FIGURE 4
Annotated Google Earth® image of the coastal system adjacent to Huaca Prieta and Paredones and extended to the Chicama River mouth. Stratigraphy of the coastal succession shows that the inland dunes lie on the gravel shoreface berm at the ~3,700 BP maximum transgression (dark blue line), at which time the shoreline would have been at the base of the Huaca Prieta mound. This is consistent with intercalated beach deposits and mound colluvium as the base of the mound dated to this time. Following maximum transgression, the shoreline prograded to the late Holocene shoreface (purple line), before a relative sea-level fall between 0.5 and 1 ka that forms a stranded shoreface and the new shoreline platform of the modern coast (aqua line). These shoreline boundaries are readily traced to the river mouth, where the stratigraphy is well exposed along the river cutbank.

and slow sediment accretion (0.2–0.5 mm/yr) in a vegetated but saturated environment, one perhaps intermittently flooded by surface water but with a very shallow groundwater table. In the area around the Sangamon terrace and the Chicama River mouth, these second-phase lagoons and wetlands were still large at ~100 m wide and 0.5–1.0 km long, but not as expansive as the earlier environments (see Figures 5, 6). Although reduced in size after ~3,500 BP, stratigraphic data reveal that wetlands persisted, as revealed by dense, dark-colored muds cemented by highly developed calcic horizons overlying lagoon deposits.

Another distinction of the second paludal phase is that new wetland habitats appeared well north of the Sangamon terrace. These wetlands were not the linear back-dune features that formed along the Chicama coast, but rather formed in the numerous, shallow inland quebrada outwash channels that are interspersed along the 20 km of coast north to Milagro (Figures 5, 6). Because these ephemeral outwash channels are not deeply incised (<2 m), these wetlands are only thin veneers of organic-rich sand or mud. A more positive water budget and higher groundwater table allowed wetland vegetation to become established, with ephemeral open-water environments (Goodbred et al. 2020). The shallow stratigraphy preserves alternating aeolian and wetland deposits, indicating that these wetlands were not as persistent as the larger, deeper features closer to the main Chicama river valley. Limited age dating suggests that many of the northern wetlands do not appear until the late Preceramic (~4,500–4,000 BP), but persist intermittently through Colonial and modern times.

The persistence of these shallow, ephemeral wetlands contrasts with the lagoons and wetlands south of the Chicama River, which, as before, infilled with river sediment after about a millennium and largely disappeared by ~3,500 BP. This time, however, they do not disappear because of aridification; rather, the delivery of fluvial sediment continues after 3,500 BP to form an incipient floodplain that is elevated above the water table. This expanding deposition of floodplain silts created new, arable landscapes in the lower Chicama Valley, which hallmarks the cultural transition from local wetland horticulture associated with Preceramic Huaca Prieta to the increasingly larger-scale agriculture of the ceramic-age Cupisnique to Gallinazo cultures (beginning ~3,500 BP; Goodbred at al. 2020). The environmental transition was driven by enhanced river discharge from the increasing strength and frequency of ENSO-driven precipitation (e.g., Moy et al. 2002). After millennia of coastal transgression since the early Holocene, the Chicama shoreline began to prograde after 3,500 years ago through the construction of gravel shoreface ridges, indicating large river discharge and transport capacity.

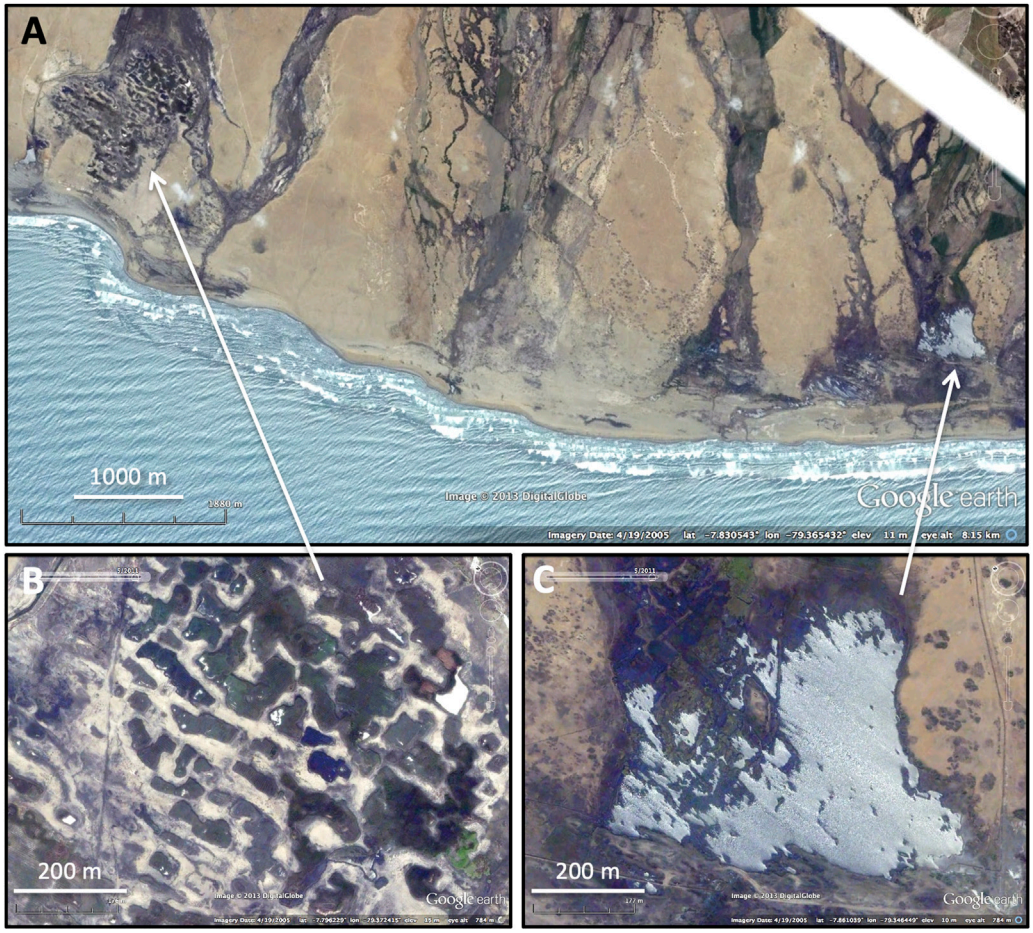

FIGURE 5
Google Earth® images of the alluvial plain north of the Chicama River valley. **(A)** The alluvial plain comprises gravelly, barren interfluves alternating with the outwash channels that define shallow depressions close to the water table and vegetated with wetland plants and desert scrub. **(B)** Close-up image of the vegetated area on the left (north) side of **(A)**, showing the area that comprises a cultural landscape organized into terraces and *camellones* (raised fields) for agricultural production, which were initially constructed ~5,000 BP. **(C)** Close-up image of the area on the right (south) side of **(A)** showing a small open-water lagoon and wetland fringe that locally form where channel scour has been especially deep during El Niño floods.

