Subsistence Economies and the Origins of Andean Complex Societies

JEFFREY QUILTER
Ripon College

TERRY STOCKER
University of Illinois, Urbana

Recent arguments stating that marine resources were relatively unimportant in cultural developments on the coast of Peru during the Preceramic Period are incorrect on several counts. It is shown that the economics and technology of maritime subsistence of coastal Peru are more complex than previously thought, that the nutritional values of terrestrial versus maritime foods are debatable, that the dynamics of El Niño *events are complex, and that maritime resources must still be seen as important for Preceramic Period economies.* [Central Andes, coastal adaptations, ecological anthropology, origins of complex societies]

> They therefore referred to the sea as Mamacocha, "mother sea," since it performed the part of a mother in feeding them. They also commonly worshipped the whale on account of its monstrous size, and some provinces worshipped some particular fish and others another, according to the value they attached to them and the quantity they caught. [Garcilaso de la Vega 1966:350]

WESTERN SOUTH AMERICA IS ONE OF THE FEW PLACES where complex societies appear to have developed relatively independent of outside influences. The origins of ranked and stratified societies in coastal Peru, a major locus of cultural development in the Andes, is therefore a subject of great interest. Special study has been recently devoted to coastal Peru because of the assertion (Lanning 1966; Patterson 1971a,b; Fung 1972; Moseley 1975; Feldman 1980; Rostworowski 1981) that maritime resources were of fundamental importance in laying the foundations of Peruvian civilization during the Preceramic Period. Others have argued against the importance of marine resources, stating that seafood could not have supported substantial Preceramic Period coastal populations (Parsons 1970; Osborn 1977) or that the large architectural complexes of the late Preceramic Period must have been based on terrestrial resources (Raymond 1981), and perhaps agriculture (Wilson 1981).

The critics of the "maritime hypothesis" have raised important points worthy of consideration in evaluating the role of seafood in prehistoric diets. Nevertheless, a careful review of the available ethnographical, archeological, and environmental data shows

JEFFREY QUILTER is Assistant Professor, Department of Anthropology-Sociology, Ripon College, Ripon, WI 54971. TERRY STOCKER is Assistant Professor, Department of Anthropology, University of Illinois, Urbana, IL 61801.

0002-7294/83/030545-18$2.30/1

that the basic argument presented by Moseley and others is the most acceptable reconstruction of subsistence economies in coastal Peru. It can also be shown that certain aspects of the maritime versus terrestrial resources debate rest on misconceptions of what the argument is about and on a poor understanding of preceramic subsistence economies. Preliminary data from the Paloma site on the central coast of Peru and field experiences by Stocker among Peruvian fishermen of the central coast further highlight the importance of marine foods for Peruvian coastal dwellers.[1]

BACKGROUND

By about 6000 B.C., populations on the central coast of Peru were exploiting three major resource zones: river valleys, the Pacific Ocean, and the *lomas,* or fog oases, which thrive during the winter months. These zones and the higher elevations of the river valleys may have been exploited in patterns of seasonal rounds by early populations (Patterson 1971b:188; MacNeish et al. 1975: Figure 5). But in some areas shifting settlement was replaced by camps and villages occupied for considerable periods of the year and within easy access to major coastal resources (Patterson 1971b:190-191). The most common or, at least, best known location for such villages was in the *lomas* zone (Lanning 1963; Patterson 1971a, b; Engel 1973, 1980; Benfer 1976, in press). Between 3000 and 2500 B.C. (based on uncorrected radiocarbon dates, Patterson and Moseley 1968:123), the *lomas* villages were abandoned in favor of small, dispersed settlements on the Pacific shore and in the river valleys.

During the period of dispersal to small littoral and valley sites, large masonry and adobe structures were constructed (circa 2500-1800 B.C.). It is commonly accepted that these large architectural complexes, such as El Paraiso (or Chuquitanta) in the Chillon Valley, and Aspero, near the mouth of the Rio Supe, were centers of regional social and economic systems. All of the large sites show evidence of sustained, concentrated human effort, and the architecture of many of them suggests planned, supervised construction, probably involving a small elite group and many laborers (Lanning 1967:78-79). Thus, a new phase in cultural complexity occurred in coastal Peru before the introduction of pottery.

THE TWO HYPOTHESES

The basic argument of the proponents of the maritime hypothesis is that marine resources provided abundant, localized, and perennially available foods that supported the development of the complex societies of the late Preceramic Period, providing the foundations for later cultural developments (Lanning 1966; Moseley 1975, 1978; Feldman 1980; Quilter 1981).

The terrestrial hypothesis argues that maritime resources were unreliable, not sufficiently abundant, and insufficiently nutritious to support coastal populations (Parsons 1970; Osborn 1977; Wilson 1981; Raymond 1981), and a variation of the argument states that preceramic peoples in Peru did not have the technological capacity to exploit many of the marine foods available to modern inhabitants (Wilson 1981:104). In this view, land-based resources must have played the key role in the development of complex societies on the central coast of Peru.

SUBSISTENCE SHIFTS, FISHING TECHNOLOGY, AND THE ARCHEOLOGICAL RECORD

Most of the earliest known sites in Peru are in the highlands and suggest hunting as a primary subsistence strategy (MacNeish et al. 1975, 1981; Matos M. 1975; Lynch 1980;

Rick 1980). Cohen (1975, 1977:256) and Osborn (1977:171) have suggested that the dates for very early occupations in the highlands and the apparent later occupation of the coast indicate that the sea was utilized for food only after high population densities were reached in the sierra. Richardson (1981a:140-145), however, has convincingly argued that much of the pre-5000 B.P. coastline of western South America is now submerged due to rising sea levels, despite postglacial uplift (cf. Bryan 1973; Sarma 1974; see Moseley and Feldman 1982). Although many early coastal sites are thus inaccessible for study, sites in four areas that escaped inundation are known (Richardson 1981a: 145-148): the Vegas complex in Ecuador, circa 10,000-7000 B.P., (Stothert 1977a,b), the Amotape/Siches complex in northwest Peru, circa 11,200-6000 B.P., (Richardson 1973, 1978), the Quebrada de Cupisnique in the Chicama Valley, circa 9800-7000 B.P., (Chaucat 1978a,b), and the Quebrada las Conchas in Chile, circa 9400-9600 B.P., (Llagostera M. 1979).

Thus the view that the coast was occupied after the highlands and that seafood was included in diets at a relatively late date may be based on skewed data.

Another problem in understanding prehistoric subsistence is the present decreased diversity and abundance of native species as compared to the prehistoric period. Both land and sea are probably poorer in resources today than they were in the past. Living informants (Engel 1980:103), and archeobotanical studies (Weir, personal communication to Quilter) indicate that many *lomas* supported more diverse plants than at present. Indeed, *lomas* degradation may have occurred several times in the past, for even a hundred years ago they were much richer than today (Ramos de Cox 1972:11).

The coastal valleys were also richer in vegetation in the past. Cieza de Leon (1959:338) notes that the Mala River Valley had "a very good river flanked by thick woods and groves." Rostworowski (1981:14-15) has argued that coastal valley woodlands as well as *lomas* were overexploited in the colonial period. Recent farming practices have lowered river flow and destroyed much native vegetation in the central coast valleys.

