Condition of Social Change at El Dornajo, Southwestern Ecuador

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This dissertation explores the role of internal and external conditions of social change at the site of El Dornajo in the El Oro-Tumbes region of southern Ecuador / northern Peru. The El Oro-Tumbes region lies on the boundary between the central and northern Andean culture areas. Consequently, the developmental trajectory of this region has often been seen as closely tied to that of its more complex neighbors. Indeed, as inter-regional interaction between these areas increased through time, the potential for such interactions to affect the intermediate region also increased. However, the El Oro-Tumbes region is also the epicenter of El Niño activity along the South American, coast making environmental hazards an equally plausible condition for social change. The possible role of these conditions, inter-regional interaction and environmental hazards, were examined at the site of El Dornajo, a central place in the Zarumilla River Valley during the Regional Development Period. Results indicate that neither condition was a catalyst for social change, although each played a role in the developmental trajectory of the site in ways not originally anticipated. Existing data suggest that social inequality at El Dornajo was most directly associated with land rights and regional interaction between elites that were manifest at the site in clambakes and the display of prestige goods.

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PREFACE

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1.0 INTRODUCTION

The El Oro-Tumbes region of southern Ecuador and northern Peru lies in a culturally transitional zone between the northern and central Andean traditions. The northern Andes are characterized by a broad range of highly variable chiefdoms, many with elaborate trade and agricultural systems. The central Andes are characterized by large expansive states with sophisticated craft production and agriculturally based economies. Because El Oro-Tumbes exhibits stylistic and cultural traits of both traditions but lacks the level of complexity exhibited by its neighbors, it has been called a "cultural frontier" (Burger 2003, Feldman and Moseley 1983, Hocquenghem 1998, Richardson et al. 1990). The designation of the area as a cultural frontier betrays deep-seated notions about the nature of social change in the region. Foremost among these is the notion that because it was a cultural frontier, it was also a political frontier; this implies that the developmental trajectory of the area was tied to that of the more complexly organized societies surrounding it. Although the first evidence for centralized sociopolitical organization in El Oro-Tumbes dates as early as the Late Formative Period, its trajectory is one of punctuated development and is relatively modest in comparison to its neighbors. No site or public architecture in El Oro-Tumbes prior to the Inca Period ever comes close to the scale of that at Jerusalén in Guayas (Delgado-Espinoza 2002) or Cerro Ñañañique in Piura (Kaulicke 2006). Nor had any burials nearly as elaborate as those found at the Río Daule sites in Guayas (Stemper 1993) or Cerro Vicús in Piura (Kaulicke 2006) been identified prior to this research. Initially the emergence of social complexity in El Oro-Tumbes was explained by diffusion, migration, or invasion (Meggers 1966). Today complex social organization continues to be discussed in terms of externally imposed conditions, although in less simplistic language, with trade and interaction figuring most prominently (Hocquenghem 1998; Holm 1983; Richardson et al. 1990). This is because two macro-regional changes in geo-politics that took place during the late prehistoric period (800–1000 AD) may have given neighboring societies a particularly strong impact on social change in the El Oro-Tumbes region. First, the Milagro-Quevedo chiefdoms in the Guayas Basin reached their maximum level of integration and may have begun to expand southward. Second, exchange between the Manteño chiefdoms in southern Ecuador and the Sicán state in northern Peru increased in scale substantially and began to pass through the El Oro-Tumbes region. These polities may have colonized the region directly (Holm 1983, Richardson et al. 1990) or may have introduced trade networks promoting re-organization in previously peripheral areas (Hocquenghem 1998).

However, the prevailing idea that social change in El Oro-Tumbes was due primarily to interactions with its more developed neighbors has never been seriously challenged by explicit consideration of factors internal to the region that might plausibly be considered. Specifically, the environmental conditions of the region invite the application of models that place environmental hazards and their effect on existing subsistence strategies at center stage. The region sits between the tropical forests of coastal Ecuador and the dry deserts of coastal Peru producing a dry thorn forest behind barrier island and mangrove coastlines. The ecosystem is diverse and experiences high seasonal variability in subsistence resources and climatic instability (Staller 1994). Average annual precipitation is very low, the soils are predominantly aridisols, and while some rivers are perennial others are not (Siemens 1988). These characteristics led early researchers to believe that the region was not suited to the development of more complex societies, and that the environment actually prohibited such development until “civilization” was brought from outside (Estrada et al. 1964). We now know that some degree of social complexity developed in the region as early as the Formative Period (see Moore 2010). It is therefore clear that the environment was not prohibiting development. While the environmental characteristics discussed above are poor for agriculture, the broad floodplain of rivers like the Zarumilla River have high water tables and would have provided fairly good, albeit limited, agricultural land in most years; but would have suffered in years of prolonged drought or flooding such as those associated with El Niño events. On the other hand, the wild plant and animal resources of the marine, mangrove, and estuary zones are rich; and although largely destroyed now, the mangrove forests would have been the most stable and rich habitat in prehistory (Currie 1989; Spath 1980; Staller 1994).

The mangroves are also particularly strongly threatened by mega El Niño events which occur approximately every 100-500 years (Douglass 2010, Sandweiss 1986). During mega El Niño events flooding of the rivers can deposit massive amounts of sediment into the estuary (Gundrum 1992, Sandweiss et al. 1983) and even lead to surge waves that engulf the back barrier and destroy the shallow reefs, tidal wetlands, and lagoons (Dyer 1995, Staller 1994). Such events would have devastated many of the marine, mangrove, and estuary resources most likely central to the region's subsistence (Barber and Chavez 1983). At the same time, however, the agricultural potential of some inland areas and the grazing potential for terrestrial fauna would have increased substantially from increased precipitation (Hocquenghem 1998, Shimada 1994). Previously marginal farmers could suddenly have found themselves in a position of economic power, as a new regional subsistence dynamic made the value of the basic subsistence resources under their control much higher. Such conditions could create hierarchical, centralized, and inland-focused patterns of sociopolitical organization with little relation to interactions with more developed neighbors to the north and south.

The research presented here is aimed at assessing the relative importance of these two potential sets of factors in the emergence and development of complex social organization at the centralized hierarchical site of El Dornajo: the impact of changing subsistence resources due to environmental hazards and the effect of increased interaction with more complex societies in neighboring regions. The objective is not simply to choose one of these alternatives over the other, but rather to assess the importance of each. There are thus four possible outcomes: one or the other of these two sets of factors may have had substantial importance in promoting the emergence of complex social organization at the site, both sets of factors may have acted fairly strongly, or neither condition may have had much impact on the social trajectory.

1.1 INTER-REGIONAL INTERACTION

The expansion of the Manteño-Sicán trade network is believed to have passed through El Oro-Tumbes by 800–1000 AD based on the appearance of Sicán *paleteada* pottery in Tumbes and a substantial increase in the quantity of spondylus shell in the Lambayeque Valley, Peru. The apparent emulation of Sicán vessels by some potters on the Zarumilla River and Chimú sherds at Loma Saavedra (Pajuelo 2006) further substantiate this claim. Evidence of interaction with these polities has been found at sites along the Zarumilla River in the form of similar ceramics (Pajuelo 2006), the introduction of non-local domesticates (Vilchez et al. 2007), specific burial practices, and metal objects. Second, the emergence of centralized Milagro-Quevedo polities in the Guayas Basin and their expansion to the south also took place at this time. Communities like Peñón del Río in the Guayas Basin reached their maximum level of integration at about 900 AD (Muse 1991); subsequently, Milagro-Quevedo style objects and *tola*s (artificial mounds) appear as far south as the Zarumilla River. The proximity of the Milagro-Quevedo chiefdoms and the appearance of a large trade network near the Zarumilla River may have provided previously unavailable economic opportunities for aspiring elites.

The Zarumilla River may therefore have been involved in a greater degree of inter-regional interaction between 800 and 1000 AD than during earlier periods. Perspectives on the role of inter-regional interaction are not all congruent, but one of the major lines of inquiry involves core-periphery models. It is this kind of interaction that applies to the Zarumilla River since no community along the river was ever comparable in complexity to the Sicán, Manteño, or Milagro-Quevedo polities. These models span a wide array of perspectives and approaches. Broadly speaking, they can be divided between those who see such interaction as encouraging the development of the lesser-developed society, and those who see it as having a discouraging effect on the lesser-developed society. Because societies are not homogenous entities, not all members of a society have equal access to external contacts. If such contacts give individuals preferential access to economically or socially valued goods, then those individuals and their factions are in a position to control access to such items within the community. Most commonly access to such items would involve an exchange in labor, thereby allowing individuals with greater external contacts to assert control over the productive activities of others (Shortman and Urban 1992). In models of this persuasion privileged access to either socially important prestige goods and/or wealth serves to promote and enhance the power of certain social factions either ideologically or economically. In the case of ideological legitimization, contact with elites in more powerful polities provides local leaders privileged access to prestige goods associated with an influential political ideology or esoteric power (Helms 1979). In the case of economic legitimization, aspiring elites gain access to a previously unavailable market by involvement in a large exchange network (e.g. Earle 2002, Feinman and Nicholas 1992, Friedman and Rowlands 1977, Langebaek 1991). For example, elites at El Dornajo might have invested in developing an export economy trading craft goods or raw materials for prestige items or wealth, similar to Earle's model for Bronze Age Thuy (Earle 2002) or Langebaek's (1991) description of the Muisca and their neighbors. Alternatively, elites at El Dornajo might have made themselves into middlemen by trading with both their neighbors to the north and south in much the same way that Ferguson (2004) describes the Yanomami at Spanish contact and Shimada (2006) has suggested for the Piura Valley in Peru.

In either case, social complexity resulting from inter-regional interaction is expected to be relatively rapid as interactions increase through time. It has been argued that hierarchy based on reliance on external interactions is inherently unstable since trade networks can change routes and the fate of those depending on them is tied to the fate of other polities (Earle 2002). In this case, the Sicán-Manteño exchange network became the Chimú-Manteño trade network after about 1300 AD, lasting until the Inca conquest of Tumbes around 1450 AD, and the Milagro-Quevedo polities remained stable until Spanish contact. This implies that strategies of power based on the control of structured transactions between leaders along the Zarumilla River and their external ties could have been relatively stable.

1.2 ENVIRONMENTAL HAZARDS

Alternatives to the commonly held position that increased inter-regional interaction produced complex society in El Oro-Tumbes have rarely been considered. As noted above, local environmental conditions have most often been considered an impediment to social complexity. The El Oro-Tumbes region is characterized by increasing aridity as one moves south, and rainfall occurs only in the first three months of the year throughout the region. This rainfall pattern is insufficient to support year-round agriculture outside of the floodplain without irrigation technology. The river has been known to change course by as much as a kilometer, and severe erosion of the high western bank is a regular occurrence resulting in a deeply cut river bank where any kind of irrigation would be difficult. Most soils away from the river are aridisols which are very poor for agriculture (Siemens 1988). At only 129mm average annual precipitation the Zarumilla River Valley receives 30-40% less rain than the Arenillas River Valley to the north and has a fraction of the annual discharge of the Tumbes River to the south (Staller 1994). This rainfall regime is insufficient for more than one crop a year (Siemens 1988; Staller 1994). Patches of fertile soils away from the river could have supported limited agriculture if waterholes were used to capture rainfall. Such features were tentatively identified as far south as Huaquillas in aerial photographs but their identification as waterholes is debatable since local inhabitants identify them as modern charcoal burning location (Siemens 1988). The Zarumilla River has highly variable water flow depending on precipitation in the watershed such that there is little to no water much of the year and flooding at other times. A high water table in the floodplain would have made *orilla* farming a viable strategy. These crops would have been subject to periodic flooding, however, making even this, a secondary subsistence strategy. Agriculture of any scale in the floodplain would also have depended on waterholes having been dug in the floodplain. The dynamic floodplain activity since prehispanic occupation would have obliterated any such features.

Staller (1994), Currie (1989), and Vilchez et al. (2007) have each noted that many sites in southern El Oro have thick shell middens composed of primarily large *Ostrea columbiensis* or *Anadaris grandis* shell. The strata composed of such shell are temporally discreet and end very abruptly. All three authors believe that the abrupt stratigraphic breaks in these middens suggest major climatic fluctuations as opposed to overexploitation or a shift in resource preferences. Such environmental shifts may be related to mega El Niño events. Ice cores and stratigraphic data indicate that there were mega events at about 500 BC, 600 AD, and 1100 AD (Shimada 1994). Sandweiss (1986) notes that mega events seem to have occurred about every 500 years. The effect of mega El Niño events in this region is high mortality of marine life with intertidal and subtidal mussel beds and kelp being especially hard hit (Davis 2000; Staller 1994). These environmental niches are strongly affected by rises in sea level and temperature, as well as changes in salinity due to increased sedimentation (Dyer 1995). During the 1982-83 mega El Niño event sea level rose 2m in seven months and buried most of the mangroves along the coast of El Oro. Furthermore, rainfall increased by 300% dumping a large sediment load into the estuary and flooding the *orilla* (Siemens 1988, Staller 1994). Finally, in El Oro mega El Niño events are known to change the pH and algae levels of the water producing toxic algal blooms in the wetland lagoons and ponds, which can decimate the fish and shellfish populations of those niches as well (Dyer 1995, Staller 1994). These disturbances could create conditions of subsistence stress, pushing the population toward different resources. Since El Niño events do not affect the landscape homogenously, not all available resources would be decimated, in fact, some would be improved considerably. Increased precipitation would result in more ground cover thereby improving the habitat for grazing mammals and patches of fertile soil away from river would have been able to produce more than one crop those years since precipitation would have been so much greater.

The Zarumilla River may, therefore, have been subject to increased stress on several important wild subsistence resources from mega El Niño events at 500 BC, 600 AD, and 1100 AD. At the same time, these events would have substantially improved certain agricultural resources. In addition to these three identified mega events the region was subject to a period of intensified ENSO (El Niño Southern Oscillation) activity between 50 BC to 750 AD during which individual events were stronger and occurred with more frequency than they do today (Moy et al. 2002, Rein et al. 2005). Those studying the relationship between environmental hazards and socio-political systems have noted that responses by communities to such events may involve institutional adjustments as existing factions within society are amplified (Oliver-Smith 1996, Van Buren 2001). This means that such events open up opportunities for socio-political change by creating a context in which existing power structures can be contested and new power structures could emergence (Oliver-Smith 1996, Williams 1997). The redistribution of resource control produced by environmental hazards creates a situation in which different segments of society are affected differently, with some undergoing subsistence stress while others see amplified opportunities. In such a situation aspiring elites can gain personal control of subsistence resources such as land or water and accumulate surplus subsistence goods as a result of that control or ownership (Earle 1991, Gilman 1995). At first, this land would require little investment beyond simply sowing seed or sending animals to areas that that are too dry to be exploited in normal years. As rainfall began to decrease it may have become necessary to invest in the construction of waterholes to retain water supplies into the dry period. Researchers involved in hazards studies have noted that newly emergent interest groups often broaden their field of influence once the hazard has passed, providing an arena in which to make complex social organization extend beyond the period of most intense subsistence stress (Oliver-Smith 1996). The construction of water holes, much like the *albarradas* of the Santa Elena Peninsula (Stothert 1995) could have been a productive way to harvest rainfall, especially in years of excess precipitation. Those persons or groups at El Dornajo with property rights to such areas could convert surplus production into wealth and status by sponsoring community ritual, warfare, or craft production.

Yet the disruption that mega El Niños produce is transitory since shell beds and estuary resources require only some 50 years for full regeneration (Coker 1908, as cited in Vilchez et al. 2007). Although increased precipitation declines after a few years, it would be considerably extended during the decades of generally increased ENSO activity that occurred between 50 BC and 750 AD. Thus during these centuries emergent elites at El Dornajo would find it especially easy to consolidate their social position since even small repeated events could exacerbate shortages in the aftermath of a mega event and prolong increased agricultural productivity. They might also expand the basis of their social position, for example by establishing themselves as ritual specialists or by participating in exchange networks. In the first case, elites would establish themselves as necessary in an ideological sense, much like Burger's (1988) Chavin "crisis cult" model. In the second scenario, by using their already established status, elites at El Dornajo may have sponsored craft production or trade activity thereby converting power and status into wealth (Gilman 1991, Langebaek 1991). Only through engaging in activities that would broaden the scope of their power could elites maintain their positions in the truly long-term.

1.3 LINES OF INQUIRY

In order to assess the models presented, two distinct lines of inquiry are pursued. The first focuses on the timing and pace of developing social complexity at El Dornajo; the second focuses on the nature of elite activities at that point in the trajectory.

1.3.1 The timing and pace of social complexity

Existing data prior to this research suggested that at El Dornajo recognizably hierarchical social organization developed sometime between 500 BC and 1200 AD. Both of the sets of factors discussed above were present during this time span, although on rather different schedules. Mega El Niño events occurred at about 500 BC, 600 AD and 1100 AD, with a period of increased ENSO activity between 50 BC and 750 AD. Increased inter-regional interaction with more complexly developed neighbors occurred between 800 and 1000 AD. If either of these factors had much importance in the development of social complexity at El Dornajo, then the timing of this development should correspond with the period when those factors were strongly in play. Specifically, if changing subsistence resources from environmental hazards had an important impact on the development of complex social organization at El Dornajo, then there should be surges in this development around 500 BC, 600 AD, or 1100 AD, with the century and a half of increased ENSO activity following the mega El Niño at 600 AD seeming a particularly propitious period for such factors to have a major and lasting impact. If interaction with more complex neighbors had an important impact on the development of complex social organization at El Dornajo, then the period of expanded trade interactions with more developed neighbors between 800 and 1000 AD should witness substantial increases in social complexity. Either slow gradual development of complex social organization throughout much of the period between 500 BC and 1200 AD, or surges of social change at points in the sequence that correspond poorly to the scheduling of environmental events and inter-regional interaction, would indicate that neither of the sets of factors considered here had much impact on the trajectory of change. Looking for episodes of dramatic social change, then, and dating them, provide one approach to assessing the roles played by these two sets of factors.

One commonly used archaeological indicator of complex social organization is the differential distribution of more elaborate artifacts of special function or more desirable food remains, all taken to have been used especially by elites (Costin and Earle 1989, Smith 1987), whose residences may also be larger, more elaborate, and in closer proximity to the site center or public space than were ordinary households (Feinman and Neitzel 1984, Smith 1987). The degree of differentiation between households with such indicators of elite status and ordinary households may increase gradually over long periods of time or they may increase sharply at one or more points in the sequence. The pace and timing of these changes in the archaeological visibility of elite households have clear implications for assessing which of the two sets of factors acted strongly on social change at El Dornajo. Gradually increasing separation between elite and non-elite households would suggest a trajectory of gradual social change without episodes of major transformation and would give weight to factors other than those proposed here. A sudden increase in the separation between elite and non-elite households would not only suggest an episode of rapid social change, but make it possible to date it and compare its date with the expectations described above for the two sets of conditions explored.

A second commonly used archaeological indicator of complex social organization is monumental architecture. Mounds like that identified at El Dornajo are public, monumental construction efforts that involve access to and coordination of a labor force on the community rather than the household scale (Kolb 1994, Peebles and Kus 1977, Trigger 1990). Mounds can be built for ceremonial activity, elite habitation, or as burial monuments; the primary function of a mound may even change through time. The function of the mound at El Dornajo and the timing and pace of its construction is an important indicator of change in social organization. Incremental construction over generations with little or no change in patterns of use would suggest a trajectory of gradual social change without episodes of major transformation. A sudden increase in the scale of monumental construction or a dramatic shift in the function of public architecture would not only suggest an episode of rapid social change, but also make it possible to date it and compare its date with the expectations described above for the two sets of conditions. Gradual evolution in the scale and function of the architecture the mound represents would suggest an absence of particular episodes of strong social change and give weight to factors other than those examined here.

1.3.2 The nature of activities at El Dornajo

Comparing the timing of episodes of social change with the timing of the two sets of conditions is very suggestive, but it is of necessity an approximate endeavor, since neither thing is archaeologically datable with great precision. A second line of inquiry is thus also pursued. It centers on the activities associated with the elites whose emergence is one of the hallmarks of increasingly complex social organization.

The two sets of factors upon which this research focuses would, if important to the emergence of elites, imply that those elites engaged in particular kinds of activities. The opportunities that access to a network of trade with their more distant neighbors presented to aspiring elites at El Dornajo would have included the option to produce goods to export through the network (Earle 1997, Schortman and Urban 1987) and/or the option to serve as middlemen in the system (Muse 1991, Zeidler 1978). If elite households at El Dornajo were engaged in such networks some of the following materials might be expected to show up in the remains recovered, and especially in elite residential contexts: small greenstone carvings and spondylus objects that circulated in these networks; llama bone, since pack llamas were a means of transport both on the north coast of Peru (Shimada and Shimada 1985) and as far north as the highlands of Ecuador (Miller and Gill 1990); and *chaquira* (strings of beads) (Fonseca Z. and Richardson 1978, Marcos 1977) or *naipes* (thin copper-foil axes) (Marcos 1977), which had a monetary-like function at Spanish contact. In this case elite households might also have specialized storage structures or containers for the bulking of goods in route to other places (Muse 1991). If involvement in inter-regional interaction was important to the emergence of elites at El Dornajo, then we would expect this emergence to be accompanied by increases in the amounts of non-local goods, in the amounts of items that might have been used as currency, or in the production of likely goods for export.

In contrast, the opportunities that mega El Niño events (especially during times of heightened ENSO activity) presented to aspiring elites would have focused on the increased agricultural productivity of pockets of better-watered fertile soils. Thus there should be a dietary shift away from mangrove foods toward agricultural goods. If control of this increased agricultural productivity were exploited by aspiring elites while the productivity of previously important wild resources was depressed, then several kinds of materials associated with agricultural production would increase as elites emerged and would be especially associated with elite contexts. These include: cultivated plants, especially maize, beans, squash, and fruit trees which are all common to agricultural societies in southern Ecuador; tools for cultivation, such as stone or shell axes for tilling soil; and tools for the processing of plants, such as grinding stones. Elite households might also have more and larger storage features. Finally, the location of El Dornajo in relation to the plots whose agricultural productivity might be increased would also be revealing. If control of agricultural production were important to emergent elites, then El Dornajo would be expected to be located near a substantial quantity of such land when compared to other sites at this time.

In order to assess the importance of the two sets of conditions discussed above I consider four types of data in this thesis. First a geographical analysis of site location is undertaken. The extent to which El Dornajo is in greater proximity to fertile and well watered plots of land than other sites along the river is evaluated by doing a spatial analysis using existing soil maps and aerial photographs for the region. Second, an analysis of the spatial and temporal distribution of artifacts across the site is undertaken. This analysis uses data derived from random sampling of the site with $1m^2$ stratigraphic tests to recover artifact and ecofact assemblages. In some parts of the site it was necessary to make a 2m diameter surface collection in place of the $1m^2$ unit because of extensive destruction. These assemblages provided a large sample of the range and distribution of garbage throughout the residential area, thus reflecting how activities, subsistence practices, and statuses of residents varied through space and time. Third, small horizontal excavations were conducted to examine household contexts in more detail. With this data I identify the nature and distribution of household features. This data does not provide extensive information on house and storage differences at the site, but it does give at least a glimpse of what those differences amounted to. Finally, the mound and surrounding features are explored in order to assess the sequence of mound construction, including its pace and timing, as well as the nature of its use.

2.0 DEVELOPMENTAL TRAJECTORIES IN EL ORO-TUMBES

The El Oro-Tumbes region has received little archaeological attention for both practical and academic reasons. In practical terms, the border between Ecuador and Peru was contested throughout most of the twentieth century making the region unsafe for investigation. Academically, because the archaeological remains in this region are modest by comparison with their neighbors, the area has not incited much interest. In fact, it has been seen as the boundary between the northern and central Andean culture traditions and thus peripheral to the socio-political trajectory of either area (Estrada et al. 1964, Feldman and Moseley 1983, Meggers 1966). Consequently, academic interest in the region has focused on understanding why the culture area boundary fell here (Burger 1988) and on identifying the shifting location of this boundary through time (Hocequenghem 1998). Recent publications on the region continue to focus on the boundary/frontier nature of the region by identifying local traditions and their relationship to neighboring traditions (Guffroy 2008, Valdez 2008). The focus on the region as a boundary or frontier has lead to a lot of attention on inter-regional interaction without understanding the local context. This chapter aims to describe what we can say about the socio-political trajectory of this region given what little we do know. First, however, it is necessary to briefly consider the chronological challenges of the region.

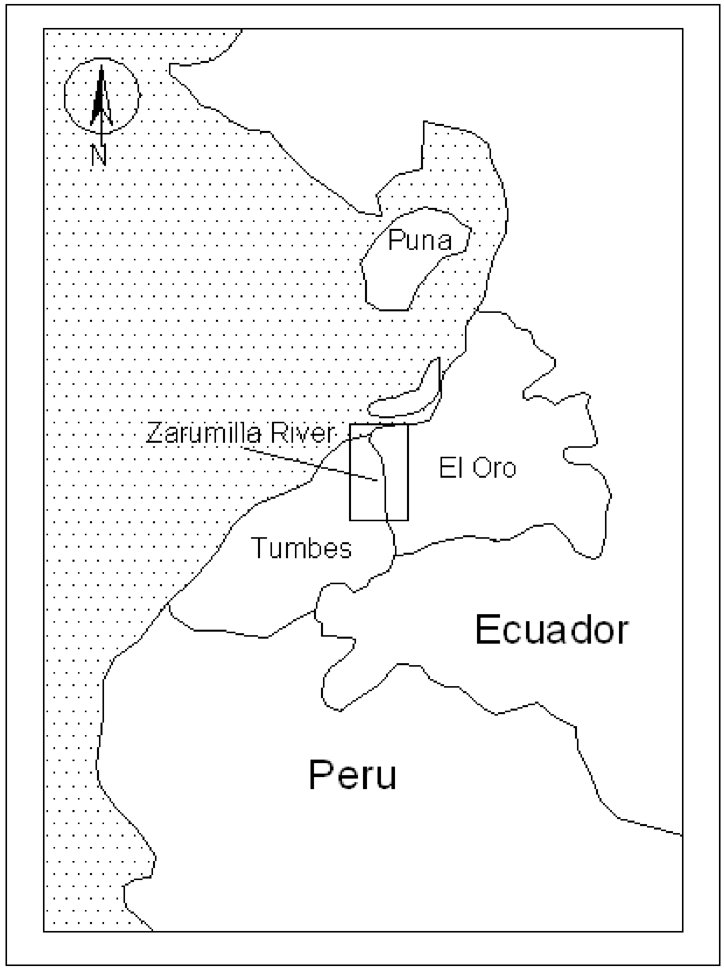


Figure 2.1 Map of the locations of the El Oro and Tumbes provinces.

Together they comprise what is referred to as the El Oro-Tumbes region in this dissertation. The Zarumilla River region is located in the middle of the El Oro-Tumbes region, as indicated by the box on the map.

2.1 CERAMIC CHRONOLOGY

Existing ceramic sequences for the El Oro-Tumbes region are not sufficiently developed to allow relative dating on the basis of ceramics. This is largely due to the very limited amount of work conducted in the region. Also, because the region spans the border of two countries, there are two separate chronologies for what is clearly one prehispanic tradition. This, of course, is the result of the intellectual boundaries formed by modern political borders, and the biases they impose on social scientific research.

The classic chronological framework used in Ecuador is divided into three periods: Formative, Regional Development, and Integration. Although Meggers (1966) was the first to apply calendar dates to this sequence it is unclear upon what basis, and the dates for the sequence have since been refined by Paulsen (1970), Currie (1985), Aleto (1988), and Masucci (1992) using radiocarbon dates from throughout southwestern Ecuador. The most widely cited scheme is as follows: Formative Period 3000–300 BC (divided into an early and late phase at about 1000 BC), Regional Development Period 300 BC–800 AD, and Integration Period from 800 AD to the fall of the Inca Empire in 1532 AD (Currie 1985).

White-on-red decoration has been viewed as a “horizon style” in southwestern Ecuador and has been the characterizing marker of the Regional Development Period (Estrada at al. 1964, Meggers 1966). The first stratigraphic excavation in the Tumbes Province was Izumi and Terada’s (1966) project at Pechiche and Garbanzal in the 1950s. While nine radiocarbon dates were analyzed from their work, the authors found the dates suspicious because they did not conform to the three part scheme discussed above due to the fact that white-on-red ceramics were not restricted to the Regional Development Period. Aleto (1988) also found that white-on-red ceramics appeared prior to the Regional Development Period on Puná Island and suggested a Late Formative Period origin. Izumi and Terrada, however, disregarded their dates and maintained that ceramics stratigraphically earlier than white-on-red dated to the Formative Period and included incised sherds, white-on-red ceramics dated to the Regional Development Period, and those stratigraphically later were considered Integration Period and included black ware sherds. Lanning (1963) and later Richardson et al. (1990) developed a different chronology for Tumbes grounded in the classic Peruvian culture chronology of the Initial through the Late Intermediate Periods and based on surface collections from numerous sites. The Initial Period (1000–600 BC) is characterized by incised and combed decoration. The Early Horizon and Early Intermediate Periods (600 BC–500 AD) are defined by fine white-on-red decoration and negative painting. The Middle Horizon, Late Intermediate and Late Horizon Periods (500–1500 AD) are defined by mold-made ceramics, black ware, and paddle stamping; as well as sloppy white-on-red (Richardson et al. 1990). The chronologies developed by Izumi and Terrada and Richardson et al. do not differ substantially, except in that Richardson et al. did not disregard their radiocarbon dates and were therefore able to distinguish two kinds of white-on-red ceramics and recognize them as dating to different periods.

In recent years the Tumbes Archaeological Project directed by Dr. Jerry Moore, has undertaken to develop a refined ceramic sequence for the region on the basis of stratigraphic excavations and numerous radiocarbon dates from four sites in Tumbes, three of which are on the Zarumilla River. Moore's chronology does not differ much from those discussed above but it is based on many more stratigraphically excavated radiocarbon dates and is therefore more precise and refined. While development of the chronology is still in its initial stages, a basic chronology has been devised. The Archaic or Pre-ceramic Period dates between 4000–3500 BC. The Formative Period can now be divided into three phases. The Early Formative Period (3500–1550 BC) is not yet associated with any particular ceramic tradition. The Middle Formative Period (1550– 1000 BC) is associated with Late Valdivia (Phases 6-8) and later Pechiche ceramics. The Late Formative Period (1000–300 BC) is associated with relatively well made Garbanzal white-on-red ceramics (Moore 2010). Thus it is clear that Aleto (1988) and

Richardson et al. (1990) were correct and white-on-red ceramics can no longer be considered a marker for the Regional Development Period exclusively. Moore and his colleagues have not located an Early or Middle Regional Development Period site so this period remains poorly understood. The Late Regional Development Period dates from 1100 to 1400 AD and is associated with Jambelí Incised and Jambelí White-on-Brown (Pajuelo 2006). Jambelí White-on-Brown ceramics seem to be similar to the sloppy white-on-red ceramics identified by Richardson et al. (1990).

When the white-on-red tradition ends and the white-on-brown tradition begins is not yet known, but it must take place during the Regional Development Period. The data in this dissertation suggest that that transition does not take place until later in the Regional Development Period, perhaps around 800 AD. This interpretation is consistent with Richardson et al. (1990) where a sloppy white-on-red ceramic variety replaces a fine white-on-red variety in the Piura phase. Moore (2010) tentatively suggests that the Regional Development Period also be divided into three phases: an Early Regional Development Period (300 BC–800 AD), a Middle Regional Development Period (800–1200 AD) with possible Lambeyeque/Sicán influences, and a Late Regional Development Period (1200–1400 AD). The Integration Period in Moore's chronology dates from 1470 AD when the Chimú and later the Inca Empires reached the region.

Considered in concert, these data provided an initial, if rough, chronology for the region. In Table 2.1 a developing ceramic chronology based on Moore (2010), Richardson et al. (1990), Izumi and Terrada (1966), and the data from this dissertation is provided. This table forces Izumi and Terrada, Richardson et al., and my own work into Moore's scheme in anticipation of its greater applicability and popularity in the near future.

Table 2.1Combined ceramic chronology

Period	**Dates**	**Ceramic Styles**
Early Formative	3500–1550 BC	?
Middle Formative	1550–1000 BC	Pechiche, Valdivia 6-8, Paita
Late Formative	1000–300 BC	Garbanzal White-on-Red, Paita, Sechura
Early Regional Development	300 BC–800 AD	Garbanzal White-on-Red, Sechura
Middle Regional Development	800–1200 AD	Piura
Late Regional Development	1200–1400 AD	Jambelí White-on-Brown, Piura
Integration	1470 AD–Contact	Chimú-Inca, Piura

2.2 DEVELOPMENTAL TRAJECTORY OF THE REGION

By grouping existing data from previous research into the chronological framework developed by Moore (2010) an initial image of the developmental trajectory of the region can be drawn. Throughout this section an effort is made to look at the Zarumilla River and the rest of the region separately so that the trajectory in the Zarumilla River Valley can be contextualized regionally by comparison with its nearest neighbors. See Figure 2.2 for the locations of many sites in the text.