Also, after 3,500 years ago, the fluvial silts that infilled coastal wetlands and developed a new floodplain were increasingly dispersed across the middle Chicama Valley, where they began to blanket the region's typical alluvial sand and gravel surface. This deposition of arable sediments across the middle and upper valley continued to expand the agriculture landscape, with floodplain aggradation accelerating after ~2,500 BP and with increased frequency of wet-phase ENSO cycles (Goodbred et al. 2020). The expansion of arable lands was also facilitated by the increasingly extensive network of irrigation canals and coincides with the peak Moche and Chimu civilizations in the Chicama Valley between ~1,600 and 500 years ago. Changing shorelines and wetland environments in the area did not determine but certainly influenced settlement location and the density and availability of economic pursuit of marine or terrestrial resources.

The Huaca Prieta area

The earliest known human presence in the study area is characterized by intermittent cultural deposits below the Huaca Prieta mound, which along with Paredones and later ceramic-age mounds, were built on the remnant Sangamon Pleistocene terrace (see Figures 3, 5). These early deposits date from ~14,500 to 10,000 BP and are associated primarily with maritime and secondarily with terrestrial foragers. The terminal Pleistocene materials are buried in the upper 1–2 m sediments of the terrace, which at the time of human occupation was about ~16 km from the sea. Later, ~10,000–9,000 BP, maritime and inland foraging continued, with incipient horticulture probably introduced in estuarine wetlands (Dillehay et al. 2012a-b). The early Holocene period

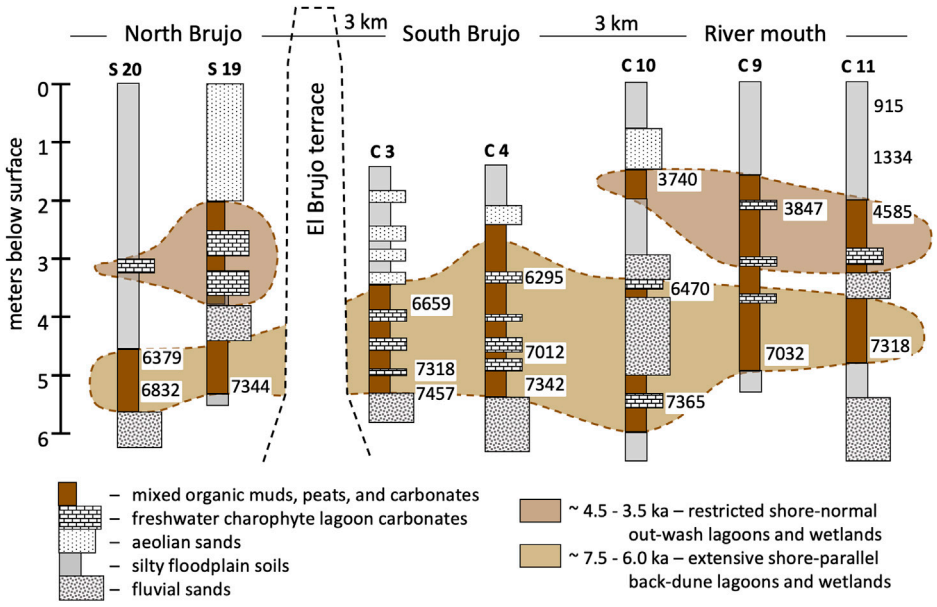

FIGURE 6
Simplified lithologs showing major sediment types and their associated depositional environments and ages (after Goodbred et al. 2017). Highlighted in brown are the organic muds, peats, and carbonate sediments that define the age and extent of paleo-lagoon and wetland systems from approximately 7,500–6,000 BP and 4,500–3,500 BP. Site locations shown in Figure 8. North Brujo refers to north of the Sangamon terrace. South Brujo refers to south of the terrace. River mouth refers to the Chicama River delta.

(9,500–8,000 BP) is represented by small-scale settlements with mixed economies. During this pre-mound period, people at Huaca Prieta focused primarily on the sea but also grew a few wild food crops, including avocado (*Persea* sp.), squash (*Curcurbita moschata*), chili pepper (*Capsicum* sp., and gourd (*Lagenaria* sp.; Dillehay et al. 2012; Vazquez et al. 2017). Faunal materials from both the late Pleistocene and early Holocene cultural deposits indicate a wide variety of shellfish, fish and other marine products, sea lion and water fowl, with deer and other mammals and wild plant foods from wetlands making up a smaller portion of the diet.

As mentioned earlier, around 7,800–7,500 BP rising sea levels led to back-flooding and the development of inland lagoonal deposits associated with the initial rise of the Huaca Prieta mound and some of the earliest domestic sites along the coastline of the Chicama Valley. Beginning around 6,500 BP, the lagoons disappeared and ephemeral paludal wetlands and the Chicama floodplain began to form (Goodbred et al. 2017). The paludal environment was almost exclusively associated with narrow, shallow inland washes where most incipient agriculture developed (Figure 5). Also appearing around 6,500 BP is the mound at Paredones, located ~600 m north of Huaca Prieta, and more numerous domestic sites along the washes to the north. It was at this time that the separate but complementary ritual communities of fishers and farmers at Huaca Prieta and Paredones more clearly developed, respectively (Dillehay 2017; Tung et al. 2020). Despite their residential and socio-economic separateness, these two groups exchanged foods and shared ritual spaces and feasting practices at Huaca Prieta and food preparation at Paredones. Although large quantities of marine and limited amounts of crop foods were consumed at Huaca Prieta, there is no clear evidence in the form of seed grinding stones, cutting blades and other crop-related lithics, hearths, and storage pits to suggest the preparation and consumption of plant food on a scale comparable to marine food. Instead, Huaca Prieta was used to occasionally perform rituals and to bury special individuals, to make bundled dedicatory offerings of coca leaves, textiles, marine shells (Figures 7A,B) and other items (e.g., feathers), and to continuously perform numerous ritual burnings of *palo santo* branches (*Bursera graveolens;* today shamans or *curanderos* still use the mound to offer coca leaves and *palo santo* sticks in bundles to cleanse ritual spaces and ward off bad spirits). These activities were bounded by hundreds of individual stone-lined structures and prepared floors (relatively clean compared to domestic house floors), probably used for small, private rituals. At Paredones, there are fewer burials, no stone-lined or other structures, prepared floors, textile bundles and similar offerings, yet numerous grinding stones, hearths, and

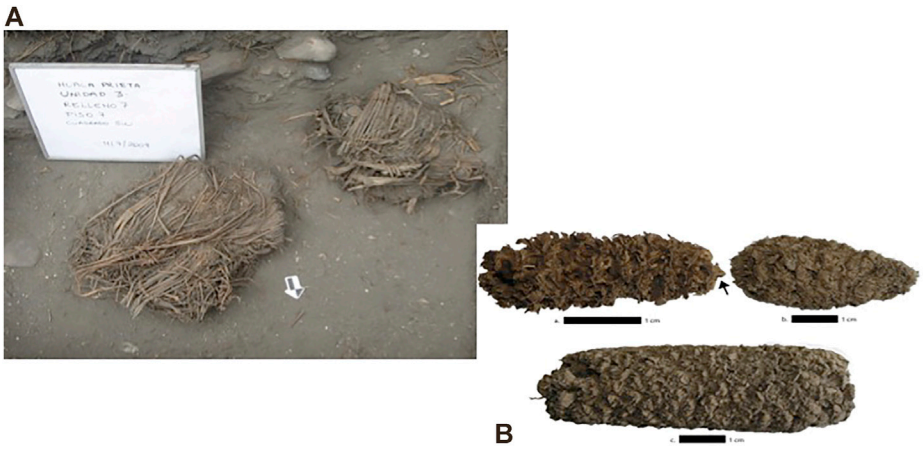

FIGURE 7
(A) Two tied- and -wrapped reed bundles containing coca leaves, marine shells, and fragments of textiles that were offerings placed on a pathway to the top of the Huaca Prieta mound and dated ~5,500 BP; **(B)** Maize cobs dated to ~6,500–6,000 BP from the Paredones mound (Grobman et al. 2012).

cutting tools indicative of food preparation, primarily plants.