While environmental changes have occurred in coastal Peru, seafood has always been important to inhabitants of the region and many *lomas* sites show an increased reliance on seafood during their occupations. Recently, the importance of seafood has been demonstrated by excavations at the Paloma site (Benfer 1976; Benfer et al. 1981; Engel 1980; Quilter 1981). Paloma is on the northern edge of the Chilca Valley at the edge of a *lomas* field. It is 4.5 km from the Pacific shore by way of a dry canyon next to the site, and about 8 km from the Chilca River. The site covers over 5 ha and is composed of concentrations of dense shell midden. Radiocarbon dates (uncorrected) indicate occupation between about 5200 and 2800 B.C. (Engel 1980:106; Benfer in press). The late occupation of Paloma appears to have been contemporary with the occupation of the nearby Chilca I site (Donnan 1964; Engel 1970).

One of the most striking aspects of the Paloma site is the dense shell midden, over a meter thick in some areas. The majority of the shells at the site are mussels, consisting primarily of *Aulacomia ater,* with slightly fewer specimens of *Choromytilus ater* (Tomka 1980:58). These molluscs were surely collected on the rocky shore at the mouth of the dry canyon that passes the site.

Not only do the large numbers of mussel shells show that the Palomans gathered shellfish, but physical evidence in the Paloma skeletons indicates that the occupants of the site spent considerable time and energy in getting seafood. Benfer (et al. 1981) has interpreted the high incidence of auditory osteomas (bone growth in the inner ear), found only in male skeletons at Paloma, as evidence of diving in cold water for marine resources. This phenomenon has also been noted by Lester (1966) in his examination of male skeletons found at Huaca Prieta on the north coast. Brock (1981) noted a higher incidence of reaction areas in the femoral nocks in male skeletons than in female skeletons

at the site. Furbee (personal communication to Quilter) suggests that these reaction areas were caused by swimming.

Some of the most conclusive proof of the importance of seafood at Paloma is the remains of molluscs, fish, and sea mammals in coprolites and intestinal areas of Paloma skeletons (Weir, personal communication to Quilter). The high strontium levels detected in human bone at Paloma (Benfer et al. 1981) also suggest a high proportion of seafood in the Paloman diets.

There is abundant evidence to indicate that preceramic Peruvians had the ability and technology to take advantage of the rich seafood of the central coast (see Wilson 1981:107; Raymond 1981:806). Fishhooks, nets, net weights, and floats have been found at many preceramic sites (Muelle and Ravines 1972: Laminas 2-4; Moseley 1978:8-10, Figures 8-10; Quilter 1981:73-88; Buse et al., n.d.). Moseley (1978:8-10) has noted that float netting of small schooling fish received progressively more emphasis through time during the Preceramic Period even though wider mesh nets were added to the tool kit for the capture of large fish late in the period.

It is also important to note that an elaborate technology is not necessary for the capture of much of the available seafood. Many shellfish and crustaceans can be gathered by hand while other molluscs need only a digging tool for recovery. Stocker collected deep water mussels with local divers on the central coast. The shellfish were simply raked into nets. Between 30 and 60 kg of mussels were collected within 20 to 40 minutes using this method. More rapid collection rates were probably achieved if near-shore beds were available for exploitation. Seals can be clubbed when they mate on beaches in January (Nishiwaki 1972:144-145), and beached whales (Jackson and Stocker 1982:17-19) would have provided bountiful, if irregular, food. The presence of whale vertebrae at Paloma and the use of whale ribs for house construction at the Chilca I site (Donnan 1964) indicate that whales were exploited when available.

Wilson (1981:97) assumes that the ancient Peruvians were confined to a 1-km-distance limit for fishing from the shoreline by supposing that the only watercraft available during the Preceramic Period were small totora reed boats (*caballitos*). As Richardson (1981b) has pointed out, Wilson takes his evidence of *caballito* use from their depiction on Moche (circa A.D. 1-700) ceramics, but ignores the illustration of large rafts. In fact, we have no definite evidence of the kinds of watercraft used by preceramic Peruvians. Any seacraft used, and most equipment, would have been left on beaches rather than hauled to *lomas* sites.

Although only a few species of pelagic fish have been identified to date at Paloma (Kelty 1980), the presence of Spanish mackerel (*Scomberomorus maculatas*) and Pacific bonita (*Sarda chilensis*) shows that deep-water fish were taken. As will be shown below, however, the fact that many deep-sea species occasionally come close to shore makes the problem of preceramic seafaring capabilities less important than it might be otherwise.

The procurement and consumption of small fish, especially the anchovy, greatly increased the role of the sea in sustaining human populations in preceramic Peru. Small fish appear to have been an important item in the Paloma diet and they also have been noted in the economy of Aspero (Feldman 1978:21, 1980:168). Lenses of oily orange-colored fish meal containing bones of *Engraulis* and *Celupeidae* (Reitz 1977) were found throughout Paloma. On the western edge of the occupation area very dense layers of the fish meal were found, up to several centimeters thick (Engel 1980:106).

Anchovies could have been obtained by the Palomans and other coastal dwellers by fishing or by merely scooping them off the beach when they occasionally run onto shore. The phenomenon of anchovy beaching is historically documented by Cobo (1946:229; see also Ravines 1978:56) and has been witnessed by Stocker. On the night of June 22, 1979, anchovies began to "leap" onto the beach at Curayacu, close to Paloma. This

phenomenon continued for two days and nights, reaching a peak during the first night, until the beach was covered with hundreds of thousands of the small fish. The inhabitants of Curayacu gathered some of the anchovies, but many people used them as bait for catching *jurel (Trachurus murphi)*, a mackerel-like fish, which were pursuing the anchovies and also swarming toward the shore. Every three to five casts of hook and line caught one of these large fish. Within an hour during the first night, most people were returning home with two buckets filled with fish. The inhabitants of Curayacu stated that this anchovy beaching occurred about four times a year.

Calculations of the carrying capacity of the central coast that have not taken anchovies and other such resources under consideration must be seriously questioned. In regard to his calculations, Raymond (1981:813) readily admits, "If small fish, such as anchovies, were consumed in quantity, the size of . . . error could be significant." Similarly, Wilson's (1981:103-107) calculations of carrying capacity would no longer show terrestrial resources as superior to maritime resources if anchovies were considered.

One of the most detailed accounts available on preceramic subsistence is from Alto Salaverry, in the Moche Valley (Pozorski and Pozorski 1979). The site dates circa 2500 to 1800 B.C. (ibid:33). Alto Salaverry was thus occupied in the time period after *lomas* abandonment on the central coast, during the development of large architectural complexes such as El Paraiso-Chuquitanta and Aspero.

While the occupants of Alto Salaverry relied more on cultivated plants than wild plant species, their sole source of animal protein was the sea. A wide variety of fish remains were found at the site, representing species that included shark (*Mustelus* sp.), croaker (*Sciena deliciosa* and *Paralonchurus peruanus*), and bonito (*Sarda chilensis*). Fish, crustaceans, and shellfish, especially mussels (*Choromytilus chorus*), have been calculated to have contributed 84.7% of the meat consumed by the population, based on the remains found at the site (ibid.: Tables 1, 3).

There is thus ample evidence to show that preceramic peoples in Peru had the technological abilities to exploit maritime resources and that they actively pursued subsistence strategies in which seafood played an important role.

THE IMPORTANCE OF SEAFOOD

Much of the debate over maritime versus terrestrial resources is concerned with the varieties of the marine foods consumed by Preceramic Period peoples and the nutritional benefits of seafood as compared with terrestrial resources in general.

