Feasting and the evolution of cooperative social organizations circa 2300 B.P. in Paracas culture, southern Peru

Charles Stanish[a,b,1,2], Henry Tantaleán[a,1], and Kelly Knudson[c,1]

[a]Institute for the Advanced Study of Culture and the Environment, University of South Florida, Tampa, FL 33620; [b]External Faculty, Santa Fe Institute, Santa Fe, NM 87501; and [c]Department of Anthropology, Arizona State University, Tempe, AZ 85281

Contributed by Charles Stanish, May 30, 2018 (sent for review April 19, 2018; reviewed by Joyce Marcus and Stephen Plog)

Recent theoretical innovations in cultural evolutionary theory emphasize the role of cooperative social organizations that unite diverse groups as a key step in the evolution of social complexity. A principal mechanism identified by this theory is feasting, a strategy that reinforces norms of cooperation. Feasts occur throughout the premodern world, and the intensification of feasting is empirically correlated to increased social complexity. A critical factor in assessing the evolutionary significance of this practice is the scale and range of the feast from that focused on a single community to ones that draw from a large region or catchment zone. This work addresses the degree to which hosts draw on a local area vs. a regional one in initial prehistoric feasting. We report on excavations at a locus of intensive feasting—a ceremonial sunken court—in a fifth- to third-century BCE Paracas site on the south coast of Peru. We selected 39 organic objects from the court placed as offerings during major feasting episodes. We analyzed the radiogenic strontium isotope (87Sr/86Sr) values to determine the geographical origin of each object. The 87Sr/86Sr data plus additional archaeological data support a hypothesis that the catchment of the court was quite extensive. The initial strategy of political and economic alliance building was macroregional in scope. These data indicate that the most effective initial strategy in early state formation in this case study was to build wide alliances at the outset, as opposed to first consolidating local ones that subsequently expand.

cultural evolution | feasting | 87Sr/86Sr | cooperation | Paracas

The evolution of archaic state societies from stateless villages to complex polities involves the emergence and consolidation of sustained cooperative organizations above the household level. This work ultimately deals with a critical question in cultural evolutionary state formation theory. How do stateless societies create the material and social conditions that foster sustained cooperation among both kin and nonkin that led to the evolution of class-based, hierarchical, and demographically large states (1)?

Recent theoretical work has defined this question as a type of collective action problem (2). That is, how do managers or leaders mobilize people, particularly nonrelated ones, to forgo short-term individual gain for long-term benefits by cooperating in a more complex political and economic organization? This phenomenon is widespread in the ethnographic literature and found in virtually all societies beyond hunter-gatherer levels of organization. This empirical fact strongly suggests that there are emergent properties in complex human interactions that lead to these kinds of social organizations under the appropriate conditions. That is, in the absence of traditional coercive state mechanisms, such as laws, codes, courts, policing power, markets, and the like, nonstate societies create cooperative norms that directly counteract the centrifugal effects seen in the "tragedy of the commons" (3). These norms become "ritualized," backed by both sanction and reward, which keeps cooperative organizations functioning (2). This process is particularly important in complex, stateless societies (aka chiefdoms, transegalitarian, or intermediate societies), where formal political coercion is not present. From this theoretical perspective, the development of evolutionary stable social organizations that overcome the collective action problem is a prerequisite for the evolution of social complexity.

The ethnographic and historical record indicates that several social practices are important in fostering cooperation, including intraregional and interregional trade and the hosting of regional fairs. Regional conflict is another significant factor in state formation. While seemingly counterintuitive, conflict between groups fosters hypercooperation within groups and is therefore intimately tied to the evolution of cooperation (2). Feasting is one documented social mechanism that has emerged in the theoretical literature as a primary means of establishing such cooperative organizations. It is a "critical element" in our models of the evolution of cooperation (4). Periodic feasts establish the context in which individuals—related, nonrelated, or distantly related—can come together for their long-term benefit. The hosting and participation in successful feasts link individuals into a series of mutually beneficial obligations that result in higher per-capita payoffs than could otherwise be obtained by working in smaller groups of households. Such events act "as the nodal contexts that articulate regional exchange systems: commensal hospitality establishes relationships between exchange partners" and other politically significant individuals in an area (5). Such an organization requires the creation of norms of cooperative behavior backed by rewards and

Significance

A key process in cultural evolution is the development of cooperative organizations that confront the collective action problems inherent in human social interactions. We demonstrate that one classic ethnographic mechanism of cooperative social organization, the hosting of feasts, was used in an early complex, nonstate society in the south coast of Peru ∼2300 B.P. We likewise demonstrate that the catchment zone of the people and goods that participated in the feast was extensive. These data support a cultural evolutionary model of early state formation as one of a network strategy. That is, key areas across a large landscape were initially integrated into a cooperative group as opposed to a strategy of local consolidation and subsequent aggregative growth.