Research on human skeletons, especially dietary assessment based on stable isotopes, dental, and mortuary patterns at Huaca Prieta and Paredones reveal an integrated economy of the two primary socio-economic sectors (fishing and farming, albeit minor foraging in estuarine wetlands for wild plant and animal food such as tubers and water fowl), with increased economic and occupational specialization and exchange and probably gender-based occupation by at least 6,000 BP (DeSantis et al. 2017; Dillehay 2017; Tung et al. 2020). Isotope studies of children's skeletons from the two mounds show dietary specialization deeply embedded in food customs early in life (see DeSantis et al. 2017; Tung et al. 2020). Specialization related to maritime and farming practices, with some groups focused on specific resources (e.g., salt, fish, shellfish, seaweeds), on specific resource zones (e.g., wetlands, shoreline and sea), and on agricultural raised fields in lagoons and canal-fed fields in washes (Goodbred et al. 2017, 2020; Vasquez et al. 2017; Tung et al. 2020). The distinct diets of some of these early farming and fishing communities apparently were a key factor in structuring their socio-economic and political organization.

In summary, the collective artifact, isotope, dental and burial data indicate that Paredones was the food preparation and occasional burial mound of farmers and Huaca Prieta was the ritual feasting and burial mound of fisherfolks. These two socio-economic segments appear to have resided peacefully side-by-side in separate shoreline and beach ridge-oriented and inland wetland- and wash-oriented household communities engaged in social and economic exchange. There is no weaponry or skeletal trauma in burials recovered from the public mounds (Bird et al. 1985; Titelbaum and Verano 2017) and domestic sites to suggest tension between the segments. If there had been conflict over competitive access to or exchange of resources, then inter-community ritual activities at Huaca Prieta and probably Paredones likely would have posed a powerful mitigating counterpart, emphasizing community-wide social cohesion and a long-term cooperative effort.

Specialized ritual centers and domestic sites

At both Huaca Prieta and Paredones, there is little to no convincing evidence of habitational debris, although it is likely that a few individuals occasionally resided on or at the base of the two mounds. The outlying domestic communities are believed to be the residencies of people who participated in rituals and/or were buried at Huaca Prieta and Paredones, as indicated by overlapping chronologies, similar diagnostic tool kits, exotic items, food remains, textiles, decorated gourds and other cultural features. It is possible that not all domestic sites were linked to the ritual mounds but current evidence suggest a strongly integrated settlement and socio-economic system along the valley littoral zone.

To reiterate, in the Huaca Prieta area subsistence and community changes were accompanied by communal constructions in the form of the large ritual and mortuary mound at Huaca Prieta (~32 m high and 182 m long; ~7,500–3,800 BP) and the associated smaller food preparation and mortuary mound at Paredones (~6 m high and 50 m long; ~6,500–3,800 BP). Chronological and construction evidence shows that both mounds were built in multiple phases over several millennia by thousands of individual ritual spaces, probably by small kin groups from residential communities

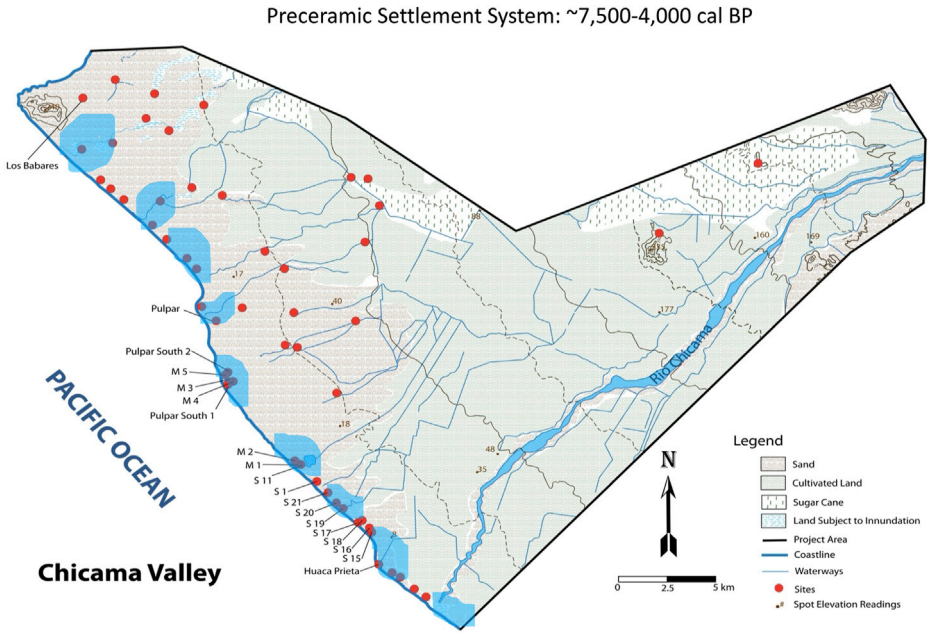

FIGURE 8
Location map of domestic sites (red dots), lagoons and wetlands (blue), narrow washes, geological coring and profiling sites (red dots and wetlands), Huaca Prieta and the Chicama River. Red dots represent clusters of domestic sites.

located on distant beach-ridges and along the terraces of wetlands and washes (Dillehay 2017). There is no evidence of corporate labor or permanent authorities at either mound. Although the mounds are separated by a short distance, as noted above, people buried in Huaca Prieta primarily ate marine foods and those in Paredones primarily consumed maize and other crop foods, suggestive of direct linkages with their corresponding outlying residential communities. Current genetic and isotope evidence suggests that there are no non-local individuals buried at either mound, indicating that interment probably was reserved for important local community members only. Burial evidence also suggests gender-based occupational roles. For instance, the current data from Huaca Prieta (Dillehay 2017) show that most females were buried primarily with weaving kits, gourd fragments, and/or textiles with distinct weaving and decorative traits, and that most men were interred primarily with fishnets, pelican feathers, shellfish, and/or other items indicative of sea-related activities. At Paredones, women were buried with grinding stones or without offerings and men had offerings of digging sticks, stone hoes, prismatic blades and/or other stone tools (starch grains of maize and other crops were recovered from cutting edges). Isotope and dental data also show that a few individuals interred in the mounds had mixed diets, suggesting, for reasons presently unknown, a few persons and/or households were not fully specialized and were more generalized food consumers (Tung et al. 2020). Additional data from households might reveal that a larger portion of the population was unspecialized and that the burial of fishing and farming specialists in the mounds might suggests that economic and occupational specialization held a privileged position in society, one that granted practitioners interrment in the mounds.