2.2.1 Archaic Period

There was very likely an extensive coastal occupation in the region during the Archaic Period. A number of shell mounds stretching from Puerto Bolívar to Zarumilla with little to no ceramics (Willey 1946) probably date to this period. Some of these mounds are 5ha in size and 10m high, suggesting that they were used for many centuries. Unfortunately the vast majority of all coastal shell middens have been destroyed for shrimp farming, so it will not be possible to evaluate their temporal associations more clearly. Several small lithic sites along the Tumbes coast indicate that this part of the region also had a coastal occupation at this time (Peterson 1956).

An inland component of settlement is visible at this early date in the lowest level of occupation at El Porvenir on the Peruvian side of the Zarumilla River, 14km inland. A ca.18m^2 circular pole-and-thatch house dating to 4700–4300 BC indicates that the site was occupied on a permanent basis (Moore 2010). This gives settled village life great antiquity along the Zarumilla River.

2.2.2 Formative Period

Zarumilla River. In the Formative Period (3500–500 BC) El Porvenir was a 3ha village of modest house mounds arranged in a ring around an open area. Houses were elliptical pole-and-thatch structures between 15 and 48m^2. Moore (2010) estimates perhaps four other such villages in the region at this time. Very likely the sites of Cuchareta Baja and Cerro Huaco, each 1-2ha in size, would be among these four (see Figure 2.2). El Dornajo also has a 1ha Early Formative Period occupation. At ca.1000–500 BC, in the Late Formative Period, there was a shift to rectangular wattle-and-daub structures of the same size range (Moore 2010).

There was one Formative Period central place along the Zarumilla River, Uña de Gato, about which Moore (2010) provides most of the information that is available. Uña de Gato consisted of a public/ceremonial core with three mound constructions surrounded by an occupational zone. In total, the site covered 20ha or more, with a 2ha public core (Moore et al. 2008). Mound II was first built in the Early Formative Period (ca. 2200–1800 BC) as a ramped platform made of rubble and midden capped in clay about 1m high and ca. 400m^2. Most of the construction at Uña de Gato dates to the Late Formative Period, at the same time that the change in house form is seen at El Porvenir. At this time (ca. 1000–800 BC) the platform on Mound II was expanded and modified to create a stepped platform about $850m^2$ some 1.5-2m high. The expansion was built using a box-and-fill technique with bread-loaf adobes. Mound I, ca. $600m^2$ and 5.4m high was constructed at this time (1000–800 BC). It began as a small stepped platform about 1.65m high built of loaf shaped adobes with red walls. It was later covered in midden deposits and capped with clay. The mound was then expanded and remodeled using a rubble-filled tapia retaining wall and by building a tapia construction based bench. Finally, the mound was once again covered in clay and midden rubble, then capped with clay. All of these construction phases happened over a relatively short period of time, with the fourth and final phase being the largest. Mound III was also built during this period (1100–750 BC). This is a small mound made of semi-spherical red adobes which cut into a Middle Formative shell midden. Mound III also had a bread-loaf adobe and wattle-and-daub construction dating to the very end of the Late Formative Period (780–450 BC). The interior walls of this structure were covered in painted and modeled clay decorations.

El Oro-Tumbes Region. Full coverage survey between the Arenillas and Buena Vista Rivers by Netherly and her colleagues in the 1980s identified eleven Early/Middle Formative Period sites, three with public architecture and the remainder about 5ha in size. Most of the information on this project comes from Staller 1994. The largest of the sites with public architecture is La Emerenciana (2200 BC and 1850–1650 BC), located 2km south of the active shoreline along the Buena Vista River. The site was 12.7ha in size with two mounds. One mound was investigated and is an elliptical platform $2670m^2$ in size and 1.5m high. There may have been a structure on the summit. The platform is a natural hill modified with filled-in retaining walls. Two wattle-and-daub oval platforms built on top of the platform oppose one another to the north and south. A smaller elliptical platform mound was 750m^2. Four burials found in the first platform were all wrapped in cloth and placed in a flexed upright position in pits filled with midden deposits and containing few to no burial goods (Staller 2001). The other two sites with public architecture are Jumón and Laguna del Cañas, each greater than 10ha in size and both located on the floodplain of the Arenillas River. Jumón has two mounds.

In contrast, Puná Island was lightly occupied during this period. El Encanto is an Early Formative Period site, 2600–1700 BC, of 1.5ha with up to 32 conical mangrove oyster shell mounds surrounding an open area (Porras 1973). Bellavista on the west side of Puná is a Late Formative Period site, 510 BC ± 100, (Parducci and Parducci 1975 as cited by Aleto 1988), though this date is likely uncalibrated. Bellavista measures about 1ha or less and includes burials on a terrace above a domestic midden. The sites of Bellavista and El Encanto are part of a light scatter of artifacts across much of the western side of the island at this time (Gundrum 1992).

To the south along the Tumbes River evidence for an Early Formative Period occupation at the site of Santa Rosa was recovered by Moore and his colleagues (Moore et al. 2008). A 120m^2 elliptical structure with a cobblestone base was built ca. 3500–3110 BC. The size of this structure may indicate that it is public in nature, though it is not clear (Moore 2010). The sites of Pechiche and Garbanzal 10km inland on the Tumbes River have a Late Formative Period occupation (1310–50 BC and 2570–1880 BC respectively) (Izumi and Terrada 1966 dates calibrated by Moore in Vilchez et al. 2007). These sites do not have public architecture.

Formative Period Summary. Throughout the region, there seems to be a greater focus on inland settlement than had been true during the Archaic Period. With the exception of Puná, there is also some evidence for emerging complexity in the form of public architecture and central sites throughout the region. The timing of those changes and the architecture itself are quite variable, however, indicating separate local developments. The Zarumilla River (and maybe the Tumbes River) has a central site with public architecture in the Early Formative Period. The Arenillas River does not have public architecture until the Middle Formative Period. Only the Zarumilla River has a surge of construction in the Late Formative Period.

We do not know enough about settlement in Tumbes to say anything, but what little data we have for the Arenillas and Zarumilla rivers present very different pictures. These differences could be a bias resulting from full-coverage survey around Arenillas and only opportunistic reconnaissance along the Zarumilla River. But because sites are generally visible on the surface near the Zarumilla River, the differences may be meaningful. Site size and number of sites indicate that the Arenillas River may have had twice as many people as the Zarumilla River, but they were more evenly distributed on the landscape. Perhaps half of the total population of the Zarumilla River Valley may have been living at Uña de Gato by the Late Formative Period. This site is also the most elaborate of the centers boasting the largest public architecture for the region during this period. While not grandiose in comparison to Central Andean centers of this time, Uña de Gato is precocious for the region. There are no sites in the region with public architecture or radiocarbon dates between about 300 BC and 300 AD, suggesting that all three areas underwent a decline in centralization and public architecture by the middle of the Late Formative Period.

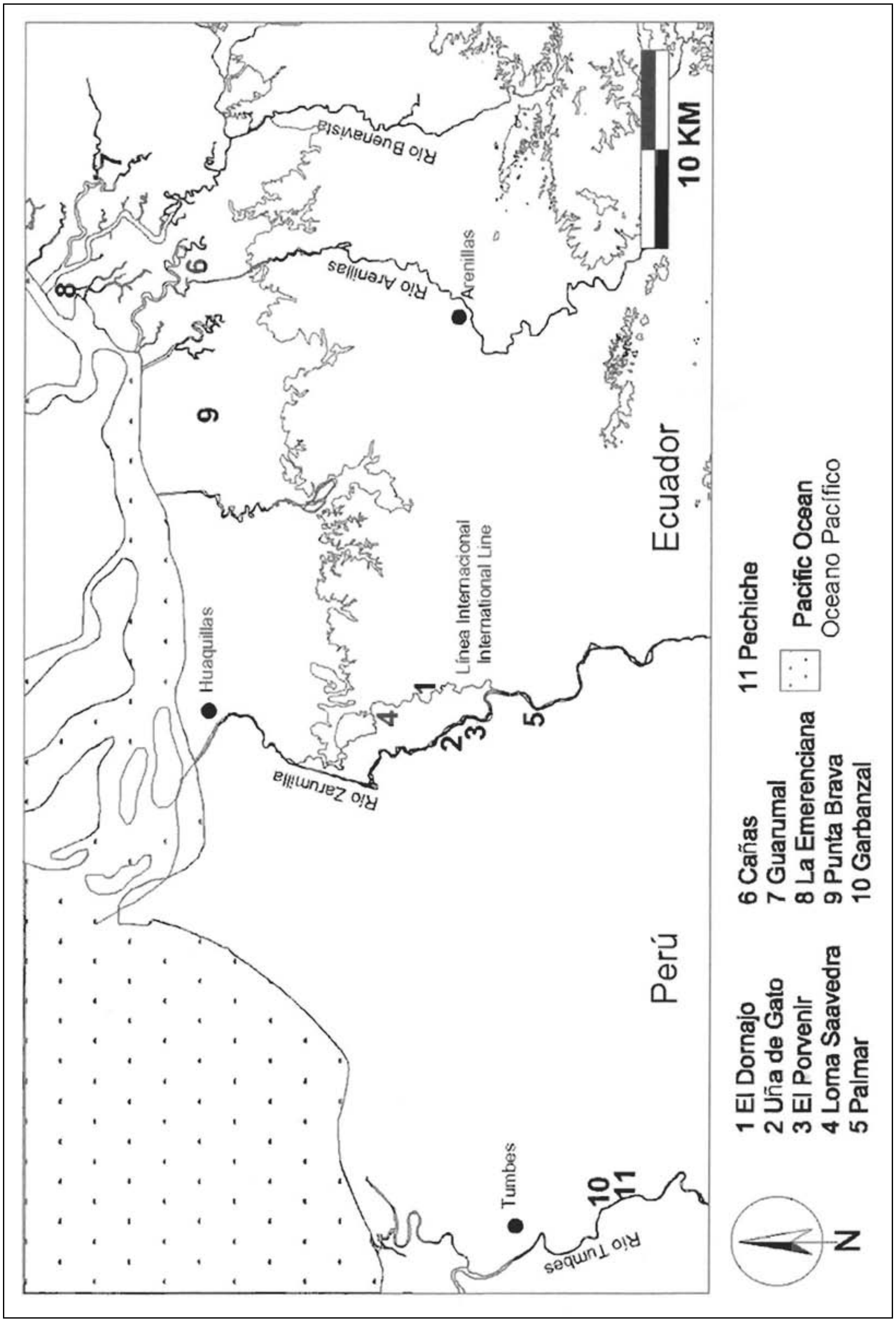


Figure 2.2 Map of the Tumbes, Arenillas, Buena Vista, and Zarumilla Rivers with locations of all known sites.

2.2.3 Early Regional Development Period

Zarumilla River. El Dornajo is the only site securely dated to this period along the Zarumilla River. It is a 5.5ha site with modest public architecture, and the only site known to have public architecture during this period. There is some reason to believe that a few other sites along the river may date to this time period, including the site of Loma del Zorro (a 1ha residential site), Hualtaco (a site located at the mouth of the river), and La Palma. All of these sites have notably more fine decorated ceramics than sites from other periods.

Estrada, Meggers, and Evans 1964 located four sites on high areas in mangroves of the Jambeli Archipelago that may date to this period on the basis of similarities to El Dornajo in vessel forms. These sites are about 1ha in size and only 20-40cm deep. Las Huacas on the north side of the archipelago has more worked shell than any other site in the region even though it was only surface collected; sixteen spondylus beads, 1 carved conch, and 7 other carved shells were recovered. Hualtaco would have been a coastal site of unknown but potentially large size based on stories during the construction of the modern city of Huaquillas. Fine vessels were reportedly uncovered during destruction of the site.

El Oro-Tumbes Region. Staller (1989) notes an increase in the number of sites along the coast in the Arenillas area during this period. One such site is Punta Brava, near Puerto Pitaya, which is a 2.5ha residential site with wattle and daub house remains (Currie 1989). Staller (1989) also notes that centers are to be found along the coast at this time rather than inland. These centers are larger than other sites but do not have public architecture. Guarumal, excavated by Currie (1989), may be one such site. Guarumal is a 15ha site with six kidney-shaped, 2-3m high, midden shell mounds. Both pile-built and wattle and daub structures were noted (Currie 1989).

While the dates for these sites are not all reliable according to Currie (1989), they suggest an Early Regional Development Period occupation in or around 300/10 BC–200/500 AD. The presence of dense oyster deposits suggests that there was likely a Formative Period occupation at these sites as well. Idrovo (1994) also excavated at Guarumal and notes that some 15% of the assemblage from his collection is decorated. The area excavated by Idrovo may also have had fewer serving vessels than that excavated by Currie (Taylor 2010). These data suggest that there could be some social differentiation at Guarumal in the form of differential wealth though no public architecture was present. Since these data are based on reports for which total counts of ceramics and excavation methodology are not available, however, this conclusion may be mistaken.

Estrada, Meggers, and Evans (1964) located four sites on the eastern side of Puná that may date to this period on the basis of ceramic forms, but no additional data is available.

Moore et al. (1997) visited seven sites along the Tumbes River that may date to this period; San Francisco, Zanja Nueva, Los Cerritos, Casa Blanqueada, San Jacinto, Tanque Puerto Pizarro, and Pichichal. All are ca.1-2ha in size. No large sites or public architecture were identified.

Early Regional Development Period Summary. This period is poorly represented throughout Ecuador, and the El Oro-Tumbes region appears to be no exception. Nonetheless, some observations can be made. There remains no evidence for complexity on Puná Island, nor is there any in the Tumbes River Valley. The Zarumilla and Arenillas river valleys, however, once again each have evidence for settlement hierarchies during this period. The central sites are not the same places identified as central sites during the Formative Period, however, and they differ substantially from their earlier counterparts. In the Arenillas River area there is no evidence for public architecture though there may be wealth differences at Guarumal.

The Zarumilla River valley is the only part of the region with public architecture at this time. However, El Dornajo is a far smaller and less architecturally elaborate central site than Uña de Gato was and it lasted for much less time as well. Like Uña de Gato, however, El Dornajo may have up to half of the valley population based on total occupied hectares.

Sites in the Arenillas and Zarumilla river valleys both show more wealth than they did in earlier periods, as well as greater stylistic similarities with each other. The modest presence of carved shell and metal items may indicate increased interaction with groups outside the region since there is currently little evidence for the production of such items within the region. The focus in this period appears to have been on modest wealth accumulation as opposed to monument construction. While these interpretations are based on very little data, they are nonetheless suggestive of a period of increased trade and interaction and an overall decline in complexity when compared to the Late Formative Period.

2.2.4 Middle-Late Regional Development and Integration Periods

Zarumilla River. The only site dated to this period on the Zarumilla River is Loma Saavedra which is a large village some 28ha in size with no evidence of public architecture or differential wealth distribution, though little of the site has been excavated. The site dates from 1100–1500 AD (Vilchez et al. 2007). Both Chimú and Chimú-Inca ceramics were found at the site, but there is no evidence of foreign occupation or control (Moore 2010). Presumably there are unidentified sites along the river or on the coast with an Integration Period occupation. This is especially true along the coast where most sites were destroyed by shrimp farming. Nonetheless, the large size of Loma Saavedra and the failure thus far to identify any other sites for this period, indicate that population may have been highly centralized at this time. Despite this centralization, the work done at the site to date does not suggest social differentiation.

El Oro-Tumbes Region. To the north there is evidence for Milagro-Quevedo expansion into the region. The site of Cañas, 9km inland near Santa Rosa Ecuador is the most southern Milagro-Quevedo site known to date. The site is over 20ha in size and boasts several large mounds 8-10m high and 100-150m^2 at their base. Chimney burials were found in one mound (Staller 1994). Hacienda La Esperanza, 15km inland on the Jubones River (Christiansen 1956) is another large Milagro-Quevedo site. The site has one rectangular 216m^2, 2m tall mound; one stepped platform mound; and one kidney-shaped mound ca. 650m^2 and 3m tall. Burials were excavated in the mound (Christensen 1956).

At the time of Spanish contact Puná Island was the seat of a small chiefdom with somewhat pronounced social differentiation. There were reportedly seven chiefs who were ruled over by one grand chief who was surrounded with considerable pomp including many wives and servants (Cieza de León 1962, Pizarro 1978). There is no archaeological fingerprint for this ethnohistoric information.

Areas along coastal Tumbes show some social development in the Late Regional Development or Early Integration periods. Los Organos, 12km north of Cabo Blanco, is a residential and cemetery site with 6m^2 stone based house structures. This is the site where a female skeleton wearing a gold lip-plug, known as the “gold-lipped *tallan* woman” was found (Peterson 1955). Numerous similar sites appear in and around Quebrada Honda and Quebrada Pariñas (Christensen 1956). Several of these sites have *palateada* ceramics suggesting a pre-Inca occupation. Specifically, these ceramics are taken to indicate Sicán interaction and are the basis for placing these sites in the Middle to Late Integration Period. *Palateada* ceramics have not yet been securely dated to this period, however. An additional 15, ca.1-2ha sites have been identified along the Tumbes River, all of which are along what is later the Inca road. These sites have both Inca and *palateada* sherds suggesting that the Inca road may have been in use before the Inca arrived. Finally, the sites of Pechiche and Garbanzal have Late Regional Development Period occupations dating from 880–1410 AD (Izumi and Terrada 1966 dates calibrated by Moore in Vilchez et al. 2007). Garbanzal I had boot-shaped tombs (Ishida et al. 1960) and 34 copper *naipes* (Mejia Xesspe 1960), which are characteristic of both Sicán and Milagro-Quevedo polities. All of these data indicate that there was greater wealth and inter-regional interaction in Tumbes during this period though no public architecture is present. This pattern is like that identified in the Zarumilla and Arenillas river regions during the Early Regional Development Period and support the hypothesis that trade between the central and northern Andes shifted from an inland to a coastal route at this time (e.g. Hocquenghem 1998).

Tumbes demonstrates remarkable growth during the Integration Period, most of which is probably very late and likely due to its importance as a port in the Inca Empire. Cabeza de Vaca or Corrales is a site of over 100ha. (Moore et al. 1997) with a double-walled rectangular Inca fortress. The primary occupation at Santa Rosa is also during the Integration Period 1400-1500 AD. At this time the site is a large, 25ha site used primarily for funerary activity of a local variety that does not appear to have been influenced by either the Chimú or the Inca, though both ceramic types are present in the burials (Moore 2010).

Middle/Late Regional Development and Integration Periods Summary. During the Middle to Late Regional Development Period Tumbes appears to have come into greater contact with central Andean polities like the Sicán, and northern Andean polities like the Manteño and the

Milagro-Quevedo. The sprinkling of *palateada* wares and *naipes* across the region may be associated with increased trade between the Manteño or Milagro-Quevedo chiefdoms and Sicán state. By the Integration Period Tumbes was clearly under the influence of the Inca and the Inca road ran through the region ending at the fortress of Cabeza de Vaca/Corrales. El Oro province, on the other hand, came increasingly under the influence of Milagro-Quevedo polities and small sites with public architecture and wealth accumulation sprang up here and there. None of these sites ever develops to the scale of those seen to the north in the Guayas Basin.

The Zarumilla River shows no development during this period. This may be due to the lack of research in the region, or it may have become a kind of buffer zone between the central and northern Andean polities. The Tumbesinos and the Punáe were enemies at the time of Spanish contact (Cieza de León 1962, Pizarro 1978) and the Zarumilla River valley lies intermediate to these places, thus the lack of population/sites dating to this time may be real.

2.3 CONCLUSIONS

A survey of previous research in the El Oro-Tumbes region suggests that the Formative Period was a dynamic one during which separate traditions developed in different parts of the region, each having a surge of complexity at different times during the period. The Zarumilla River appears to have developed complexity earlier, lasted longer, and developed in a more pronounced way than its neighbors.

In contrast the Early Regional Development Period is one of generally lesser complexity than seen in the Late Formative Period. This period also shows more evidence of interaction in the region stylistically as well as greater wealth accumulation. El Dornajo is the only site in the region known to have public architecture at this time and represents a very different kind of complexity than seen in the previous period. El Dornajo is characterized by modest wealth accumulation as opposed to large monumental constructions. The amount of time separating the decline of Uña de Gato and the emergence of El Dornajo as central places is uncertain though existing radiocarbon dates suggest a roughly 500 year hiatus.

The Middle/Late Regional Development and Integration Periods are characterized first by a decline in complexity, then by Milagro-Quevedo expansion in El Oro, and later by centralization around the Inca site of Corrales in Tumbes. While wealth accumulation and centralization are seen in El Oro and Tumbes, both are conspicuously absent along the Zarumilla River.

In the context of this very general regional trajectory the Zarumilla River Valley can be seen as following a different trajectory than that of its neighbors. Within the Zarumilla River's developmental trajectory El Dornajo represents one of two moments of complexity. Social complexity at El Dornajo appears to differ from that at Uña de Gato. Furthermore, this social change occurs during a period of potentially greater regional interaction than had been seen earlier. El Dornajo declines just when inter-regional interaction in the rest of the El Oro-Tumbes seems to really heat up.

What this generalized trajectory does not tell us is just when within the very long time span represented by the Regional Development Period El Dornajo became a central place that could be characterized by social inequality. Neither do we know whether it emerged as a center rapidly or over several centuries. These are precisely the things that we need to know to address the timing and pace of social change at the site, and consider how they compare to the expectations outlined in Chapter 1. Specifically, whether the site emerges at the same times as the conditions herein examined, and whether or not social change happens rapidly as our models predict it should.

3.0 THE SITE OF EL DORNAJO AND PROJECT METHODOLOGY

3.1 FIELD METHODOLOGY

El Dornajo is located 12km from the coast and 10km from the foothills of the Andes Mountains on the coastal plain above the Zarumilla River floodplain. The site consists of cultural deposits on two of a series of slightly undulating hills created by the gradual erosion of softer sediments at the edges of harder strata, at an average elevation of 20masl. Unsystematic survey of the hills 200m in all directions confirmed the absence of additional cultural remains, thereby substantiating the designation of both hilltops as pertaining to one site. The northern hill is referred to as Loma Segarra while the southern hill is artificially divided into two hills for analytical purposes since half of the site in this area is destroyed. The eastern side of the hill is referred to as Loma Blasio while the destroyed western half is called Loma Alvarado (Figure 3.1). The names reflect those of the land owners at the time of fieldwork. The entire area has been used repeatedly in military campaigns and has numerous war trenches along the western edges of the hills as well as additional military-related disturbances such as a bunker and roads across Loma Blasio, and ramparts on top of the *tola*/mound.

The site boundaries were determined by a combination of surface survey and shovel tests. Until recently all of the land that the site sits on belonged to the Pizarro family and was used for cattle ranging. In 2007 Loma Segarra was purchased by Gerardo Segarra, along with several surrounding hectares, for the purpose of planting hardwood trees. There is no record of this land having been planted in the past due to the expense of irrigation. At the time this project was undertaken Loma Segarra had very recently been cleared to prepare the land for cultivation. The hill was cleared with a backhoe which was used to fell trees. The underbrush was burned and all of the debris was pushed into piles. This process scraped approximately 10cm of soil off the surface of the site, but displaced artifacts very little. As a result, the boundaries of the site on this hill could be easily identified by the distribution of artifacts on the surface of the hill.

Loma Blasio and Loma Alvarado were sold to the Aponte family in the 1970s. The Apontes built a house on the far eastern end of the hill, raised pigs, and cultivated a small plot of land on the far eastern edge of the site. In the 1980s a construction company scraped this portion of the site to test for high quality gravel and sand deposits. Old backdirt piles suggest that this part of the site was originally occupied sparsely though no intact deposits remain.

In 2000 the Apontes sold Loma Blasio to George Blasio. Blasio has done nothing with the land and it was covered in dense winter growth at the time of fieldwork. The boundaries of the site in this area were defined through systematic shovel testing following clearing of the site with machetes. Shovel tests were spaced 20m apart and were not screened. The boundary was placed at the last positive shovel test, after two consecutive negative tests had been dug.

In the 1990s the Apontes sold Loma Alvarado to Lenin Alvarado. Alvarado exploited the hill for its underlying sand and cobble sediments which are used in the manufacture of concrete and as fill for low-lying parts of the city of Huaquillas. These deposits were exploited with the use of large machinery and resulted in the near complete destruction of this side of the hill leaving large back-dirt piles of cultural deposits which had no commercial value. The site is assumed to have originally covered all of this side of the hill. The boundaries of the site were therefore defined as the estimated boundaries of the hill itself.

The portions of the site referred to as Loma Segarra and Loma Blasio were divided into $2500m^2$ blocks and one 1m x 1m test unit from each block was selected for excavation using a random number generator (Figures 3.2 and 3.3). When fewer than seventy artifacts were recovered from a unit, an additional 1m x 1m unit was excavated next to it. In this case the artifacts from both units were combined in order to increase the sample size of the test unit and therefore improve statistical significance. The portion of the site referred to as Loma Alvarado was also divided into $2500m^2$ blocks; but since most of this part of the site is no longer intact, units were chosen more opportunistically. Four of the six units on Loma Alvarado are 2m dog-leash surface collections of back-dirt piles. Two units were placed in intact deposits along the cut between Loma Blasio and Loma Segarra. In total there are twenty-three units referred to as the test units which comprise a sample of artifact distribution from across the site. Randomly selected test units were located using a Garmin GPS76 set to the WGS84 datum. Test units were excavated in 20cm levels within natural/cultural strata. All soil was passed through a ½" screen mesh and all artifacts were recovered from the screen. A 2L soil sample was collected from each level of excavation and was water-screened in 1mm mesh to improve the recovery of fish bone and micro-artifacts.

Three 1m x 1m units were placed on the north, south, and east edges of the *tola* to look at *tola* construction through time. No unit was placed on the northern edge of the *tola* because there are military berms and trenches in this area and the Ecuadorian military was concerned with their potential disturbance. Trenches and berms were profiled, however. Like the test units, the *tola* units were excavated in 20cm levels within natural/cultural strata. All soil was passed through a

½” screen mesh and all artifacts were recovered from the screen. A 2L soil sample was also collected from each level of excavation and later water-screened in 1mm mesh.

Finally, horizontal excavations were opened up around Units 7 and 10 on Loma Segarra in an effort to look more closely at house features, and around Unit 16 on Loma Blasio to look at burial features. These units were excavated in natural/cultural strata and all soil was passed through a ½” screen mesh. Shell was weighed in the field but not collected. All other materials were collected. Two liter soil samples were not collected from these units; instead, one unit in each area was 100% wet screened through 1mm screen mesh. Previous excavations in the area have noted that some 91% of fish bone is lost in ¼” screen mesh and have recommended that one unit be treated this way in each area of excavation (Vilchez et al. 2007). This methodology is extremely time consuming and expensive making it impossible to use with my testing strategy. For this reason, only one unit in each broader excavation was treated thus. All water screening took place in the Arenillas River near the field house in Arenillas.

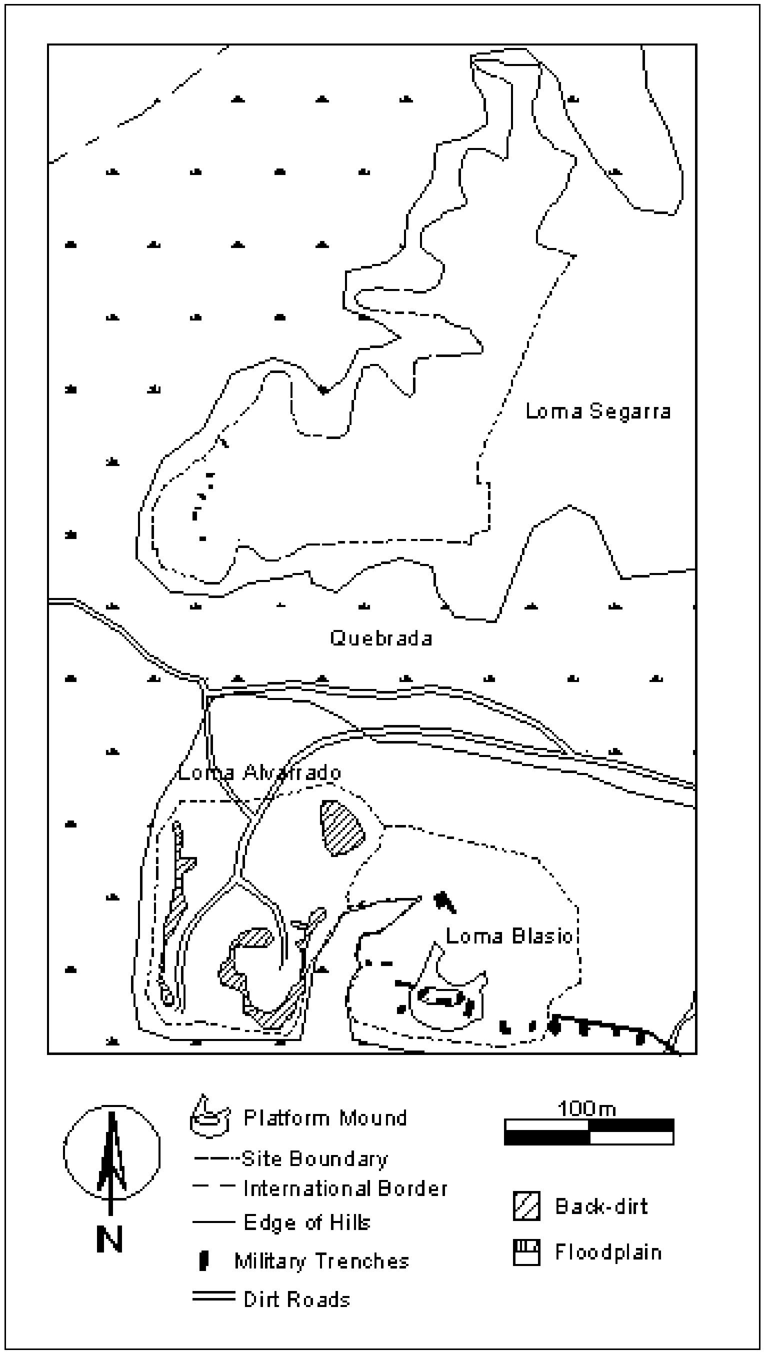


Figure 3.1 Map of El Dornajo and the three sectors of the site.

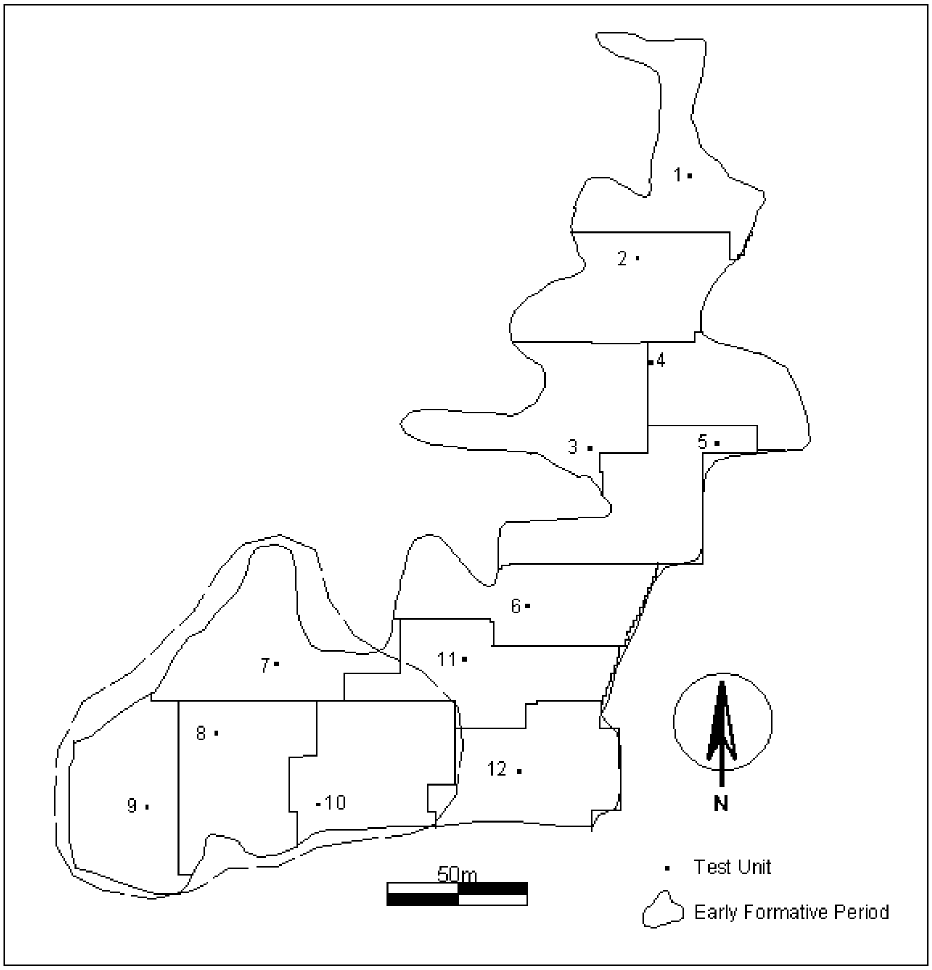


Figure 3.2 Map of Loma Segarra, including 2500m^2 blocks and test units.