Osborn (1977:171-177) argues that molluscs were a poor source of protein and that, per unit weight, deer meat has much more protein than shellfish. He contends that shellfish were only a secondary, back-up resource and that the peoples of preceramic coastal Peru must have depended more on hunting than on shellfish collecting. Both Wilson (1981:104-108) and Raymond (1981:807-813) support the notion that molluscs are a poor source of food, but there is no consensus of opinion as to the exact food value of various Peruvian shellfish in relation to red meat. As Raymond (1981:808) has noted, the nutritional value of Peruvian molluscs can only be approximated using caloric values for other shellfish. Thus, for example, Osborn (1977:175) cites .35 and .13 for the protein/edible meat ratio of whitetail deer meat and clams respectively. Hurlburt and Hurlburt (1974), however, state that for 84 g of raw meat, a blue mussel *(Mytilus edulis)* contains 14.4 g of protein while a choice T-bone steak contains 14.7 g of protein, making shellfish quite competitive with meat in protein (see Lishka 1982a:16-19). Experiments conducted using equal portions of steamed mussels *(Mytilus edulis)* and steamed beef have shown that the seafood was more completely metabolized by the digestive system than the beef in a 24-hour period (Van Slyke 1909:104). If seafood in general is more

completely metabolized than red meat, it would increase the nutritional value of maritime resources relative to other animal foods.

It also has been argued (Osborn 1977:172) that the low meat-to-shell ratio of molluscs makes them a poor source of food given the effort needed to obtain and process them. But Tomka's (1980:Table 5) study of modern Peruvian shellfish has presented mean weights for mussels (*Aulacomia ater*) ranging from 4.726 g to 15.2 g, depending on shell length. Even at the lower figure, this is considerably more meat per mollusc than the 1.065 g of meat from the riverine samples used by Osborn (1977:172) in his calculations.

Problems of food-to-residue ratios exist in studying midden contents in general as well as for specific food resources such as mussels. It has been pointed out that the relative size and perservability of various food remains may present a false impression of subsistence economies in shell middens. Cohen (1974), for example, has suggested that plant remains may be underrepresented at Peruvian coastal sites because of relatively poor preservation. Osborn (1977:173-174) has also argued that the size of shell mounds in Peru may misrepresent the importance of shellfish, because of the large amounts of residue created by mollusc consumption.

While preservability and residue volume are important considerations in evaluating subsistence, they cannot be viewed alone but must be seen in relation to procurement, transportation, processing, and storage practices of any given population (Hassan 1978: 73-74; Nietschmann 1973:175). Furthermore, these factors must be evaluated in terms of their relation to differentiation in sexual and social divisions of labor and oscillations in both the gross environment and specific resources (Binford and Chasko 1976:134-136) to properly evaluate the role of subsistence changes in other aspects of culture change.

Investigations at the Paloma site have indicated that the shell middens may underrepresent the amount of seafood eaten by the Palomans. As the site is a long uphill walk from the shore, it is curious that the site inhabitants took the trouble to haul both shell and meat to the site when processing on the shore could have considerably lightened their burden. Numerous grass-lined pits at Paloma may be evidence of short-term shortage. Judging from the size of the pits, a maximum of from five to six dozen mussels could have been stored at any one time in each pit. Of course, the primary storage area for shellfish was the beaches and rocks where they thrive. Any storage pits at Paloma were there for convenience, to be used by less-mobile villagers or groups engaged in other subsistence pursuits. Stocker and Tomka conducted a series of experiments at Paloma in 1979. Two or three dozen mussels were roasted each day and it was found that cooking allowed the shellfish to be preserved for several days. Thus, consumption at or near the collection site, processing at the beach for later use, and short-term storage at Paloma may be factors that have produced an underrepresentation of seafood in the shell middens.

Other seafoods, such as sea lions, may also appear with less frequency in middens due to processing and consumption elsewhere. At the preceramic site of Avic, in the Sechura Desert, a midden was encountered by Cardenes M. (1978:12) that yielded a great amount of burned and partially burnt sea lion bones. Whether the meat was consumed on the spot or taken elsewhere, this example shows the complexities involved in evaluating the quantities of resources in subsistence economies.

The ethnographic literature also supports the contention that coastal habitation sites may not represent the percentages of different foods in ancient diets. The Muringin only eat at their base camp in the evening, consuming other foods away from their camp (Thompson 1949:32). Coastal tribesmen of the Transkei, some of whom travel up to 9.6 km to obtain shellfish, are known to eat some mollusc species only at the beach (Bigalke 1973:146). Transhumant peoples in southern Peru transport some shellfish to their local residences, but a great number are dried and placed in large bags that can hold 45 to 50 kg (Masuda 1981:180). Masuda reports that a full bag of shellfish could be collected by

one person on a summer day. The shelled molluscs consumed from these bags would leave no traces at a home base. If mollusc processing occurred on or close to the beaches where they were collected, these special activity sites would not be preserved in the archeological record.

Data from the late prehistoric and early historic periods show that seafood remained important up to and beyond the Spanish conquest. S. Pozorski's (1982) study of Chimu subsistence systems demonstrates that fish, molluscs, and crustaceans were valuable sources of protein even in a society that had a tremendous range of resources available and the means to distribute them among its population. The farming village of Cerro la Virgen, for example, which relied on domesticated llama as its primary source of meat, still depended on fish to contribute almost a third of the total animal protein consumed by the villagers (ibid.:188).

The Incas, who went to great extremes to maximize the amount of available cultivable land through the construction of terraces and irrigation systems, appear to have depended on fish to bolster their protein intake. Juan de Batanzos, writing circa 1551, states that Inca Yupanqui ordered that his 50,000 artisans and their families in Cuzco be supplied with maize, *charqui* (dried meat), and dried fish every four days (cited in Antúnez de Mayolo R. 1981:34-35). Rostworowski's (1981:84-85, 95-100) discussion of ethnohistoric evidence for separate legal rights of fishing communities supports the argument that maritime economies were important in ancient Peru. Even without midden analysis and historical records, the numerous depictions of sea life on textiles and ceramics of ancient Peruvian coastal dwellers indicates a concern with and reliance on the sea (Mead 1909; Seler 1923; Buse et al., n.d.).

In general, the maritime subsistence economies of preceramic Peru appear to have had the potential to be very efficient with regard to nutritive and logistical considerations. Tool kits are simple for shellfish collecting and for most fishing activities (Evans 1967:480), which only require considerable labor when large nets become important. Immobile coastal shellfish beds require little search time. Preparation and transportation costs may vary depending on the desirability of storage. So, too, the organization requirements for fishing vary, but many species can be obtained without need of organized hunting parties.

AGRICULTURE, *EL NIÑO,* AND STRATEGIES FOR DISASTER

It has been argued that agriculture (Raymond 1981:813-815), especially maize agriculture (Wilson 1981:101-103), offered greater security from environmental perturbations on the coast of Peru than maritime subsistence economies because terrestrial resources did not suffer as greatly as marine life during severe changes in the flow of the Peru Coastal Current. The inability to store seafood for a long time, due to lack of preservation technology, and the nature of seafood have also been cited (Wilson 1981:112) as making terrestrial resources better insurance against long-term famine and environmental changes.

Maize agriculture has been cited as a means of solving the problem of food storage for preceramic peoples in coastal Peru (see Wilson 1981:101, 106-112), but debate is open as to what was the earliest use of maize in the region. Much of the maize found at Preceramic Period sites may be intrusive from later occupations or the debris from Ceramic Period visits to these locations (Bird 1978, 1981), as was the case for maize found at Paloma (Weir, personal communication to Quilter). Even if maize was cultivated by preceramic peoples, there is no clear evidence that it formed an important part of their diets.