In regard to domestic communities, they are located on littoral beach-ridges and inland on low terraces of lagoons and narrow washes from 2 to 20 km north and 0.5–5 km south of Huaca Prieta (Figures 8, 9). A total of 88 Preceramic house mounds have been recorded (Figure 8). These mounds are generally oval in form, contain oval and rectangular houses, and vary in size from ~8–18 m in length, ~1–2.3 m in height (with portions often below-ground), and ~7–15 m in width. Littoral house mounds are located on beach-ridges and generally contain fishnets, seafood remains, and only a few small grinding stones (<15 cm in diameter) and were used by fishers. Inland house mounds are about the same size, contain semi-rectangular to rectangular houses, are located around shorelines of wetlands (0.5–1 km inland) and farther inland (1–5 km) on low terraces of narrow washes, and after about 5,500 BP often associated with raised and canal-fed agricultural fields. In some washes, there are 3–6 clustered house mounds: in one cluster there are 15–20 house mounds that form a semi-circular arrangement and in others there are 3–4 house mounds positioned on opposite terraces of washes. Inland mounds often are associated with small stone-lined

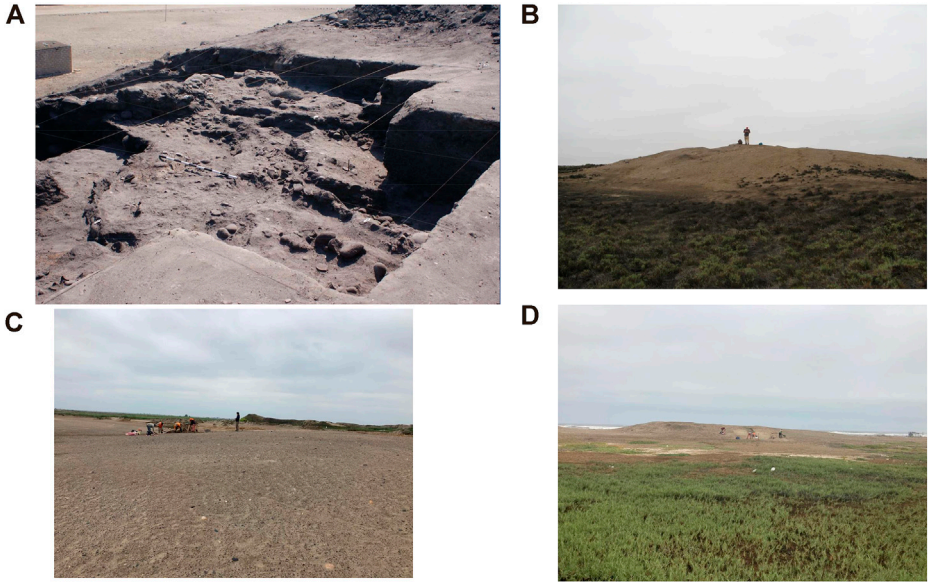

FIGURE 9
(A) Stratigraphically sequenced and superimposed oval-shaped, stone-lined Preceramic houses in Unit 16 located on the western edge of the Sangamon terrace near the Pacific Ocean and proximal to the Huaca Prieta mound; **(B–D)**: Domestic mound sites located along littoral beach ridges and inland washes and wetlands north of the Sangamon terrace (see Figure 8). An increasing number of these sites are being destroyed by modern-day residential and agricultural expansion.

FIGURE 10
Cotton textiles dated to ~5,800–5,500 BP at Huaca Prieta.

feeder ditches leading to small agriculture plots and often with large seed grinding stones (20–40 cm in diameter) and food preparatory lithics (e.g., prismatic cutting blades, stone hoes, scrapers). Current data suggest that the inland agricultural sites are associated with slightly more crop than marine foods, all suggestive of farming. Analyses of food remains (Bonavia et al. 2017; Vasquez et al. 2017), tool kits (Dillehay 2017), and preliminary isotope and dental studies on human skeletons (Tung et al. 2020) from beach-ridge and inland sites suggest that households closer to the shoreline specialized primarily on seafood and those in the interior focused primarily on farming. The differential forms and settlement patterns of households are generally consistent over time from roughly 7,500 to 4,000 BP, but probably increased in

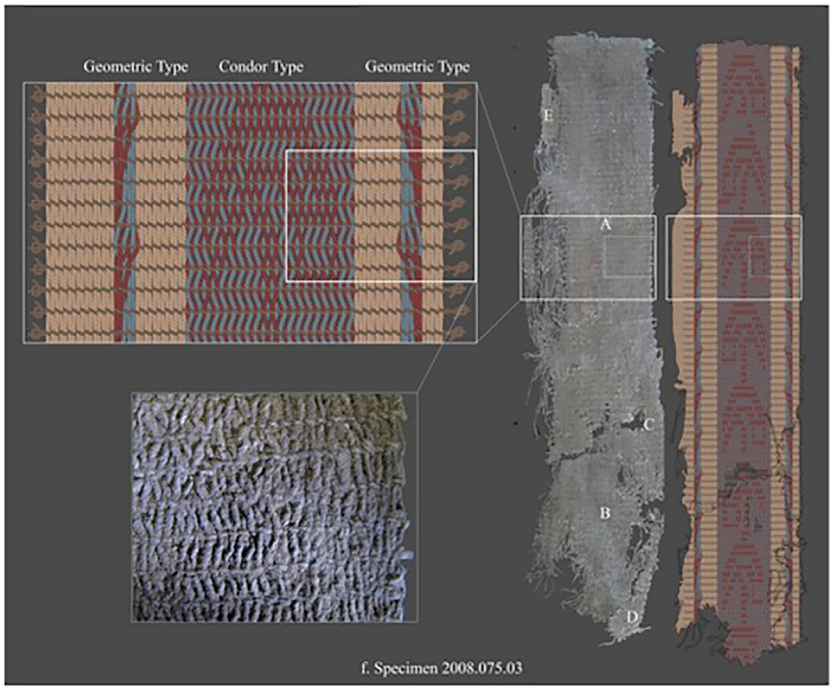

FIGURE 11
Schematic reconstruction of cotton textile with tightly woven design dated to about ~5200 BP.

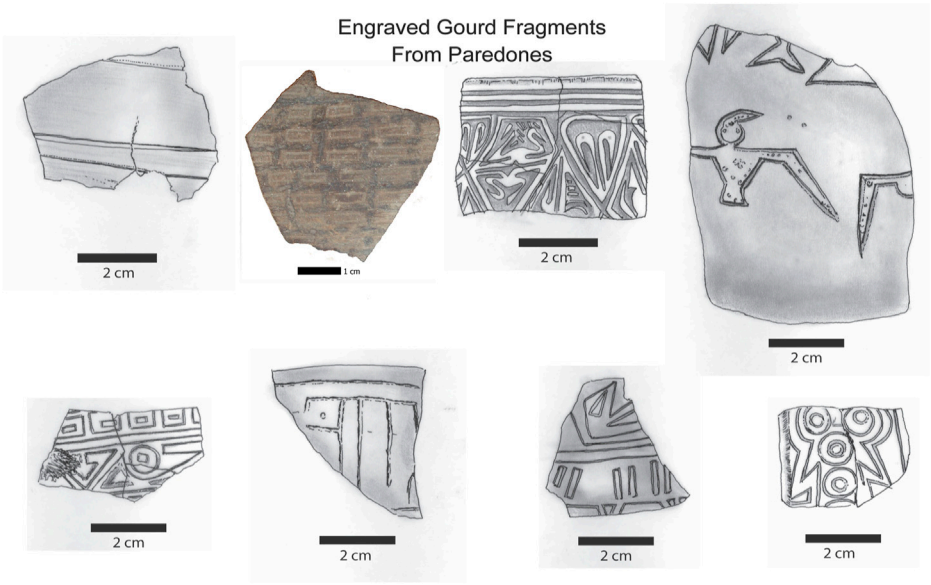

FIGURE 12
Etched gourds with various geometric and natural designs (e.g., human figures and birds) from the Paredones mound dated to ~5,800–5,000 BP.

number and density when wetlands and washes expanded in the interior areas between ~6,200 and 5,000 BP. There is no evidence to suggest that littoral and beach-ridge populations were significantly influenced by environmental changes except marine transgression and regression over time and perhaps during specific major El Nino and tsunami events (Goodbred et al. 2020), and then settlements probably adjusted their location accordingly. The micro-stratigraphy in several littoral and inland house mounds also reveal occasional abandonment for reasons not presently understood.