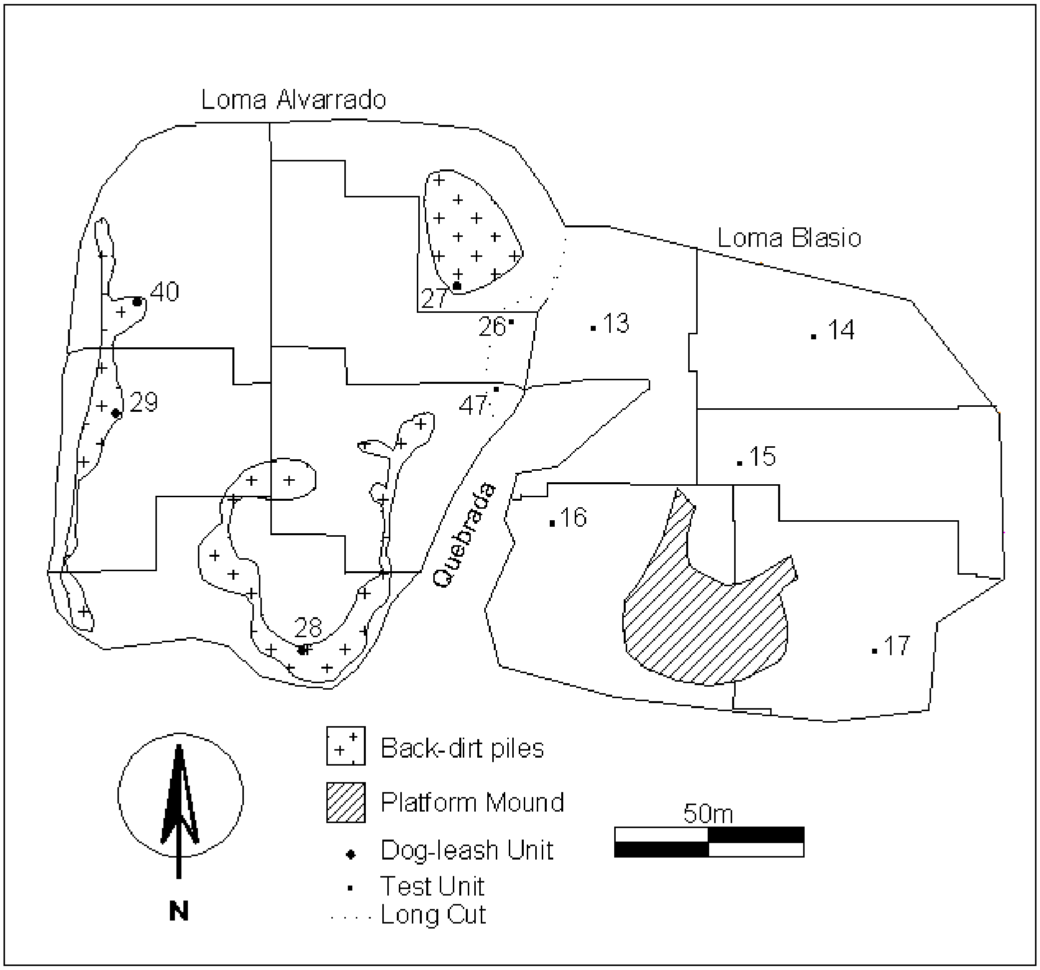


Figure 3.3 Map of Loma Blasio and Loma Alvarado, including 2500 m^2 blocks, test units, and dog-leash units.

3.2 SITE STRATIGRAPHY

Units on the eastern sides of both hills (1-6, 11-15, 17) have only one cultural stratum ranging from 20-70cm in depth and consisting of a very low density of artifacts (Figure 3.4). Geologically this stratum is a moderately hard, dark brown clay that overlies an extremely hard dark brown aridisol. This is the hard stratum that the coastal plain is made of in this region. Units on the western end of Loma Segarra (7-10) have two cultural strata overlying a 10cm soft yellow silt deposit on a hard dark brown aridisol. The silt layer (Stratum C) is a thin flood deposit containing small and well rounded grains of iron oxides. The lower cultural stratum, Stratum B, is 30cm-1m in thickness and consists of an extremely dense shell midden with little soil. The upper stratum, Stratum A, averages 20cm in thickness and consists of a dense shell midden in light brown silt (Figure 3.5). Unit 26 (Figure 3.6), on the edge of Loma Blasio and Loma Alvarado, has two cultural strata that overlie a 1+m thick, soft yellow silt deposit (Stratum C) on top of a paleo-river channel. The yellow silt is a flood deposit. The lower stratum of Unit 26, Stratum B, is a 50cm thick, dense midden deposit of light brown silt. The upper cultural stratum, Stratum A, is 35cm thick and consists of a moderately dense midden deposit of light brown silt. Above Stratum A there is 50cm of disturbed overburden which appears to have been scraped into a pile. Unit 47 (Figure 3.7), also on the edge of Loma Blasio and Loma Alvarado has three cultural strata overlying a 40-70cm thick yellow silt deposit on top of an ancient river channel. This is the same flood deposit seen in Unit 26. Stratum F, the lowest stratum, is a 60cm thick moderately dense midden deposit of light brown silt. Stratum F is overlain by a 10cm thick yellow silt deposit (Stratum E) which was probably culturally deposited since there is no mixing at the interface of the strata and Stratum E has moderate artifact density. Stratum E is overlain by Stratum D, a 60cm thick moderately dense midden deposit of light brown silt. Stratum D is overlain by Stratum B, a 20-40cm thick moderately dense midden. Stratum B is in part overlain by yet another 10cm yellow silt deposit (Stratum C), which is similar to Stratum E. Above Stratum B and C is 20-50cm of backdirt from a nearby military trench. The remainder of Loma Alvarado very likely consisted of stratigraphy like Units 26 and 47 before it was destroyed. Unit 16 on Loma Blasio is a complex palimpsest of burials in midden deposits that also exhibits three main strata and will be discussed in detail in Chapter 4. Stratigraphy of horizontal excavations and the three *tola* units will be examined in detail in Chapter 4 as well.

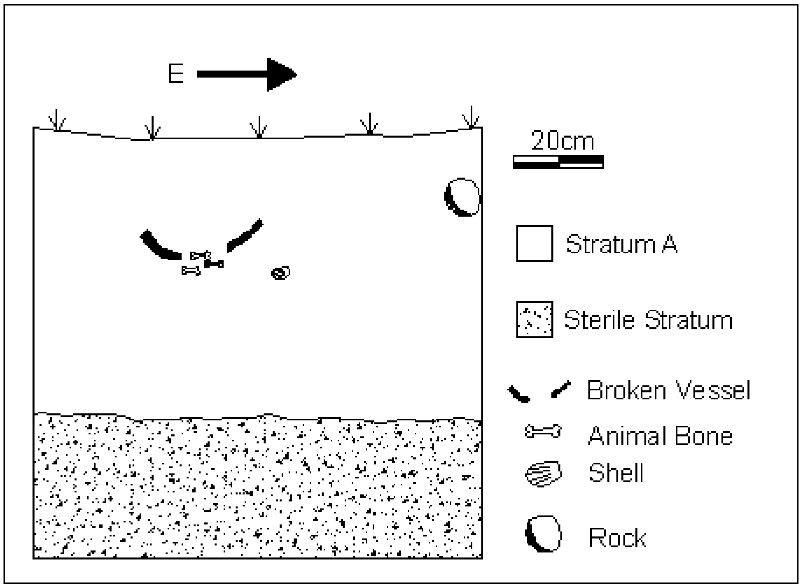


Figure 3.4 East profile of Unit 17.

*This unit is characteristic of all units on the eastern side of Loma Segarra and the eastern side of Loma Blasio.

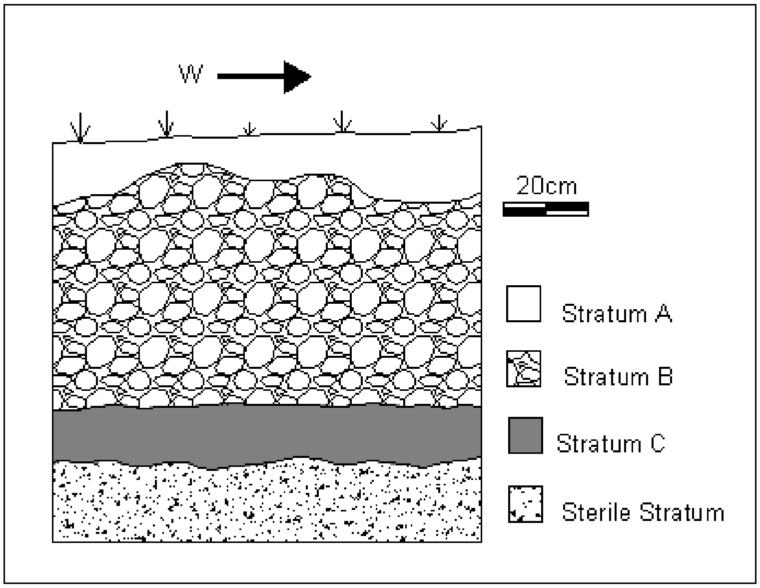


Figure 3.5 West profile of Unit 10.

*This unit is characteristic of all units on the western side of Loma Segarra.

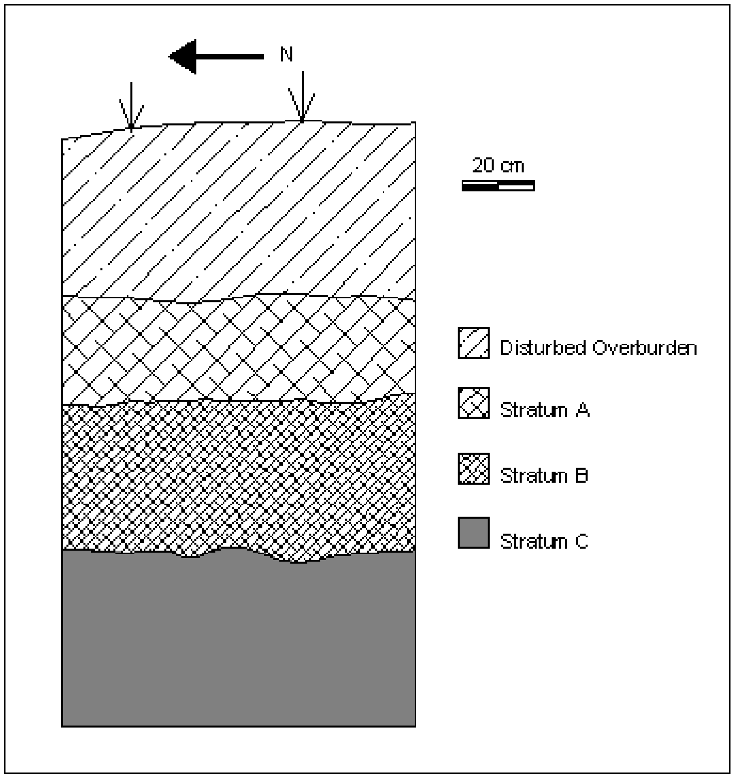


Figure 3.6 North profile of Unit 26.

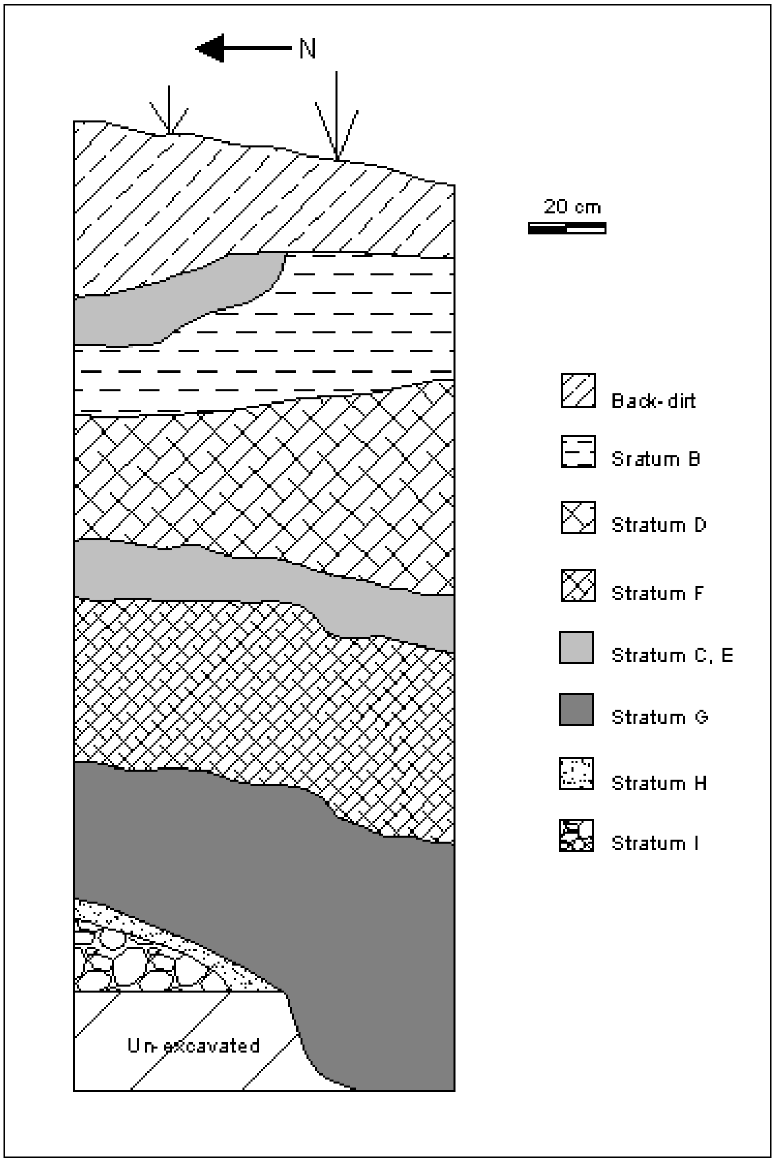


Figure 3.7 North profile of Unit 47.

3.3 ANALYTICAL GROUPS AND RADIOCARBON DATES

3.3.1 Multi-dimensional scaling

The distinct sections of the site described by the stratigraphic differences discussed above were matched by marked differences in shellfish assemblages. That is to say, units on the west side of Loma Segarra have large quantities of oyster while other units do not; and units on Loma Alvarado and the west side of Loma Blasio have large quantities of *C. subrugosa* while other units do not. The apparent grouping of the site into sectors sharing similar shellfish assemblages and stratigraphy suggested an interesting differentiation of social segments worth pursuing. On the other hand, it was possible that these differences between sectors represented nothing more than a lack of contemporaneity between two occupations. The initial observation was explored further with a multidimensional scaling analysis.. This analysis was based on proportions of shellfish species by MNI. It was necessary to use proportions, as opposed to counts since units exhibit different densities of material. MNI was chosen in place of weights because the relatively heavy weight of oyster when compared to most other species tends to exaggerate their importance in the analysis.

Similarities between units/strata were measured with Gower's Coefficient using the SIMS program at the University of Pittsburgh. Multi-dimensional scaling configurations were produced in 1-5 dimensions. Figure 3.8 represents the pattern of declining stress which clearly indicates that a two-dimensional analysis provides good interpretation of the data. The results of this analysis are presented in Figure 3.9.

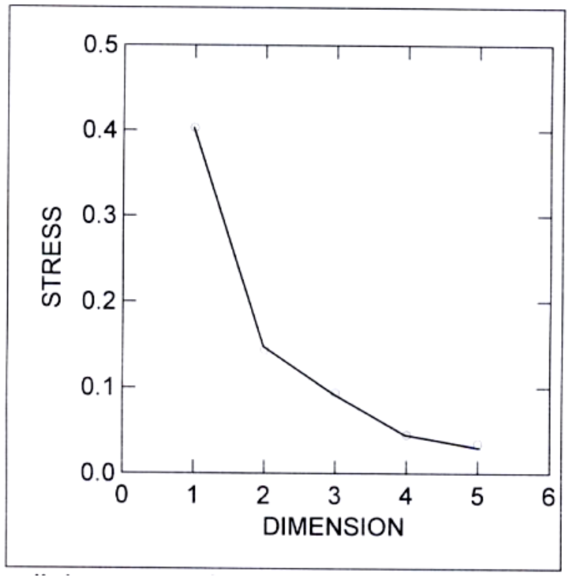


Figure 3.8 Plot of the declining stress for shellfish proportions at 1-5 dimensions.

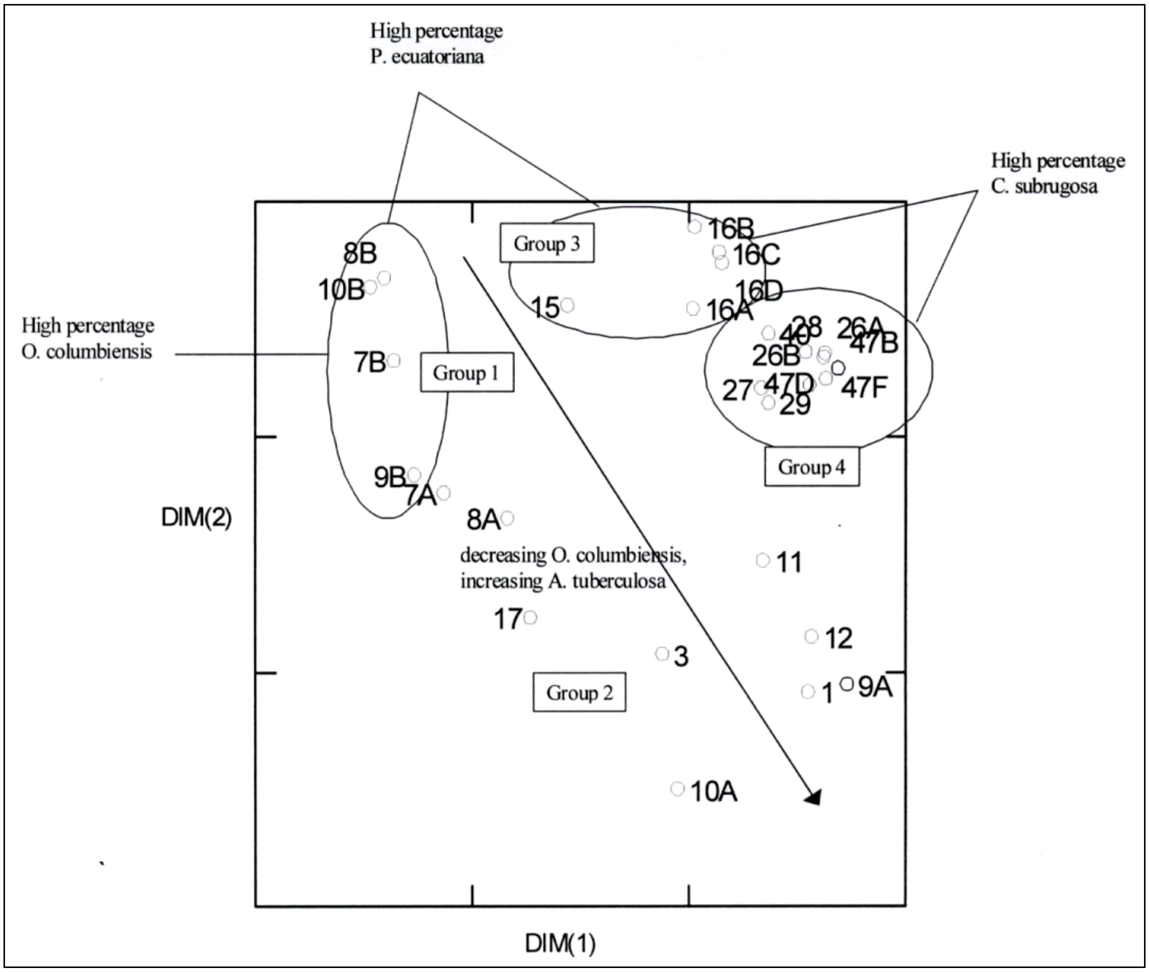


Figure 3.9 Results of multi-dimensional scaling of shellfish proportions at the site.

*Note that units with an MNI of 3 or less were erased from the image as they blurred the results, this includes Units 2, 4, 5, 6, 13, and 14. All of these units fall in Group 2.

The multi-dimensional scaling analysis identified four distinct analytical groups based on the percentage of shell species present in those groups. These groups are spatially consistent with geological and stratigraphic differences across the site. Group 1 has high percentages of both *O. columbiensis* and *P. ecuatoriana*. The contexts included in this is group correspond to the lower strata of the units on the western end of Loma Segarra. Group 2 has increasingly higher percentages of *A. tuberculosa* and lower percentages of *O. columbiensis*, compared to Group 1. The contexts in this group correspond to the upper stratum of all units on Loma Segarra and all units on the eastern margins of Loma Blasio. Group 3 has high percentages of both *P. ecuatoriana* and *C. subrugosa*, this group corresponds to the units near the platform and cemetery on Loma Blasio. Group 4 has high percentages of *C. subrugosa* and corresponds to the units on Loma Alvarado. Thus, the MDS analysis confirms the suspicion that distinct groups or kinds of occupation are represented at the site. Radiocarbon dates were used to determine whether the differences are temporal or not.

3.3.2 Radiocarbon dates

Six carbon and two shell samples were sent to the NSF-ASM Radiocarbon Lab for analysis. These samples were collected from secure contexts to date major strata at the site. Shell samples were adjusted using a Delta R of -216 ± 37 (which is rounded to -220 ± 40 in the calibration programs). This Delta R adjustment is based on Taylor and Berger 1967 (CHRONO Marine Reservoir Data Base 2008) which is derived from a single *Cerithidea valida* sample. It is currently the best available Delta R value to use since the shell which was dated from El Dornajo is also an intertidal species (*A. grandis*). Samples of carbon and shell from a single context dated by Moore and his colleagues (Vilchez et al. 2007) have shown that shell dates are about 200 hundred years earlier than associated carbon dates in this region, even after having been adjusted with this Delta R value. Sample 1 of the El Dornajo collection includes both carbon and shell from a single midden context (the carbon was found inside the shell). The dates associated with these samples concur with Moore’s findings. In other words, the shell in Sample 1 is given a date some 400 years earlier than the unequivocally associated carbon, rather than the 200 years or so suggested by Taylor and Berger's (1967) correction. I therefore consider Sample 1 to provide a date of 3052–2672 BC and Sample 2 is thus taken to provide a date around 250–460 AD for Group 2. This date makes Group 2 contemporaneous with Grous 3 and 4, an interpretation that is corroborated by the presence of unusual ceramic stool fragments in all three groups.

Table 3.1 Radiocarbon samples

Sample No. and Type	**Context**	**RCYBP**	**Calibrated Date (2 SE)**	**Analytical Group Represented**
1:shell and carbon	Bottom of Stratum B Unit 10, midden	4,506 +-52 4,113 +-50	3252–2872 BC shell 2864–2468 BC carbon	1
2: shell	Bottom of Stratum A Unit 10, midden	2,031 +-50	56BC–260AD	2
3: carbon	*Tola* Unit 2 Stratum AA, hearth	1,720 +-48	254–534 AD	3
4: carbon	*Tola* Unit 2 Stratum I, floor	1,663 +-50	265–572 AD	3
5: carbon	Unit 47 Stratum F, midden	1,769 +-48	145–431 AD	4
6: carbon	Unit 47 Stratum D, midden	1,758 +-48	262–572 AD	4
7: carbon	Unit 50 Stratum C-2, floor	1,410 +-47	602–773 AD	3

*Shell was calibrated with a Delta R of -216 ± 37 per Vilchez et al. 2007. Calibrated using the OxCal on-line calibration program, Southern Hemisphere calibration curve.

Group 1 then has a date much earlier than the others, corresponding to the Early Formative Period. Groups 2, 3 and 4 provide a pretty consistent set of dates indicating contemporaneity and corresponding to the Early Regional Development Period. Thus both temporal and spatial differences are implicated in the data.

The results of the MDS analysis, dated with the radiocarbon results, allow the recognition of analytical groups in the data. The MDS analysis shows that all units within a given group have more in common with one another than they do with units from other parts of the site. The radiocarbon dates provide the temporal relationship between those groups. Throughout much of this dissertation these four analytical Groups (1-4) are used to look at temporal and spatial similarities and differences among the residential zones at the site level. The materials from the *tola* comprise yet another set, not included in any of these four analytical groups.

3.4 PHYTOLITH SAMPLES

Soil samples were collected from nearly all features and floors, and a pollen column was collected from a deeply stratified midden context. Unfortunately, no storage pits or domestic floors were found so no samples from primary domestic use or processing areas were collected. Only six, 15ml, soil samples were analyzed due to financial constraints. The pollen column and remaining samples are stored with the INCP in Guayaquil in the hope of doing additional analysis in the future. Three samples from lower levels and three from upper levels at the site were chosen for analysis and sent to Linda Cummings and Chad Yost at the Paleo Research Institute Colorado.

Table 3.2 Soil samples submitted for analysis.

Sample No. Group No.	Area	Unit-Strat-Level	Feature	Description
1 *Tola*	Loma Blasio	*Tola* 1-L	1	Fill from pit full of midden deposits dug into clay 3m below ground surface. Believed to be associated with early phase of an artificial platform construction.
2 *Tola*	Loma Blasio	*Tola* 3-D-2	F-1	Fill from posthole in an upper level of platform modification about 1m below ground surface.
3 Group 3	Loma Blasio	50-G	F-B	Fill from bottom of hearth-like feature in the lowest level of the cemetery area, 2.5m below ground surface.
4 Group 3	Loma Blasio	50-B-1	Floor 1	Fill from chalky ashy surface 1m below ground surface located near platform in cemetery area. Midden deposits found both above and below.
5 Group 1	Loma Segarra	31-C	1	Fill from posthole 1.5m below ground surface in a household area.
6 Group 2	Loma Segarra	45-B	F-2	Fill from posthole 1m below ground surface in the later midden deposits of a household.

*No phytolith sample was run from Group 4 though the pollen column was collected from Unit 47 which is part of this group.

At the laboratory phytoliths were extracted using a heavy liquid flotation technique. After the removal of clays, the remaining silts and sands in the samples were mixed with sodium polytungstate and centrifuged to separate phytoliths from inorganic silica fraction, and then dried under a vacuum. Finally, the phytoliths were mixed with potassium cadmuim iodide which greatly improved the recovery and concentration of the phytolith fraction. The samples were then rinsed with alcohol to remove any remaining water. The samples were mounted in optical immersion oil and counted using a light microscope at a magnification of 500 xs. A phytolith diagram was produced using the Tilia system developed by Eric Grimm of the Illinois State Museum (Yost 2009). All samples were counted to a total of 301 phytoliths to obtain relative abundance and additional slides from the samples were scanned for diagnostic food related phytoliths and cross-type phytoliths used in the maize vs. wild grass discriminant function analysis (Yost 2009).

These samples are used to evaluate both environmental conditions at the site as well as changes and differences in diet. The results of this analysis will be explored in greater detail in Chapter 5.

3.5 OTHER LABORATORY ANALYSES

Laboratory analysis for other artifacts will be discussed in the chapter in which that artifact class is examined. Analysis of fauna, shell, and ground stone are discussed in Chapter 6; analysis of ceramics and chipped stone are discussed in Chapter 7; and analysis of human bone, metals, and exotics are discussed in Chapter 4.

4.0 SOCIAL DIFFERENTIATION AT EL DORNAJO

Concomitant with the re-occupation of El Dornajo during the Early Regional Development Period there is evidence for institutionalized social inequality at the site seen in three lines of data: monumental architecture, uneven distribution of decorated ceramics, and wealthy burials. There is only one other site along the river, in any period, with monumental architecture and no other sites with wealthy burials have been identified. This chapter describes the three lines of evidence for social inequality at El Dornajo and outlines the character of that inequality at the site.

4.1 PUBLIC ARCHITECTURE

One commonly used archaeological indicator of complex social organization is monumental architecture. Mounds, or *tola*s, are public, monumental construction efforts that involve access to and coordination of a labor force on the community rather than the household scale (Kolb 1994; Peebles and Kus 1977; Trigger 1990).

Mounds can be built for ceremonial activity, elite habitation, or as burial monuments; the primary function of a mound may even change through time. The functions of mounds and the timing and pace of their construction, are important indicators of social change at a site. Incremental construction over generations with little or no change in patterns of use is suggestive of a trajectory of gradual social change without episodes of major transformation. A sudden increase in the scale of monumental construction or a dramatic shift in the function of the mounds, however, suggests an episode of rapid social change like that expected if a mega El Niño event or the introduction of a trade route were the kinds of conditions promoting change.

There is one *tola* at El Dornajo (Figure 4.1) that measures about 40m by 24m, with a final height of just over 4m. The *tola* at El Dornajo was investigated in order to determine its function and the timing of its construction. Initially I thought that the *tola* was a 5m high platform mound with two ramps. Excavations demonstrated that the top 1m of deposits and both of the ramps are modern military features. During the 1995 war between Ecuador and Peru the site of El Dornajo served as a defense station with a bunker and multiple trenches. The *tola* was raised one meter to improve visibility of the Peruvian border and the ramps were built to allow vehicles to transport goods to the top of the *tola*. These disturbances appeared in the profiles of *tola* excavation units as mixed cultural deposits. Their modern origin was confirmed by the previous landowner and interviews with the provincial Coronel. The Coronel says that the soil came from the now destroyed site of Loma del Zorro. But because the deposits are indistinguishable from those at El Dornajo, they may simply have come from the destroyed portion of the site.

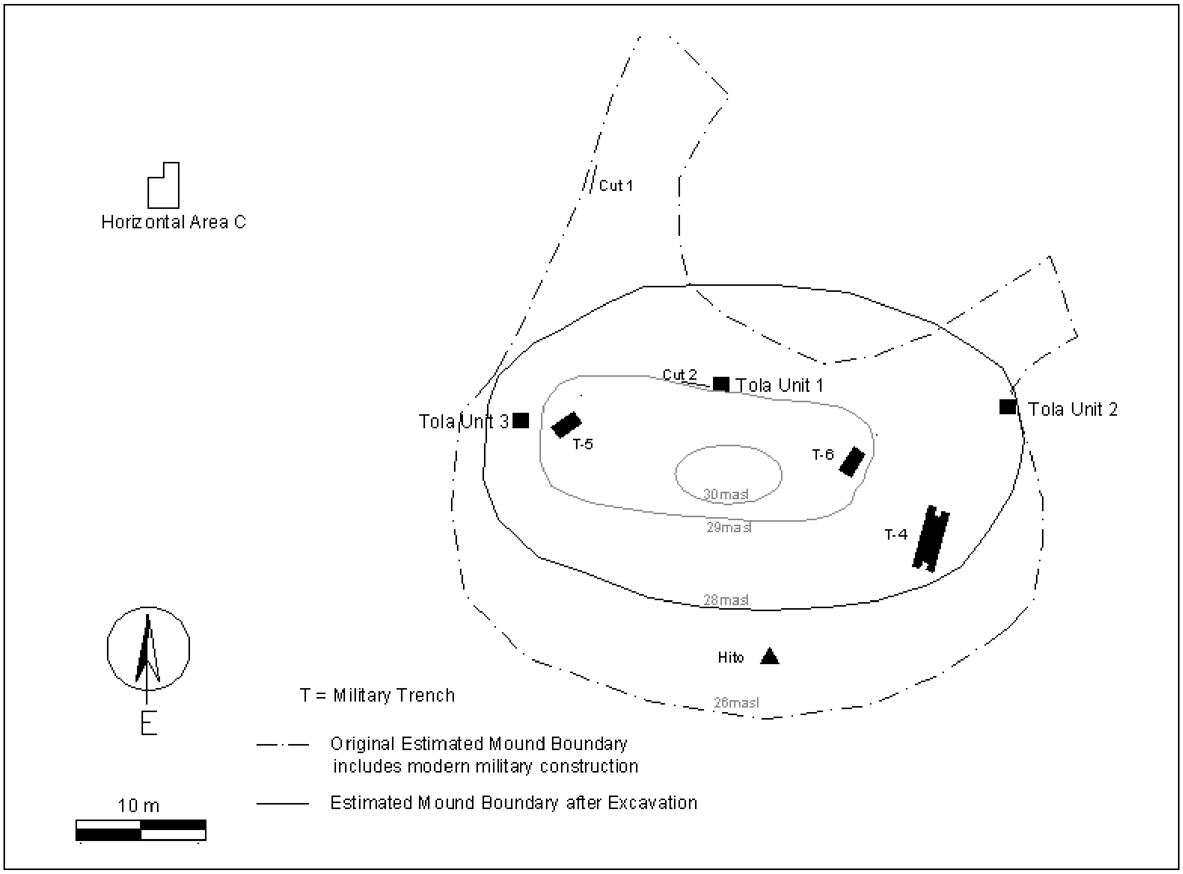


Figure 4.1 Map of the *tola* and Horizontal Area C at El Dornajo.

4.1.1 Methodology

Two cuts were made to explore the stratigraphy in the *tola*. Cut 1 was placed on one of the supposed ramps of the *tola* (see Figure 4.1). This cut confirmed that the two ramps on the eastern side of the mound were built by the military. Cut 2 was placed close to the center of the *tola* in a partially destroyed section. A 1m by 1m unit (*Tola* Unit 1) was placed off of Cut 2. Additional 1m by 1m units were placed on the southern (*Tola* Unit 2) and northern (*Tola* Unit 3) edges of the *tola*. It was not possible to place units on the eastern and western edges. The eastern edge was destroyed by the military in 1995, probably to build the two ramps. The western edge lies very close to the modern border marker, or *hito*, and the military prohibited excavation in this area. All three units were excavated in 20cm levels within natural/cultural strata. All soil was screened through 1/2" screen mesh and all artifacts were collected. *Tola* Units 2 and 3 were excavated to sterile soil. *Tola* Unit 1 was terminated prematurely when I mistook part of the *tola* construction for sterile green-gray clay. In addition to the test units, the walls of military trenches on the mound were cleaned and profiled. Together these units, cuts, and trenches provide a preliminary examination of *tola* construction and use.