In general, no greater insurance against severe environmental changes is provided by

reliance on domesticated plants; monocrops that require elaborate support systems such as irrigation canals are especially apt to be severely affected by catastrophic rains, which occasionally occur on the coast of Peru. The rainfall and associated events, called *El Niño,* usually start in late December (Wyrtki et al. 1976; Cromie 1980). The immediate cause of the rain is a disruption of the offshore currents. Sometimes, the intrusion of a warm wedge of tropical waters over the cold Peru current only affects sea life. Many cold-water species die or are forced to migrate to unaffected regions while the land is untouched. Under more severe conditions, *El Niño* also devastates the coastal land mass with torrential rains. In 1925, during one of the worst *El Niño* events recorded, walls of water swept down desert valleys that had been dry for centuries, the Viru and Moche Rivers rose to their highest known levels, and throughout the coast, canals, rail lines, and roads were washed away. Large tracts of agricultural land were inundated or eroded by swollen rivers, and entire villages of adobe houses were flattened (Murphy 1926; Nials et al. 1979). Thus, irrigation agriculture is not a subsistence system immune to a major *El Niño* event. Some rain-soaked areas, however, may subsequently bloom with native plants or be available for short-term cultivation. How simple floodwater farming is affected by *El Niño*s torrential rains is unclear. Flash floods would probably destroy small fields, although replanting would likely be feasible (see Lishka 1982a:53).

There is much ethnographic evidence to argue that preceramic coastal dwellers could have prepared for and survived drastic changes in their environment. In order to cope with *El Niño,* coastal populations would have had to have had some warning of the impending change and the social and technological skills to adapt to new conditions or to maintain their way of life through reliance on stored foods (see Yesner 1980). Some of the measures commonly taken by groups expecting decreased availability of food resources include the storage and transmission of information on famine foods, the diversification of subsistence activities, the cultivation of social relationships with groups in other regions who might supply them with food or temporarily allow immigration, and changes in social organization that allow famine foods to be obtained (Wing and Brown 1979: 161-174; Colson 1979; Greenough 1977).

The cyclical nature of *El Niño* and early-warning signs associated with it were likely to have been known to coastal dwellers in early Peru. Cromie (1980:38) cites the sensitivity of inhabitants of the equatorial Pacific to subtle climatic shifts associated with events related to *El Niño.* While specific preparation times and techniques for surviving an *El Niño* cannot presently be established for Preceramic Period populations in Peru, it seems certain that ancient fishermen could have been forewarned and forearmed for the upcoming event.[2]

Furthermore, *El Niño* may sometimes bring a bounty to coastal inhabitants when other species are forced closer to shore, providing easily caught food for local populations (Lishka 1982a:28-29). Sabella (1974:202) reports that "during March 1972, a month that brought disastrous rains to the entire North Coast, large schools of corvina, chirella, and pampano crowded into the rocky shoals, a few hundred yards off our beaches. For twenty days these fish provided a bonanza." Thus, different species are available during an *El Niño* rather than no seafood at all.

In addition to new foods in their diets, coastal dwellers could have relied on stored food during periods of disruption of their normal way of life. Simple drying during the hot coastal summers could have preserved food for long periods of time, a practice followed by the Atacameño of the north coast of Chile (Bennett 1946:599-618).

The preparation of fish meal or paste is known to have been practiced by the Palomans and has been documented for many South American peoples, such as the inhabitants of the Orinoco River region (Kirchoff 1948:482), the Querandi of Argentina (Lothrop 1946:182), and many groups throughout the eastern tropical lowlands (Roosevelt

1980:106-108). The preservation period for fish meal on the Peruvian coast should be considerably longer than in the humid tropics. Even though the winter fogs create humid air conditions on the coast, the subsoil remains relatively dry throughout the winter season. Preservation could have been improved in the *lomas* with subsoil storage (see Bonavia and Grobman 1979).

Although it is uncertain how long edible fish meal could have been preserved on the central coast, fish oil certainly could have been kept for long periods of time. Kelty (1980) has experimented with fish meal and oil production at Paloma. By drying the fish on the ground or in a suspension bag for few days he could easily have collected oil as the fish dried. Modern Peruvians use such oil as a soup base, and the Chono of southern Argentina drank seal oil as a protein-rich beverage (Cooper 1946:50). Oil can be purified by recooking and thus stored for longer periods of time than other foods. The Makah of Cape Flattery use stored oil as a famine food, as well as supplies of dried fish eggs, fish, meat, and berries (Colson 1979:21-22).

Fish meal, sea lions, and whales at Paloma indicate at least three sources of oil for the inhabitants of the site. However, storage containers are not common at Paloma. Gourds are the only containers frequently found at the site, and the numerous repairs made on many of them suggest that they were a valued and perhaps rare commodity. Oil could have been stored in hide, perhaps sealskin, bags. The absence of all but traces of skin on the Paloma skeletons indicates less than perfect preservation in the *lomas* zone, and hide containers, if they existed, would not have been preserved. Of course, an alternative explanation for the lack of containers at Paloma is that resources were sufficient enough that oil was not a crucial part of the diet.

The ability to preserve and transport seafood over long distances and for considerable periods of time in ancient Peru is supported by many examples. Engel (1970:56) found mussel shells at Tres Ventanas, high in the Chilca drainage, indicating that preceramic peoples could and did transport molluscs over long distances. Burger (1979:149) found the remains of shellfish, primarily *Choromytilus* and *Mesodesma* (personal communication to Quilter) in domestic contexts in Urubarriu phase deposits at Chavin de Huantar. Numerous ethnohistorical sources indicate that preserved seafood was regularly sent to the highlands in late prehistoric and early colonial times (Antúnez de Mayolo R. 1981: 34-35). Even algae, which would leave little residue, is known to have been collected in large amounts by transhumant populations of the south coast. It was dried and then transported to the highlands for food (Masuda 1981:182-187; Horkheimer 1973:105).

THE DEVELOPMENT OF COMPLEX SOCIETIES IN PERU

By the late Preceramic Period large architectural complexes had been constructed on the coast of Peru. Unfortunately, the dates of initial occupations and constructions, the social organizations, and subsistence economies of most of these sites are poorly known. Nevertheless, enough information is available to evaluate the sites and address the problems of their sociopolitical and economic roles.

The huge sizes of the sites, and evidence of rebuilding phases and intensive use, have made it difficult to establish dates for their first construction phases. Aspero consists of at least six platform mounds with a site area of about 12 ha (see Feldman 1980:Figure 7). El Paraiso is not one building as Wilson (1981:112) wrongly asserts; it has between seven and nine stone structures comprising about 100,000 m^3 of mass and covers 58 ha (Moseley 1981). Fifteen thousand tons of rock and fill alone were used in Engel's (1966:49, n. 2) reconstruction of Unit I at the site. Unit I exhibited between four and six rebuilding stages (ibid.:49); this suggests considerable antiquity for its initial construction. A radiocarbon date of 1620 B.C. ± 150 (uncorrected) was obtained from refuse apparently left

after site abandonment (ibid.:46), thus suggesting a considerably earlier date for initial occupation.