Author contributions: C.S. and K.K. designed research; C.S., H.T., and K.K. performed research; C.S., H.T., and K.K. analyzed data; and C.S., H.T., and K.K. wrote the paper.

Reviewers: J.M., University of Michigan; and S.P., University of Virginia.

The authors declare no conflict of interest.

[1]C.S., H.T., and K.K. contributed equally to this work.

[2]To whom correspondence should be addressed. Email: stanish@usf.edu.

Published online July 2, 2018.

punishments, as understood by recent work in evolutionary game theory.

The material basis for this process involves the creation of rudimentary economies of scale (2). Specialized labor increases efficiencies by reducing redundant tasks. Individuals do not have to work more to increase productivity. Rather, they have to work differently in a group with specialized tasks. This organization results in higher per capita resource allocation for individuals for equal or less amounts of labor. The benefit of a rudimentary economy of scale is increased production. The costs derive from the social tensions that arise in the allocation of the production of group labor. Individual household production is inefficient, but the question of ownership is not an issue. With a larger specialized group, however, a fair distribution of the produced resources becomes a central problem. Maintaining group cohesion via enforced norms and ritualized behaviors is critical. Feasting is precisely the kind of behavior that supports sustained group cooperation by overcoming the free-riding and defection problems inherent in collective action (2).

In this study, we refine our understanding of prehistoric feasting strategies in a complex, stateless society known as Paracas (Figs. 1 and 2). Paracas was the first such society that flourished on the south coast of Peru circa the eighth to third century BCE. We excavated an architecturally complex late Paracas platform mound, called Cerro del Gentil, that securely dates from the fifth to third century BCE based upon a suite of ^{14}C results (6). This mound housed a stone-lined and plastered sunken court within which people placed many high-valued objects during multiple feasting episodes (Fig. 3). The feasting function of the court is supported by several independent lines of evidence, including the nature of the food remains, repeated deposit of liquids, the existence of geoglyphs in the site area, repeated architectural enhancements of the platform, a lack of domestic areas on or around the site, and the deposition of high-valued objects (7, 8).

Local vs. Regional Strategies

Archaeological and historical data indicate that major ceremonial sites in complex stateless societies serve as regional centers where people from a certain catchment area congregated during periodic festivals (9). The early monumental site of Poverty Point in Louisiana, for instance, received objects and presumably people from areas hundreds of kilometers distant, as did later centers like Moundville in the Southeast United States (10, 11). Neolithic henge monuments in Britain had a catchment of considerable size serving as "the meeting places of scattered communities from the surrounding areas" (12, 13). Later henge monuments, all created by complex stateless societies, usually had catchments that were considerably larger, such as Neolithic Durrington Wells near Stonehenge (14). The primary Nasca period settlement of Cahuachi in the Nasca Valley of Peru likewise attracted pilgrims from a large catchment (15, 16). Nasca culture (circa AD 100–700) represents the successor polity to Paracas on the Peruvian south coast. Kantner and Vaughn explicitly note that "...pilgrimage was an important component in maintaining cooperation, group cohesion, and identity" at Cahuachi (17). By its very nature, pilgrimage is a phenomenon that draws from a region beyond the local community. Pilgrimage is empirically and theoretically linked to feasting. In short, feasting is a strategy by which elites can increase power and by which complex cooperative social organizations can evolve in the absence of coercion (18).

Ethnographic data demonstrate that exotic objects are important in feasting and other coalition-building social events. In general, exotic objects are highly valued and can be crucial political tools in cementing relationships across many communities (19). Such objects may be traded in or brought by participants (pilgrims) involved in the feasting episodes. However, we remain unclear on the precise relationship between the development of initial social complexity and the size of the catchment area that participated in these events. Understanding this relationship is critical to more fully developing cultural evolutionary theory; it directly addresses the question of the kinds of strategies people used in constructing more complex political and economic institutions in nonstate contexts.

Fig. 1. Map showing valleys on the southern coast of Peru.

Fig. 2. Map showing the Chincha and Pisco valleys with archaeological sites linked to Paracas period settlement in Chincha, Peru.