When viewed from a long-term perspective, by ~7,500–7,000 BP, during the primary lagoonal phase in the valley, household clusters increased in number and intensified exploitation of both marine and crop resources (Dillehay 2017). Other changes occurred between 6,500 and 5,500 BP, including the transition from oval to rectangular houses along interior washes, an increase in site size and increased production of textiles (Figures 10, 11), etched gourds and other symbolic artifacts (Figure 12), as suggested primarily by greater frequency in women's tombs and in ritual spaces at Huaca Prieta. Although some degree of cultivation existed earlier (~9,500–8,000 BP: see Vasquez et al. 2017), as evidenced by the presence of wild squash, avocado, chili peppers and beans, new and more intensified farming households eventually formed as the population expanded between ~7,000 and 6,000 BP in the interior wetlands and washes. By 5,500–5,000 BP, more than 350 marine species and 45 domesticated cultigens (especially maize) and wild plant species formed the local diet. By at least 5,000 BP, increased economic specialization is indicated by new agricultural techniques, that is, raised platforms in lagoons and canal-fed fields in washes (Dillehay 2017).

Once more crops were introduced and agriculture intensified ~5,500–4,500 BP, the local population increased, as indicated by a greater number and cluster of domestic sites during this period, moving farther inland along washes to access more land. Larger, presumably older residential sites are located on beach-ridges and around wetlands and washes: smaller, more shallow mounds are more inland, perhaps representing more recent households that expanded into the interior in later times. Rather than outsiders moving in to establish farming, current skeletal, isotope, dental and preliminary genetic evidence suggests that a portion of the existing population converted from a maritime to an agricultural economy. (Based on the intermittent presence of exotic items from southern Ecuador and extreme northern Peru (i.e., green stones and fragments of *Strombus* sp., *Spondylus* sp. and *Pocillopora* sp.) in a few littoral sites throughout the period under study, it is possible, however, that migrants from warm water areas farther north moved into the Huaca Prieta area. These exotics also may have been procured through exchange.). Given their location, the interior wetlands and washes were primary attractions for expansion, nucleation, and agriculture specialization, which probably increased resource competition and complementary exchange between fishers and farmers, especially with the continuous addition of more food crops (Vasquez et al. 2017). There also is some evidence of animal husbandry or exchange with farther inland pastoralists, as suggested by the presence of camelid wool fibers in textiles and bones around 5,500 BP, but this element of the local economy is currently poorly understood. Presumably, not only did small, specialized farming sectors continuously emerge after ~5,000 BP to complement marine food production and prior farming sectors, as well as exchange with more interior valley populations, but also new settlements were likely catalysts for technological innovation, such as the continuous addition of new weaving and twining techniques on textiles and nets (Splitstosser 2017), decorating gourds, raised and canal-fed fields, and food storage.

Location, location, location: tiered communities and mixed or specialized foodways

To date, our data indicate a three-tiered socio-economic community pattern based on location, site type and subsistence. The first and highest ranked tier is the location of the Huaca Prieta and Paredones mounds on the remnant Pleistocene terrace (Figure 4). The second highest ranked tier is stone-lined dwellings with prepared floors (e.g., Unit 16) located on the Sangamon terrace near Huaca Prieta and Paredones (Figure 8A). The third and lowest tier is pole-reed thatched oval dwellings and later wattle-daub semi-rectangular to rectangular huts in low house mounds located on the outlying littoral beach ridges and along the shorelines of inland wetlands and washes (see Figures 8B–D). From ~7,500 to 6,000 BP, current evidence indicates that houses in all locations initially were oval (~9–12 m^2) in form, with unprepared floors (Figure 13A), and that later from ~6,000 to 5,500 BP they either remained oval or changed to slightly larger semi-rectangular to rectangular forms (~12–15 m^2) either with unprepared or prepared floors: see Figure 13B). (A similar shift from oval to rectangular houses dates slightly later in the Nanchoc area located approximately 100 km northeast of Huaca Prieta on the lower western slopes of the Andes (Dillehay 2011). Moore reports a similar shift in house forms occurring later in far northern Peru (Moore 2010)).

There are three major archaeological indicators of food procurement, preparation and/or consumption associated with the three tiered-community pattern: 1) dental and isotope data from human skeletons (DeSantis et al. 2017; Tung et al. 2017; Tung et al. 2020; T. Tung personal communication, 2022); 2) activity areas associated with the presence or absence of seed grinding stones and lithic cutting and scrapping tools (with starch grains, phytoliths and/or fish scales on their use-edges) and storage pits or fishing nets and

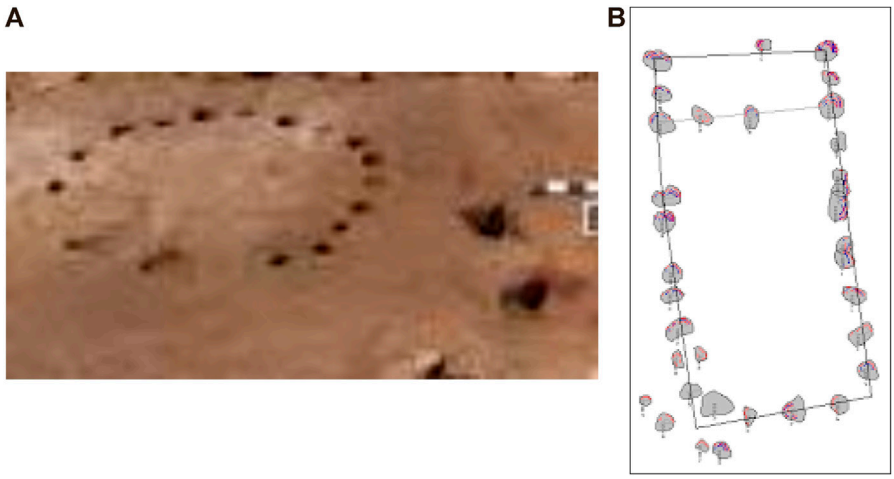

FIGURE 13
(A) Postholes of oval-shaped hut at domestic Site S-11 on a beach ridge ~5 km north of Huaca Prieta; **(B)** postholes of rectangular hut located at M-32 domestic site on the terrace of a narrow inland wash.