Considerable organization, planning, and labor was required to construct El Paraiso, Aspero, and other late Preceramic Period architectural complexes. Their size suggests that they were regional economic, social, and perhaps political centers, but there is little evidence as to the exact nature of their methods of human organization. Although none of the proponents of the maritime hypothesis have said that these sites represent state systems (see Wilson 1981:108-112), they do appear to represent nonegalitarian societies. Carneiro (1981:53) has suggested that the complexes may have been chiefdoms, with two-tiered settlement systems.

Much of recent literature on preceramic Peru has been centered on the relative importance of marine versus terrestrial resources in the subsistence economy of the large coastal preceramic sites. While this paper attempts to show the great value of seafood during the Preceramic Period, it is clear that the problem is more complex than simply framing the discussion as one of sharp binary contrast between sea and land. The rich protein provided by the sea probably was always paired with wild or domesticated plant foods. Thus terrestrial and maritime resources complemented each other. The shift from hunting and gathering to plant domestication was a land-based process that did not directly involve marine foods.

Lomas and river valley wild plants were in short supply compared to the abundant seafood. Plants would thus have been the critical resource affected by population growth (Cohen 1975, 1977), human overexploitation (Vehik 1977), or environmental change (Pickersgill and Smith 1981:96-97). While fluctuations in water temperatures qualitatively affect the marine environment by providing different species, they quantitatively affect the size of *lomas* fields and the number of animals and people the fog fields can support (ibid.:97).

The late preceramic architectural complexes were supported by mixed economies that included seafood, domesticated plants, and imported foods. It is also probable that different sites relied on different proportions of these foods in their economies. Las Haldas (Fung 1969), for example, was founded in the Preceramic Period but was mostly built during the Formative Period (Matsuzawa 1978:667-668). The site overlooks the sea and the majority of food remains in its midden are marine resources (ibid.:669). El Paraiso is oriented toward the floodplain of the Chillon River but is also close to the shore. Engel (1966:62) recovered jiquima *(Pachyrizus tuberosus),* beans *(Phaseolus lunatus),* achira (*Canna* sp.), and lucuma *(Lucuma obovata)* at El Paraiso, as well as fish and mollusc remains, although the proportions of these and other foods in the subsistence economy of the site are unclear. It was not simply the adoption of domesticated plants or the importance of seafood that led to complex societies in Peru but the roles of a variety of subsistence and other resources within the context of social interactions (see Patterson 1982).

In recent years it has become increasingly clear that coastal and highland cultural developments were interrelated in preceramic Peru (MacNeish, Patterson, and Broama 1975; Bonavia and Grobman 1979:40-41; Burger 1982; Moseley 1982). Potatoes *(Solanum tuberosum),* oca *(Oxalis tuberosa),* and ullucu *(Ullucus tuberosus)* have been discovered at Ancon on the coast (Martins 1976:127-130), where they do not grow well; thus they were probably imported from the highlands (Hawkes 1967; Leon 1964; cited in Pickersgill and Smith 1981:102), although (Lishka 1982b:13) has suggested that some root crops had the potential for cultivation in the *lomas.* Given evidence for shipment of marine products to the highlands in the late prehistoric period and after, it is likely that long-distance exchange in food and other resources was common in preceramic Peru. This system included near-shore sites, such as Las Haldas, providing seafood, and perhaps salt (Burger 1982), in return for plant foods from nearby coastal valleys and for highland products (Matsuzawa 1978:669).

But long-distance interactions consisted of more than just the exchange of raw materials and food. There is evidence of a common ideological system that was shared by populations, from the Pacific shore to the tropical forest, and that accompanied economic interactions (Lathrap 1973, 1982). Standardized patterns in religious architecture have been identified at sites on the eastern edge of the Andes (Izumi and Sono 1963), in the highlands (Burger and Burger 1980), the western slopes of the sierra (Grieder and Bueno M. 1981), and the coast (Engel 1966; Williams L. 1980). Grieder (1982) has suggested that one of these sites, La Galgada, in the arid western slopes of the Andes, may have prospered partly because it was a link in a chain of communication between coast, highlands, and the tropical forest.

The interrelation of different Andean environmental zones extended to symbolic objects associated with ritual prestige. It has been known for some time that *Spondylus* shells were brought from Ecuador to the Peruvian central coast in the Preceramic Period (Patterson 1973:3; Quilter 1981:66; see Paulsen 1974). Such contacts also existed between highlands and coast. Distinct, biconvex, red stone beads have been found at Aspero and Bandurria on the coast (Feldman 1980:157) and at Huaricoto in the Callejon de Huaylas (Burger, personal communication to Quilter). The depiction of similar beads on clay figurines found in a deposit atop a pyramid at Aspero (Feldman 1980:148, Figure 40) suggests that these ornaments had high status value. Thus, it appears that a fairly standardized ideological system, including religious ideas and prestige items, was widespread throughout the greater Andean area by at least the late Preceramic Period (see Lathrap 1973, 1982).

It was not simply the availability or use of any particular food resource that contributed to the development of Andean complex societies. Clearly, seafood and, eventually, maize were important in their roles in accommodating or encouraging growing populations, in requiring or demanding new forms of human group organization. But it was the interaction of a number of factors, including subsistence, exchange, and ideas, that resulted in new forms of social and political integration. The evidence and arguments presented here demonstrate that maritime resources were an important part of these larger processes.

NOTES

Acknowledgments. This paper is dedicated in fond memory of Junius B. Bird—scholar, mentor, and friend. An original draft of this paper was greatly improved by helpful comments from Thomas C. Patterson and anonymous reviewers. We thank Michael Moseley, Robert Feldman, Glendon Weir, Craig Morris, and Richard and Lucy Burger for their advice and comments. Robert A. Benfer was especially kind in his detailed review and commentary on this paper. We also wish to thank the many scholars who allowed us to cite unpublished papers and who provided us with numerous personal communications.

Many of our ideas on preceramic subsistence were formulated during the Paloma Project in 1976 and 1979. Frederic A. Engel, Carlos Lopez Ocaña, and the staff of the *Centro de Investigaciones de Zonas Aridas* who hosted the American contingent of the project are warmly thanked for their hospitality. The Paloma project was funded by National Science Foundation grants to Robert A. Benfer (NSF BNS-76-12316, NSF BNS-78-07727a/b, and NSF BNS-81053940). Additional study in Peru by Quilter was partially supported by a Ripon College Faculty Development Grant and by a grant from the Continental Coffee Products Company in 1982. Dr. Ramiro Matos M., Jorge Silva S., of the *Gabinete de Arqueología Universidad Nacional Mayor de San Marcos,* and Rolando Paredes E. of the *Instituto Nacional de Cultura* provided great help to Quilter during this work. Quilter's field associate position at the Field Museum of Natural History and Stocker's Lounsbury Fellowship at the American Museum of Natural History also helped in the development of this paper. The moral support of Peggy Bird, Sarah Quilter, and Barbara Jackson is greatly appreciated. Comments on the final draft by Paul Axelrod, Russell Blake, and Seale Doss, all of Ripon College, are also gratefully acknowledged.

[1] The Paloma project, under the direction of Robert A. Benfer, has involved the efforts of over 40 investigators since its commencement in 1976. Because major elements of analysis, especially archeobotany, zooarcheology, and stratigraphy, are still in progress, results presented here are tentative. The information presented is based on the field experiences of the authors, personal communication, and available unpublished manuscripts by project participants.