ANTHROPOLOGY

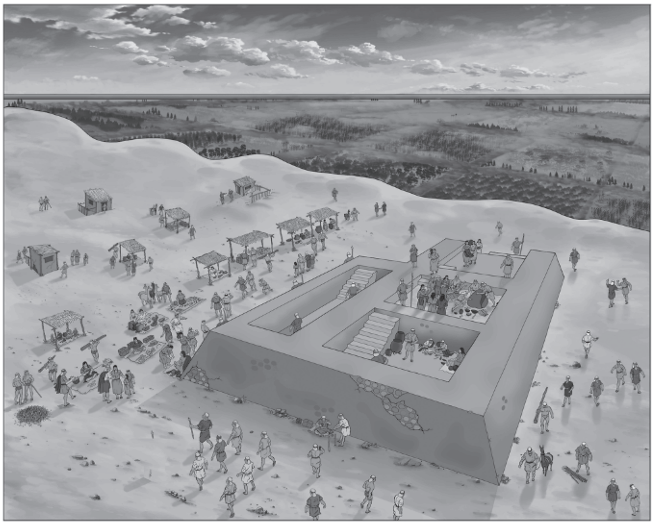

Fig. 3. Reconstruction of a late Paracas platform mound. Illustration courtesy of Robert Gutierrez (artist).

This is a theoretical problem that can only be addressed with archaeological data. A critical question, therefore, surrounding the nature of feasting in the archaeological record is the degree to which people in stateless societies draw on a local population (restricted catchment) vs. a regional one (broad catchment) to create and sustain these strategies in its initial stages. What strategy is more successful: First, build a strong local organization that expands over time or, in contrast, construct one across a wide geographical area at the outset that can successfully compete at the regional level? The latter strategy would indicate that external sources of wealth and people were critical in creating complex cooperative organizations from the start. In contrast, the former pattern supports models in which local resources and relationship-building were key components in the initial stages of this process that subsequently scaled up into large and more complex regional systems.

Research Design

The Paracas site of Cerro del Gentil dates to ∼400–200 BCE and has been described in great detail elsewhere (6, 8). It is a modest monumental platform mound with at least two sunken courts located above the agricultural fields in the Upper Chincha Valley at the edge of a high pampa. The site is small in scale compared with the archaeological examples cited above. From this scalar perspective (monumental architectural and labor input), Poverty Point, Chaco, and the other examples are at least an order of magnitude larger than the site of Cerro del Gentil. The data reported here therefore characterize the earliest strategies used in the construction of evolutionarily stable and complex political and economic systems associated with monumentality and high labor inputs focused on specific places on the landscape.

Cerro del Gentil is located on a pampa that houses an extensive geoglyph complex (7). Archaeological research indicates that Cerro del Gentil was the endpoint of periodic visits by people for more than two centuries, conducted on a landscape with numerous geoglyphs and small ceremonial structures. We also demonstrated that the June solstice was a significant time marker for these ritual events, suggesting a high degree of periodicity for these social gatherings. This platform mound site is tied directly into a larger settlement system in the Chincha Valley that included at least five substantial pyramid complexes (20). The combined data indicate that Cerro del Gentil was a small but monumental ceremonial platform structure that was built to host periodic feasting events during the height of the Paracas occupation of the Chincha Valley. There is no resident population on or around the mound. There is substantial evidence of food and liquid consumption. Cerro del Gentil is in fact a textbook example of a feasting and ritually-charged center of early social interaction in the archaeological record.

Hypotheses

We can logically construct three hypotheses to evaluate the Cerro del Gentil data in light of the theoretical discussion above: (*i*) The demographic catchment area of the court was large and included the coast and the highlands of the southern part of the Central Andes; (*ii*) the catchment area was intermediate in scale, restricted to the coastal valleys; and (*iii*) the catchment was small, restricted to the upper Chincha Valley in the area surrounding the site.

Hypothesis Testing

We assessed our hypotheses by determining the place of origin of objects and people interred in these feasting locales. We excavated one of the sunken courts at Cerro del Gentil during several field seasons (Fig. 3). We discovered a full range of offerings in the court, including very high-quality pottery, baskets, textiles, animals, plants, stone objects, wood, and human remains. All recognizable iconography on the objects was Paracas in style, and a large suite of ^{14}C dates securely dated the court to the later Paracas period ∼400–200 BCE. The distribution of Paracas cultural objects extended throughout several valleys on the Peruvian south coast and into the adjacent highlands (21).

Several archaeological techniques are available to determine the geographical source of artifacts and individuals. The identification of such objects includes chemical characterization of pottery and stone, light isotope analysis of organics, recognition of distinctive exotic features, and artifact style (22). In this study, we used 87Sr/86Sr analysis to infer the geographic origins of individuals and objects excavated at Cerro del Gentil. Briefly, the radiogenic isotope of strontium, 87Sr, varies worldwide based on the age and initial composition of the underlying bedrock (23, 24). Reported as 87Sr/86Sr, radiogenic strontium isotope values from the bedrock, which vary geologically, are then reflected in the soil, plants, and animals living in a given geologic region (25, 26). When local strontium is consumed and imbibed, the 87Sr/86Sr in archaeological enamel and bone can be used to infer the geologic zone or zones in which that individual was living during tooth or bone formation (27, 28). Archaeologists have also used 87Sr/86Sr data to infer the geologic zone in which a plant or animal lived (29–32). When using archaeological samples, this technique is only possible when samples have not undergone substantial diagenetic, or postdepositional, contamination, and when the inferred movement occurred between geologic zones that exhibit different 87Sr/86Sr values. In this study, we benefited from both the exceptional preservation in the hyper-arid Chincha Valley and the well-established variability of 87Sr/86Sr values throughout the geologic zones of the Andes (33).