In Table 4.1 there is a description of each of the strata encountered during the excavation of *Tola* Units 1, 2, and 3 (Figures 4.13-4.15). Many strata appear in only one of the three units. Strata appearing in multiples units were used as horizons to vertically correlate the three $1m^2$ units.

4.1.2 Sequence of mound construction

Construction of the *tola* at El Dornajo began shortly after the site was re-occupied in the Early Regional Development Period (Figure 4.2). As the stratigraphy shows, there was a pre-mound occupation in this part of the site dating to 254–534 AD. This occupation consisted of an ashy midden, postholes, and hearths, and was likely domestic in nature (Figure 4.3). Too little of this occupation was uncovered to be able to characterize social organization at this time.

This occupation was capped with green-gray clay and a few adobes as the first visible step in mound construction. Postholes in Stratum X suggest that there may have been a structure built into this cap before fill was heaped over it. This clay cap was then followed by a series of clean sand, silt, and clay layers to build a 2.5m high mound. Phase 1 is below the modern ground surface since the *tola* is largely surrounded by accumulated midden deposits. Postholes in Stratum V suggest that there may have been an episode of use/remodeling midway through this phase of construction, but no surfaces were identified. The clean sand and silt used in mound construction are the same yellow alluvial deposits that underlie much of the site. The green-gray clay mixture is made of natural clay lenses that formed within the flood deposits by water that did not evaporate or drain away. This clay was collected and then puddled into clay caps by the builders.

Thus the residents of El Dornajo used naturally occurring and locally available materials for *tola* construction. This is an earthen mound made by piling silts, midden, and clays on top of one another much like the early phase of Mound 2 at Uña de Gato. Other mounds at Uña de Gato were built with adobes which are uncommon at El Dornajo. The few adobes that were found, however, are circular red and yellow adobes like those found at Uña de Gato (Moore 2010). The top of this phase of construction is identified by a fairly flat stratum of green-gray clay with a thin lens of yellow silt that had a posthole and a pit in it. The pit was full of ordinary shell midden. This is the only storage pit identified at the site. Because the pit is filled with ordinary midden deposits the most plausible function of the mound at this time would have been domestic.

In the second phase of construction the mound was elevated approximately 80cm with layers of brown clay, midden deposits, and yellow silt. Strata P and L both had postholes indicating that there may have been an episode of use/remodeling during this phase of construction as well. The top of the mound in this phase has a thin sandy oxidized floor with a posthole in it. There are no features to help identify what the most plausible use of the mound might have been at this time. This surface dates to 265–572 AD which entirely overlaps the C14 date for the pre-*tola* occupation suggesting that little time passed between the pre-*tola* occupation and the first two phases of *tola* construction. This means that construction must have begun shortly after the re-occupation and occurred relatively rapidly.

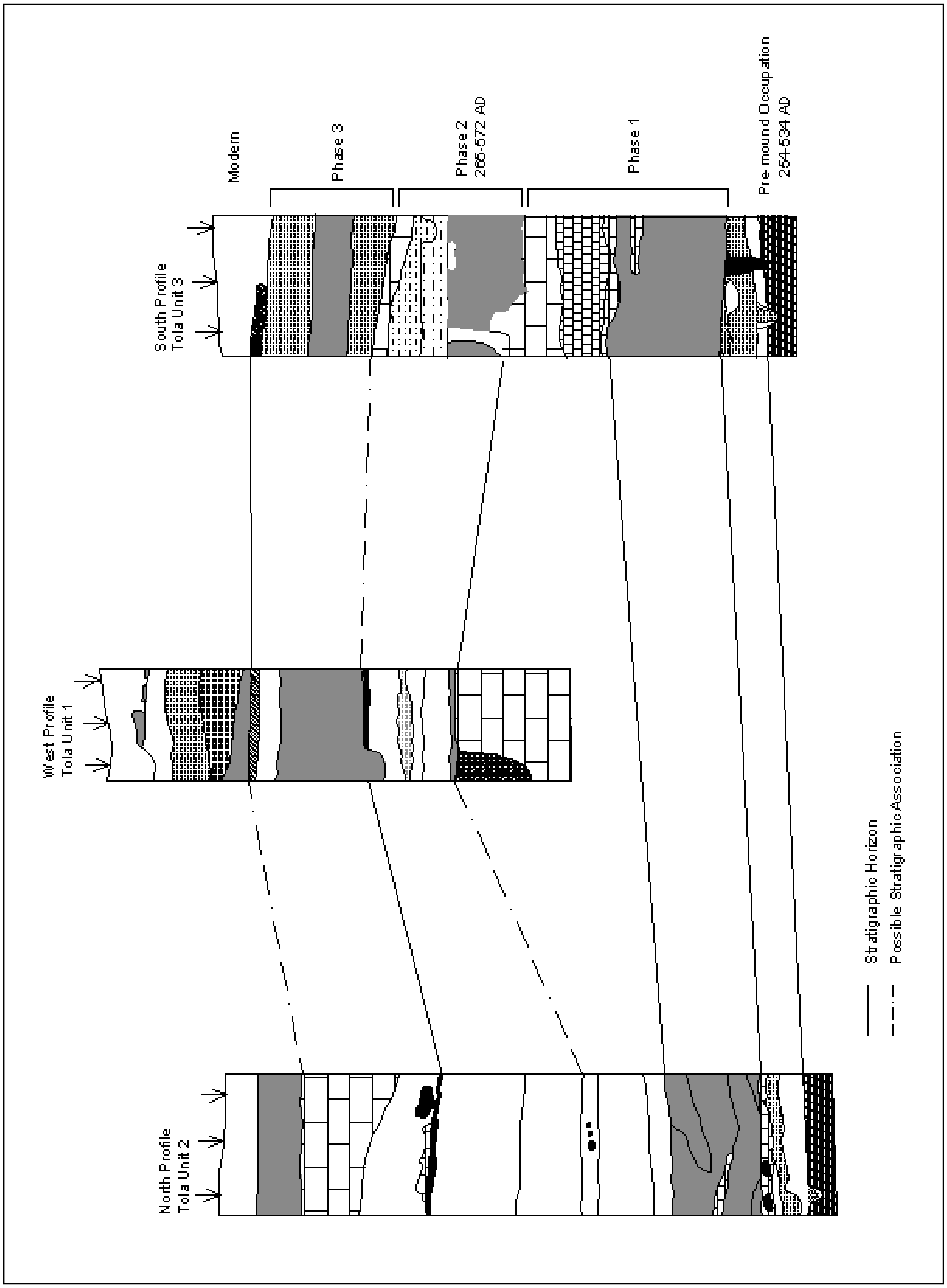


Figure 4.2 Phases of *tola* construction and stratigraphic horizons.

The final phase of mound construction raised the *tola* another meter with layers of yellow silt, green-gray clay, and midden deposits. At the top of the *tola* a hard yellow clay floor was encountered. The only feature associated with this floor was a puddle adobe mass in the shape of a post support (Figure 4.4). There are no other features to help ascertain the most likely function of the mound in this third and final phase of construction.

Figure 4.3 Hearth at the bottom of *Tola* Unit 2.

Figure 4.4 Puddled adobe post support.

4.1.3 Labor investment

In terms of labor investment the *tola* at El Dornajo is not particularly impressive when compared to the kinds of monumental constructions common to the coastal Andes. The formula for the volume of an ellipsoid divided by two was used to calculate the volume of the *tola*. Using Erasmus' (1965) estimates for carrying dirt 50m and Abrams' 1994 estimates for excavating dirt, the first phase of construction would have taken 7,285 person days with a total volume of 1,256m^3. Even if only one third of the population was working, assuming a total population of 150, this is about 146 days. The second phase of construction comes out to a volume 402m^3 or about 2,331 person days, this equals 47 days of labor if one third of the population participated. The final phase of construction has a volume of about 502m^3, which comes out to 2,914 person days, or 58 days of construction with one third of the population working. The total *tola* volume is 2,160m^3, which comes out to about 12,530 person days, or roughly 251 days of construction with one third of the population working. If we imagine that El Dornajo was occupied for about 300 years, then this is only about .84 days of construction per year. But the *tola* at El Dornajo was not built in yearly incremental additions. Instead it was built in at least three discrete episodes. The later episodes would have lasted no more than a month while the first phase of construction would have been a more substantial labor investment.

The largest mound at Uña de Gato (Mound 1) has a total volume of 2,165m^3 based on the dimensions provided in Moore 2010 and using the formula for the volume of an ellipsoid divided by two. Using a composite value for adobe construction from Smailes 2000 (which includes excavation of the dirt as well as manufacture, transport and the laying of the adobes) this comes out to 13,336 person days. Uña de Gato was just over three times the size of El Dornajo, however. With a population estimate of ca. 450 people, and assuming that one third of the population worked on the mound, the mound would have taken about 83 person days. Moore (2010) estimates that the mound was used for 200 years. Thus the construction investment would only have been .42 days of construction per year, or half that of El Dornajo. Yet Uña de Gato had four mounds of adobe while El Dornajo boasts only one of earthern fill. Uña de Gato may have been occupied for about three times as long as El Dornajo, however, based on existing radiocarbon dates. Finally, it does not appear that the labor investment at Uña de Gato was very substantial either. Indeed, Moore (2010) estimates that Mound 1 would only have taken some twenty men 2-3 months to build.

Labor investment along the Zarumilla River was therefore, never very substantial. Mound 1 at Uña de Gato and the *tola* at El Dornajo are both larger than contemporaneous public architecture in the El Oro-Tumbes region all the same. Certainly the *tola* at El Dornajo clearly distinguishes the site from others along the river during the Regional Development Period. The likelihood that its initial, if not later, use was domestic strongly suggests that it is marking social inequalities at the site. The first phase of *tola* construction took place relatively rapidly and appears to have occurred shortly after the re-occupation of the site during the Early Regional Development Period around 300 AD. There were then at least two phases of *tola* expansion which also happened within a relatively short period of time after that, perhaps each generation or so. Overall, these data support our expectations for the nature of public architecture if social change happened rapidly at the site.

4.2 DECORATED CERAMICS

Another commonly used marker of high status is the distribution of decorated ceramics. Household possessions are a strong indicator of household wealth, and serving wares are an especially strong indicator of wealth cross-culturally (Smith 1987). Decorated ceramics require greater production investment and are therefore more costly than plain wares. They are also made to be seen and therefore often used in more public or visible contexts to advertise status and wealth. In this dataset bi-chrome slipped, painted, incised, appliquéd, stamped, or mold-made designs are all considered decorated. Slipped and burnished vessels, especially red slipped vessels, are quite common in this dataset. Many sherds without a slip are exfoliating and may have originally had such slips. A monochrome slip is therefore not considered decorated. Some bowl/plate sherds are slipped red on one side and white on the other. These sherds are considered decorated. Painted, incised, or appliquéd sherds are far less common. Paint is usually white on a red slip, but can be red-on-white, black-on-red, or orange-on-white. Stamped designs and mold-made designs are rare. For a complete description of ceramic collection and laboratory methodology see Chapter 8.

Using the three Early Regional Development Period groups identified in the MDS analysis in Chapter 3 the proportion of decorated ceramics in each group was calculated as a cluster sample. Group 2 includes Stratum A in all of the test units on Loma Segarra and the eastern side of Loma Blasio, Group 3 includes the test units on the western side of Loma Blasio, and Group 4 includes all of the test units on Loma Alvarado.

Figure 4.5 illustrates that we can be 99% confident that Group 4 had over three times as many decorated ceramics as either Groups 2 or 3. This is a strong difference. In fact, since some of the units in Group 4 were surface collections, and surface collections are often biased against decorated ceramics because of their popularity with passersby, the strength of this difference is probably under-represented. The results of this analysis therefore identify Group 4 as a wealthy, or elite, sector of the site.

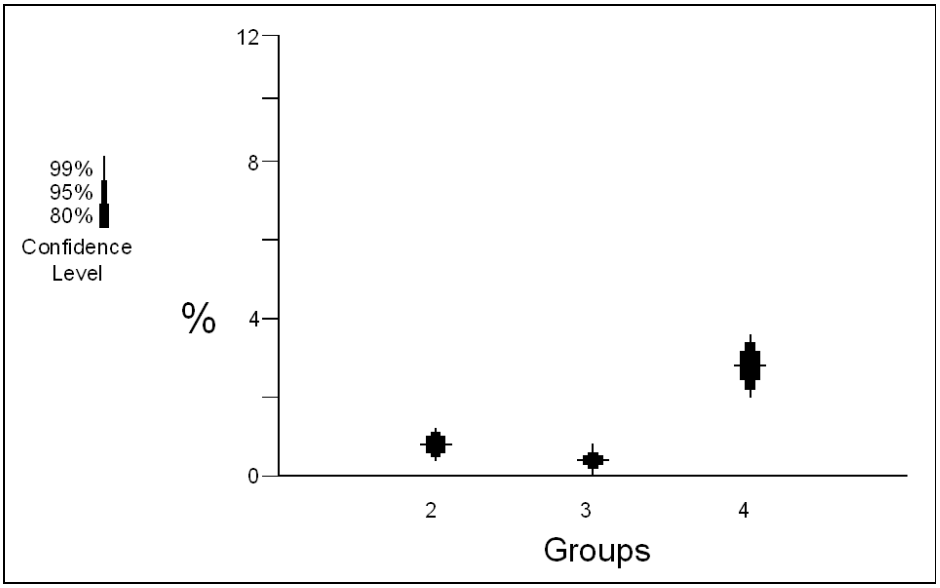


Figure 4.5 Proportion of decorated ceramics in the Early Regional Development Period groups.

4.3 BURIALS

The final gauge of social differentiation examined in this dissertation is burials. Both contextual variables and osteological variables of burials can be used to gauge the nature and degree of social differentiation in a community. This study addresses only contextual variables such as grave goods, body position and orientation, and basic sex and age determinations. Grave goods are an important measure of differentiation, especially as it relates to wealth. People who have more in life often have more in death, and will thus receive more elaborate and wealthier burials (e.g. The Binford-Saxe Paradigm). Institutionalized social inequality can be determined by the presence of wealthy child burials on the basis of the assumption that a child will not have had any time to achieve status (e.g. King 1990).

4.3.1 Horizontal Area C

During the excavation of Unit 16 (a test unit) numerous burials and associated floors were encountered. In order to better understand the deposition and to get a sample of burial data, four additional $1m^2$ units were opened up off of Unit 16 (Unit 16-2 and Units 48-50) (see Figure 4.1). These units were excavated like test units (except that shell was weighed and not collected). Unit 50 is a special collection unit used for water screening, a process that is fully described in Chapter 3.

All burials were excavated by the field crew. Skeletal analysis was done by Maria Patricia Ordoñez, an Ecuadorian student from Pontificia Universidad Católica del Ecuador with an adequate background in skeletal analysis. Age, sex, and pathologies are all from Ordoñez 2008. Sex was determined using the scoring system for sexually dimorphic cranial features (after Acsadi and Nemeskeru 1970, as found in Buikstra and Ubelaker 1994). Other sex related features found in the pelvic girdle were not taken into account because of the poor condition of the remains. Age was assessed through dental development patterns and when possible through suture closure. For the former both the sequence of formation and eruption of teeth (after Ubelaker 1989a as found in Buikstra and Ubelaker 1994) and the Scott system for scoring surface wear in molars (after Scott 1979: 214, as found in Buikstra and Ubelaker 1994) were used. For cranial suture closure the criteria stated by Meindl and Lovejoy 1985 (as found in Buikstra and Ubelaker 1994) was used.

Like the stratigraphy of the *tola*, the stratigraphy in this area has a pre-burial occupation followed by three separate burial and midden layers. Because of the complex nature of the stratigraphy and an inexperienced field crew many smaller stratigraphic changes were not differentiated during excavation, though they are included in the profiles (Figures 4.16-4.20). The strata are fully described Table 4.2. The burials themselves are fully described in Table 4.3.

Burial Floor A. Approximately 50cm below ground surface patches of an ashy, oxidized floor no more than 5cm thick, with some more compact areas, was encountered. The surface slopes gently to the west. No features were visible and no burials are associated directly with this surface (Figure 4.6).

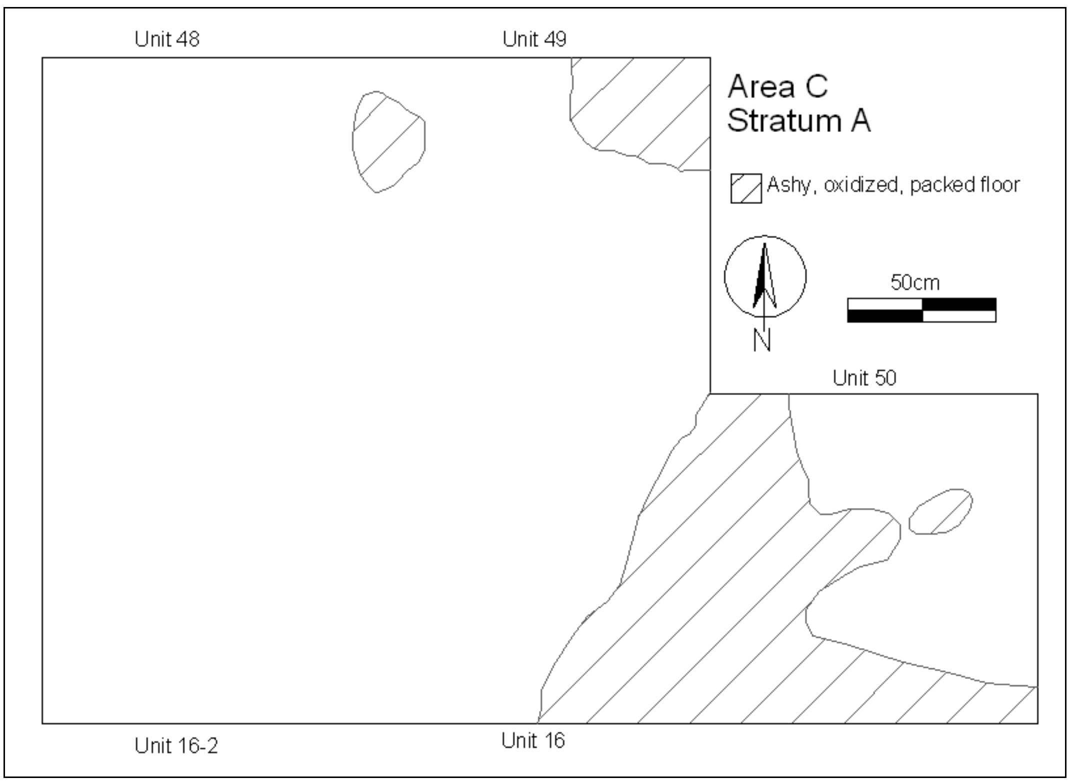


Figure 4.6 Burial Floor A

Burial Floor B. At approximately 80cm below ground surface the remnants of a second ashy surface identical to the first, though about 10cm thick, was encountered. This surface is associated with several burials and ceramic vessels (Figure 4.7). Burials 1 and 2 were laid side-by-side in the same burial position. They may have been interred in a shallow pit in the floor because the remains continue below floor level. The pit was probably about 30-50cm deep though no pit boundaries were identified.

Burial 1 is the most elaborately adorned of the burials on this surface and is a sub-adult. The individual was wearing copper jewelry and a shell and stone bead collar (Figures 4.21, 4.22). An inverted ceramic vessel was found on the left side of the individual and a spindle whorl was found near the right hand. Burial 2, an adult female, is associated with several ceramic vessels, including a non-local jar, and a copper alloy ring (Figures 4.23-4.25).

Burial 5 consists of the remains of an infant (perhaps even neonatal) lying next to a plain *olla* (Figure 4.26). Both are sitting on top of a large broken fragment of a *tinaja*. Just north of Burial 5 is Burial 6, a secondary interment of disarticulated child bones mixed with animal bones, most of which are *Canis familiaris*. Because Stratum A and Stratum B deposits are hardly distinguishable, it is possible that Burial 6 was in a pit associated with Burial Floor A since it is a bit higher than other burials associated with Burial Floor B. It has been grouped with Burial Floor B because no burial pit was visible in the profile it intersects. Burial 11 is the secondary interment of disarticulated infant bones mixed with animal bones. This burial was found next to a burnished red-slipped *olla* and includes copper alloy earrings (Figure 4.27). Burial 11 lies a bit lower than other burials associated with this surface but above Pit 1 (containing a burial) below it. For this reason it has been grouped with Burial Floor B.

There are two vessels on the far eastern end of Horizontal Area C that are not directly associated with any of the burials but are associated with the ashy surface and two pit features in the corner of the unit. Vessel 11 is a large fragment of a composite jar lying flat. It had the articulated remains of an iguana and a wood stain in the shape of a spear or staff inside of it. Vessel 12 is a plain, incomplete jar. A radiocarbon sample taken from this surface dates from 602–773 AD. This is the latest radiocarbon date at the site.

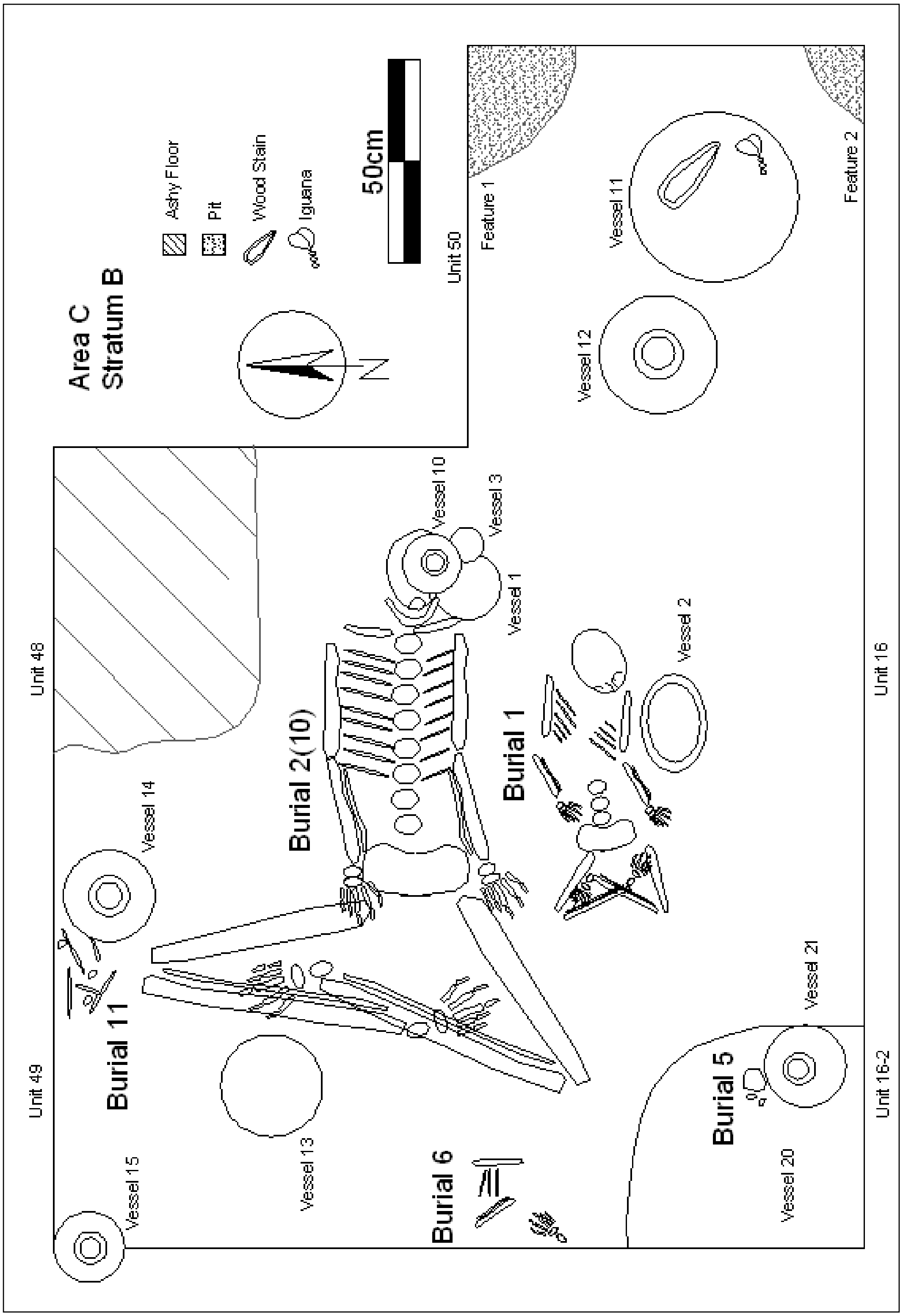


Figure 4.7 Burial Floor B.

Burial Pits Stratum C. Stratum C is an intentionally laid layer of relatively clean alluvial silt and sand. At the top of this stratum, about 1.5m below ground surface three burial pits were excavated (Figure 4.8). Each pit differs from the other in depth and configuration.

Pit 1 contains Burial 12 which is an adult male with no grave goods. The pit was only visible in the north profile (Figures 4.17, 4.18) and is a 40cm deep midden-filled pit. Pit 2 contains Burial 13, most of which is outside of the excavation area. This burial has several ceramic vessels and a copper spatula (Figures 4.28, 4.29). Pit 2 was capped with yellow and red adobes and had a green-gray clay matrix floor (Figure 4.16, 4.17).

Pit 3 most closely resembles lower Pits 4 and 5 but has no elaborately adorned individual; though it was not completely excavated. It is an 80cm deep pit filled with midden deposits that was only visible in the profiles (Figure 4.18). The bottom of the pit was oxidized and contained the remnants of an organic mat. The lowest 20cm of the pit were filled with clean sand. There were two individuals (Burial 7 and 17) and two additional crania (Burials 8 and 20) in the pit. Burial 7 is a sub-adult associated with two ceramic vessels (Figure 4.30).

Burial Pits Stratum D-F. Two burial pits were found in this stratum and multiple individuals were found in each pit. Each pit also contained a clear principal personage (Figure 4.9). The pits in this stratum are round to oval in shape and about 50cm deep. They are oxidized on the bottom and have the remnants of organic mats. Patches of wet clay-midden matrix were placed over the mats and the individuals in the pit were set into this wet matrix. About 25cm of clean sand was poured over the burials; the remainder of both pits was then filled with midden deposits.

The principal personage in Pit 4 is Burial 4, a child in a seated position with several copper alloy, emerald, and gold adornments, as well as a few ceramic vessels (Figures 4.31-

4.33). The lower halves of two additional individuals (Burials 3 and 9) were also found in this pit. These burials were disturbed when Pit 4 was cut by Pit 3.

Pit 5 contained five individuals. The principal personage, Burial 18, is an adult male. He wore a copper/wood/textile headdress and several copper alloy, emerald, and ceramic adornments (Figures 4.36-4.38). Burials 14 and 15 were both seated against the edge of the pit. Burial 14 had a ceramic bowl and a copper ring (Figure 4.34). Burial 15 wore a shell and stone bead collar and a copper alloy *nariguera* (Figure 4.35). Burials 16 and 19 were not associated with any grave goods.

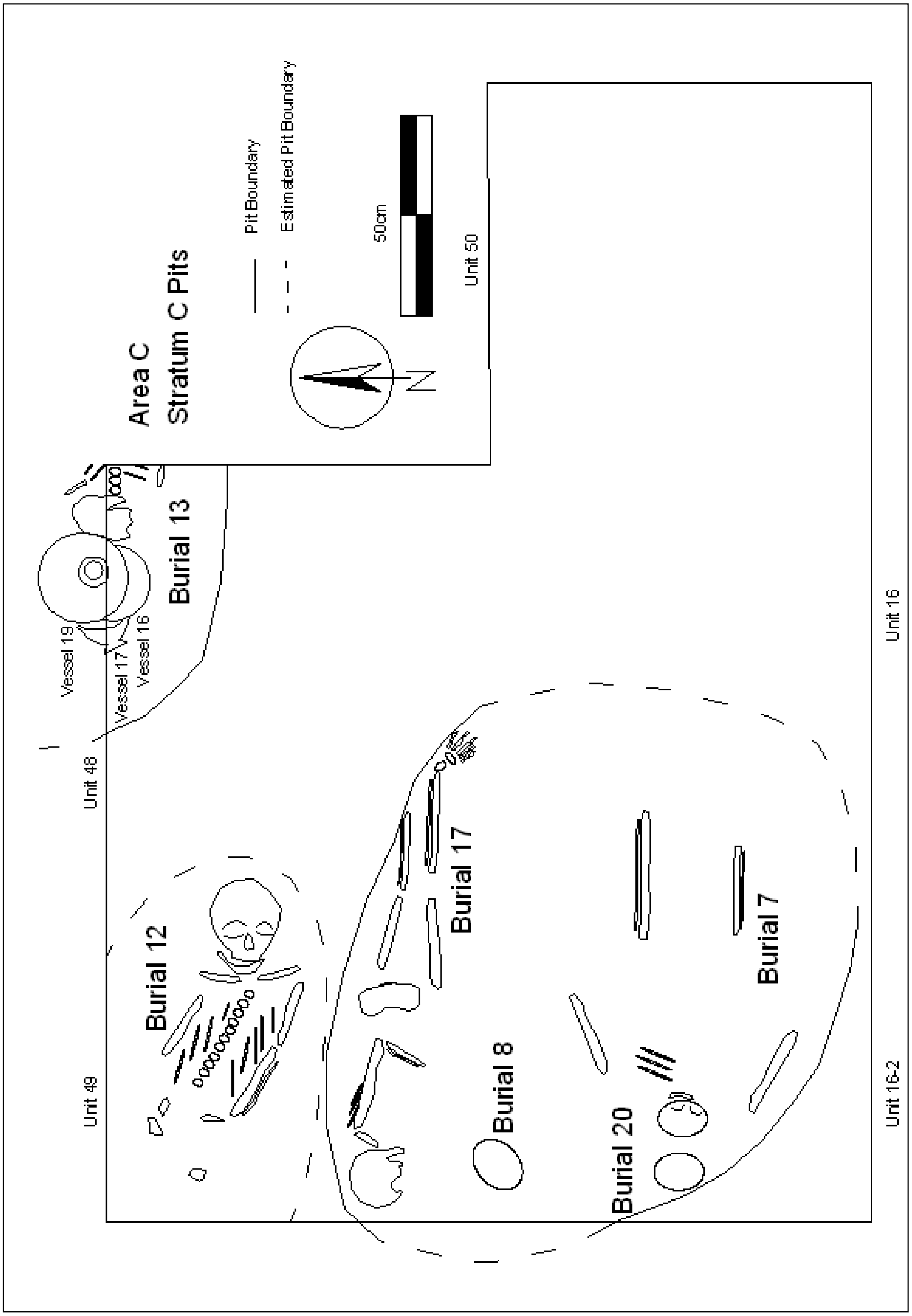


Figure 4.8 Stratum C Burial Pits.

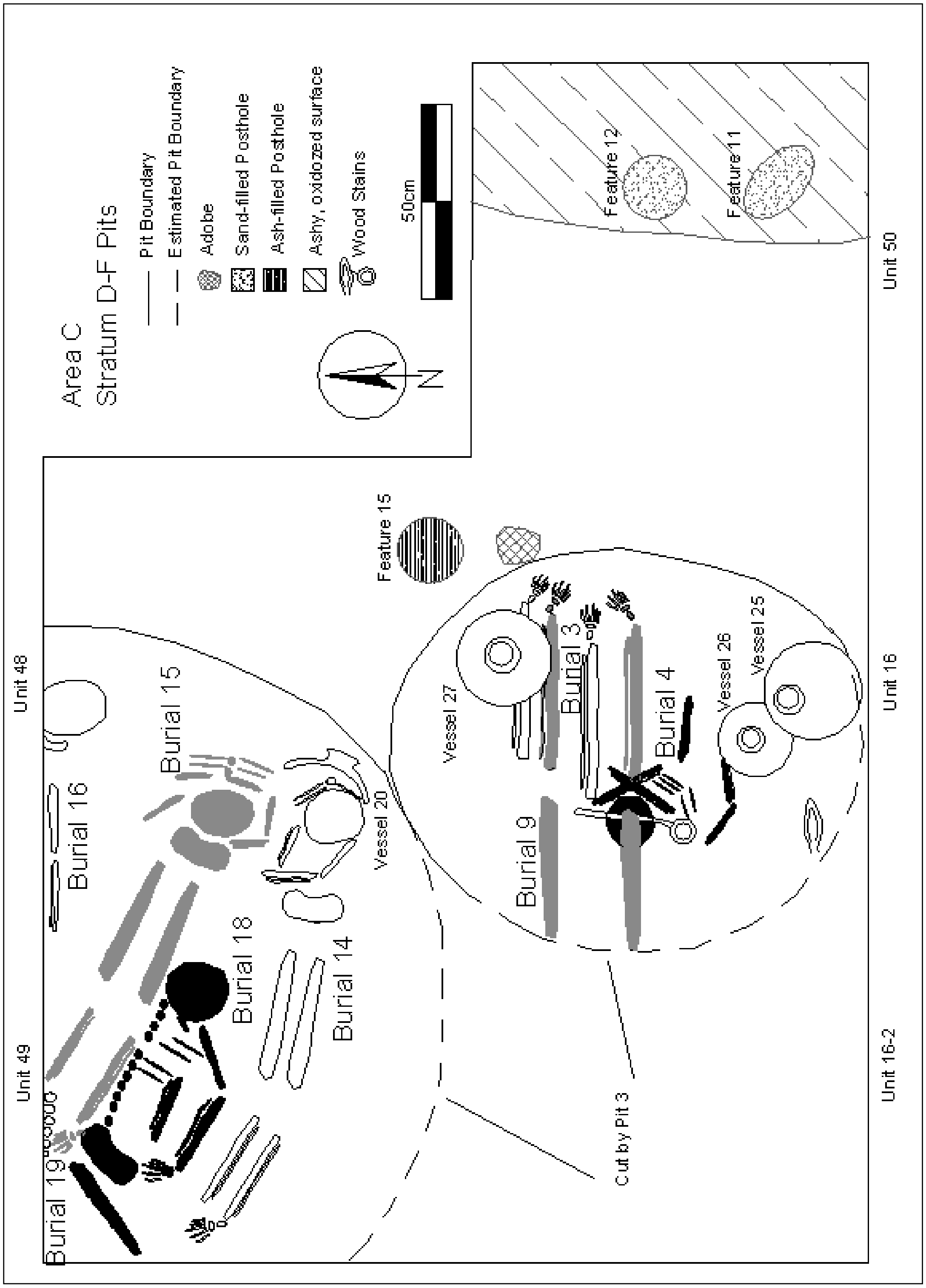


Figure 4.9 Burial Pits Stratum D-F. Black colored individuals are principle personages.