[2] After this manuscript was accepted by the *American Anthropologist,* the relatively late *El Niño* event of 1983 began to take its toll on the environment and inhabitants of coastal Peru and Ecuador. Unusual winter weather observed by Quilter in June and July of 1982 was surely a portent of this event, as suggested by Patterson (personal communication to Quilter) at the time. Many more sunny days and decreased amounts of fog were the chief weather changes observed on land. Many *lomas* fields did not blossom in their full richness and others were late in reaching their winter stages. *Lomas* with arboreal vegetation seemed to be less severely affected than those without trees or bushy cover. While such events could have complicated the subsistence economies of prehistoric coastal dwellers dependent on *lomas* foods, unusual winter weather may have provided warning signs half a year or more in advance of an *El Niño.*

REFERENCES CITED

Antúnez de Mayolo R., Santiago E.
1981 La Nutrición en el Antiguo Perú. Lima: Banco Central de Reserva Del Perú.

Benfer, Robert
1976 The Paloma Project: A Multidisciplinary Study of the Demography, Health, and Microecology of a Prefarming Village in Coastal Peru. Abstract in American Journal of Physical Anthropology 47:117-118.
in press Holocene Coastal Adaptations: Changing Demography and Health at the Fog Oasis of Paloma, Peru (4,000-7,700 B.P.). *In* Andean Archeology, 1981. Ramiro Matos M., ed. Los Angeles: Archaeological Institute, University of California.

Benfer, Robert A., J. A. Vogt, and S. Schlagel
1981 Instrumental Neutron Activation Analysis of Ancient Peruvian Bone: The Effects of Soil, Strata, Demography, and Disease. Paper presented at the Biogeochemistry in Archaeology Symposium, meeting of the Society for Archaeological Science, San Diego, Calif.

Bennett, Wendell C.
1946 The Atacameño. *In* Handbook of South American Indians, Volume 2, The Andean Civilizations. Julian H. Steward, ed. pp. 599-618. Smithsonian Institution Bureau of American Ethnology Bulletin 142. Washington, D.C.: United States Government Printing Office.

Bigalke, E. H.
1973 The Exploitation of Shellfish by Coastal Tribesmen of the Transkei. Natural History (Ann Cape Province Museum) 9(9):159-175.

Binford, Lewis R., and W. J. Chasko, Jr.
1976 Nunamuit Demographic History: A Provocative Case. *In* Demographic Anthropology, Quantitative Approaches. Ezra B. W. Zubrow, ed. pp. 63-143. Albuquerque: University of New Mexico Press.

Bird, Robert
1978 Maize Genetics Cooperation Newsletter 52:90-92.
1981 Maize, Models and Messiness. Paper presented at the Fourth Andean Colloquium, University of Texas, Austin.

Bonavia, Duccio, and A. Grobman
1979 Sistema De Depositos Y Almacenamiento Durante El Periodo Preceramico En La Costa Del Peru. Journal De La Société Des Américanistes 66:21-45.

Brock, Sharon S.
1981 Paleopathology. *In* Adaptations to Sedentism and Food Production: The Paloma Project. Robert A. Benfer, comp. Paleopathology Newsletter 36:11-13.

Bryan, A. L.
1973 Paleoenvironments and Cultural Diversity in Late Pleistocene South America. Quaternary Research 3:237-256.

Burger, Richard L.
1979 Resultados Preliminarios de Excavaciones en los Distritos de Chavín de Huantar y San Marcos, Perú. *In* Arqueología Peruano: Investigaciones Arqueologicas en el Perú, 1976. Ramiro Matos M., ed. pp. 133-155. Lima: Centro de Proyección Cristiana.
1982 Summary: Early Peruvian Civilization and Its Relation to the Chavin Horizon. Paper presented at the Symposium on Early Ceremonial Architecture in the Andes, Dumbarton Oaks, Washington, D.C.

Burger, Richard L., and Lucy Salazar Burger
1980 Ritual and Religon at Huaricoto. Archaeology 33(6):26-33.

Buse de la Guerra, H., E. Sarmiento, F. Pease, M. Rostworowski, Y. Amano, and J. Antonio del Busto
n.d. La Pesca en el Perú Prehispanico. No editor cited. Lima: Empresa Pública de Producción de Harina y Aceite de Pescado (PESCA PERU).

Cardenes M., Mercedes
1978 Obtencion De Una Cronologia Del Uso De Los Recursos Marinos En El Antiguo Perú. Arqueologia PUC. Boletin Del Seminario De Arqueologia 19-20, 1977-1978. Publicacion No. 107 Del Instituto Riva Aguero.

Carneiro, Robert L.
1981 The Chiefdom: Precursor of the State. *In* The Transition to Statehood in the New World. Grant D. Jones and Robert R. Kautz, eds. pp. 37-79. New York: Cambridge University Press.

Chauchat, C.
1978a Additional Observations on the Paijan Complex. Ñawpa Pacha 16:51-65.
1978b Recherches Préhistoriques sur la Côte Nord du Peřou. Bulletin Societe Prehistorique Francaise 75:253-256.

Cieza de Leon, Pedro
1959[Original, 1553] The Incas of Pedro de Cieza de Leon. Harriet de Onis, transl.; Victor W. Von Hagen, ed. Norman: University of Oklahoma Press.

Cobo, Bernabe
1946[Original, 1653] Historia del Nuevo Mundo. Obros del padre Bernabe Cobo de la Compania de Jesus. Estudio preliminary edicíon del P. Francisco Mateos de la mismo Compania. Biblioteca de Autores Espanoles desde la Formacion del lenguaje hasta nuestros dias. Madrid: Ediciones Atlas.

Cohen, Mark N.
1974 Some Problems in the Quantitative Analysis of Vegetable Refuse Illustrated by a Late Horizon Site on the Peruvian Coast. Ñawpa Pacha 10-12:49-60.
1975 Population Pressure and the Origins of Agriculture: An Archaeological Example from the Coast of Peru. *In* Population, Ecology, and Social Evolution. S. Polgar, ed. pp. 79-122. The Hague: Mouton.
1977 The Food Crisis in Prehistory: Overpopulation and the Origins of Agriculture. New Haven: Yale University Press.

Colson, Elizabeth
1979 In Good Years and in Bad: Food Strategies of Self-Reliant Societies. Journal of Anthropological Research 35:8-29.

Cooper, John M.
1946 The Chono. *In* Handbook of South American Indians, Volume 1, The Marginal Tribes. Julian H. Steward, ed. pp. 47-54. Smithsonian Institution Bureau of American Ethnology Bulletin 143. Washington, D.C.: United States Government Printing Office.

Cromie, William J.
1980 When Comes El Niño? Science 80 1(3):36-43.

Donnan, Christopher B.
1964 An Early House from Chilca, Peru. American Antiquity 30(1):137-144.

Engel, Frederic-Andre
1966 Le Complexe Preceramique d'El Paraiso (Perou). Journal de la Societe des Americanistes 55:43-96.
1970 Exploration of the Chilca Canyon, Peru. Current Anthropology 11(1):55-58.

1973 New Facts about Precolumbian Life in the Andean Lomas. Current Anthropology 14(4):271-280.
1980 Prehistoric Andean Ecology, Man, Settlement, and Environment. Papers of the Department of Anthropology, Hunter College of the City University of New York. New York: Humanities Press.