Methodology

A random sampling strategy was used to collect samples from different artifact categories from a single court at Cerro del Gentil. In the Archaeological Chemistry Laboratory at Arizona State Laboratory, samples were photographed and then mechanically cleaned by abrasion with a Dremel Minimite-750 cordless drill or Dremel 3956-02 Variable Speed MultiPro drill equipped with an engraving cutter. This removed any adhering organic matter or contaminants as well as the outermost layers of archaeological tooth or bone, which are most susceptible to diagenetic contamination (34–38). Bone samples were additionally chemically cleaned with 0.8 M acetic acid (CH_3COOH), and both bone and plant samples were ashed at 800 °C for 10 h.

Radiogenic strontium isotope analysis methodology powdered samples were dissolved in 0.50 mL of 16 M nitric acid (HNO_3). The strontium was then separated from the sample matrix by using the fully automated PrepFast system equipped with a 1-mL Element Scientific Inc. Sr-Ca column in the W. M. Keck Foundation Laboratory for Environmental Biogeochemistry (39). For each sample, the column was first eluted with 2 M nitric acid and 1 wt% hydrogen peroxide (H_2O_2) to remove most major, minor, and trace elements from the sample matrix. The sample was loaded onto the column in 2 M nitric acid, and strontium was then eluted in 6 M nitric acid. Before the column was reused for the next sample, 10 mL of 1 M hydrofluoric acid was used to remove all remaining elements on the resin, which ensured the resin was clean for the next sample.

The samples were analyzed by using a Thermo-Finnigan Neptune multicollector inductively coupled plasma mass spectrometer (MC-ICP-MS). Analyses of strontium carbonate standard SRM-987 yielded a value of 87Sr/86Sr = 0.710250 ± 0.000003 (2 sigma, n = 37), which agrees with analyses of SRM-987 using a thermal ionization mass spectrometer, where 87Sr/86Sr = 0.710263 ± 0.000016 (2 sigma), and analyses of SRM-987 using an identical MC-ICP-MS, where 87Sr/86Sr = 0.710251 ± 0.000006 (2 sigma) (40).

Results

We present 87Sr/86Sr data from 39 organic objects from the sunken court at Cerro del Gentil along with contextual information (Fig. 4 and Table 1). Ten samples (10 of 39, or 26%) were outside of the local range, as defined and discussed below. Of these 10 outliers, 5 were within 87Sr/86Sr = 0.70596–0.70614 and were therefore from the coastal region. The other 5 values fell within 87Sr/86Sr = 0.70762–0.71683 and were from the highlands. Twelve samples (31%) were from the immediate area of the court. The rest (17 of 39, or 43%) most likely originated from the Paracas cultural area on the coast.

Discussion

We first compared the Cerro del Gentil 87Sr/86Sr data with published data from other areas in the south-central Andes (41, 42). Previous research at a nearby site, known as Pampa de los Gentiles or PV57-137, allowed us to define with very high precision the 87Sr/86Sr values in the local population of this mid-valley location (43). This site is less than a half-hour walk from Cerro del Gentil. Both sites are ∼17 km from the ocean and are situated in virtually identical geological and ecological contexts.

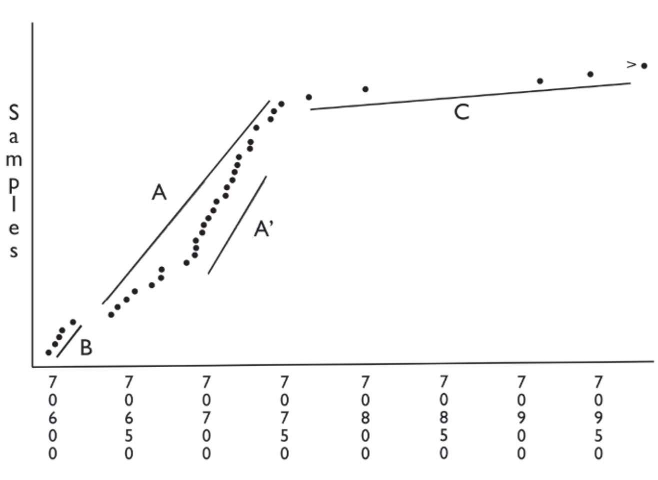

Fig. 4. Visual graphic of strontium isotope data from Cerro del Gentil (Table 1). A, Paracas cultural area; A′, local; B, far south coast; C, highlands.