Stratum G. Underlying all of the burial activity in the area are the remains of a structure with several post-holes and a hearth (Figure 4.10). The post-holes were intentionally filled with sand and the structure was covered in a green-gray clay matrix cap. In Unit 50 there is an ashy surface overlying the green clay stratum. These features are from an occupation pre-dating the *tola* and burials. The hearth and postholes are most likely domestic and probably associated with the domestic occupation underlying the *tola*.

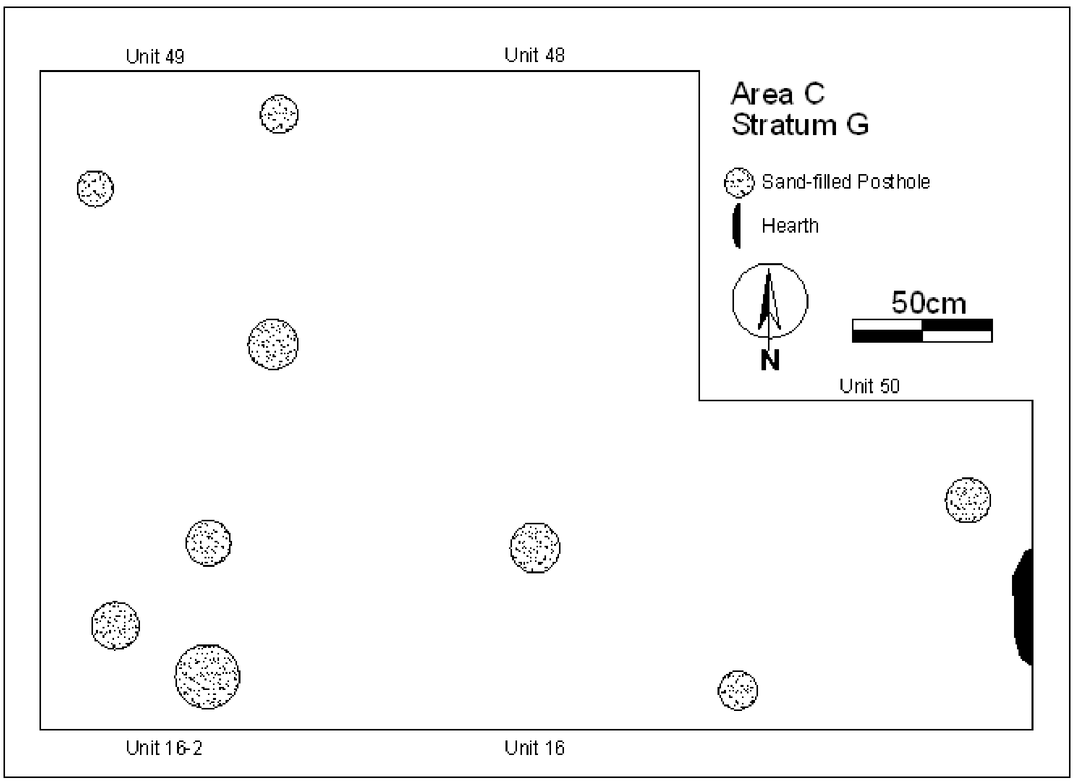


Figure 4.10 Stratum G.

4.3.2 Loma Alvarado

During the destruction of Loma Alvarado numerous burials were noted by local informants. Appendix B has pictures of artifacts and burials taken during the destruction. Informants say that many individuals were buried with one or two ceramic vessels and that there was one particularly wealthy and elaborate burial looted at this time. Multiple individuals are said to have been found in a triangular wooden chamber, one of whom had gold and emerald earrings, a gold head ornament, a copper point, and a copper rattle, as well as several ceramic vessels (see Appendix B for pictures of these items). No other wealthy burials were reported. Since findings of gold and riches are usually exaggerated rather than minimized, I am confident that there was just one elaborate burial on this part of the site. All of the other burials contained few to no grave goods, and few metal items, according to participants.

4.3.3 Multi-dimensional scaling

In order to identify any patterns in the burial data that might be related to class or social organization, a multi-dimensional scaling analysis (MDS) was conducted on the data. Similarities between the burials were measured with Gower's Coefficient using the SIMS program at the University of Pittsburgh. The variables considered were sex, age (child, sub-adult, adult), number of metal goods, number of ceramic vessels, number of additional items, total number of goods, orientation, and position of the body. Multi-dimensional scaling configurations were produced in 1-5 dimensions. Figure 4.11 represents the pattern of declining stress which clearly indicates that a two-dimensional analysis provides good interpretation of the data. The results of this analysis are presented in Figure 4.12.

Figure 4.12 shows that the excavated burials can be divided into two groups based on east and west body orientation. These groups do not correspond to sex as all three individuals for whom sex was determined (Burials 2, 12, and 18) are in the east facing group; this includes two males and one female. These groups may represent different clans, lineages, ethnic groups, or moieties.

The burials also divided into three groups based on the number and kind of grave goods accompanying them. The class or wealth based groups cross-cut the east/west orientation social groups. Because several of the burials were not completely excavated, this grouping should be considered cautiously. Nonetheless, these three groups might be considered rulers, elites, and non-elites respectively. Rulers consists of burials with 9+ burial goods including many metal items, elites consists of burials with 2-6 burial goods including very few metal items, and non-elites consists of burials with 0-2 burial goods and no metal items.

The principal personages in Burial Floor A and Burial Pits 4 and 5 are wealthier than any known burials from the El Oro-Tumbes region. El Dornajo is the only site along the Zarumilla River with such burials. While the archaeological record for the region is very fragmentary, the amount of site destruction in the region and the tendency for wealthy burials to be widely remembered, indicate that this pattern is real. These burials demonstrate that some persons could amass modest wealth and were important enough to be accompanied to the grave by secondary persons. One of these principal personages (Burial 4) is a child. Cumulatively the burial data indicate that El Dornajo was hierarchically organized and that status was very likely ascribed. The data furthermore indicate that there were two social groups at the site (clans/lineages/ethnicity/moieties).

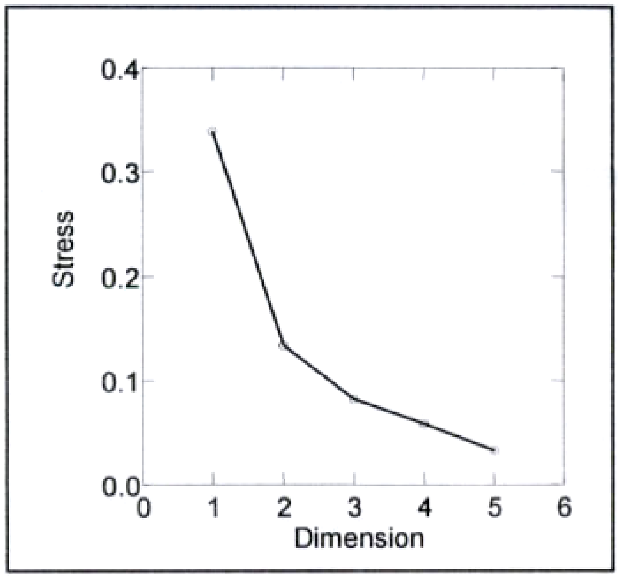


Figure 4.11 Scatter plot of declining stress in burial data in dimensions 1-5.

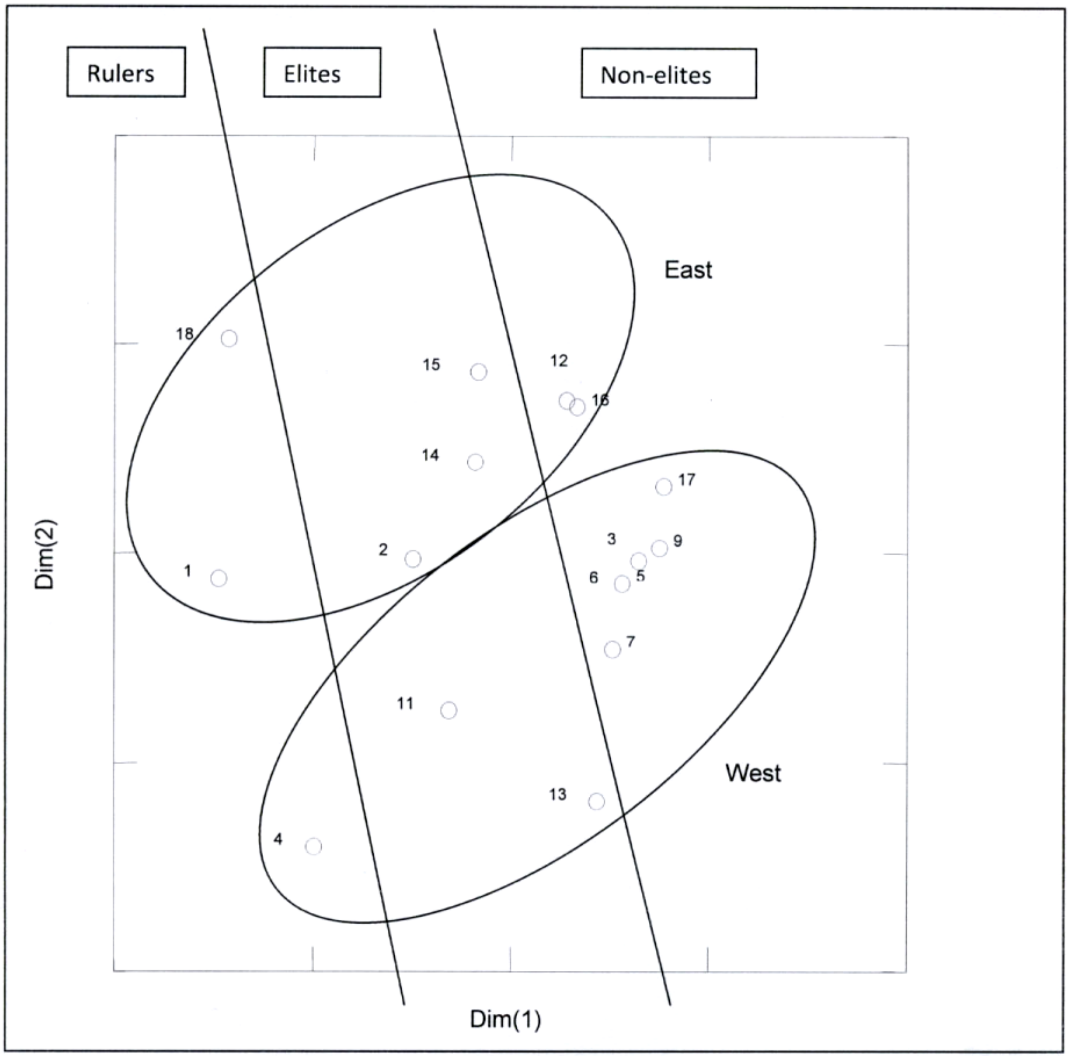


Figure 4.12 Results of multi-dimensional scaling for the burial data.

*The data show that burials group by body orientation (east, west) and number and kind of grave goods (Rulers=9+, Elites=2-6 w/ metals, Non-elites=0-2 w/o metals). Burials 8, 19, and 20 excluded because there were too many missing data. Note that some data points overlap.

4.4 CONCLUSIONS

Hierarchical social organization emerged shortly after the re-occupation of El Dornajo during the Early Regional Development Period, at about 300 AD. At this time a modest-sized *tola* was built, very likely serving a domestic function. Two burial pits containing multiple individuals were placed to the north of the *tola*. Each of these pits contained a principal personage who was adorned in copper, gold, and emerald finery. One of these principal personages was a child indicating that the status of such persons is likely to have been ascribed. The *tola* was expanded at least twice following its initial construction and there was a structure on its summit each time. Each of these episodes of expansion was accompanied by new burials in the same area of the first burial pits. Some of these individuals were well adorned while others were not. MDS analysis of the burials indicates that there were two social groups at the site marked by body orientation upon interment. These two groups are cross-cut by three different groups based on wealth that might be considered non-elites, elites, and rulers. Radiocarbon dates for the lowest and upper most strata suggest that all three phases of *tola* construction and all three levels of burials date to within a relatively short time span of no more than perhaps 300 years.

The burials are located within Group 3 of the shell based MDS analysis from Chapter 3. Group 3 includes all units from the western side of Loma Blasio. This and the proximity of this group to the *tola* suggest that Group 3 was an elite sector of the site. An examination of the proportions of decorated ceramics at the site show that Group 4 from the shell based MDS analysis had a much higher frequency of fancy pottery. Group 4 includes all of the units on Loma Alvarado. This data therefore suggests that Group 4 was also an elite sector of the site. Group 2 from the shell based MDS analysis did not have a high frequency of decorated ceramics, nor wealthy burials or a *tola*. This indicates that Group 2 is a non-elite sector of the site. Group 2 corresponds to Stratum A of all units on Loma Segarra and the eastern side of Loma Blasio.

While Groups 3 and 4 express their higher status differently, they do share some characteristics that mark them as more similar to one another than either is to Group 2. The deposits in Groups 3 and 4 are deep (2-3m) with distinct strata of dense midden deposits. Group 2 deposits are quite shallow (.20-.50m) and consist of sparse midden deposits scattered across a wide horizontal expanse. Since these sectors are all considered contemporaneous (on the basis of C14 dates and ceramic types) the differences in the nature of the deposits reflect differences in the nature of habitation in elite and non-elite sectors of the site. Elite residents appear to have lived in the same location over several generations showing a strong attachment to the location and the land. Non-elite residents appear to have lived in a given location for no more than one generation, indicating that they had a much weaker attachment to the land.

Table 4.1 *Tola* stratigraphy

Stratum	Phase	Description
NA	Modern	This stratum consists of 1m of mixed military deposits in *Tola* Unit 1, 60cm in *Tola* Unit 2, and 30cm in *Tola* Unit 3. Mixing includes midden deposits and yellow silt lenses. Reportedly these deposits came from the now destroyed site of Loma del Zorro. They are cultural and were deposited by the military in layers using large machinery.
A	Phase 3 Construction	Surface This stratum is only found in *Tola* Unit 1. It is a 5cm thick compacted gray silt lens that is believed to represent the final phase of mound construction. Puddled adobe in a half circle that represents the location of a post was found on this surface at about 28masl.
B		This stratum is found only in *Tola* Unit 3. It is a 10cm thick mixed yellow clay cap that extends only half way across the unit at an angle toward the west. This stratum is believed to be associated with Stratum A and may be the edge of the mound.
C		This stratum is only found only in *Tola* Unit 2. It is a 45-70cm thick layer of gray clay with yellow inclusions beginning at .60mbd. This stratum looks like a cap.
D		This stratum is found in *Tola* Unit 1. It is a 20cm thick brown-yellow silty clay deposit.
E		This stratum is only found in *Tola* Unit 3. It is a 30-40cm gray-tan silty midden deposit.
F		This stratum occurs only in *Tola* Unit 2. It is a 30-50cm thick layer of yellow-brown sandy clay with low artifact density. It is similar to Stratum D.
G		This is a clean yellow alluvial silt deposit. This stratum is 60cm thick in *Tola* Unit 1 and 30m thick in *Tola* Unit 3.
H		This stratum is found only in *Tola* Unit 3. It is a 20-30cm thick light brown silty midden deposit.

Table 4.1 continued

I	Phase 2 Construction	Surface This stratum is found in *Tola* Unit 1 and *Tola* Unit 2. It is a thin 3-5cm oxidized surface believed to represent the top of the second phase of mound construction. In *Tola* Unit 2 a possible adobe and some melted green gray clay were found on this surface. It is lower in *Tola* Unit 2 and sloping south, indicating that this is the edge of the mound. The surface begins at about 27masl. A radiocarbon date taken from this surface in *Tola* Unit 2 dates from 265–572AD.
J		This stratum only occurs in *Tola* Unit 3. It is a 15cm green-yellow clay cap. This stratum may be associated with Stratum I. It is sloping westward and may represent the edge of the mound.
K		This stratum is found in *Tola* Unit 1 and *Tola* Unit 2. It is a layer of dark gray-brown clay with moderate artifact density. In *Tola* Unit 1 it is 25cm thick, in *Tola* Unit 2 it is a 60cm thick.
L		This stratum is only found in *Tola* Unit 3. It is a 45cm thick light brown silty midden deposit that decreases in artifact density in the final 20cm. One posthole was found in the upper 20cm (12cm in diameter, 32cm deep). One posthole was found in the lower 20cm (15cm in diameter, 21cm deep). Both post-holes were sand-filled.
M		This stratum occurs only in *Tola* Unit 1. It is a 10cm thick light brown ashy midden deposit.
N		This stratum occurs only in *Tola* Unit 2. It is a 65cm thick, hard brown clay with moderate artifact density.
O		This stratum is a 10-15cm cap in *Tola* Unit 1 made of yellow clay mixed with ash and silt.
P		This stratum is a 20cm cap in *Tola* Unit 1 made of green clay mixed with ash and silt. There is a remnant of Stratum P at the top of *Tola* Unit 3. Two postholes were found in association with the cap: one 15cm in diameter by 40cm deep, and another 22cm in diameter by 34 cm deep. Both postholes were sand-filled.
Q		This stratum is a layer of clean yellow sandy silt. It is 5cm thick in *Tola* Unit 1 and 55cm thick in *Tola* Unit 3. There is a large rodent hole in the eastern side of the profile.

Table 4.1 continued

R	Phase 1 Construction	Surface This is the layer at which *Tola* Unit 1 was prematurely terminated. It is a green-gray clay deposit at least 85cm thick, beginning at about 26masl. This stratum is also seen in *Tola* Unit 3 as a 25-55cm irregular deposit with more yellow inclusions. In *Tola* Unit 1 the corner of a 30cm+ in diameter by 55cm deep pit filled with shell midden and a 25cm+ in diameter by 10cm deep sand-filled posthole were encountered. This level represents the top of the mound after the first phase of construction.
S		This stratum is only found in *Tola* Unit 2. It is a 10cm thick layer of dark brown clay with daub.
T		This stratum is only found in *Tola* Unit 2. It is a 50cm layer of dark, gray-brown clay very much like the natural aridisols in the area.
U		This stratum is only found in *Tola* Unit 3. It is a 15-20cm orange-tan silty clay deposit.
V		This stratum is only found in *Tola* Unit 2. It is a 15cm thick layer of dark brown sandy clay with high artifact density. At the bottom of this layer two pits filled with silty midden deposits were identified. One was 70+cm by 55+cm by 14cm deep, the other was 30+cm in diameter by 12cm deep. There may have been the remnants of an adobe wall along the eastern edge of the unit.
W		This stratum is a yellowish tan sandy silt layer with very low artifact density. In *Tola* Unit 2 this layer is 65cm thick, and alternates sand lenses with sandy silt layers. In *Tola* Unit 3 this layer is 1.10m thick, alternating 10cm thick sandy green-yellow clay caps with sandy silt in the upper half.
X		This stratum is only found in *Tola* Unit 2. It is a 10cm cap of mixed green-yellow clay with two adobes. Two post holes and an oblong feature were identified at 3.68mbd. The oblong feature is 50cm by 10cm by 9cm deep, and is filled with ash. The postholes are 10cm in diameter by 4cm deep and 10cm in diameter by 13cm deep, both were filled with sand. This may be the beginning of *tola* construction.

Table 4.1 continued

Y	Pre-*Tola* Occupation	This stratum was only encountered in *Tola* Unit 3 at about 24masl. It is a 5-10cm tan silt layer that does not cover the entire unit. It is capped with a thin layer of sand and lies somewhat within Stratum Z. Two postholes are associated with this level: a 15cm in diameter by 30cm deep posthole filled with sand, and a 20cm by 15cm by 26cm deep posthole filled with sand.
Z		This stratum appears in both *Tola* Units 2 and 3. It is a 10-25cm layer of light brown ashy, sandy silt midden. A 15cm depression was noted in the profile of *Tola* Unit 2 in association with this layer.
AA		This stratum is a 10-20cm layer of light brown silty clay with very few artifacts. *Tola* Unit 3 had a 10cm diameter by 18cm deep tapering posthole with oxidized edges and ash fill. On the western side of *Tola* Unit 2 a large hearth was excavated. A radiocarbon sample from this hearth dates from 254–534 AD. *Tola* Unit 3 had six postholes and two ashy pockets in this stratum. All of the postholes were full of ash except for one on the northern end which was full of sand. The postholes were 10cm in diameter by 8cm deep, 10cm in diameter by 9cm deep, 12cm in diameter by 18cm deep, 12cm in diameter by 8cm deep, 10cm in diameter by 10cm deep (sand fill), and 9cm in diameter by 21cm deep. The ash pockets represent slight depressions full of ash.
AB	Sterile	At about 23masl sterile deposits were encountered in *Tola* Unit 2 and *Tola* Unit 3. The sterile soil is the same hard dark brown aridisol underlying all units on the eastern side of the site. *Tola* Unit 2 has two posthole features in this level: a 10cm in diameter by 10cm deep posthole full of charcoal, and a 10cm in diameter by 10cm deep posthole full of sandy silt. *Tola* Unit 3 had 3 postholes in this layer. The postholes were 10cm in diameter by 10cm deep, 10cm in diameter by 12cm deep, and 5cm in diameter by 13cm deep. All three were full of ashy silt.

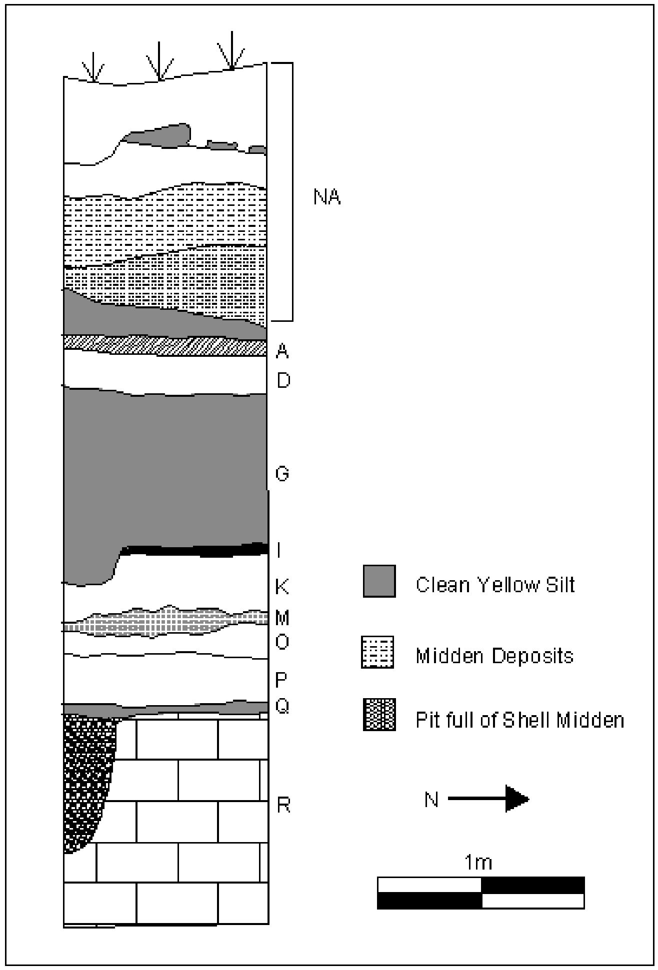


Figure 4.13 West profile of *Tola* Unit 1.

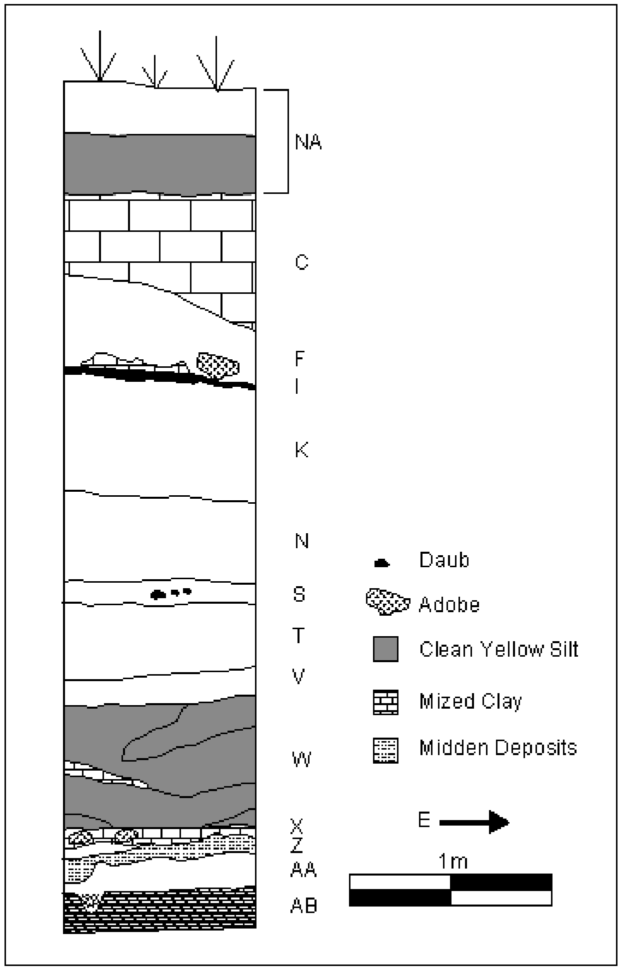


Figure 4.14 North profile of *Tola* Unit 2.

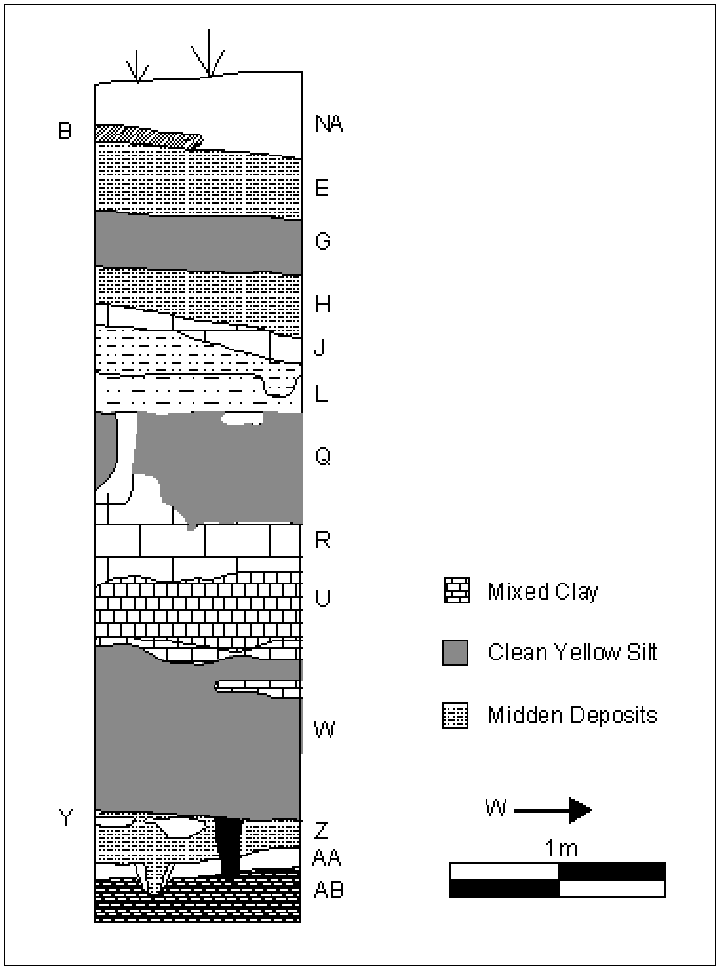


Figure 4.15 South profile of *Tola* Unit 3.

Table 4.2 Horizontal Area C stratigraphy

Stratum	Description
A	A light gray-brown silty midden deposit with a moderately high density of debris, the midden is domestic in nature. This stratum ends at an ashy lens (Floor A) that is likely associated with the final phase of *tola* construction.
B	A dark gray-brown silty midden deposit with a high density of debris, the midden is domestic in nature. This stratum ends at an ashy floor with several burials (Floor B), and is likely associated with the second phase of *tola* construction.
C	A light yellow sandy silt deposit consisting of alluvial soil with light artifact density. This stratum is likely related to Stratum G in the *tola* units, though it is not as clean as Stratum G.
D-F	Stratum D is a dark gray midden overlying burial pits. Stratum E is yellow sandy silt outside of the burial pits. Stratum F is clean sand at the bottom of burial pits. These three strata are combined in all analyses because they were inconsistently separated and labeled in the field. Therefore Stratum D-F consists of all strata below stratum C and above Stratum G. In Unit 50 these strata end at an ashy floor that is likely associated with the first phase of *tola* construction.
G	This is a sterile green-gray clay with sand-filled postholes. This stratum includes a green clay cap placed over the sterile deposit and the postholes. It is a pre-*tola* and pre-burial occupation.

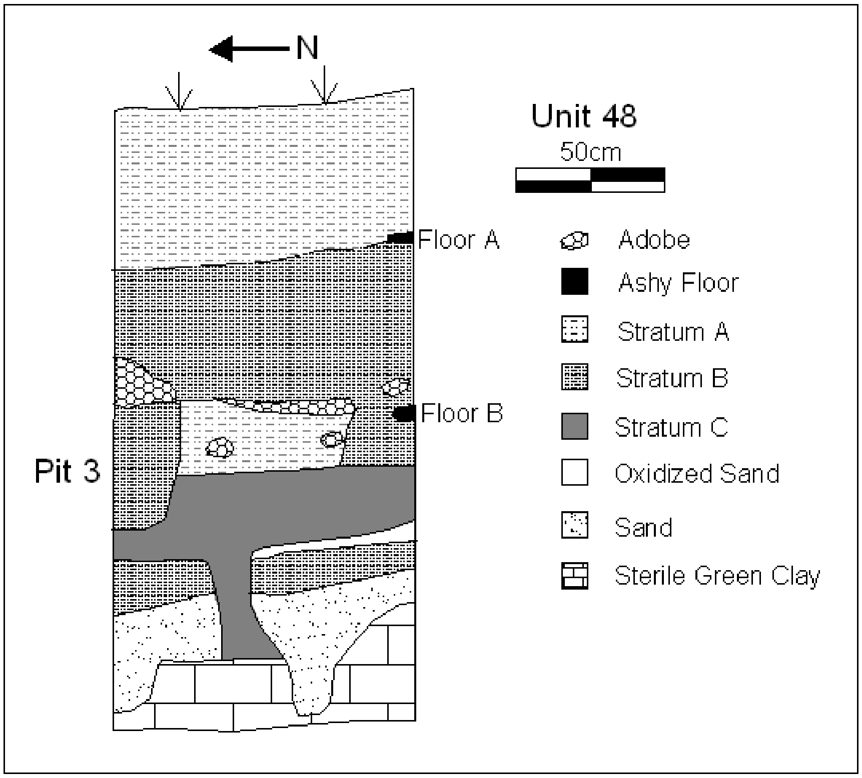


Figure 4.16 East profile of Unit 48.