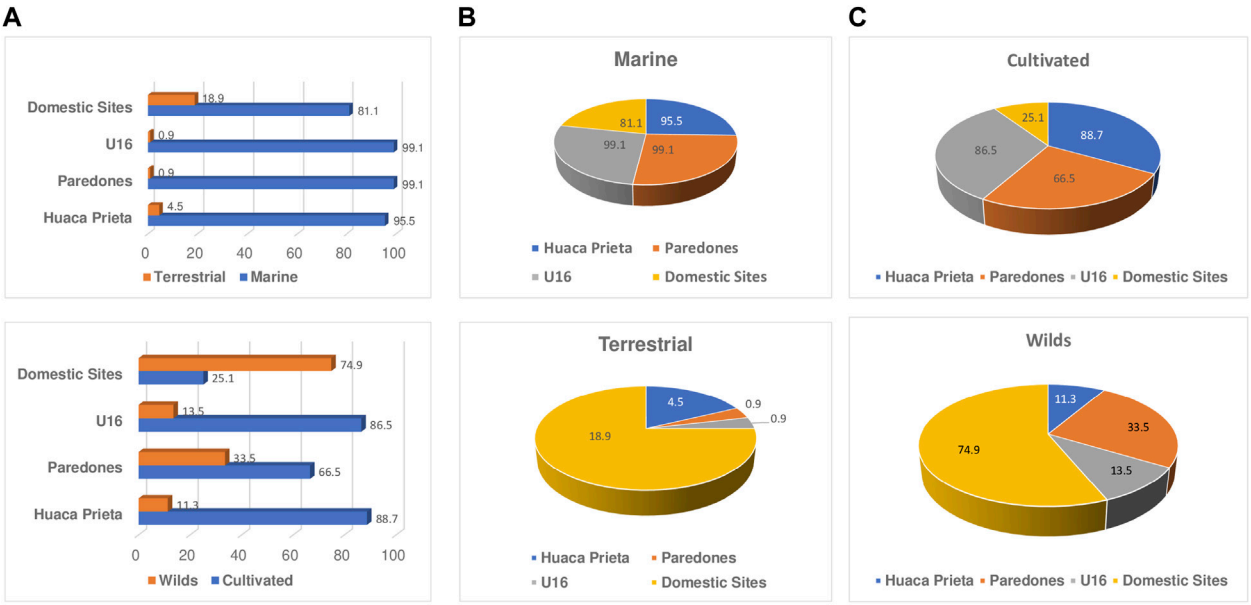

FIGURE 14
Bar-graphs and pie-charts showing percentages of marine, terrestrial (wild plants and animals in wetlands) and cultivated crops at ritual mounds (Huaca Prieta and Paredones) and domestic sites (Unit 16 or U16 near Hiuaca Prieta and outlying domestic sites).

other marine food-related implements (e.g., stone sinkers and gourd floats; Dillehay 2017: Bird et al. 1985); and 3) the frequency and type of food remains in sites (Bonavia et al. 2017; Vasquez et al. 2017). Based exclusively on data for indicator 3, Figure 14 shows the schematic relative frequency of maritime, cultivated and terrestrial wetland (i.e., tubers and other wild plants, water fowl, deer) foods recovered from ritual mounds and domestic sites, the latter divided into tier-2 residential sites (i.e., Unit 16: Figure 9A) located proximal to Huaca Prieta and tier-3 domestic localities situated in outlying areas. Results show that marine foods dominated at tier-3 sites (81.1%) and that wetland resources

(74.9%, mainly plants) were consumed more than cultigens (25.1%). In these sites, food remains probably reflect local procurement, preparation and consumption and inter-household and -community resource exchange between beach-ridge and inland communities. Marine foods were primary and cultigens were secondary food sources at tier-1 and -2 sites, the ritual mounds and Unit 16 households (i.e., U16 in Figure 14) near Huaca Prieta, respectively. At Paredones, marine resources constituted 99.1% of the food remains while at Huaca Prieta it was 95.5%. More cultivated foods were found at Huaca Prieta than at Paredones.

Data for indicators 1 and 2 disagree with evidence for indicator 3. That is, indicator 2 at the Paredones mound and its off-mound activities, which are primarily associated with seed grinding stones, lithic cutting tools (with phytolith, starch grains and fish scales on used edges; Dillehay et al. n. d.) and related activity areas (i.e., small storage pits, cooking hearths, food waste) indicate the preparation of large amounts of marine foods (99.1%) and much smaller quantities of plant foods (0.9%). Moreover, indicator 1, dental and isotope data from human skeletal remains, on and off the Paredones mound, indicate primary consumption of cultigens, mainly maize (Tung et al. 2020). It is doubtful that the high percentage of marine food revealed by indicator 3 was consumed by occupants or workers at this site. Based on indicators 1 and 2, it is most probable that workers prepared fish, shellfish and plant food at Paredones, mainly cultigens, probably for Huaca Prieta or eslewhere. At outlying domestic sites, 81.1% of the food remains were marine resources and 74.9% of the plant foods were wild plant species, the latter of which is not surprising since these sites are located adjacent to wetland areas. Although not detailed in Figure 14, indicator 3 data for households on beach ridges near the sea show a mixed diet primarily based on marine foods (98.2%) and secondarily on plants (1.8%), both cultivated and wild. Indicator 3 data for inland households along washes suggest 82.2% marine foods and 17.8% plant foods, mainly wild species. Although activity area, burial, dental and isotope data on recently excavated outlying households are currently under analyses, preliminary findings based exclusively on indicator 3 suggest primarily marine food specialization for beach-ridge households and primarily wetland resource specialization for inland households. There also is evidence from a few households to indicate mixed diets equally based on marine and terrestrial foods. At Huaca Prieta, the indicator 3 data reveal primary consumption of marine foods (95.5%) and secondary consumption of mainly cultigens with a few wild foods (4.5%). There are no grinding stones and only a few cutting tools and no activity areas (e.g., storage pits and cooking hearths) indicative of significant plant food preparation at Huaca Prieta, although there is widespread evidence of ritual feasting associated with food consumption, mainly marine foods (Dillehay 2017). Human dental and isotope records from Huaca Prieta confirm primary consumption of marine foods (Vasquez et al. 2017; Piperno 2017; Tung et al. 2020). All three indicators are generally in agreement for Unit 16, which is a cluster of tier-2 households located on the Sangamon terrace near Huaca Prieta (Figure 9A). In these households, marine food dominate the diet (99.1%). In summary, based on indicators 1 and 2, it appears that Paredones was the primary location of food preparation and Huaca Prieta was the place for ritual feasting and the consumption of a wide variety of foods. We currently do not have sufficient data to evaluate gender differences in food consumption among site types.

To conclude, caution is urged in collectively or singularly applying the different indicators of food preparation and consumption patterns at these types of sites. It appears that the frequency of food remains recovered from different site types primarily relates to different and changing settlement, occupation exchange, and foodway patterns, with some groups mainly focused on procurement, others on preparation, others on local and non-local exchange and others on consumption, all of which seem to invariably account for the low or high frequency of food types found in sites. In this case study, it appears that the exchange of different foods among specialized (and perhaps unspecialized) communities located in different habitats and the economic specialization of communities preparing and/or consuming foods partially account for the frequency of food types found in sites. Based on our current evidence, it seems that the most reliable indicators, of local food consumption are human isotope and dental records, that is, indicators 1 and 2. Also, to accurately reconstruct the socio-economic relationships among communities, several different types of domestic and ritual sites need study, not just one or two, and this approach requires a long-term research committment.