The human remains from a small 2.1 × 2.4-m collective tomb were analyzed at PV57-137 by Weinberg et al. (44). Based on osteological analysis, the minimum number of individuals in this tomb was 63. Knudson et al. (43) analyzed the 87Sr/86Sr of 42 teeth from seven individuals in the tomb. The Pampa de los Gentiles work confirmed the precision of the 87Sr/86Sr analysis by examining intraindividual variation in human teeth. Because of the nature of the sample, it also allowed us to define the local 87Sr/86Sr values in the region with a very high level of confidence. These samples were intentionally chosen from a time with high levels of regional conflict and low political centralization. These cultural practices mitigated against substantial human mobility. Furthermore, the Pampa de los Gentiles sample came from a small and isolated agricultural village in which interaction with more mobile coastal and highland populations was far less likely. Based upon the observations of the hundreds of looted tombs in the area plus excavations in intact tombs, it was evident that there are virtually no exotic textiles or other objects included in these contexts.

Knudson et al. (2016) demonstrated that six of seven of the individuals sampled in the collective tomb had a very restricted 87Sr/86Sr range between 0.70703 and 0.70732 (43). One individual had a mean ratio of 87Sr/86Sr = 0.70625, indicating an origin outside of this site area, probably the coastal zone further to the west. The other six samples, in turn, provided a precise baseline for the 87Sr/86Sr values for this location, which is the same ecological and geologic zone and elevation as Cerro del Gentil. Therefore, we interpreted radiogenic strontium isotope values between 87Sr/86Sr = 0.70703 and 0.70732 as "local" (A′ in Fig. 4); we argue that this population is an excellent proxy for the mid to upper Chincha Valley local 87Sr/86Sr range and represents the immediate area of the Cerro del Gentil sunken court as well.

Comparing the two sites, we observed a greater geographic diversity in the Cerro del Gentil data (n = 39) than that seen in the Pampa de los Gentiles 87Sr/86Sr data (Table 1 and Fig. 2). In the former, the 10 (26%) outliers at the low and high end of the range had values of 87Sr/86Sr = 0.70596–0.70614 (B in Fig. 4) and 87Sr/86Sr = 0.70762–0.71683 (C in Fig. 4), respectively. This range is consistent with southern coastal areas such as Moquegua and Nasca at the low end and with the Andean highlands at the high end (33, 45). The rest of the sample (A in Fig. 4) exhibited radiogenic strontium isotope values consistent with 87Sr/86Sr data from the coast, most likely originating from the Nasca, Ica, Pisco, and/or lower Chincha Valleys. These values correspond to the Paracas cultural area. All human remains (n = 6) sampled from Cerro del Gentil exhibited 87Sr/86Sr values consistent with the south coast, with four (of six) falling within the immediate area of the court. Of the 13 decorated textiles sampled, 10 were outside of the Pampa de los Gentiles range. Four almost certainly originated outside of Chincha. These combined data support the hypothesis that the catchment of the Paracas period sunken court at Cerro del Gentil was relatively large and included the cultural area known as the Paracas polity which extends from Cañete in the north to Nasca in the south. Objects from the highlands were also incorporated in the feasting events.

In summary, during the Paracas period, the Cerro del Gentil sunken court was filled with objects and people that originated from a wide area. It was a finely built structure with a complex architectural plan including ramps, stairs, and finely plastered walls. The site itself was at the endpoint of a series of elaborate small structures and geoglyphs spread across the pampa to the east (7). There were numerous high-value objects, both local and nonlocal, interred in the court. The artifactual, architectural, and contextual data (e.g., settlement patterns) all point to a site that