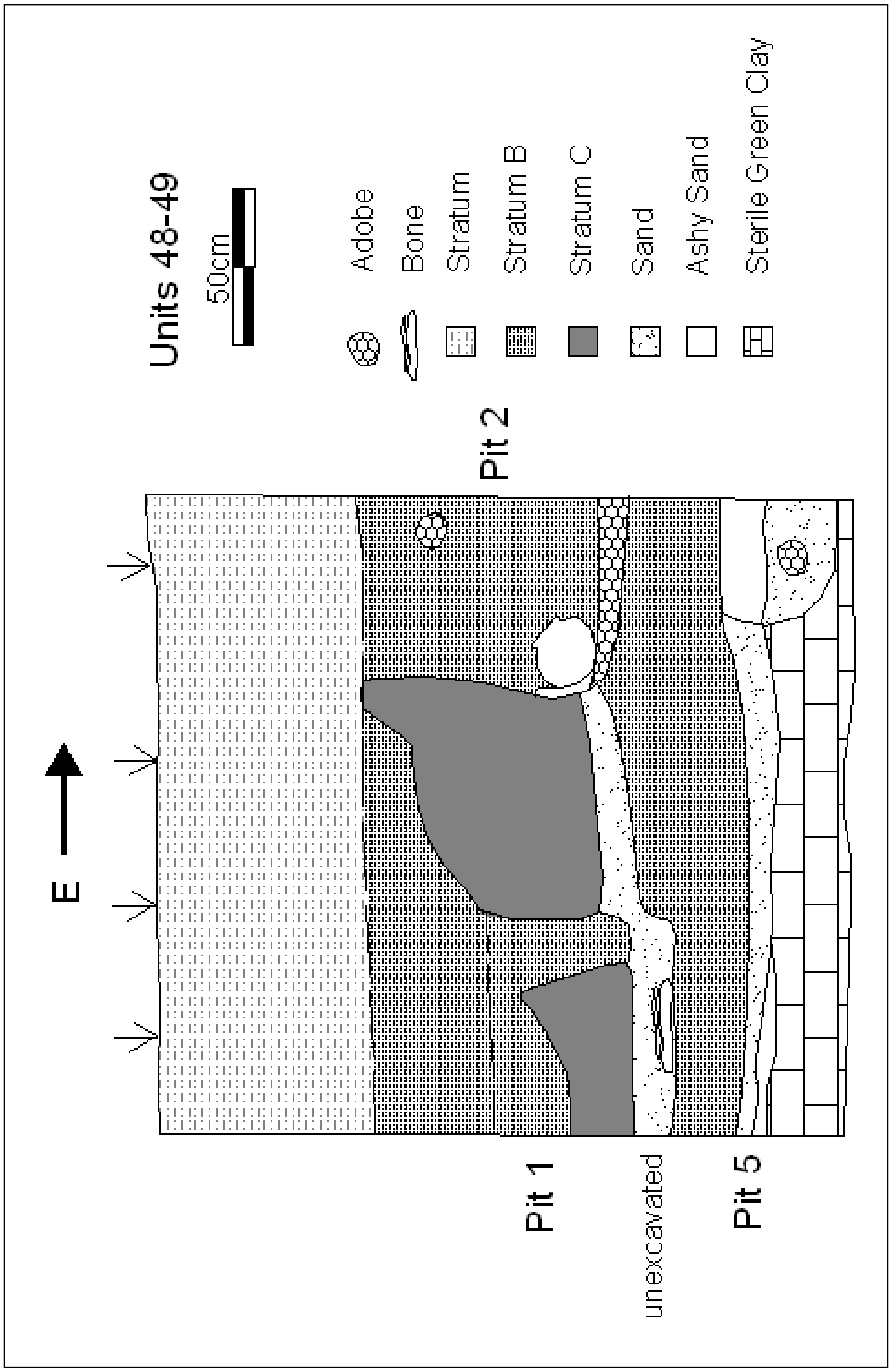


Figure 4.17 North profile of Units 48 and 49.

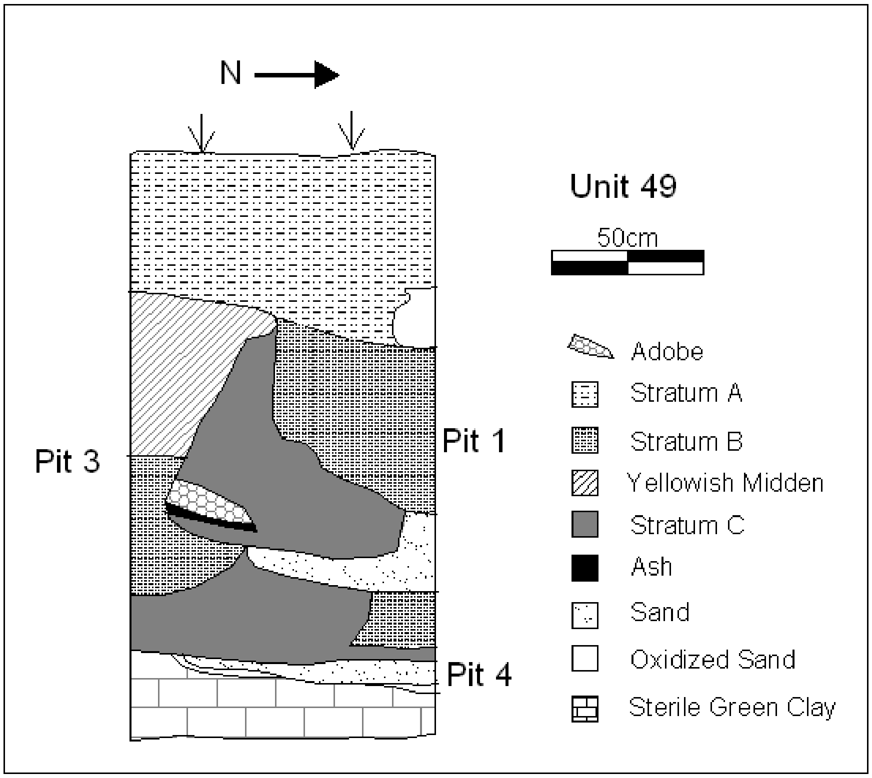


Figure 4.18 West profile of Unit 49.

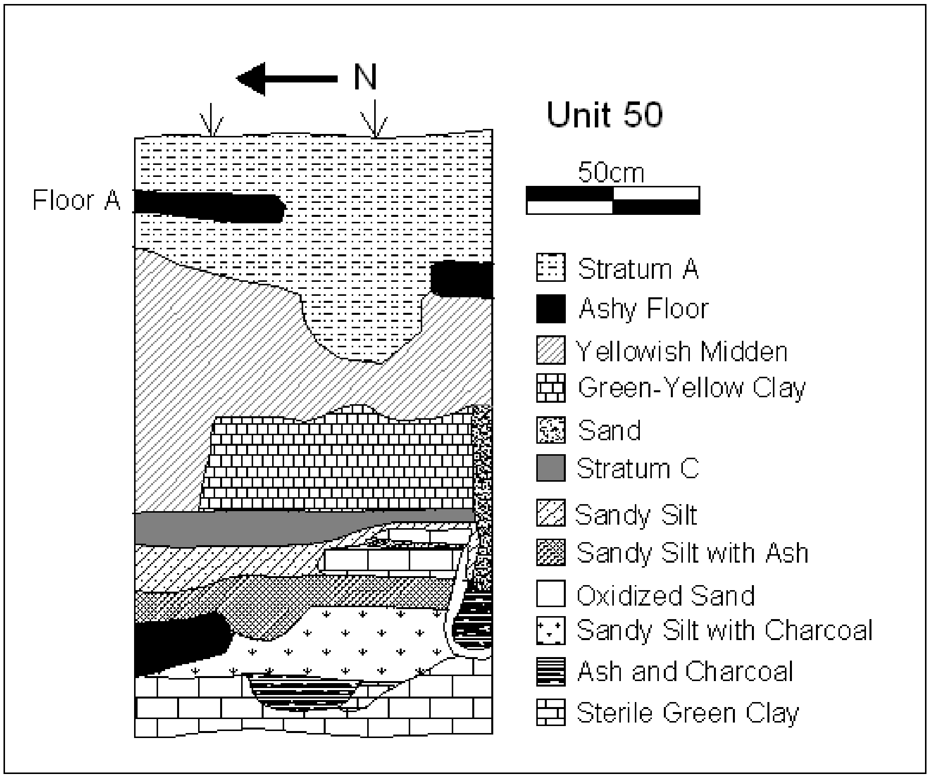


Figure 4.19 East profile of Unit 50; note the ashy floor at the bottom of Stratum D-F.

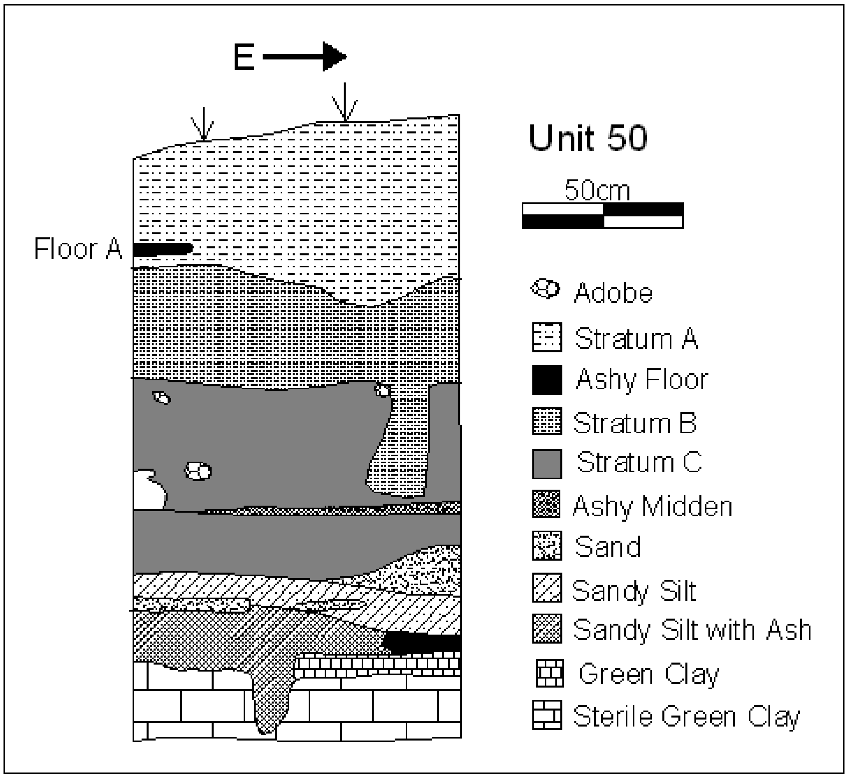


Figure 4.20 North profile of Unit 50.

Table 4.3 Burial details

Burial	**Description**
Burial Floor B	
1	A sub adult 6-9 years of age, sex unidentifiable. The individual was found lying on its back with legs crossed and arms extended to the sides, head pointing east. A very low degree of porotic hyperostosis was noted on cranial fragments. The state of the atlas indicates cifosis, a birth defect which can create an abnormal curvature of the upper vertebrae of the spine, caused by metabolic or neuromuscular problems. This is one of the more elaborately adorned individuals in the sample. The individual wore a shell and stone bead collar consisting of four strands joined with bone separators. A quartz crystal bead, like those reported by Bruhns (2003) from the highland site of Pirincay was associated with the collar, as was a plain red ground stone pendent (Figure 4.21). Thin anthropomorphically shaped cut-copper sheet earrings and rolled copper hoops were found on either side of the cranium. Three stacked *narigueras* were found near the nasal aperature. Two are cut-copper sheets one is rolled gold (Figure 4.22). A broken ceramic vessel in an inverted position was found on the left side of the individual and a ceramic splindle whorl was found near the left hand.
2(10)	An adult female 17-21 years of age. The individual was found lying on its back with legs crossed and arms extended to the sides, head pointing east. Deviation of the spinous processes on cervical vertebrae and a thickening of the process on C3, as well as bulked rims on the lumbar vertebrae, might indicate scoliosis. An eruption of the third molar fracturing the mandible was noted, this condition would have been preceded by gum infection. Very extensive infection of the frontal bone was also noted and likely caused by sinus infections due to an obstruction of the right nasal conduct. Pigeon/dove, rabbit, and deer bones were found in association with this burial but could have come from the surrounding midden matrix. Four ceramic vessels were associated with this individual. Two pedestalled jars (Figure 4.23), one sitting on top of the cranium. A plain jar and a Manteño frogwar jar (Figure 4.24) were also associated with this burial. Finally, one copper alloy earring was found (Figure 4.25).
5	An infant less than 1 year of age, sex unidentifiable. Burial consist of infant cranium fragments and one tooth lying on a large tinaja fragment, next to a plain olla (Figure 4.26). This burial may be neonatal based on the extremely thin cranium fragments and lack of other associated bones.
6	A child of less than 6 years of age, sex unidentifiable. This is a secondary burial consisting of disarticulated and incomplete body parts including some extremities, ribs, and a few cranium fragments. The bones were found in a pile mixed with *Canis familiaris* (dog), *Dasypus sp.* (armadillo), and *Falco peregrines* (peregrine falcon) bones.

Table 4.3 continued

11	Likely an infant of unidentifiable sex. This is a secondary burial consisting of disarticulated and incomplete body parts including ribs, scapula, and cranium fragments. The bones were found in a pile mixed with artiodactyla (probably deer or camelid) and Columbidae (pigeon/dove) bones. The bones were lying next to a burnished jar with stamped sunbursts around the shoulder. Mixed with the bones were five copper-gold alloy earrings. One pair has dangles and cloth attached to them. Two additional earrings also have dangles. One earring is a simple hoop with a bead and cloth attached (Figure 4.27).
Pit 1	
12	An adult male 18-28 years of age. The individual was found in an extended position lying on its back with the head pointing east. The lower legs of the individual are outside of the unit extending to the west and were not excavated.
Pit 2	
13	Sex and age unidentifiable. Only the cranium, upper vertebrae, and shoulders of this individual were excavated, the remainder of the individual is outside of the excavation unit to the north and was not excavated. The head was lying on its side pointing west. This individual was found with three complete vessels and two vessel fragments. Two of the vessels are pedestalled bowls (Figure 4.28) one is a coffee bean face-neck jar. A copper spatula was also found with this individual (Figure 4.29).
Pit 3	
7	A sub adult of less than 15 years of age, sex unidentifiable. The individual was found in an extended position lying on its back, head pointing west. Abnormal enamel formation (an extra portion of enamel or abscess) on one molar may be related to diet. This pit seems to have cut into two lower burial pits, substantially disturbing one of them. This burial is the deepest pit at the site and is similar in pit construction to the lower Pits 4 and 5. Two ceramic vessels were found with this individual, a ceramic drum or incensario and a pedestalled jar (Figure 4.30). The drum/incensario is most likely a drum as it closely resembles vessels identified as drums in Piura and Catamayo.
8	An adult, sex unidentifiable. This burial consists of an isolated skull. There could be more body parts to the west of the unit though nothing was seen in the profile.
20	Sex and age were unidentifiable. This burial consists of an isolated skull. There could be more body parts to the west of the unit though nothing was seen in the profile.
17	An adult 18-20 years of age, sex unidentifiable. Found in an extended position lying on its right side, head pointing west.
Pit 4	
3	Sex and age were unidentifiable. This is likely the disturbed burial of an individual with legs extended; only the lower body was encountered. A possible pathology was noted on the auricular surface of the illium that could be the result of work related stress.

Table 4.3 continued

4	This burial is the principle personage of Pit 4. The burial is a child 4-6 years of age, sex unidentifiable. The individual was found in a seated position with the legs crossed and the upper body slumped forward, head originally looking to the east. This individual was found with three ceramic vessels and several elaborate adornments. Two of the ceramic vessels are identical jars that would be better considered bottles and almost surely held liquids (Figure 4.31). One pair of copper earplugs with gold inlay were found with the individual; the left earplug was found on the left side of the cranium while the right earplug was found about 30cm to the right of the body, having fallen out and rolled away when the individual slumped forward. Three stacked copper-gold alloy *narigueras* were found underneath the cranium (Figure 4.32). The smallest has a 3-D bird attached to the front of it while the largest has a moon monster design repousséd into it (Figure 4.32). An emerald bead was found near the *narigueras*. A very unusual collar was found just behind the body. The collar is made of clay beads with two donut-shaped pendents. Each of the pendents was about 4cm in diameter and is made of gold nuggets baked into a clay matrix (Figure 4.33). Finally, three green micro-lithic flakes were found under the body.
9	Sex and age were unidentifiable. This is likely the disturbed burial of an individual with legs extended; only the legs and feet were encountered.
Pit 5	
14	A sub adult 7-11 year of age, sex unidentifiable. The individual was found in a seated position leaning against the wall of the burial pit with legs extended, head looking to the west. This individual had a pedestalled bowl behind its back and a copper ring associated with the fill surrounding the cranium (Figure 4.34).
15	An adult of unidentifiable sex. The individual was found in a seated position leaning against the wall of the burial pit with legs extended, head looking to the west. Extensive wear and possible signs of rheumatoid arthritis were noted on the thoracic vertebrae. Extra enamel on the surface of one middle molar was also noted. As with Burial 7 this abnormality could be related to diet. This individual was found wearing a shell and stone bead collar. A possibly heat damaged copper alloy *nariguera* was found in the surrounding fill (Figure 4.35).
16	An adult 18-25 years old of unidentifiable sex mixed with the extremities of an infant. The adult was found in an extended position lying on its back, head pointing east. The infant bones were not recognized or mapped during excavation. There is a hole in the distal epiphysis of the adult.

Table 4.3 continued

18	This burial is the principle personage of Pit 5. The burial is an adult male found in an extended position lying on its left side. The teeth and mandible appear to have been exposed to heat damage based on their color and texture. This individual was elaborately adorned. He wore a copper headdress with textile and wood on the exterior, indicating that the headdress likely had perishables (such as feather) attached to it. Two possibly heat damaged copper alloy *nariguera*s were found near the mandible (Figure 4.36). A pair of copper-gold alloy earrings with dangles, as well as two emerald beads,were found on either side of the cranium (Figure 4.37). A clay bead bracelet was found by the right arm, and a clay ornament was found by the right hand (Figure 4.38).
19	Sex and age unidentifiable. The burial consists of fragments of lumbrar vertebrae and ribs in the northern profile of Unit 49 and extends in that direction beyond the unit. The individual is probably lying on its right side. The individual is considered to likely be an adult or young adult based on the size of the bone fragments.

Figure 4.21 Burial 1 spondylus and stone bead collar.

Figure 4.22 Burial 1 copper earrings (left) and copper and gold *narigueras* (right).

Figure 4.23 Burial 2(10) Vessel 10 (left) and Vessel 3 (right).

Figure 4.24 Burial 2(10) Vessel 13 (right) and Vessel 1 (left).

Figure 4.25 Burial 2(10) copper alloy earring.

Figure 4.26 Burial 5 Vessel 21.

Figure 4.27 Burial 11 Vessel 14 (left) and copper alloy earrings (right).

Figure 4.28 Burial 13 Vessel 16 (left) and Vessel 17 (right).

Figure 4.29 Burial 13 Vessel 19 (left) and copper spatula (right).

Figure 4.30 Burial 7 Vessel 23 (left) and Vessel 24 (right).

Figure 4.31 Burial 4 Vessel 25 (left) and Vessel 27 (right).

*Vessel 26 is identical to 25 but a bit smaller and less well preserved.

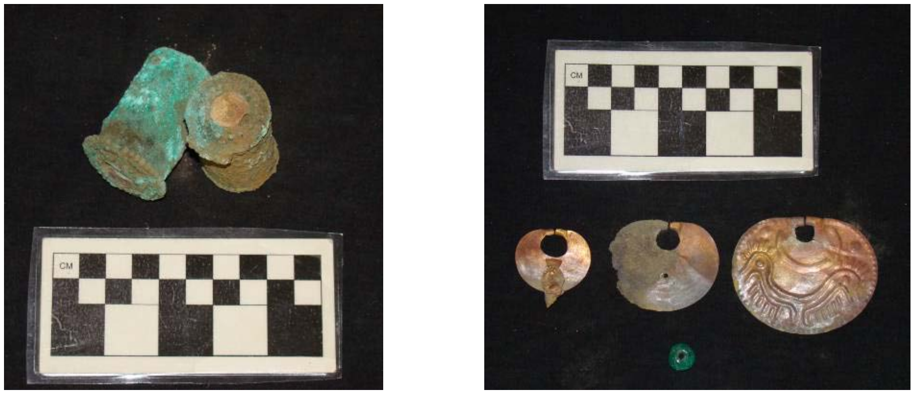


Figure 4.32 Burial 4 copper and gold ear spools (left) and *nariguera*s and emerald bead (right).

Figure 4.33 Burial 4 gold nugget and clay bead collar.

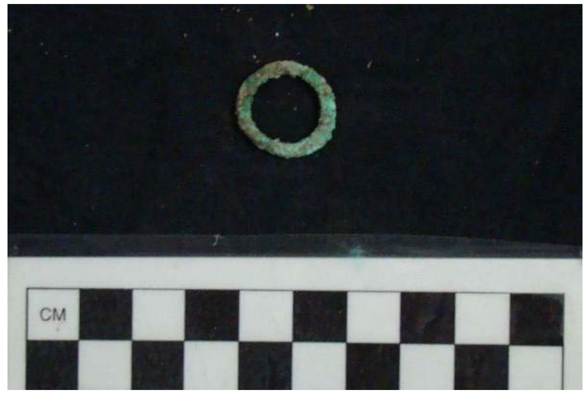


Figure 4.34 Burial 14 Vessel 20 (left) and copper ring (right).

Figure 4.35 Burial 15 spondylus and stone bead collar (left) and copper alloy *nariguera* (right).

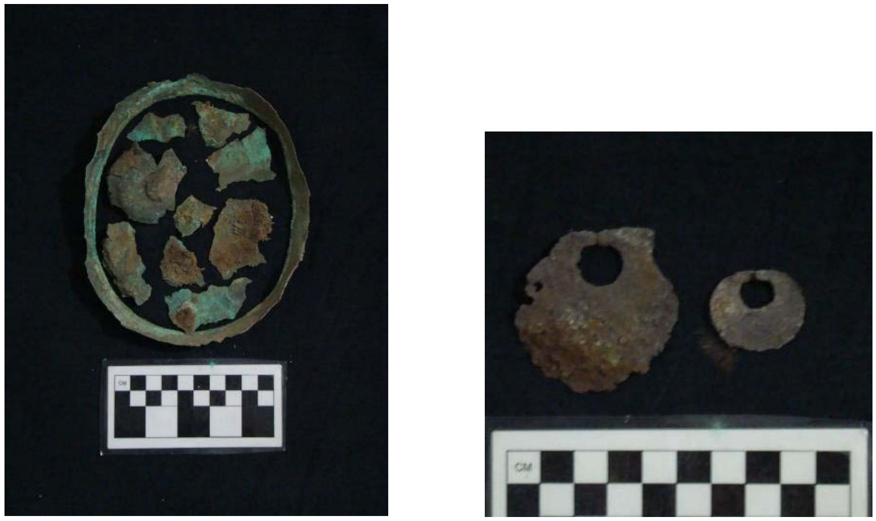


Figure 4.36 Burial 18 copper, wood, and textile headdress (left) and copper alloy *narigueras* (right).

Figure 4.37 Burial 18 copper-gold alloy earrings (left) and emerald beads (right).

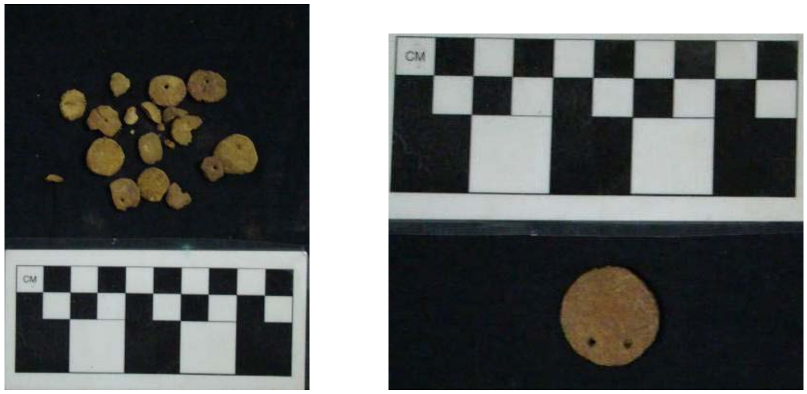


Figure 4.38 Burial 18 clay bead bracelet (left) and clay ornament (right).

5.0 ENVIRONMENT, SETTLEMENT, AND ENSO

Environmentally the Zarumilla River lies on an ecotone between the arid desert coast of northern Peru and the sub-humid tropical coast of central Ecuador. The region as a whole is characterized by high species diversity and a high incidence of endemic plants and animals because of its proximity to the mangrove coastline and the Huancabamba Deflection (Parker and Carr 1992). The Huancabamba Deflection is a point in the Andean cordillera where the mountain spine shifts direction creating the lowest passage between the coast and the eastern slopes. Vegetation along the Zarumilla River consists mainly of thorn scrub forests; primarily *hualtaco*, *algarrobo*, and *ceiba* trees. A number of shrubs, cacti, and wild grasses are also endemic to the region. The area was known to be a natural habitat for crocodile, jaguar, and white-tailed deer in the past. Today the region boasts a remarkable number of bird species and very large iguanas. The mangrove coastline is rich in shellfish and fish species. These varied resources would have made hunting and gathering a viable subsistence strategy in the past.

In general this region has poor soil, making it less desirable agriculturally than its neighbors. Seimens (1988) describes much of the soil as aridisols which are hard desert clays that dominate xeric scrub habitats. Aridisols have low organic content and absorb little water. In addition to poor soils the water table is deep and there is little rainfall. The dry season lasts from April to December leaving only a three month rainy season, during which time the area receives a meager 200mm of precipitation (Staller 2001). Because the Zarumilla River changes course from time to time good quality floodplain sediments overly paleo-river channels providing a 2km wide floodplain along the river. In addition to better quality soil the water table is significantly higher in these areas so they would have supported plant cultivation. No prehispanic agricultural features have been identified in aerial reconnaissance of the region (Staller 2001) indicating that cultivation in the past would have been limited to the riverbank or hand-watered fields where good soil can be found.

Weather patterns in the El Oro-Tumbes region are strongly affected by the Humbolt Current and the Andean Cordillera. This region is the epicenter of El Niño activity in the western hemisphere. It is here that the cold northward flowing Humbolt current leaves the coast of South America and veers off to sea, meeting the warm El Niño countercurrent on its way south from California. During mega El Niño events the Zarumilla River is prone to flooding, and sometimes changes its course. Indeed, in 1998 a large El Niño event resulted in substantial discharge from the Zarumilla River causing the river to move 1km to the east. Events large enough to cause the river to shift seem to be considerably less frequent than events that would qualify as “mega El Niños”. Flooding creates the broad floodplain but also deposits a heavy sediment load into the mangroves and estuaries. Heavy rainfall and discharge decrease oxygen content of the water creating conditions of hypoxia and lower the salinity to below some species thresholds (Lucero et al. 2006). Consequently, ENSO activity disturbs the mangrove estuary habitat while increasing vegetation for terrestrial fauna and improving agricultural potential through greater rainfall. While flooding of the Zarumilla River would destroy floodplain crops in the short term, the river would recede more quickly than the mangroves would recover, leaving a fertile silt deposit in its wake.

5.1 SETTLEMENT

A visual examination of known site locations in the region (see Figure 5.1) shows that ten out of twelve sites are located along this stretch of good soil. No full coverage survey has been conducted in the region and since sites are often destroyed wholesale, this map cannot be seen as a full settlement map. Nonetheless, informal survey along the Peruvian side of the river by Moore and his colleagues in the late 1990s (Moore et al. 1997), and informal survey undertaken by myself along the Ecuadorian margin of the river in 2007 and 2008, failed to locate more than two sites outside of this fertile stretch.

One of the two sites located outside the stretch of floodplain along the river, is on the mangrove shoreline. The coastline is part of the Jambeli archipelago mangrove barrier reef which provides a rich marine and mangrove habitat. Prior to the construction of dozens of shrimp farms in the 1980s, Estrada, Meggers and Evans (1964) noted several other sites on this coastline and within the archipelago itself. The site identified here would have been one of several in the archipelago.

Only one site is located further inland away from the Zarumilla River's broad floodplain. This site is located at the foothills of the Andes Mountains. Neither I nor Moore ventured beyond this point in our explorations so there may very well be additional sites in the foothills. In fact, local residents noted that archaeological sites were found in the Puyango National Petrified Forest, not far from the site on this map, during the 1970s and 1980s when the area came under state protection.

Thus, the settlement pattern appears to have had a coastal component, an inland component, and very likely a foothills component. The extent to which any of these components was integrated socially or politically is unclear. Certainly the coastal and inland sites share the Jambelí ceramic style.

El Dornajo is part of the inland component of sites. Inland sites are all located near the river, on either the Peruvian or Ecuadorian margin. These locations provide access to both a higher water table and well watered alluvial soils. In addition to its greater agricultural potential, the improved soils and high water table would also promote greater abundance of wild plant resources and attract animals for game. The sites within this stretch are known to date from the Archaic through the Integration Period, so it seems that this location was a preferred environmental zone throughout the prehispanic sequence.

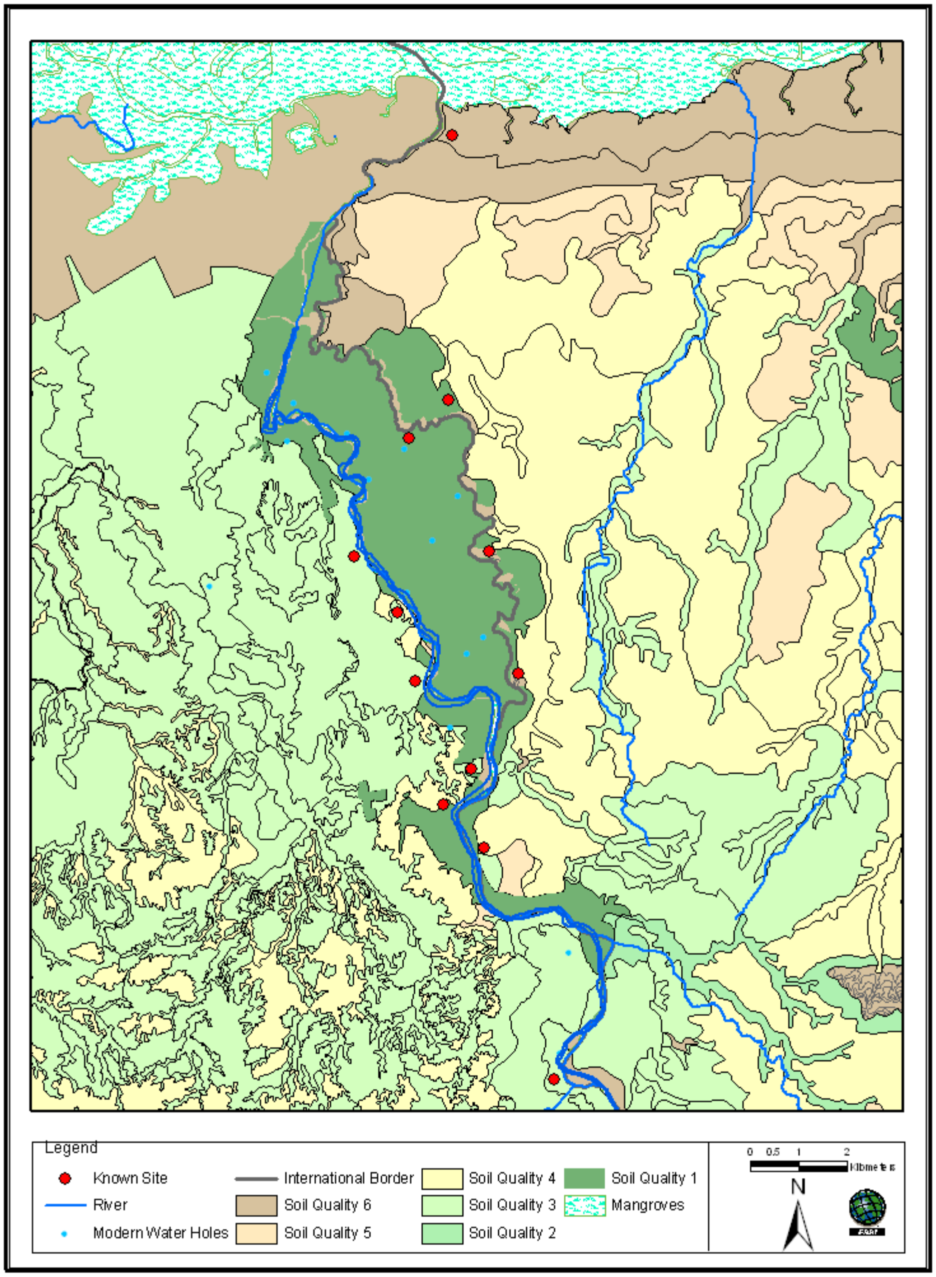


Figure 5.1 Map of soil quality and site locations along the Zarumilla River.

*The best soil quality is number 1. This map is courtesy of the Puyango-Tumbes Binational Project. Sites were added by the author. UTMs for sites on the Peruvian side of the river were taken from Moore et al. 1997.

5.2 ENSO ACTIVITY AT EL DORNAJO

Massive flooding events are evident in the geological record of the river valley as paleo-river channels with accompanying flood deposits. It is these deposits that make the area so attractive for modern gravel mining, which systematically destroys overlying cultural deposits in order to collect the gravel. This is precisely what happened on Loma Alvarado at El Dornajo. The destruction of Loma Alvarado left a 100m cut through the site as well as some deep pits reaching down to the water table. This cut and the deep pits were used to examine the geological history of the site prior to its human occupation.

Examination of the large cut created by the destruction of Loma Alvarado revealed what appeared to be paleo-river channels and accompanying flood deposits (Figures 5.2, 5.3, and 5.4). Subsequently, geologist Reynoldo Reyes was contracted to examine cuts at the site and map the course of the paleo-river channels. Reyes identified two separate courses of the river, each with at least one flooding event (Reyes 2008). Reyes study was not extensive and did not include cores, so it is likely that other channels exist, and it is not possible to identify the chronological relationship between the channels with any certainty.