Feldman, Robert A.
1978 Informe Preliminar Sobre Excavaciones En Aspero, Peru y Sus Implicaciones Teoricas. Investigacion Arquelogica 2:20-27.
1980 Aspero, Peru: Architecture, Subsistence Economy, and Other Artifacts of a Preceramic Maritime Chiefdom. Ph.D. dissertation, Department of Anthropology, Harvard University, Cambridge, Mass.

Fung, Rosa
1969 Las Aldas: su ubicacion dentro del proceso historico del Perú antiguo. Dedalo 5 (9-10). São Paulo: Museu de arte e arqueologia, Universidade de São Paulo.
1972 El temprano surgimiento en el Perú de los sistemas socio-políticos complejos: planteamiento de una hipótesis de desarollo original. Apuntes Arqueológicos 2:10-32.

Garcilaso de la Vega, "El Inca"
1966[Original, 1609] Royal Commentaries of the Incas and General History of Peru, Part 1. Harold V. Livermore, transl. Austin: University of Texas Press.

Greenough, Paul R.
1977 The Ultimate Mechanism: Patterned Domestic Break-up during the Bengal Famine, 1943-44. Paper presented to the Workshop on Risk and Uncertainty in the South Asian Setting, University of Pennsylvania, Philadelphia.

Grieder, Terence
1982 Ceremonial Architecture at La Galgada. Paper presented at the Symposium on Early Ceremonial Architecture in the Andes, Dumbarton Oaks, Washington, D.C.

Grieder, Terence, and A. Bueno Mendoza
1981 La Galgada: Peru Before Pottery. Archaeology 34(2):44-51.

Hassan, Fekri A.
1978 Demographic Archaeology. *In* Advances in Archaeological Method and Theory, Vol. 1. Michael B. Schiffer, ed. pp. 49-103. New York: Academic Press.

Hawkes, J. G.
1967 The History of the Potato. Journal of the Royal Horticultural Society 92:207-224.

Horkheimer, Hans
1973 Alimentacion y Obtencion de Alimentos En El Perú Prehispanico. Lima: Universidad Nacional Mayor de San Marcos.

Hurlburt, C. Graham, and Sarah W. Hurlburt
1974 Blue Gold: Mariculture of the Edible Blue Mussel *(Mytilus edulis)*. Reprint from a report delivered to the Society for the Advancement of Food Service Research.

Izumi, Seiichi, and T. Sono
1963 Excavations at Kotosh, Peru, 1960: Andes 2. Tokyo: Kodokawa Publishing.

Jackson, B., and T. Stocker
1982 Peru's Preceramic Menu. Field Museum of Natural History Bulletin 53(7):12-23.

Kelty, M.
1980 Vertebrate Fish from Paloma. *In* Algunos Informes del Proyecto "Paloma" 1976-1981. R. Benfer, ed. Ms. on file at the Instituto Nacional de Cultura, Lima, Peru.

Kirchoff, Paul
1948 The Tribes North of the Orinoco River. *In* Handbook of South American Indians, Volume 4, The Circum-Caribbean Tribes. Julian H. Steward, ed. pp. 481-493. Smithsonian Institution Bureau of American Ethnology Bulletin 143. Washington, D.C.: United States Government Printing Office.

Lanning, Edward P.
1963 A Preagricultural Occupation on the Central Coast of Peru. American Antiquity 28: 360-371.
1966 American Aboriginal High Cultures: Peru. Actas y Memorias del XXXVI Congreso Internacional de Americanistas (España, 1964), Volume 1. pp. 187-191. Seville: Editorial Catolica.

1967 Peru Before the Incas. Englewood Cliffs, N.J.: Prentice-Hall.

León, Jorge
1964 Boletin Technico 6. Instituto Interamericano de Ciencias Agricolas Zona Andina, Lima.

Lathrap, Donald
1973 The Antiquity and Importance of Long-Distance Trade Relationships in the Moist Tropics of Pre-Columbian South America. World Archaeology 5:170-186.
1982 Jaws: An Iconographic Structure Underlying Ceremonial Architecture of Nuclear America. Paper presented at the Symposium on Early Ceremonial Architecture in the Andes, Dumbarton Oaks, Washington, D.C.

Lester, C. W.
1966 Notes on the Skeletons from Huaca Prieta. Ms.

Lishka, Joseph L.
1982a The Niño as a Natural Hazard: Its Role in the Development of Cultural Complexity on the Peruvian Coast. Ms.
1982b The Beginnings of Agriculture on the Peruvian Coast: The Rational Selection of Cultigens. Ms.

Llagostera, Martinez A.
1979 9,700 Years of Maritime Subsistence on the Pacific: An Analysis by Means of Bioindicators in the North of Chile. American Antiquity 44:309-323.

Lothrop, S. K.
1946 Indians of the Paraña Delta and La Plata Littoral. *In* Handbook of South American Indians, Volume 1, The Marginal Tribes. Julian H. Steward, ed. pp. 177-190. Smithsonian Institution Bureau of American Ethnology Bulletin 143. Washington, D.C.: United States Government Printing Office.

Lynch, Thomas F.
1980 Guitarrero Cave, Early Man in the Andes. New York: Academic Press.

MacNeish, Richard S., T. C. Patterson, and D. L. Browman
1975 The Central Peruvian Prehistoric Interaction Sphere. Papers of the Robert S. Peabody Foundation for Archaeology, Vol. 7. Andover, Mass.: Phillips Academy.

MacNeish, Richard S., A. G. Cook, L. G. Lumbreras, R. K. Vierra, and A. Nelken-Terner
1981 Prehistory of the Ayacucho Basin, Peru, Volume 2: Excavations and Chronology. Ann Arbor: University of Michigan Press.

Martins, Rena
1976 New Archaeological Techniques for the Study of Ancient Root Crops in Peru. Ph.D. dissertation, University of Birmingham.

Masuda, S.
1981 Cochayuyo, Macha, Camaron y Higos Charqueados. *In* Estudios Etnograficos del Peru Meridional. S. Masuda, ed. pp. 173-192. Tokyo: University of Tokyo.

Matos M., Ramiro
1975 Prehistoria y ecología humana en las punas de Junín. Revista del Museo Nacional (Lima) 41:37-80.

Matsuzawa, Tsugio
1978 The Formative Site of Las Haldas, Peru: Architecture, Chronology, and Economy. Izumi Shimada, transl. American Antiquity 43(4):652-673.

Mead, C.
1909 The Fish in Ancient Peruvian Art. *In* Putnam Anniversary Volume. F. Boas, ed. pp. 126-136. New York: G. E. Stechert.

Moseley, Michael E.
1975 The Maritime Foundations of Andean Civilization. Menlo Park, Calif.: Cummings Press.
1978 Pre-agricultural Coastal Civilizations in Peru. Carolina Biology Readers No. 90. Burlington, N.C.: Carolina Biological Supply Company.
1981 Untitled Ms.
1982 The Exploration and Explanation of Early Monumental Architecture in the Andes. Paper presented at the Symposium on Early Ceremonial Architecture in the Andes, Dumbarton Oaks, Washington, D.C.