Table 1. 87Sr/86Sr data from Cerro del Gentil

Sample no.	87Sr/86Sr	Material	Archaeological context and locus
8426	0.70596	Cotton (*Gossypium barbadense*) textile	Mummy bundle 3, L247
6728	0.70603	Camelid (*Lama spp.*) bone	L119
8425	0.70606	Cotton (*Gossypium barbadense*) textile	Mummy L345
8416	0.70608	Cotton (*Gossypium barbadense*) textile	Mummy bundle 6 L247
8422	0.70614	Cotton (*Gossypium barbadense*) textile	Cavernas mummy L345
8418	0.70637	Gourd (*Lagenaria siceraria)*	Cavernas mummy L345
8410	0.70640	Cotton (*Gossypium barbadense*) textile	Cavernas mummy L345
8406	0.70648	Gourd (*Lagenaria siceraria*)	Mummy bundle 3 L247
6729	0.70655	Molar (*Homo sapiens*)	Mummy bundle 3
8413	0.70665	Cotton (*Gossypium barbadense*) textile	Mummy bundle 6
6710	0.70670	Cotton (*Gossypium barbadense*) textile	Textile L150 inside L142
6719	0.70670	Gourd (*Lagenaria siceraria*)	L246
6718	0.70687	Maize (*Zea mays*)	L304
6722	0.70691	Cotton (*Gossypium barbadense*) textile	L97-1
8414	0.70691	Gourd (*Lagenaria spp.*)	Mummy bundle 6
6712	0.70692	Cotton (*Gossypium barbadense*) textile	Mummy bundle 1 L247
8417	0.70694	Gourd (*Lagenaria siceraria*)	Mummy L345
6716	0.70695	Gourd (*Lagenaria siceraria*)	L82
6720	0.70701	Rib (*Homo sapiens*)	L246
6715	0.70704	Camelid (*Lama spp.*) skin	L293
6714	0.70705	Rib (*Homo sapiens*)	Mummy bundle 3
8420	0.70711	Cane (*Gynerium sagittatum*)	L231
6730	0.70712	Gourd (*Lagenaria siceraria*)	L246
6711	0.70716	Molar (*Homo sapiens*)	L150
8427	0.70717	Cotton (*Gossypium barbadense*) textile	Mummy bundle 5 L247
6721	0.70718	Cotton (*Gossypium barbadense*) textile	L97-2
8429	0.70719	Basket (*Scirpus spp.* or *Juncus spp.*?)	L97
6731	0.70726	Cotton (*Gossypium barbadense*) textile	L116
8428	0.70727	Basket (*Scirpus spp.* or *Juncus spp.*?)	L97
8421	0.70728	Botton (*Gossypium barbadense*) textile	Mummy bundle 6
6724	0.70730	Rib (*Homo sapiens*)	L150
6723	0.70738	Matting (*Scirpus spp.*?)	L82
6717	0.70741	(*Lagenaria siceraria*)	L82
8409	0.70747	Rib (*Homo sapiens*)	Mummy bundle 5 L247
6725	0.70762	Maize (*Zea mays*)	L104
6727	0.70799	Wood bottle stoppers (species unidentified)	L330
8419	0.70915	Gourd (*Lagenaria spp.*)	Mummy bundle L345
8430	0.70943	Basket (*Scirpus spp.* or *Juncus spp.?*)	L97
8415	0.71683	Cotton (*Gossypium barbadense*) textile	Mummy bundle 6 L247

L, locus. See ref. 8 for contextual information.

was built by a local population to attract people from near and far; the 87Sr/86Sr data are consistent with this interpretation.

Like the court at Cerro del Gentil, the Pampa de los Gentiles collective tomb was designed to be revisited over many occasions, likely as a place for kin groups to congregate. The tomb type is common with hundreds of similar such constructions in the upper valley region (46). However, these tombs were architecturally simple and represented a labor input scale substantially smaller than the Cerro del Gentil court. There was no evidence of any exotic or high-valued objects placed in the tomb or in the hundreds of other looted ones examined. The artifactual assemblage was almost exclusively domestic and local. The artifactual, architectural, and contextual data all point to a structure built by a local population for a very restricted group; the 87Sr/86Sr data are consistent with this interpretation.

In summary, this case study demonstrates that initial sociopolitical complexity in the south coast of Peru ∼400 BCE involved a wide demographic catchment of people and objects. An alternative model in which cooperation intensifies in a small area and then expands is rejected. Rather, successful strategies for creating intense cooperation at the local level required the incorporation of a much more widely spread group of people who congregated for significant periods of time in specifically-built feasting locations.

The Evolution of Archaic States

Many decades of archaeological research on the oldest state societies in the world have discovered a common pattern: The earliest states grew rapidly and expanded into widely spread enclaves with large areas of unincorporated territory and people in between (47–50). Early states such as Tiwanaku and Wari in South America, Teotihuacan in Central Mexico, and those in northern Mesopotamia share this feature. The model of an archipelago or network of enclaves of strategic areas connected by a road system is appropriate for these initial state societies. Unlike later states in the same areas, we do not see a pattern of initial consolidation in one area and then a gradual expansion of territory outside of a core. Rather, the long process of state-building includes the rise and fall of chiefly societies like Paracas. The data from Cerro del Gentil provide a testable hypothesis to explain this cultural evolutionary pattern. We suggest that local cooperative groups, no matter their size, cannot compete with well-constructed regional ones that provide access to resources not available locally. We suggest that the initial state development in any area represents a scaled-up version of the Paracas strategy as the only viable way to compete in a culturally and politically heterogeneous landscape. Consistent with data elsewhere, we predict a series of geographically and temporally overlapping, but autonomous, networks in the complex stateless societies that precede the emergences of inequality and established states. The network pattern of the first archaic states is in effect an intensification of the earlier chiefly patterns of regional cooperation in the competitive environmental and social contexts in which they evolved.