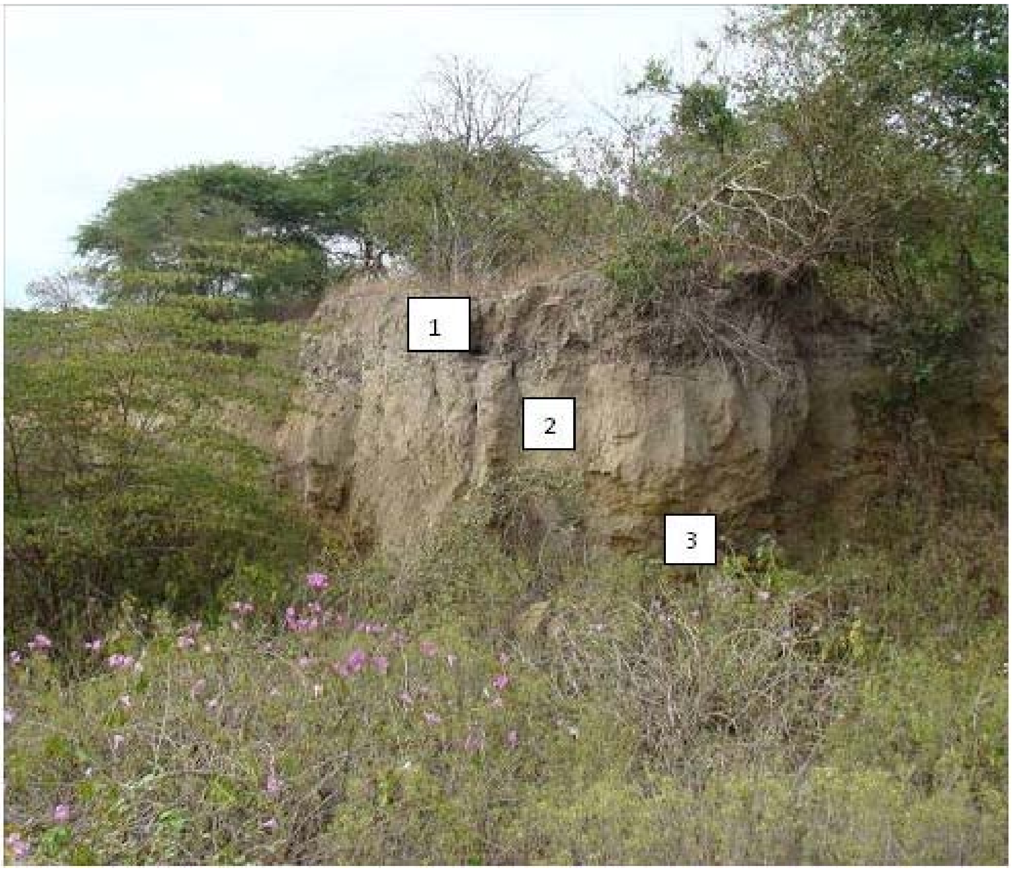


Figure 5.2 Photograph of the long cut between Lomas Blasio and Alvarado, showing flood deposits (2) underlying cultural deposits (1) and overlying the paleo-river channel (3).

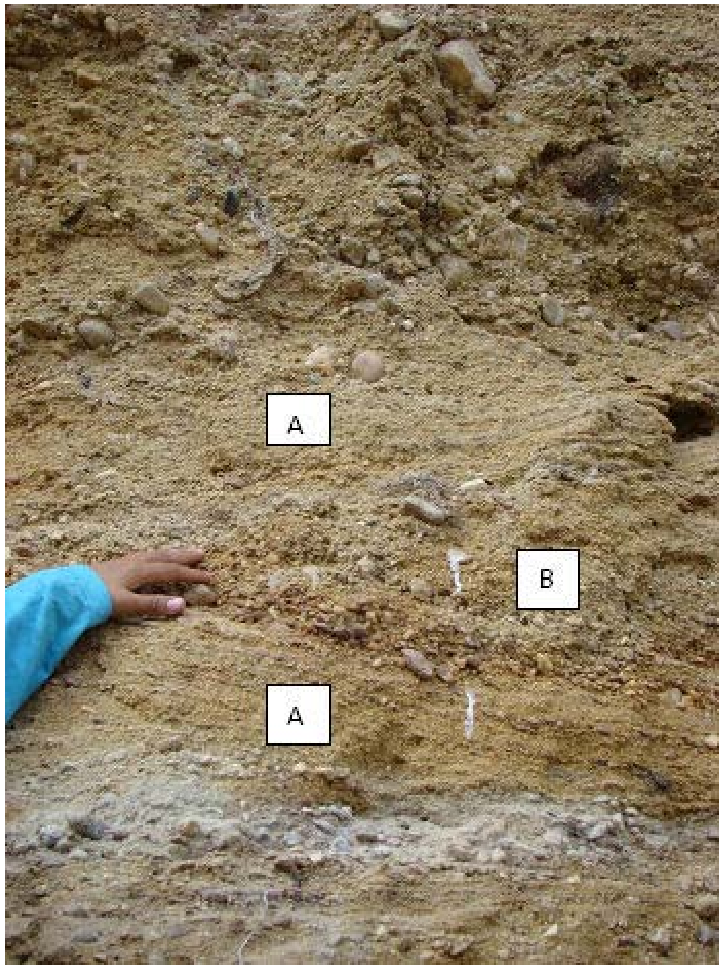


Figure 5.3 Photograph of paleo-river channel 2 showing alternating bands of summer (A) and winter discharge (B).

Nonetheless, a likely sequence of events can be deduced. All of the western side of the site is underlain by flood deposits. The eastern side of the site is made up of harder and higher aridisols that did not flood. On Loma Segarra the flood deposit is only 10cm thick while on Loma Blasio and Loma Alvarado the deposit is upwards of a meter in places. Since the elevation of the two hills is similar and radiocarbon dates for the deposits overlying them are so far apart (see Chapter 3), these flood deposits represent different flooding events. Thus, Loma Segarra flooded prior to any human occupation of the site. Then, the small Early Formative Period occupation on that hill appeared. Phytolith data to be discussed below indicate that the river ran near the site at this time. This occupation was evidently followed by a mega El Niño event that wiped-out the mangrove shell beds of the region as indicated by the marked decrease of oyster shell in midden deposits throughout the region after about 1000 BC (Currie 1989, Moore 2008, Staller 1994). This event would likely have caused the river to move back across the floodplain to the Peruvian side. The flooding event indicated in the stratigraphy underlying Loma Blasio and Alvarado (paleo-river channel 2) is likely the fingerprint of a third mega El Niño event that caused the river to return to the Ecuadorian side of the floodplain prior to the re-occupation of El Dornajo around 300 AD.

Figure 5.4 Paleo-river channels at El Dornajo.

Paleo-river channel 2 underlies the occupation of Loma Blasio and Loma Alvarado which make up half of the Early Regional Development Period occupation of the site. The precise temporal association of these deposits with the occupation of the site is not clear, but since there is no non-cultural soil development overlying the flood deposits they must have been relatively close in time. Furthermore phytolith data indicate that the river continued to run near the site throughout the Early Regional Development Period occupation, which also supports close temporal proximity.

Phytolith samples from all periods of occupation at the site suggest that arboreal vegetation was denser, that grass populations were less dense, and that soils had more moisture at that time than they do today. Specifically, diatoms (siliceous algae) and freshwater sponge spicules were very common (Figure 6.11:H,I), as well as phytoliths diagnostic and highly distinctive of bamboos (Bambusoideae), indicating a riparian environment (Yost 2009). It is therefore clear, that the river passed near the site at the time that it was occupied.

The diatoms and spicules observed were likely derived from water transported to the site for various uses, or from storm surges and uncommonly high tides that would have deposited brackish-water tolerant diatoms across the site (Yost 2009). Since the site is 10km inland, storm surges are not very likely to have reached El Dornajo, nor is water likely to have been transported this far by people. A likely explanation for the presence of these diatoms is discussed in Chapter 8.

One sample from the upper stratum (Stratum A) of Loma Segarra has a high percentage of saddle phytoliths diagnostic of the grass subfamily Chloridoideae which typically thrive under hot and dry conditions. It is likely that this sample was contaminated as it was collected very near the surface and these plants characterize vegetation of the site today.

In summary, the geological stratigraphy of the site indicates that settlement along the Zarumilla River followed the shifting riverbed. This is not a surprising find in a dry region with otherwise poor soils. It is notable however that the river historically shifts course in response to mega El Niño events and that there is evidence for such an event prior to the re-occupation of El Dornajo in the Early Regional Development Period. This conclusion is further examined by looking at changes in the size of oysters and growth breaks on clams from the site.

5.2.1 Shellfish growth

The average size of shellfish was examined to further address the likelihood that the mega El Niño event seen in the stratigraphy of the site occurred in close temporal proximity to the emergence of social inequality at the site, as opposed to several hundred years prior. The fairly small size range for all species of shellfish (except *A. grandis*), and the fact that the range is usually within that of mature individuals for the species, suggests that larger shellfish were selectively harvested by people in the region. This means that a decrease in the size of certain species through time most likely represents a decrease in the average size of the shellfish population. The most likely explanation for a decrease in shellfish size is a change in habitat since growth in shellfish depends most heavily on environmental factors (Kathiresan and Bingham 2001). Thus, a decrease in shellfish size would support an interpretation of continuing El Niño activity since these events negatively affect the habitat of shellfish. This is especially true if not one mega event, but an overall increase in ENSO activity was affecting the region since this condition would prolong the affects of increased runoff and hypoxia on the shellfish population.

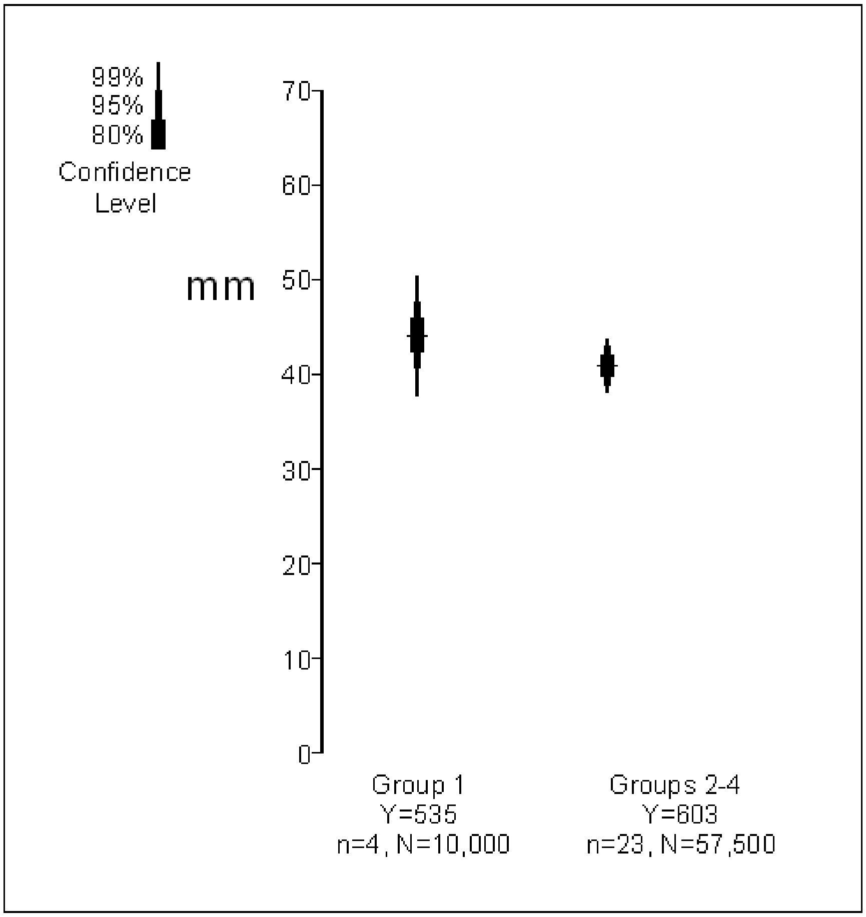


Figure 5.5 Oyster valve length for Groups 1 and 2-4.

*Group 1 corresponds to the lower strata on the western side of Loma Segarra. Group 2 corresponds to the upper strata across Loma Segarra and the eastern side of Loma Blasio. Group 3 corresponds to the western side of Loma Blasio, and Group 4 corresponds to Loma Alvarado.

If a period of more regular ENSO activity were taking place, one would expect more regular flooding of the Zarumilla River, or at least greater discharge than normal, resulting in higher siltation and lower salinity. Oyster growth everywhere is strongly stunted by low salinity water and high turbidity because of a decrease in the availability of phytoplankton and detritus, their primary food sources (Angell 1986). The average size of *O. columbiensis* in the Early

Formative Period (Group 1) is just over 3 mm larger than its average size in the Early Regional Development Period (Groups 2-4) (Figure 5.5). This difference is moderately strong for shellfish growth but does not have very much significance. Valve height is the most sensitive measure of growth on oysters, however, and would therefore be a better gauge of the impact of environmental stress than valve length used here. Since this data is not available due to confusion in laboratory measuring procedures, the results for changes in shellfish size are ambiguous.

Figure 5.6 Photograph of growth breaks on *C. subrugosa*.

On the other hand, prolonged ENSO activity is strongly indicated in the *C. subrugosa* remains. Nearly all *C. subrugosa* specimens from all excavated contexts exhibit marked growth breaks (Figure 5.6). These breaks were so prevalent at the site that I stopped recording their presence and began looking for their absence since there were several thousands *C. subrugosa* shellfish in the assemblage. Finally, I found so few specimens without growth beaks that I am comfortable characterizing the assemblage as having such breaks throughout. Rollins et al. (1987) demonstrated that such breaks in this shellfish species are associated with mega El Niño events. The breaks are signs of environmental stress at the site disrupting the growth pattern of the shells. The ubiquity of growth breaks in this species therefore, suggests that the mega El Niño event noted in the stratigraphy happened in temporal proximity to the re-occupation of the site, and that ENSO activity was likely marked throughout the primary occupation of site. Indeed the dates for the occupation of El Dornajo fall within the period previously identified as a time of heightened ENSO activity (50 BC–750 AD).

5.3 SUMMARY

Inland settlement in this region followed the river, hugging fertile alluvial land and shifting with the changing course of the river. The river shifts back and forth across this floodplain as a result of massive flooding events caused by an especially large mega El Niño events. This pattern appears to have been consistent throughout the prehispanic occupation. It is logical that inland occupation would have hinged on access to the river and to the floodplain created by its wanderings. The river would have provided not only access to fresh water but also access to fertile land otherwise scarce in the surrounding aridisols.

Examination of the natural stratigraphy underlying the site indicates that the primary occupation of El Dornajo (ca. 300–700 AD) came soon after a mega El Niño event that likely caused the river to jump to the Ecuadorian margin of the floodplain. Analysis of shellfish growth breaks and phytolith data indicate that ENSO activity continued to be pronounced throughout the Early Regional Development period occupation of the site, though oyster growth does not support this notion.

In summary then, the stratigraphy underlying the site provides evidence for a mega El Niño event just prior to about 300 AD when El Dornajo was re-occupied. This event is not one previously noted in the archaeological literature. Previously identified mega events are primarily based on data from ice cores from the highlands and may not therefore, have noted this event. Analysis of growth breaks on shellfish support the idea that ENSO activity was pronounced throughout the Early Regional Development Period occupation from about 300-700 AD. There is also evidence for social inequality at the site at this same time, as seen in the *tola* and burial data presented in Chapter 4. Together these observations are consistent with our expectations if a mega El Niño event and prolonged heightened ENSO activity were associated with emergent complexity at the site.

There is reason to believe that the mega El Niño event prior to the re-occupation of El Dornajo had a lot to do with why the site was reoccupied. When the river changed its course in prehistory, it would likely have changed the regional settlement pattern. Both Uña de Gato and El Dornajo are located along the stretch of river that is most likely to change course during mega El Niño events. Indeed this is why there is such a broad floodplain at this point along the river. It seems reasonable to conclude that El Dornajo was not occupied during the Middle and Late Formative Periods because the river was probably running along the Peruvian margin at that time, near Uña de Gato which was thriving. A mega El Niño event between 0 and 300 AD likely caused the river to jump to the Ecuadorian margin causing a shift in settlement to El Dornajo. If this event was associated with the abandonment of Uña de Gato, then there may have been no real break in hierarchical organization at this point in the sequence, but rather a re-location and the potential for changes in the ways that hierarchical relationships were expressed and negotiated. The latest date for Uña de Gato is some 700 years earlier than the earliest date for El Dornajo, however, making this an unlikely scenario. Yet since all of the dates from Uña de Gato come from public architectural contexts one cannot be sure that the gap was as wide as it appears to be. In any case, displacement of the primary water source in a region like that along the Zarumilla River could effectively collapse the primacy of a central site like Uña de Gato. In the aftermath of such an event, whether it precipitated the collapse of Uña de Gato or not, those who could claim rights to land along the new course of the river would be in a position of advantage.

6.0 SUBSISTENCE SHORTAGE AND SOCIAL CHANGE

If a mega El Niño event promoted the shift to increased social differentiation at El Dornajo by giving farmers an advantage in times of food shortage, then we expect to see a number of specific changes in the archaeological record. First, there should be evidence of El Niño activity at the site roughly contemporaneous with changes in social complexity. The data presented in Chapter 5 support this expectation. Second, there should be a dietary change involving increased reliance on agricultural products. This shift should take place at about the same time as the El Niño activity at the site. Third, if emerging elites were taking advantage of these conditions by virtue of their greater access to agricultural resources, then plant foods and processing materials should be differentially associated with elite areas of the site. These expectations are examined in this chapter by looking at subsistence patterns at the site through time.

6.1 FLORA, FAUNA, AND GROUND STONE FIELD COLLECTION AND LABORATORY METHODOLOGY

6.1.1 Shellfish

All shell from the $1m^2$ test units, including fragments, was collected for analysis. Shell from additional $1m^2$ units in areas of horizontal exposure was weighed in bulk in the field and discarded. Once in the laboratory shell from the test units was washed and then separated by species using Keen (1971) and Stahl (2003). For photographs of shell by species see Appendix A. Once the shell had been separated, a total weight in grams for each species was recorded. All fragments were separated from individuals and discarded. Fragments are pieces of shell lacking an umbo.

The remaining bivalve shells were separated into right and left valves, and counted. The valve half having a higher count was recorded as the MNI for that species. The valve half having a lower count was set aside. In the case of oyster, the bottom half was always used for the MNI. Oyster is the only asymmetrical bivalve at El Dornajo and asymmetrical bivalves often have differential preservation of the halves. According to Cox (1994) the bottom valve in oyster has a better survival rate in larger specimens. Other analysts contend that in exfoliating samples the top half survives better (see Classen and Whyte 1995). The lower valve was chosen for this study because many oysters were quite large and relatively little exfoliation was observed. The MNI for gastropods was counted by the number of spires.

Lastly, two dimensions were chosen for measurement (see Figure 6.1). Up to seventy individuals from the specimens comprising the MNI count for each species and unit/stratum/level were measured in millimeters. For gastropods only shell height was recorded. This value is always an underestimate since nearly all gastropods were missing the very tips of their bases. Both valve length and semi-diameter were recorded for symmetrical bivalves. For oysters valve length and valve height were recorded in most cases, however, due to a misunderstanding in laboratory procedure, semi-diameter was sometimes recorded in place of valve height. Consequently, no statistical analysis was conducted using semi-diameter or valve height of oysters, instead analysis relies exclusively on valve length.

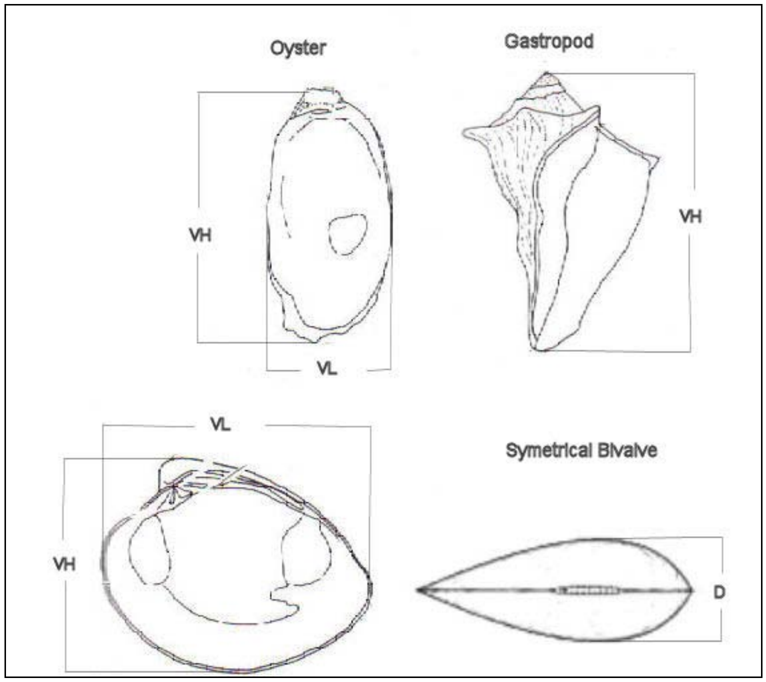


Figure 6.1 Dimensions measured on shells.

*VH=valve height, VL=valve length, D=diameter (semi-diameter is ½ of D). Adapted from Classen 1998:109.

6.1.2 Bone

All bone found in screens during excavation, whether from $1m^2$ test units or from additional $1m^2$ units in areas of horizontal exposure, was collected. It was later rinsed using very little water and inventoried. Bone was analyzed by Amelia Sanchez in Guayaquil. Sanchez used comparative collections from the Salango Center of Investigations in Manabí, Ecuador and remains from excavations at Chanduy and Loma de los Cangrejitos in the Santa Elena Province; which were previously analyzed using the comparative collection at STRI-Panama. Each specimen was weighed and then identified to the lowest taxonomical level possible and the element when possible. In the vast majority of cases both sex and age were indeterminate. Specimens were not measured since most of the remains are highly fragmented.

Because many small fish bones are not recovered with dry screening, additional samples were collected by wet screening. Resources for analyzing the large number of very small fish bones recovered have not yet become available, so the analyses presented here rely on the materials recovered from dry screening during excavation. Small fish are surely under-represented, but they are under-represented to a similar degree in all samples, making it possible to compare them.

6.1.3 Phytoliths

While many soil samples were recovered from the site, only six samples were analyzed due to cost constraints. The samples analyzed were not from ideal contexts. The recovery of phytoliths associated with consumption is best on domestic floors, but the lack of clearly domestic surfaces prohibited the collection of such samples. Instead, I opted for features that could be clearly associated with specific temporal contexts and that represented different horizontal contexts at the site. Phytolith recovery was good in all of the samples from El Dornajo despite the fact that phytolith recovery is often poor in burned or sandy contexts like those represented in these samples. Nonetheless, these samples are likely diluted by environmental inputs and in hindsight it would have been better to use samples from midden deposits. A complete pollen/phytolith column was collected from the deep midden deposits in Unit 47 with the aim of compiling a more comprehensive record of plant use in the future.

Table 6.1 The context of the soil samples analyzed for phytolith recovery.

Sample No.	Context
1	Shell midden-filled pit on top of the *tola* in its first phase of construction
2	Sand-filled posthole on top of the *tola* in its last phase of construction
3	Hearth from the lowest level of Horizontal Area C, prior to the first burials
4	Stratum B ashy burial surface in Horizontal Area C
5	Sand-filled posthole associated with Stratum B of Horizontal Area A
6	Midden-filled posthole associated with Stratum A of Horizontal Area B

The six soil samples selected were analyzed by the PaleoResearch Institute in Colorado and the following description of laboratory methodology for phytolith recovery is paraphrased from Yost 2009. The extraction of phytoliths was based on heavy liquid floatation. First hydrochloric acid (HCL) was used to remove calcium carbonates and iron oxides from a 15ml sediment sample. Second, sodium hypochlorite (bleach) was used to destroy the organic fraction of the sediment and a 5% solution of sodium hexametaphosphate was added to the mixture to suspend the clays. Each sample was rinsed thoroughly with distilled water to remove the clays. Third, a 10% solution of ethylenediaminetetraacetic acid (EDTA) was added to each sample to help with the removal of organic humic substances, and thoroughly mixed. Fourth, the remaining silt and sand size fraction was dried under a vacuum. The dried silts and sands were then mixed with sodium polytungstate (SPT, density 2.3g/ml) and centrifuged to separate the phytoliths. Because a lot of silt-sized inorganic silica was floated with SPT, each sample was again dried under a vacuum and then mixed with potassium cadmium iodide (density 2.3g/ml) to improve the recovery and concentration of the phytolith fraction. Finally, any remaining clay that was floated with the phytoliths was removed by centrifugation. Samples were then rinsed with alcohol to remove any remaining water. After several alcohol rinses, the samples were mounted in optical immersion oil for counting with a light microscope at a magnification of 500x. Approximately 320 phytoliths were counted out from each sample and identified.

6.1.4 Ground stone

All ground stone encountered in screens or during excavation was collected. This includes all $1m^2$ test units as well as all additional $1m^2$ units in areas of horizontal expansions. Once in the laboratory, they were dry brushed, weighed, and measured.

6.2 DIET AT EL DORNAJO

The mangrove habitat was an important component of early subsistence at El Dornajo as indicated by the dense oyster middens. El Niño events are known to affect the mangroves by reducing salinity and increasing turbidity as a result of heightened alluvial discharge (Barber and Chavez 1983). The most detrimental result of increased rainfall and runoff is hypoxia which lowers the oxygen level of the water below many organisms minimum threshold (Lucero et al. 2006). During mega El Niño events the mangroves may even be completely destroyed through submersion by tidal waves and rising sea level (Dyer 1995; Gundrum 1992; Sandweiss et al. 1983; Staller 1994). Even if ENSO activity did not completely wipe out preferred resources, it may still have required people to look elsewhere for food by retarding the growth of mangrove or estuarine species.

If the mega El Niño event prior to the re-occupation of El Dornajo in the Regional Development Period created subsistence shortages by destroying coastal resource zones, then one would expect to see a change in diet including a decreased reliance on mangrove and estuarine resources. This shortage might be compensated for through diversification or increased reliance on agricultural resources, terrestrial animals, or offshore fishes. Since El Niño events are generally favorable to agricultural production in arid regions and since hunting is a high energy, low reliability subsistence strategy, it is expected that plant foods would likely become more important, giving the farmers who produced them an economic advantage over others. In order to evaluate these expectations the abundance of various food remains in the Early Formative Period and the Early Regional Development Period are compared.

Even if the kind of dietary shift discussed above is demonstrated, however, it does not mean that emerging elites were necessarily controlling plant foods or had preferential access to foods in general. To examine the possibility of differential access to foods, intra- and inter-group distribution of food remains for the Regional Development Period occupation is explored. As was discussed in Chapter 4, residents of Groups 3 and 4 are considered to have been wealthier than those of Group 2, though on the basis of different criteria. Group 3 contains rich burials and is next to the only *tola* at the site. Group 4 is reported by local informants to have contained a rich burial and has a much higher proportion of decorated ceramics than any other group at the site. If emerging elites were directly benefitting from subsistence shortages brought on by El Niño events then they should be differentially associated with plant foods and processing tools. This expectation is examined by comparing food use in Groups 2-4 from the Early Regional Development Period.

As the previous paragraph indicates, comparisons both between and within time periods were undertaken using the four groups identified in multi-dimensional scaling discussed in Chapter 3. Group 1, which includes the lower stratum of all 1m^2 units on the western end of

Loma Segarra, dates to the Early Formative Period. Groups 2, 3, and 4 all date to the Early Regional Development Period. Group 2 includes the upper stratum of all $1m^2$ units on Loma Segarra and of all $1m^2$ units on the eastern end of Loma Blasio. Group 3 includes all strata in all $1m^2$ units on the western end of Loma Blasio. Group 4 includes all strata in all $1m^2$ test units and 1m dog-leash surface collection on Loma Alvarado.

Proportions of shellfish, mammal bone, and fish bone were calculated for each group as a cluster sample whose sampling units were the strata in the 1m by 1m units excavated at the site. Groups 2-4 were then pooled to arrive at pooled proportions for the Early Regional Development Period that could be compared with Group 1 for the Early Formative Period. The proportions were calculated by converting animal food to sherd ratios into proportions. For example, the MNI of shell divided by the MNI of shell plus the number of sherds. The approach taken here assumes that ceramic use remained essentially constant through time. This assumption was validated in this dataset by comparing a rank order of shell to sherd ratios with a rank order of bone to sherd ratios. If changes in ceramic use were strongly affecting the ratios then we would expect the shell to sherd and bone to sherd rations to align with one another. That is, the same contexts should appear in the same rank order, in both lists of ratios. The two ranked orders do not align so we can be confident that the primary variable affecting the ratios are animal remains.

These proportions should not be read as the percentage of the diet, or even of the animal diet, that shellfish/mammals/fishes comprised. In other words, shellfish, mammal bone, and fish bone proportions should not be compared with one another because taphonomic processes affect plant, shellfish, and bone remains very differently. What these proportions allow us to do is compare the use of shellfish (or mammals or fishes) between time periods and between groups within a single time period in a relative rather than an absolute manner.

Finally, a Simpson's diversity index was calculated for each group as simple random samples of all specimens recovered, and for Groups 2, 3, and 4 as a single sample representing the Early Regional Development Period. Bootstrapped error ranges were then calculated at the 95% and 99% confidence levels. The indexes were calculated using the Species Richness and Diversity software program by PICES Conservation Ltd. They were originally expressed in the 1/L format but were later converted to the 1-L format for ease of understanding. In this format the possible range for each index is 0-1 with 1 representing the highest possible diversity and 0 representing no diversity at all.

6.2.1 Shellfish

Shellfish populations are among the most strongly affected by environmental perturbations such as those caused by mega El Niño events. If subsistence at El Dornajo were affected by major or prolonged ENSO activity like that indicated in Chapter 5, we expect to see a decrease in shellfish use (especially mangrove species), or at least diversification of the species exploited.

Shellfish proportions are based on shell MNIs and sherd counts. Shellfish are typically transported whole to their place of consumption. In this dataset upper and lower, or right and left, valve-half counts were similar, indicating that paired halves are likely represented. Additionally, the shellfish in this dataset suffered very little from deterioration on the whole. Thus, MNI is a better measure of shellfish consumption than NISP in this case. Weights were not used because oyster shell weighs much more than any other kind of shellfish at the site, thereby biasing the data in favor of oyster.

Figure 6.2 clearly illustrates an overall decrease in the use of shellfish between the Early Formative (Group 1) and Early Regional Development Periods (Groups 2-4) at El Dornajo. We can be more than 99% confident that overall shellfish use dropped by nearly 40% between these two periods. This is consistent with our expectations for the data if ENSO activity caused a shift away from shellfish resources.

This decrease is not uniform across the site during the Early Regional Development Period, however. Residents of Group 4 did not decrease their shellfish consumption nearly so much as others. The difference in shellfish consumption between Group 4 and Groups 2 and 3 is strong; we can be 99% confident that residents in Group 4 consumed roughly twice as much shellfish as those in Groups 2 and 3. This pattern does not correlate simply with wealth differences at the site. Both Groups 3 and 4 are considered wealthy, and only Group 4 continued to consume large quantities of shellfish. This is likely an indication of different kinds of activities taking place in Group 4. This difference will be explored in the conclusion of this chapter.

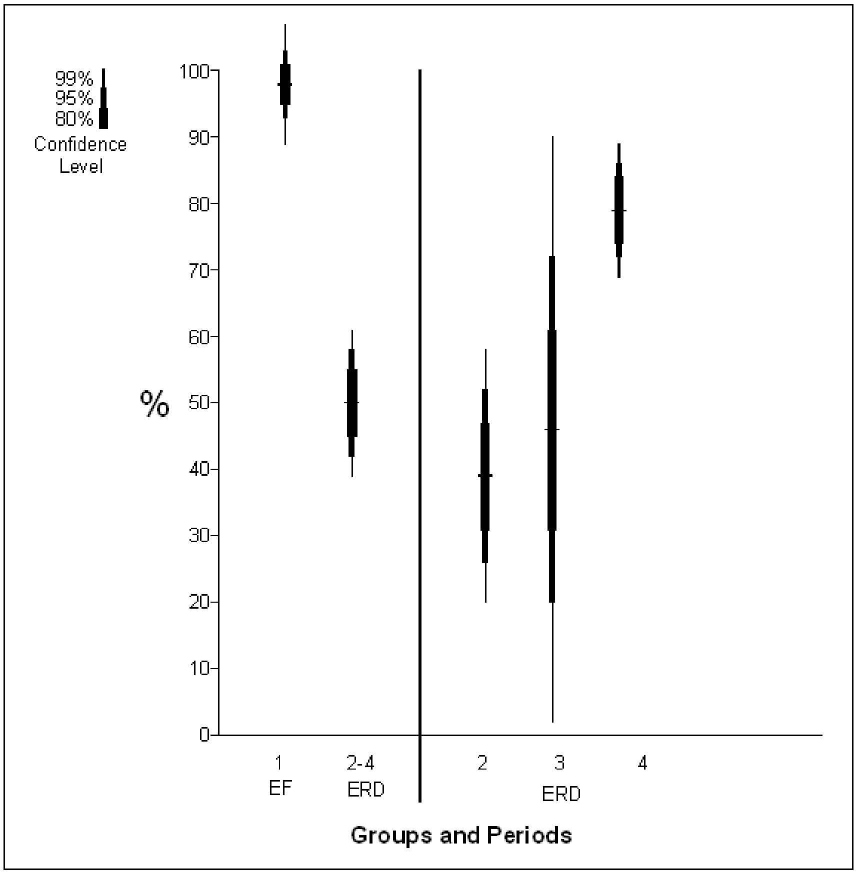


Figure 6.2 Shell to sherd proportions by group, and for pooled Groups 2-4.