Social differentiation

Previous research suggested that there was little social differentiation expressed in house forms and burial patterns, respectively, at domestic sites and ritual mounds (Dillehay 2017; Dillehay and Rosales Tham 2022). More recent evidence, however, indicates that there is greater social differentiation than previously inferred and perhaps incipient stratification. As a result of obtaining more data, especially from domestic sites, differentiation now is evidenced by diversity in burial patterns, and particularly in the location of domestic sites and the types of house forms in them. Space does not permit a detailed explanation here, but in general social differentiation and probably marked inequality were defined by a combination of three variables: 1) tier-1, 2 and 3 settlement location; 2) smaller

oval and larger semi-rectangular to rectangular house forms, with the latter later in time and likely associated with larger and perhaps more highly ranked social groups (e.g., extended family); 3) burial placement, whether in the ritual mounds and households proximal to them (i.e., Unit 16) or in outlying domestic sites, albeit status-linked patterns of body treatment and elaborate offerings (e.g., shells, colorful stones, decorated textiles, etched gourds) seem to not have been a major distinguishing social factor among the dead; and 4) type and frequency of food and food preparation implements present in different site types.

Recent research also suggests the existence of other social patterns: that is, particular households and groups of households seem to have persisted more than others in the same location through time, especially on beach ridges and lagoons near the shoreline, possibly associated with continuing ancestry and, for farmers, possibly of inheritance of land use rights, as inferred from uninterrupted refurbishing of house floors in the same house mounds and by stratigraphically continuous house floors (n=15–38) over a long period dating from ~7,000–4,000 BP. (A few house mounds reveal occasional abandonment for unknown reasons.) House mounds of fishers show the same patterns but perhaps more related to access rights to the sea. Overtime, a response to increased growth of the human population and probable increased pressure and selectivity on local resources and preferred habitats possibly brought about more intergroup competition and exchange and household and individual community (and possibly gender) identity-marking, although wider inter-community social integration is expressed in the expansion and use of the communal ritual mounds of Huaca Prieta and Paredones. Significant is that by at least ~6,200–5,500 BP symbolic artwork on textiles, baskets, gourds, and painted stones appeared in greater quantities at Huaca Prieta and Paredones (Dillehay 2017: Creamer et al. 2013; Bird et al. 1985). During this period, the most elaborate and innovative material culture was expressed in various decorative and weaving techniques on textiles and baskets found in only women's tombs and selected ritual spaces at Huaca Prieta. These developments are interpreted as probable increased identity-making among local communities, including gender-based identity, and as markers of social differentiation.

Splitstoser (2017) study of textiles from Huaca Prieta and Paredones indicate at least two separate weaving technologies and various subtypes associated with two different community sectors, each respectively representing the identity technologies of fishers and farmers. The same pattern holds for twining of baskets, which shows two major techniques and five to eight subtypes at the same time (Illinsgworth and Adovasio 2017). Variations in weaving and decorative techniques is not simply a function of time whereby new technologies were gradually learned and developed, because several different techniques are found together as offerings in the same female tombs and across contemporaneous tombs. Such variation offers no presently known technological or economic advantage, but likely were more symbolic in nature, that is, identity-markers associated with economic and occupational specialization and exchange, probably female occupation roles, and social cohesion.

Although more data are required to better understand these patterns, perhaps competitive farming and increased exchange with fishers (and probably other farmers, for instance, in the more interior areas of the valley after ~5,000 BP) eventually resulted in an increased demand for social distinction and identity-marking between individual households and communities, which different weaving and decorative techniques would have met for local women, if not men. If so, then the different techniques might be associated with distinct farming and/or fishing household groups on beach-ridges and along wetlands and washes. Varieties in weaving and decorative techniques documented at domestic sites, in turn, are linked to the same varieties found in female burials at Huaca Prieta.

Specialized communities of fisherfolks and farmers

The types of early ritual and domestic mound construction, specialized complementary economies and technologies (including raised agricultural platforms, canal agriculture, decorated textiles and gourds) suggest certain forms of supra-household and community-level collective practices. The social life of farming implies communities variously associated with affiliated household clusters in estuarine wetlands and interior washes, limited land clearance for cultivation plots, planting, harvesting and food processing, and probably shared water rights. Not only does farming require high inputs of labor and group collaboration, but farmers are tied generally to the land they cultivate and, thus, to more fixed communities. A challenge in developing an early farming life that has been widely acknowledged is the potential link between agricultural production cycles and the appearance of land use and property rights (e.g., Engel 1981; Shennan 2011; Bowles and Choi 2013; Becker 2014; Economou and Kyriazis 2017). In this regard, both the early raised field and small, scale, canal-fed farming in the study area might reflect long-term investments in land that probably would have created household- and community-based management, social and group identity-marking, use rights, and eventually ownership and inheritance.

In some ways, the same may be the case for fishers living together on beach-ridges near the Pacific shoreline and perhaps coming together to build reed boats or produce cotton nets, yet laboriously perhaps to a lesser extent than agriculture because the sea requires no preparation for food extraction the way land does. In contrast, a fishing community presumably would have less concern over resource use and property rights perhaps because the Pacific Ocean was probably defined as an open "commons" area, over which there is no, or less, strict ownership or

jurisdiction (D'Altroy 2003; Dillehay and Navarro 2003; Lozada et al. 2009; Tellenbach 1986).

Archaeological and ethnohistorical evidence from the Andes suggests that later maritime communities were tightly affiliated and particularly specialized (e.g., Lizárraga 1908; Rostworowski 1999:170–171). This is the case in coastal Peru today and perhaps the same in the middle Holocene (although caution must be exercised in projecting from more recent times to the deeper past). Based on Spanish documents, we know that late pre-Hispanic and colonial fishers inhabited economically specialized communities (Lizarraga 1908; Rostworowski de Diez Canseco 1977a-b, 1989). Fishers did not till the land; by exchanging fish, they acquired a wide variety of marine and agricultural produce. In turn, neighboring farmers exchanged crops for marine foods. There were exceptions to these occupational divisions, and some fishing populations were not spatially isolated from other occupational groups (Lozada and Buikstra 2002; Lozada et al. 2009). However, whether these groups co-resided or lived separately, fishing and farming communities exchanged products, albeit primarily consuming seafood, thereby tying them together in bonds of reciprocity informed by resource sharing and other forms of cooperation. Maritime communities were particularly specialized, engaging in fishing, hunting sea lions, and collecting seaweed, shellfish, and marshy plants, activities that required specialized tools, sea craft, and deep knowledge of littoral and ocean ecologies. This occupational specialization also extended into other forms of difference. For example, maritime specialists often used their own types of pottery (Lozada et al. 2009), worshipped their own gods and temples, used different artistic symbols and identity-markers, and, in some cases, spoke their own dialects (Rostworowski de Diez Canseco 1977a; Mannheim 1991).