ACKNOWLEDGMENTS. At Arizona State University, we thank Drs. Ariel Anbar, Gwyneth Gordon, and Everett Shock for laboratory access to and their expertise in the W. M. Keck Foundation Laboratory for Environmental Biogeochemistry; and laboratory technicians in the Archaeological Chemistry Laboratory. We obtained all necessary permits. We thank the Peruvian Ministry of Culture for permits and supervision of our fieldwork. We thank the people of Viña Vieja, El Carmen, and Chincha Alta. We thank the compañía agroexportadora Virgen del Rosario for their gracious assistance. This project was funded by National Science Foundation Grants BCS-1523209 and BCS-1523293; the University of South Florida, and the Institute for Field Research.

1. Flannery K, Marcus J (2012) *The Creation of Inequality: How Our Prehistoric Ancestors Set the Stage for Monarchy, Slavery, and Empire* (Harvard Univ Press, Cambridge, MA).
2. Stanish C (2017) *The Evolution of Human Co-operation* (Cambridge Univ Press, Cambridge, MA).
3. Hardin G (2009) The tragedy of the commons. *J Nat Resour Policy Res* 1:243–253.
4. Hayden B, Villeneuve S (2011) A century of feasting studies. *Annu Rev Anthropol* 40:433–449.
5. Dietler M (2010) *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power*, eds Dietler M, Hayden B (Univ of Alabama Press, Tuscaloosa), pp 65–114.
6. Tantaleán H, Stanish C, Rodríguez A, Pérez K (2016) The final days of Paracas in Cerro del Gentil, Chincha Valley, Peru. *PLoS One* 11:e0153465.
7. Stanish C, Tantaleán H, Nigra B, Griffin L (2014) A 2,300-year-old architectural and astronomical complex in the Chincha Valley, Peru. *Proc Natl Acad Sci USA* 111:7218–7223.
8. Tantaleán H, Stanish C, eds (2017) *Cerro del Gentil. Un sitio Paracas en el Valle de Chincha, Costa Sur del Peru* (Publicaciones del Programa Arqueológico Chincha-PACH/PACH Press, Lima).
9. Renfrew C, Cherry JF, eds (1986) *Peer Polity Interaction and Socio-Political Change* (Cambridge Univ Press, Cambridge, UK).
10. Sassaman KE (2005) Poverty point as structure, event, process. *J Archaeol Method Theor* 12:335–364.
11. Knight VJ, Jr, Steponaitis VP (2007) *Archaeology of the Moundville Chiefdom*, eds Knight VJ, Jr, Steponaitis VP (University of Alabama Press, Tuscaloosa), pp 1–25.
12. Mercer R, Healy F (2008) *Hambledon Hill, Dorset, England: Excavation and Survey of a Neolithic Monument Complex and Its Surrounding Landscape* (English Heritage, London).
13. Renfrew C (1983) The social archaeology of megalithic monuments. *Sci Am* 249:152–163.
14. Viner S, Evans J, Albarella U, Pearson MP (2010) Cattle mobility in prehistoric Britain: Strontium isotope analysis of cattle teeth from Durrington walls (Wiltshire, Britain). *J Archaeol Sci* 37:2812–2820.
15. Silverman H (1994) The archaeological identification of an ancient Peruvian pilgrimage center. *World Archaeol* 26:1–18.
16. Silverman H (1990) *The Lines of Nazca*, ed Aveni A (American Philosophical Society, Philadelphia), pp 209–244.
17. Kantner J, Vaughn KJ (2012) Pilgrimage as costly signal: Religiously motivated cooperation in Chaco and Nasca. *J Anthropol Archaeol* 31:66–82.
18. Swenson ER (2006) *Andean Archaeology III*, eds Isbell W, Silverman H (Springer Science+Business Media, New York), pp 112–142.
19. Spielmann KA (2002) Feasting, craft specialization, and the ritual mode of production in small-scale societies. *Am Anthropol* 104:195–207.
20. Nigra B (2017) Huaca Soto and the evolution of Paracas communities in the Chincha Valley, Peru. PhD dissertation (Univ of California, Los Angeles).
21. Isla E (1992) La culture Paracas dans le site archéologique "El Mono - Édifice C1", Chincha - Pérou [The Paracas culture at the archaeological site "El Mono - building C1", Chincha - Peru]. PhD dissertation (Université de Paris 1 Panthéon-Sorbonne, Paris).
22. English NB, Betancourt JL, Dean JS, Quade J (2001) Strontium isotopes reveal distant sources of architectural timber in Chaco Canyon, New Mexico. *Proc Natl Acad Sci* 98:11891–11896.
23. Faure G (1986) *Principles of Isotope Geology* (John Wiley, New York).
24. Faure G (1991) *Principles and Applications of Inorganic Geochemistry* (Macmillan, New York).