Moseley, Michael E., and Robert A. Feldman
1982 Living with Crises: Relentless Nature Stalked Chan Chan's Fortunes. Early Man 4(1): 10-13.
Muelle, Jorge C., and R. Ravines
1973 Los Estratos Preceramicos de Ancon. Revista del Museo Nacional (Lima):49-70.
Murphy, R. C.
1926 Oceanic and Climatic Phenomena along the Coast of South America during 1925. Geographical Review 16:25-54.
Nials, Fred L., Eric E. Deeds, Michael E. Moseley, Shelia G. Pozorski, Thomas G. Pozorski, and Robert A. Feldman
1979 El Niño: The Catastrophic Flooding of Coastal Peru. Parts 1 and 2. Field Museum of Natural History Bulletin 50(7):4-14, 50(8):4-10.
Nietschmann, B.
1973 Between Land and Water: The Subsistence Ecology of the Miskito Indians, Eastern Nicaragua. New York: Seminar Press.
Nishiwaki, M.
1972 General Biology of Sea Mammals. *In* Mammals of the Sea: Biology and Medicine. S. H. Ridgeway, ed. pp. 3-204. Springfield, Ill.: Charles C Thomas.
Osborn, Alan J.
1977 Strandloopers, Mermaids, and Other Fairy Tales: Ecological Determinants of Marine Resource Utilization—The Peruvian Case. *In* For Theory Building in Archaeology. Lewis R. Binford, ed. pp. 157-243. New York: Academic Press.
Parsons, Mary H.
1970 Preceramic Subsistence on the Peruvian Coast. American Antiquity 35:292-302.
Patterson, Thomas C.
1971a Central Peru: Its Economy and Population. Archeology 24(4):316-321.
1971b The Emergence of Food Production in Central Peru. *In* Prehistoric Agriculture. Stuart Streuver, ed. pp. 181-208. Garden City, N.Y.: Natural History Press.
1973 America's Past: A New World Archaeology. Glenview, Ill.: Scott, Foresman.
1982 La Florida and the Organization of Labor During the Second Millennium B.C. Paper presented at the Symposium on Early Ceremonial Architecture in the Andes, Dumbarton Oaks, Washington, D.C.
Patterson, Thomas C., and M. E. Moseley
1968 Late Preceramic and Early Ceramic Cultures of the Central Coast of Peru. Nawpa Pacha 6:115-134.
Paulsen, Allison
1974 The Thorny Oyster and the Voice of God: *Spondylus* and *Strombus* in Andean Prehistory. American Antiquity 39(4):597-607.
Pickersgill, Barbara, and Richard T. Smith
1981 Adaptation to a Desert Coast: Subsistence Changes Through Time in Coastal Peru. *In* Environmental Aspects of Coasts and Islands, Symposia of the Association for Environmental Archaeology No. 1. D. Brothwell and D. Dimbleby, eds. pp. 89-115. BAR International Series 94.
Pozorski, Shelia G.
1982 Subsistence Systems in the Chimu State. *In* Chan Chan: Andean Desert City. Michael Moseley and Kent C. Day, eds. pp. 177-196. Albuquerque: University of New Mexico Press.
Pozorski, Shelia, and Thomas Pozorski
1979 Alto Salaverry: A Peruvian Coastal Preceramic Site. Annals of Carnegie Museum of Natural History 49:337-375.
Quilter, Jeffrey
1981 Paloma: Mortuary Practices and Social Organization of a Preceramic Peruvian Village. Ph.D. dissertation, Department of Anthropology, University of California, Santa Barbara.
Ramos de Cox, J.
1972 Marcadores y Niveles de Ocupacion en Tablada de Lurin, Lima. Arqueologia PUC 13: 7-30.

Ravines, Rogger
1978 Recursos Naturales de los Andes. *In* Technologia Andina. Rogger Ravines, ed. pp. 3-90. Lima: Instituto de Estudios Peruanos.

Raymond, J. Scott
1981 The Maritime Foundations of Andean Civilization: A Reconsideration of the Evidence. American Antiquity 46(4):806-821.

Reitz, Elizabeth
1977 Preliminary Faunal Report. *In* Human-Environmental Interaction in Arid Coastal Peru. Ms. on file at the Instituto Nacional de Cultura, Lima, Peru.

Richardson, J. B., III
1973 The Preceramic Sequence and the Pleistocene and Post-Pleistocene Climate of Northwest Peru. *In* Human Variation. D. Lathrap, ed. pp. 73-89. Urbana: University of Illinois Press.
1978 Early Man on the Peruvian North Coast: Early Maritime Exploitation and the Pleistocene and Holocene Environment. *In* Early Man in America from a Circum-Pacific Perspective. A. Bryan, ed. pp. 247-259. Edmonton: University of Alberta Press.
1981a Maritime Adaptations on the Peruvian Coast: A Critique and Future Directions. Paper presented at the 47th Annual Meeting of the Society for American Archaeology, San Diego, Calif.
1981b Modeling the Development of Sedentary Maritime Economies on the Coast of Peru: A Preliminary Statement. Annals of the Carnegie Museum Volume 50, Article 5, pp. 139-150.

Rick, John
1980 Prehistoric Hunters of the High Andes. New York: Academic Press.

Roosevelt, Anna C.
1980 Parmana, Prehistoric Maize and Manioc Subsistence along the Amazon and Orinoco. New York: Academic Press.

Rostworowski de Diez Canseco, Maria
1981 Recursos Naturales Renovables Y Pesca, Siglos XVI Y XVII. Lima: Instituto de Estudios Peruanos.

Sabella, James
1974 The Fishermen of Caleta San Pablo. Latin American Studies Program Dissertation Series No. 57. New York: Cornell University.

Sarma, A. V. N.
1974 Holocene Paleoecology of South Coastal Ecuador. Proceedings of the American Philosophical Society 18:93-134.

Seler, E.
1923 Die buntbemalten Gefasse von Nasca in sudlichen Peru und die Hauptelemente ihrer Verzierung. Gesammelte Abhandlungen zur Amerikanischen Sprach-und Alterthumskunde 4. Berlin: Behrend.

Stothert, R. E.
1977a Preceramic Adaptation and Trade in the Intermediate Area. Paper read at the 76th Annual Meeting of the American Anthropological Association, Houston.
1977b Proyecto Paleoindio, Informe Preliminar. Guayaquil: Publicaciones del Museo Antropologico Del Banco Central.

Thompson, D.
1949 Economic Structure and the Ceremonial Exchange Cycle in Arnhem Land. Melbourne: McMillan.

Tomka, Steve
1980 Preceramic Subsistence Patterns in the Central Coast of Peru, As Evidenced in the Paloma Village. Honors Thesis, Department of Anthropology, University of Missouri, Columbia.

Van Slyke, Donald D.
1909 Metabolism Experiments. *In* The Food Value of Sea Mussels. I. A. Field, ed. pp. 102-104. Bulletin of the Bureau of Fisheries 29:86-128. Washington, D.C.: United States Government Printing Office.

Vehik, Susan
1977 Climate, Population, Subsistence and the Central Peruvian Lomas between 8000 and 2500 B.C. Ms.
Williams León, Carlos
1980 Complejos pirámides con planta en U, patrón arquitectónico de la costa central. Revista del Museo Nacional (1978-80) 44:95-110.
Wilson, D.
1981 Of Maize and Men: A Critique of the Maritime Hypothesis of State Origins on the Coast of Peru. American Anthropologist 83(1):93-120.
Wing, Elizabeth S., and Antoinette Brown
1979 Paleonutrition, Method and Theory in Prehistoric Foodways. New York: Academic Press.
Wyrtki, Klaus, E. Stroup, W. Patzert, Robert Williams, and W. Quinn
1976 Predicting and Observing El Niño. Science 191(4225):343-346.
Yesner, David R.
1980 Maritime Hunter-Gatherers: Ecology and Prehistory. Current Anthropology (216):727-750.