Although we have learned more about the lifeways and types of interactions between farmers and fishers, other questions and lacunae exist. For instance, not known is the extent to which changes in the local economy and the development of separate, neighboring agricultural groups between ~7,500 and 5,500 BP might have led to open sharing of maritime and terrestrial resource zones or to the drawing of fixed boundaries (e.g., walls, canals) and identity-marking (e.g., textiles, other artwork) between farmers and fishers. The geomorphological setting of the study area itself defines natural boundary conditions, spatially and sequentially, from shoreline to beach-ridges to inland wetlands and washes (all within a distance of 0.5–2.5 km), but still there might have been overlapping claims. Also not known is whether the development of cultivation and the production of an ever-increasing variety of food crops raised concerns over land use rights and land produce, and over social and gender status linked to these activities, if not between farmers and fishers, then perhaps between different subtypes of specialists or between specialists and non-specialists.

These scenarios lead us to ask what are the social and spatial consequences when one group, agriculturalists, for instance, required land use rights and the other, fishers with open access to the sea, perhaps did not? Did competition, boundary-making, and identity-marking occur between these co-existing communities and between gender-based occupations within and across them, the latter suggested by distinct weaving and decorative techniques in cotton textiles placed as offerings with only female burials at Huaca Prieta and Paredones (Splitstoser 2017)? Are these practices mirrored in the contemporaneous, outlying domestic fishing and farming communities, or are they different within and across them? In other words, do the ritual mounds or centers at Huaca Prieta and Paredones and the domestic sites differ in terms of their communities of socio-economic practices despite their interdependence, or can we presume that if we understand the centers, we understand their supporting domestic components, which seems not to be the case here. Why were more outlying community members not buried at the ritual centers but interred in domestic communities? Do individuals buried in the centers represent preeminent individuals, families, households, lineages or ritualized occupational or other associations cross-cutting local communities within and across the fishing and farming communities? Or were they simply representing household groupings of segmented, economically and environmentally (e.g., beach-ridges, lagoons, washes) specialized and perhaps unspecialized communities? More burial, isotope and genetic data are required from domestic sectors to answer these and other questions. More archaeological data also should refine the contextual differentiation between the different parts and scales of connectivity between centers and domestic sites. Especially needed is a better understanding of the socio-economic and demographic relationships between ritual centers and their associated domestic sites, which requires more focus on the latter. As noted earlier, in the Central Andes, archaeologists tend to concentrate on the centers, generally believing that if you understand their function and meaning, then, by extension, you invariably comprehend the domestic sites.

Discussion

The findings reported here focused on people residing in household clusters in varying littoral and wetland habitats and practicing rituals and burials at Huaca Prieta and Paredones, on their access to individual resource zones, and on the symbolic expression of their identities with specialized food production, individual communities, and gender identity-marking. Although an understudied theme in Andean studies, this research has shed new light on the long-term relationships between the traditionally perceived "dominant culture" of ritual centers and the generally perceived

subordinate culture of domestic sites (Lohse 2007), and whether they equally expressed the same socio-economic practices and privileges. These data also offer a specific database to identify the various co-dependent domestic and public parts that conciliated to form increased and different venues of social complexity and interacting fishing and farming communities during the lengthy middle Holocene period under study. The coalescing of various institutions and activities passing into larger, interconnected ritual and specialized economic units had to have resulted from a changing combination of multiple, forming communities of fishers and farmers that learned new technologies, organizational strategies, and other practices with and from each other. As the communities developed and coalesced over time, they formed and became dependent upon the wider Huaca Prieta network and constellation of co-dependent communities. In turn, some members of this wider symbiotic community probably became more specialized in terms of interacting habitats, whether they were the sea, littoral, lagoons or washes. These early formations, especially between ~7,500 and 5,500 BP, were highly localized and largely confined to the wider littoral zone of the lower Chicama Valley, although contact with distant groups to the north is south Ecuador and to the east farther upvalley and in the Andean highlands is suggested by the presence of exotic shells, stones and cultigens, respectively.

Co-dependent maritime and agricultural activities involved different habitat locations organized by different communities beginning by at least 7,000 years ago. Although co-dependent, these communities were not necessarily coalescing as one unified society, at least not at the outset. When increased sedentism at this time brought people together into a locus of dense habitation along the littoral and specialized economies, neighboring inland habitats also experienced a settlement restructuring. At its most basic level, this must have included exchange of resources and mutual social relations operating within the specialized (and perhaps unspecialized) economies evidenced in these habitats. Exchange relations between these groups also probably consisted of exchanging goods for status rather than strict goods-for-goods exchange. More complex relationships of co-dependency could also have evolved, as when the littoral and more inland-based sites exchanged maritime and agricultural produce, respectively, to each other in transactions that depended on mutual exploitation of cycles of social and probably ceremonial debts.

Throughout the period under study, human populations grew significantly in the Huaca Prieta area with at least three socially, demographically, ecologically and economically differentiated tiers. In addition to different mixed and specialized economies, tiered settlement and community patterns, varying types of house forms and public mounds, other impressive features of this period are decorated cotton textiles and gourds, artworks in the form of sculptured stones and painted stones, all suggestive of communication with the cosmological and spiritual world. The type of political system represented by these societies is difficult to estimate. Several Andeanists believe that during the late Preceramic period there was a group-level of decision making due to the absence of elaborate houses and burials (Burger 1992; Dillehay 2017; Quilter 2022), but this thinking may change as more early sites are studied.

In north Peru, the Huaca Prieta area does not stand alone in its early socio-cultural complexity. It is probable that other ceremonial centers dating around or prior to 6,000 years ago exists along the coast and in the highlands, but they have not yet been discovered or their remains lie under later Preceramic or early Formative mound sites. Around 7,500 BP, the mound at Huaca Prieta was much smaller, estimated ~4-5 m high and 25-30 m long and associated with impermanent to permanent campsites of fishers and gardeners (Dillehay et al. 2012; Dillehay 2017). A similar case occurred at the Cementerio de Nanchoc site on the western slopes of the Andes in north Peru ~7,000 BP, where a small ceremonial mound (~2 m high and 25 m long) was flanked by outlying residential sites engaged in a mixed economy of long-distance exchange, hunting-gathering, and small-scale farming (Dillehay et al. 1989; Dillehay 2017).

To conclude, the scale and scope of socio-cultural complexity and mixed fishing and farming economies expanded greatly throughout the Central Andean coastal area (and farming and camelid husbandry simultaneously in the highlands) in the middle to late Preceramic period (7,500–4,000 BP). Archaeological knowledge of emergent socio-economic integration, technological exploration, innovation and development, and the antecedents and consequences of these activities are becoming clearer in the region, with different pathways to sociocultural and economic complexity depending on the local environmental and historical circumstances. The period of ~7,500 to 4,000 years ago is a critical time, representing the spread and evolution of sedentism, incipient occupational specialization, labor demands and lifestyle, dependence on domesticated plant and animal food sources, climate fluctuations, symbolic material expressions, perhaps more formalized ideological foundations, and population growth in several pre-state settings along the Pacific coast of the Central Andean region. The early dual maritime and agricultural society in the wider Huaca Prieta area was one of the most intense and complex coastal adaptations in the region during this period. Our long-term study of the area has elucidated some of the primary mechanisms that led to the inception and growth of this complexity and to a better understanding of the coalescing processes that fostered the development of non-centralized, incipient non-egalitarian communities in the area, economic specialization, gender-based occupational roles, social and labor division, technological innovation, and symbolic artwork. Other areas of the Central Andes may reveal similar or dissimilar socio-cultural transformations during the time period under study here.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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