25. Graustein WC (1989) *Stable Isotopes in Ecological Research*, eds Rundel RW, Ehleringer JR, Nagy KA (Springer, New York), pp 491–512.
26. Turekian KK, Kulp JL (1956) The geochemistry of strontium. *Geochim Cosmochim Acta* 10:245–296.
27. Bentley RA (2006) Strontium isotopes from the earth to the archaeological skeleton: A review. *J Archaeol Method Theor* 13:135–187.
28. Ericson JE (1985) Strontium isotope characterization in the study of prehistoric human ecology. *J Hum Evol* 14:503–514.
29. Minniti C, Valenzuela-Lamas S, Evans J, Albarella U (2014) Widening the market. Strontium isotope analysis on cattle teeth from Owslebury (Hampshire, UK) highlights changes in livestock supply between the Iron Age and the Roman period. *J Archaeol Sci* 42:305–314.
30. Frei KM, Skals I, Gleba M, Lyngstrøm H (2009) The Huldremose Iron Age textiles, Denmark: An attempt to define their provenance applying the strontium isotope system. *J Archaeol Sci* 36:1965–1971.
31. Benson LV (2010) Who provided maize to Chaco Canyon after the mid-12th-century drought?. *J Archaeol Sci* 37:621–629.
32. Reynolds AC, et al. (2005) 87Sr/86Sr sourcing of Ponderosa pine used in Anasazi great house construction at Chaco Canyon, New Mexico. *J Archaeol Sci* 32:1061–1075.
33. Knudson KJ, Webb E, White C, Longstaffe FJ (2014) Baseline data for Andean paleomobility research: A radiogenic strontium isotope study of modern Peruvian agricultural soils. *Archaeol Anthropol Sci* 6:205–219.
34. Budd P, et al. (2000) Differential diagenesis of strontium in archaeological human dental tissues. *Appl Geochem* 15:687–694.
35. Montgomery J, Budd P, Cox A, Krause P, Thomas RG (1999) LA-ICP-MS evidence for the distribution of lead and strontium in Romano-British, medieval and modern human teeth: Implications for life history and exposure reconstruction. *BAR Int Ser* 792:290–296.
36. Waldron HA (1981) Postmortem absorption of lead by the skeleton. *Am J Phys Anthropol* 55:395–398.
37. Waldron HA (1983) On the post-mortem accumulation of lead by skeletal tissues. *J Archaeol Sci* 10:35–40.
38. Waldron HA, Khera A, Walker G, Wibberley G, Green CJS (1979) Lead concentrations in bones and soil. *J Archaeol Sci* 6:295–298.
39. Romaniello SJ, et al. (2015) Fully automated chromatographic purification of Sr and Ca for isotopic analysis. *J Analytic At Spectrom* 30:1906–1912.
40. Stein M, et al. (1997) Sr-isotopic, chemical and sedimentological evidence for the evolution of Lake Lisan and the Dead Sea. *Geochim Cosmochim Acta* 61:3975–3992.
41. Knudson KJ, Williams SR, Osborn R, Forgery K, Williams PR (2009) The geographic origins of Nasca trophy heads using strontium, oxygen, and carbon isotope data. *J Anthropol Archaeol* 28:244–257.
42. Knudson KJ, Tung TA (2011) Investigating regional mobility in the southern hinterland of the Wari Empire: Biogeochemistry at the site of Beringa, Peru. *Am J Phys Anthropol* 145:299–310.
43. Knudson KJ, Stanish C, Lozada MC, Faull KF, Tantaleán H (2016) Intra-individual variability and strontium isotope measurements: A methodological study using 87 Sr/86 Sr data from Pampa de los Gentiles, Chincha Valley, Peru. *J Archaeol Sci* 5:590–597.
44. Weinberg C, et al. (2016) Demographic analysis of a looted late intermediate period tomb, Chincha Valley, Peru. *Andean Past* 12:8.
45. Knudson KJ (2008) Tiwanaku influence in the south central Andes: Strontium isotope analysis and middle horizon migration. *Latin Am Antiq* 19:3–23.
46. Bongers J, Arkush E, Harrower M (2012) Landscapes of death: GIS-based analyses of chullpas in the western Lake Titicaca basin. *J Archaeol Sci* 39:1687–1693.
47. Smith ML (2005) Networks, territories, and the cartography of ancient states. *Ann Assoc Am Geogr* 95:832–849.
48. Stein G (1999) *Rethinking World-Systems: Diasporas, Colonies, and Interaction in Uruk Mesopotamia* (Univ of Arizona Press, Tucson).
49. Algaze G (1993) *The Uruk World System* (Univ of Chicago Press, Chicago).
50. Marcus J, Flannery KV (2004) The coevolution of ritual and society: New 14C dates from ancient Mexico. *Proc Natl Acad Sci USA* 101:18257–18261.