*The data used to produce this graph include shell from only the 1m^2 test units at the site.

Not only did shellfish use decrease overall, but there is a shift in the intensity of the different habitats exploited and the overall diversity of the assemblage. The most abundant eight species found at the site can be grouped into those found in the mangroves and those found in the intertidal zone. *O. columbiensis* and *A. tuberculosa* are mangrove species. *A. grandis*, *P. ecuadoriana*, *C. subrugosa*, *M. pallida*, *C. valida*, and *C. stercusmuscarem* are all intertidal species. Additional less common bivalve species that were recovered are all found in the intertidal flats as well.

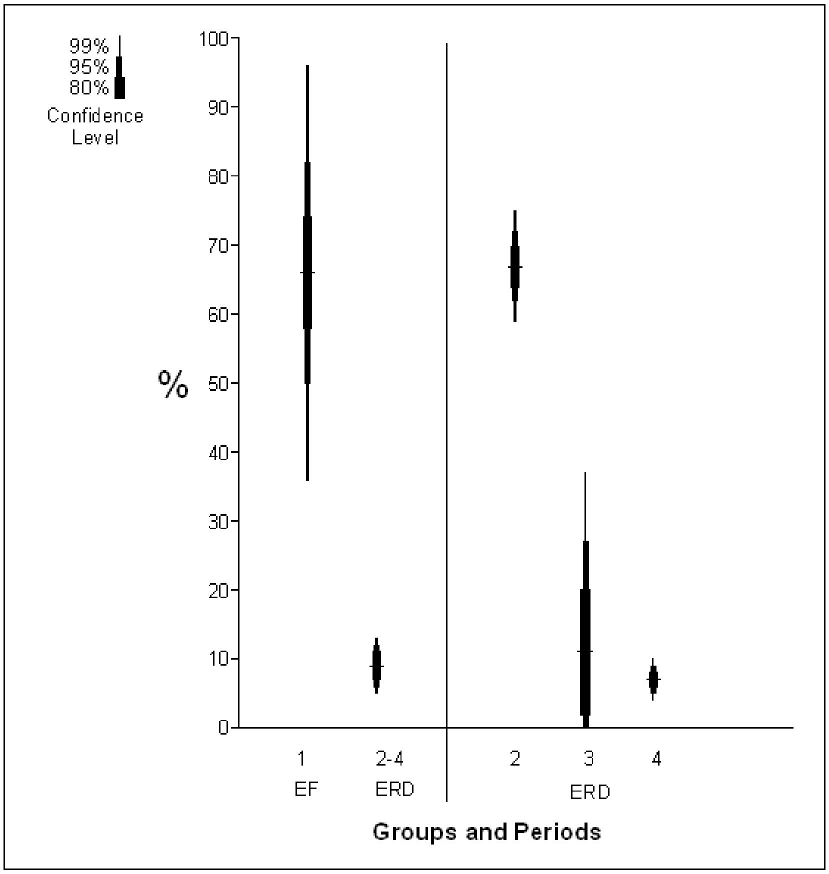


Figure 6.3 Proportion of mangrove shell to total shell by group, and for pooled Groups 2-4.
*The data used to produce this graph include shell from only the $1m^2$ test units at the site.

We can be more than 99% confident that use of the mangrove habitat decreased dramatically between these two periods. This too, is consistent with our expectations since the mangrove habitat is expected to be especially hard hit.

Within the Early Regional Development Period there is differential habitat exploitation, however. Residents in Groups 3 and 4 relied much less on mangrove species than did those in Group 2. We can be more than 99% confident that the exploitation of mangrove species in Groups 3 and 4 was less than $1/6^{th}$ of that seen in Group 2. This difference corresponds with differences in wealth at the site. It is clear that wealthy residents at El Dornajo exploited the intertidal zone much more intensively than they did the mangrove habitat. Specifically, residents in these sectors exploited a lot of *C. subrugosa*, which makes up 75% ± 7% at the 99% confidence level of all shell in these groups when pooled. Group 3 separates from Group 4 in the MDS analysis because of a higher proportion of *P. ecuadoriana*. The extremely high proportion of *C. subrugosa* in these deposits is somewhat unique for the region. Currie (1989) notes such a level at Guarumal, but otherwise no sites along the river had this kind of concentration. *C. subrugosa* are known to sometimes live in beds so they would be easier to harvest in certain places than other intertidal bivalves. This may have made them especially easy to harvest in large numbers during the low-tide season from September to December which would overlap partially with planting before the rainy season began in October/November.

Although residents of Group 2 relied strongly on mangrove resources, they exploited a greater variety of mangrove shellfish than had residents of Group 1 in the Early Formative Period. Figure 6.4 illustrates that we can be more than 99% confident that in the Early Formative Period (Group 1) residents relied almost exclusively on *O. columbiensis*, while during the Early Regional Development Period (Group 2) *O. columbiensis* made up a smaller proportion of the mangrove shellfish exploited. This difference is most likely related to environmental conditions as opposed to dietary preferences since *O. columbiensis* seems to disappear from other sites in the region during the Late Formative Period (Currie 1989; Staller 1984, Vilchez et al. 2007). This is precisely the pattern we expected to find if the area had been severely affected by a mega El Niño event and is the explanation suggested by all other scholars to observe this pattern. This pattern may very well reflect the slow recovery of the habitat and the need to rely on more than just *O. columbiensis* during periods of increased ENSO activity. *O. columbiensis* as a population may be very slow to recover from such events as they prefer to live in groups. Indeed, there is some indication that this species has not yet recovered from a mass die-off in the region in 1878 (Coker 1908 as cited in Vilchez et al. 2007) since they are much less plentiful in the region today than Coker suggests they were in the nineteenth century.

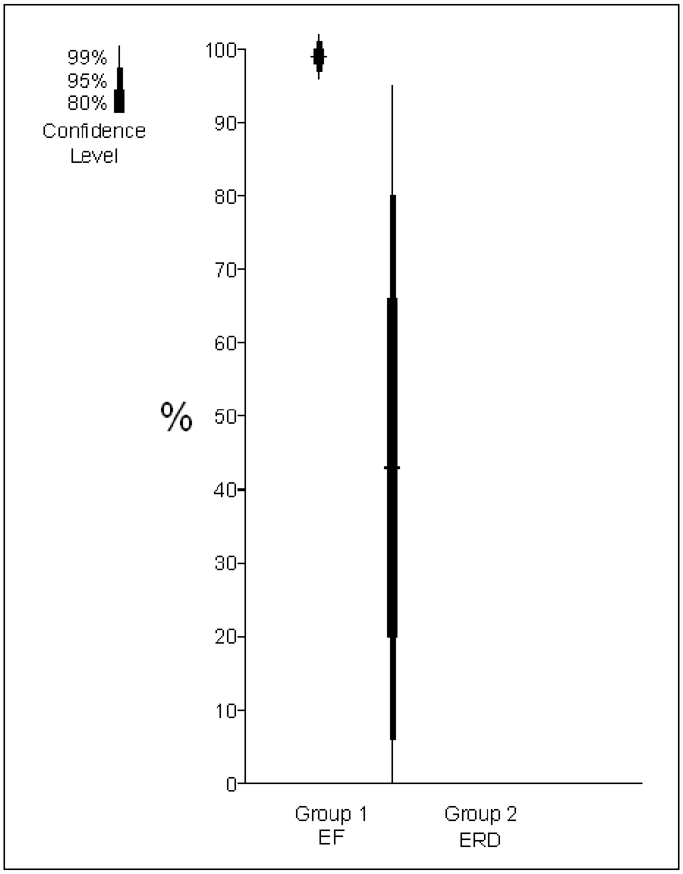


Figure 6.4 Proportion of *O. columbiensis* out of all mangrove shell remains in Groups 1 and 2. *The data used to produce this graph includes shellfish from only the $1m^2$ test units at the site.

Finally, Figure 6.5 illustrates that there was a slight decrease in the diversity of shellfish exploited between the Early Formative and Early Regional Development Period. It also illustrates that we can be more than 99% confident that there were differences in the diversity of shellfish exploited between groups during the Early Regional Development Period. In particular, Group 2 had the greatest diversity while Group 4 had the least. This is a reflection of the strong preference for *C. subrugosa* in elite sectors of the site. These data suggest that non-elite residents not only consumed less shellfish, but they likely collected the shellfish more opportunistically resulting in greater diversity.

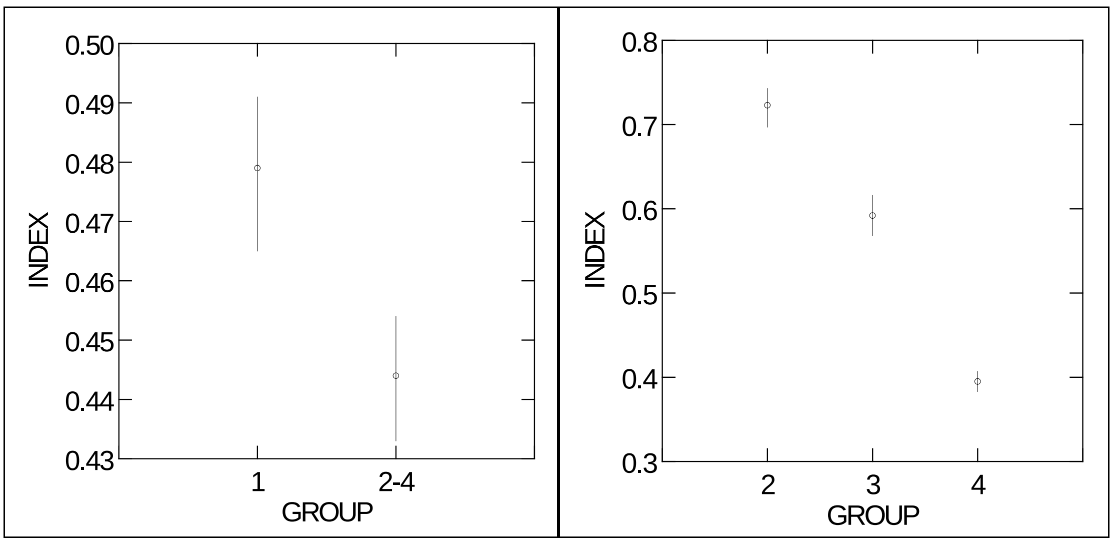


Figure 6.5 Hi-lo close plots of Simpson's diversity indexes for shellfish.

*Bootstrapped error ranges at the 99% confidence level for all of the groups at the site and for pooled Groups 2-4. The data used to produce these graphs includes shellfish from only the $1m^2$ test units at the site.

6.2.2 Fishes

Fish species at the site are divided into Chondreichthyes and Osteichtyes, as well as some crab remains (Ucides). Osteichtyes include Ariidae (marine catfish), Centropomiodae (snook), Carangidae (jack), Sparidae (porgies), Tetraodontidae (puffers), Gerreidae (rayfin fish), Lutjanidae (snapper), Sciaenidae (drums), Polynemidae (threadfin/bobo), Serranidae (bass/grouper), Coryphaenidae (dolphin fish), and Clupeidae (herring/sardines). The first ten families can be found in the mangrove, estuary, and laguna environments. The last two families are usually found in the seaward pelagic zone. This means that fishes, like shellfish, would have been strongly affected by changes in water quality. Unlike shellfish, fish do have the capacity to migrate out of affected zones. This migration would likely make them less available for human exploitation, however.

Most of the Chondreichthyes are rays (Gymnuridae, Milobatidae, Urolophidae, and Rajidae), though a few sharks are represented (Hammerhead and Hound). All of the rays can also be found in the mangrove/estuary habitat. Although open water fishes were found at the site of Loma Saavedra dating to the Late Regional Development and Integration periods (Vilchez et al. 2007), the only open water fishes at El Dornajo are the sharks. While the sharks inhabit the offshore environment, they feed inshore in shallow bays. Sharks were found in such small numbers that they could easily have ended up in nets in the estuaries where they feed. The use of nets is supported by the variety of rays in the sample (Sanchez 2009).

Fish bone proportions are based on NISP values. The difficulty of determining MNI for fish remains is exacerbated in this dataset by having such a high number of vertebrae due to preservation, screen size, and ease of identification among novice screeners. Without direct access to an extensive reference collection determining MNI from these remains was a specious procedure. Weights were not used because some fish bones, particularly non-vertebrae, weigh so little they would hardly contribute to the proportions at all.

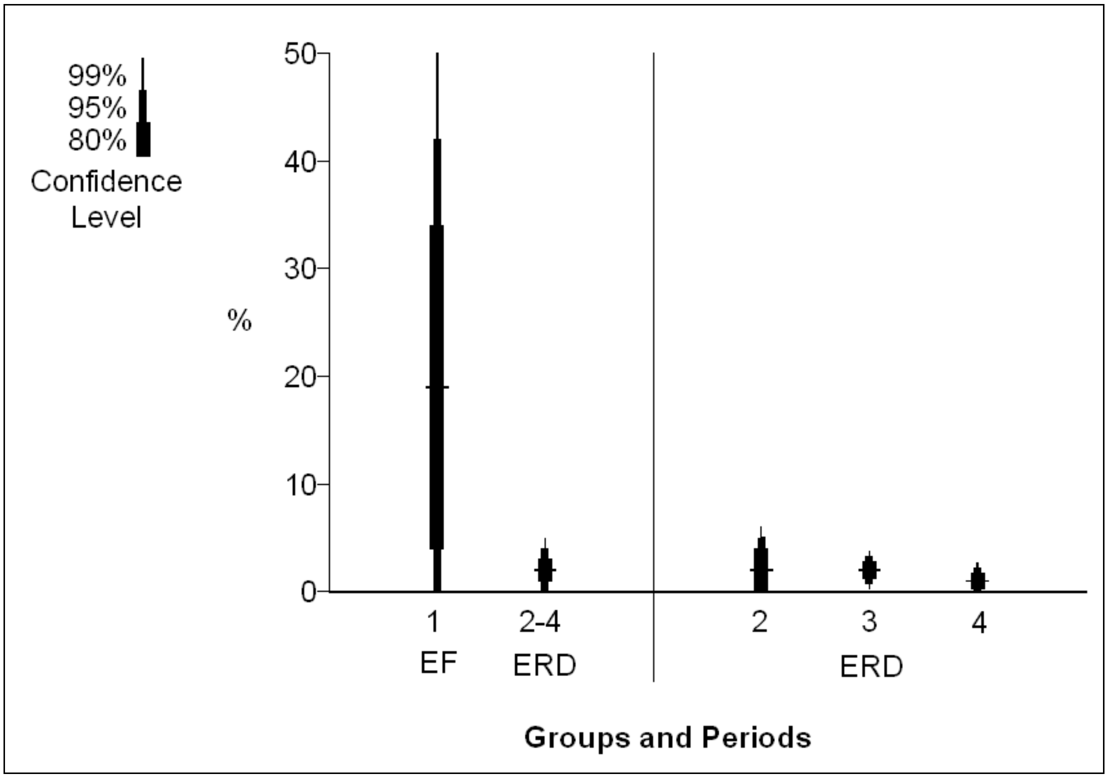


Figure 6.6 Fish bone to sherd proportions for each group, and for pooled Groups 2-4.

*The data used to produce this graph include fish bone from all $1m^2$ units excavated at the site (test units and horizontal expansions).

Figure 6.6 illustrates that although fish use may have decreased by as much as 75% between the Early Formative (Group 1) and the Early Regional Development periods (Groups 2-4), we are barely more than 80% confident of this difference. This means that the fish population and fish consumption may not have been affected by changing environmental conditions. Indeed, upon closer inspection, 97% of the fish bone from Group 1 comes from Units 7 and 33 which represent the same household. This suggests that this household was a unique context for the Early Formative Period and strongly indicates that fish use between the two periods does not in fact differ. There are no differences in fish use between groups within the Early Regional Development Period indicating that residents relied on fish equally at that time.

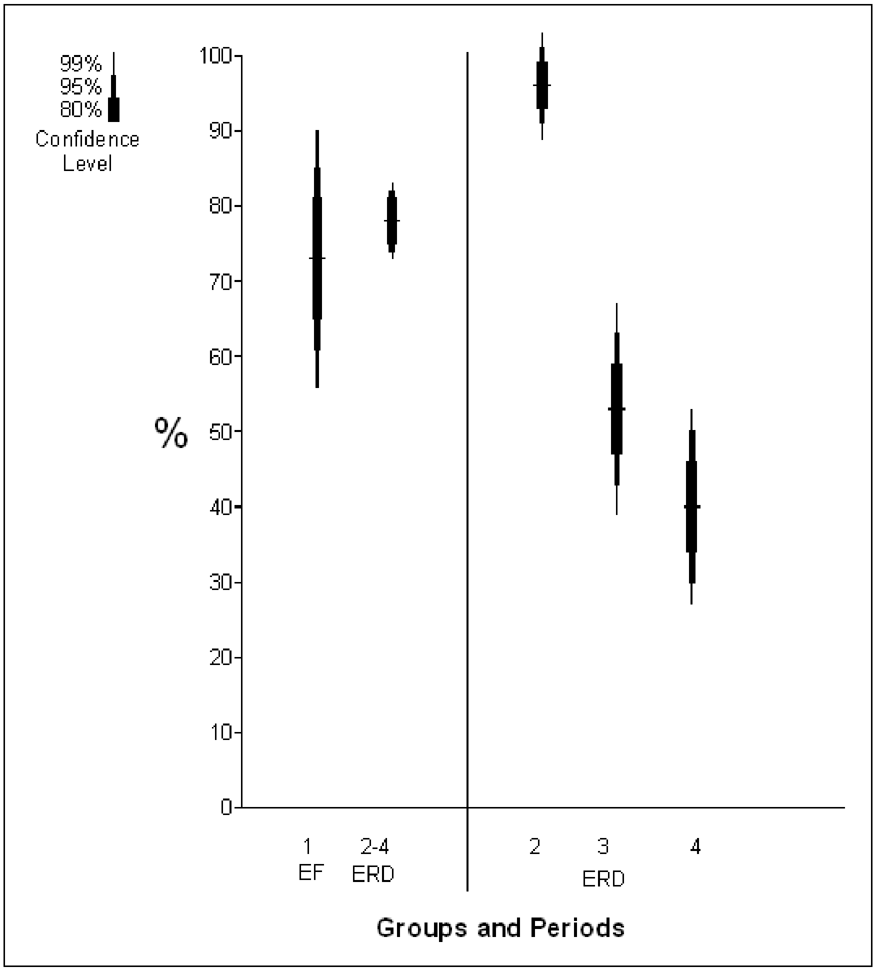


Figure 6.7 Proportion of all identified fish bone from the ariidae family for all groups, and for pooled Groups 2-4.

*The data used to produce this graph include fish bone from all 1m^2 units excavated at the site (test units and horizontal expansions).

The data presented in Figure 6.7 demonstrate that ariidae made-up the majority of all fish consumed at El Dornajo in both the Early Formative and Early Regional Development periods.

This is not surprising given their abundance in mangrove habitats and prevelance in prehispanic populations throughout the new world.

Within the Early Regional Development Period, however, Group 2 consumed a higher proportion of ariidae than did other groups. We can be more than 99% confident that residents of Groups 3 and 4, which are the wealthy sectors of the site, relied about half as much on ariidae as those of Group 2; and about 99% confident that Group 4 consumed about 10% less ariidae than Group 3. This difference reflects the greater diversity of fish consumed in Groups 3 and 4.

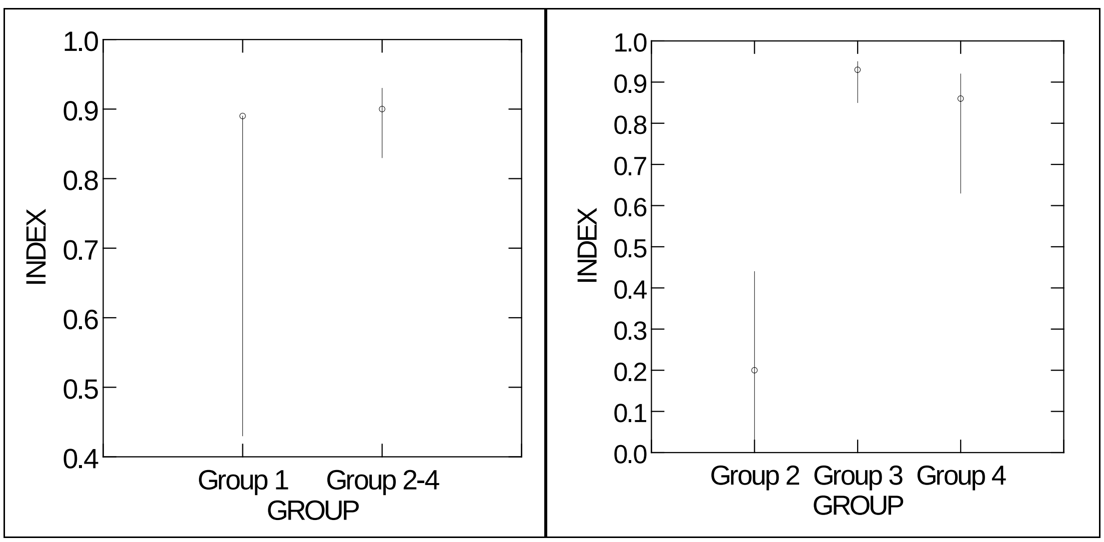


Figure 6.8 Hi-low close plots of Simpson's indexes for fish diversity.

*Bootstrapped error ranges at the 99% confidence level for each of the groups and for pooled Groups 2-4. The data used to produce this graph include fish bone from all $1m^2$ units excavated at the site (test units and horizontal expansions).

Finally, Figure 6.8 illustrates that the diversity of fishes exploited at El Dornajo may have increased somewhat between the Early Formative and Early Regional Development Period. Most importantly, however, this figure illustrates that we can be far more than 99% confident that

Groups 3 and 4 had a far greater variety of fish in their diets than those in Group 2. This means that elite sectors of site had access to more kinds of fish even if they did not eat more fish in general. This result is highlighted by the fact that the Early Formative Period diversity estimate was also very high. The implications of this difference will be explored in the conclusions of this chapter.

6.2.3 Mammals

While increased rainfall is detrimental to the mangrove habitat it is a favorable condition for the plant community, whether cultivated or wild. Increased rainfall would also result in greater vegetation and provide more food for terrestrial animals. This means that even if El Niño activity induced subsistence shortages for residents of El Dornajo by adversely affecting the mangrove habitat, occupants would potentially have had the opportunity to increase their reliance on terrestrial animals instead of agricultural products. Such a strategy would limit the advantage given to farmers in the wake of an El Niño event.

Mammal bone proportions are based on NISP and sherd counts. The faunal remains in this dataset are highly fragmented making NISP a better measure than MNI since the MNI is almost always equal to one because high fragmentation decreases the number of identifiable elements. Weights were not used because the differential weight of different species and elements does not provide as accurate a measure of comparison.

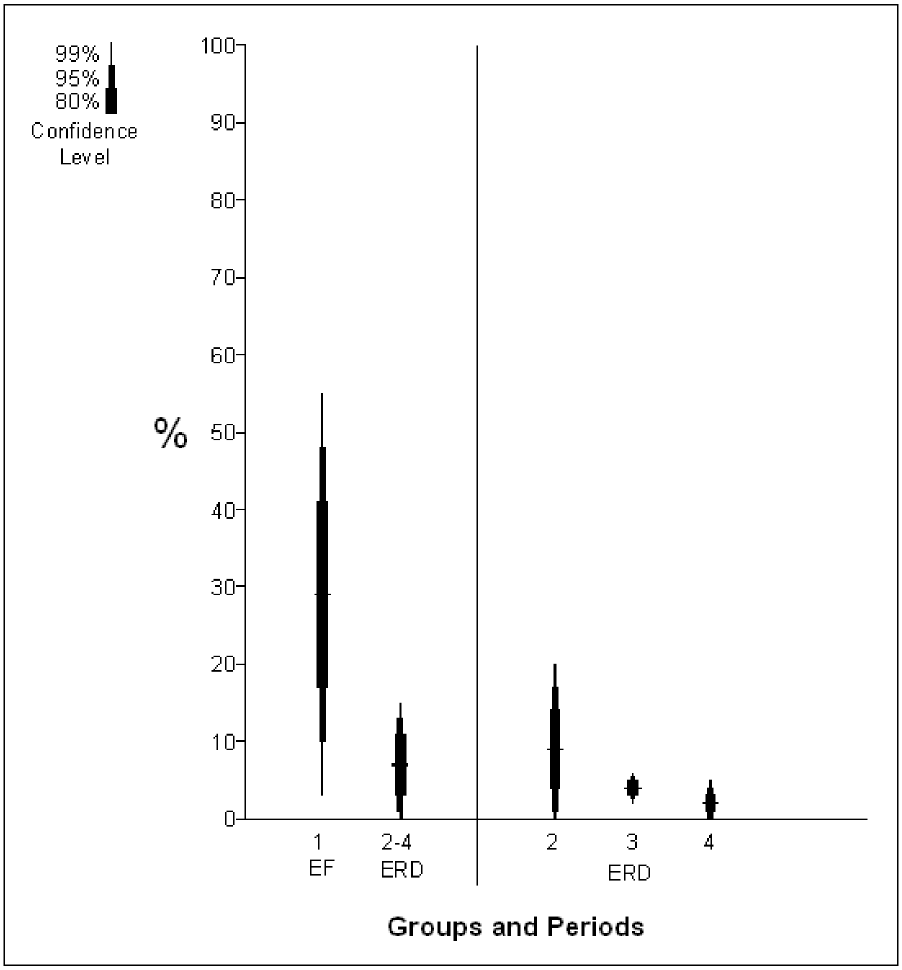


Figure 6.9 Mammal bone to sherd proportions for each group, and for pooled Groups 2-4.

*The data used to produce this graph includes mammal bone from all $1m^2$ units excavated at the site (test units and horizontal excavations).

Figure 6.9 illustrates that mammal use decreased between the Early Formative Period (Group 1) and Early Regional Development Period (Groups 2-4). We can be 99% confident that mammal bone decreased by 2/3 between these periods. This means that residents of El Dornajo did not increase their reliance on mammals to compensate for a reduction in mangrove foods, and is consistent with our expectations for increased reliance on plant foods rather than terrestrial mammals.

Additionally, there is little difference in the reliance on mammals between groups within the Early Regional Development Period. Residents of Group 2 could have consumed about twice as much mammal meat as those in Groups 3 and 4, but we are only 80% confident in this difference.

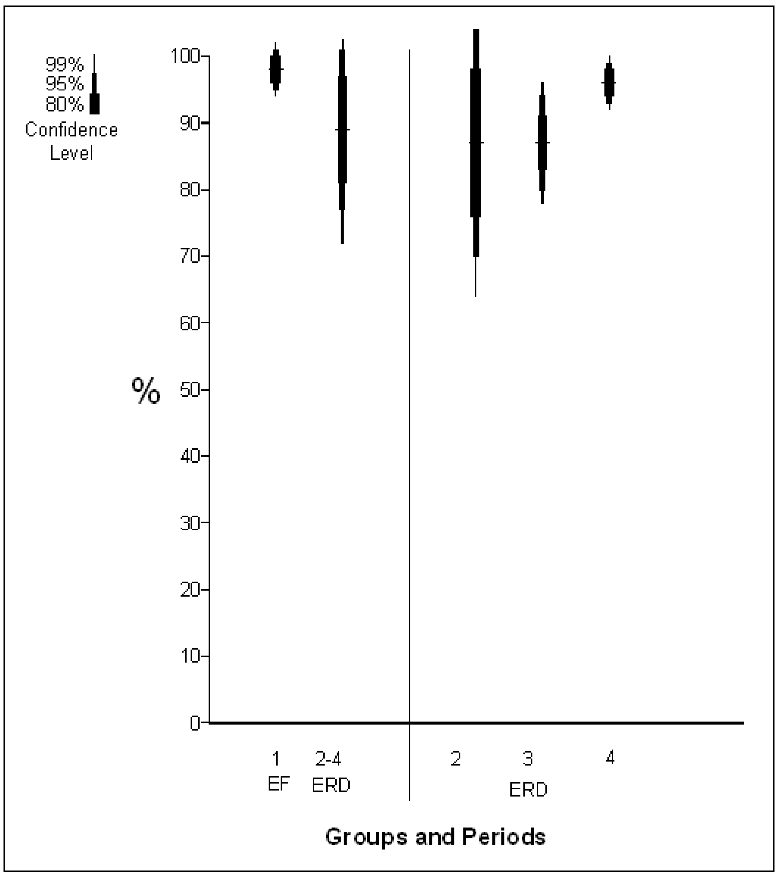


Figure 6.10 Proportion of all identified mammal bone that is deer for each group, and for pooled Groups 2-4.

*The data used to produce this graph includes mammal bone from all 1m^2 units excavated at the site (test units and horizontal excavations).

Figure 6.10 illustrates that deer made-up the majority of the identified mammal bone at the site in both the Early Formative (Group 1) and Early Regional Development periods (Groups 2-4). The figure suggests that the use of deer may have declined by about 10% between these two periods, but we can only be just more than 80% confident of this difference.

Within the Early Regional Development Period Group 4 once again stands out from the other sectors of the site, though not with nearly as much strength or confidence as we saw with the shellfish data. Deer continued to comprise more than 90% of the identified mammal bone in Group 4, while Groups 2 and 3 used less than 90%. We can be about 95% confident of the difference in deer use between Groups 3 and 4, but less than 80% confident of the difference between Groups 2 and 4.

Deer consumption can also vary by meat packet. Wealthier residents often consume better cuts of meat like the axial, hindquarter and forequarter packets. High fragmentation of the bones and the ease of identifying cranial and rib fragments result in very high NISP values for the head and axial packets in all groups. Figure 6.9 illustrates that there was no real difference between the proportion of good cuts of meat in Early Regional Development Period groups. Group 4 has a higher proportion than Groups 2 and 3, but we can only be about 80% confident in that difference.

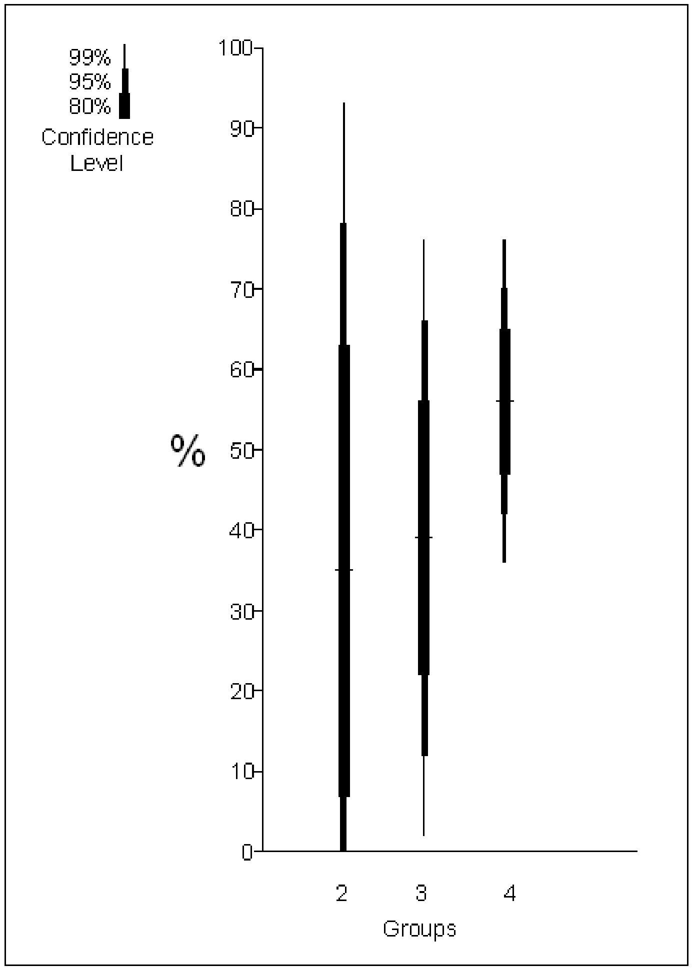


Figure 6.11 Proportion of good cuts of meat by NISP for Early Regional Development Period groups.

*Good cuts include the axial, forequarter, and hindquarter.

It is of interest to note that all *O. virginianus* remains in the sample for which age could be identified are 12-18 months old. This species breeds from October to December and births in early summer. This means that they were hunted between summer and fall, around July. These months fall after the harvest of rainy season crops (January-April) and before the low-tide season (September to January) when mangrove resources are most easily exploited. Deer bone is unevenly distributed among the units in most groups. Unit 38B (from Horizontal Area A) has

42% of the deer bone for Group 1; Unit 9A has 69% of the deer bone for Group 2; and Unit 26B has 48% of the deer bone in Group 4. Deer bone in Group 3 is more evenly distributed among the units. Thus, deer appears to have been consumed seasonally and may have been shared among kin groups.

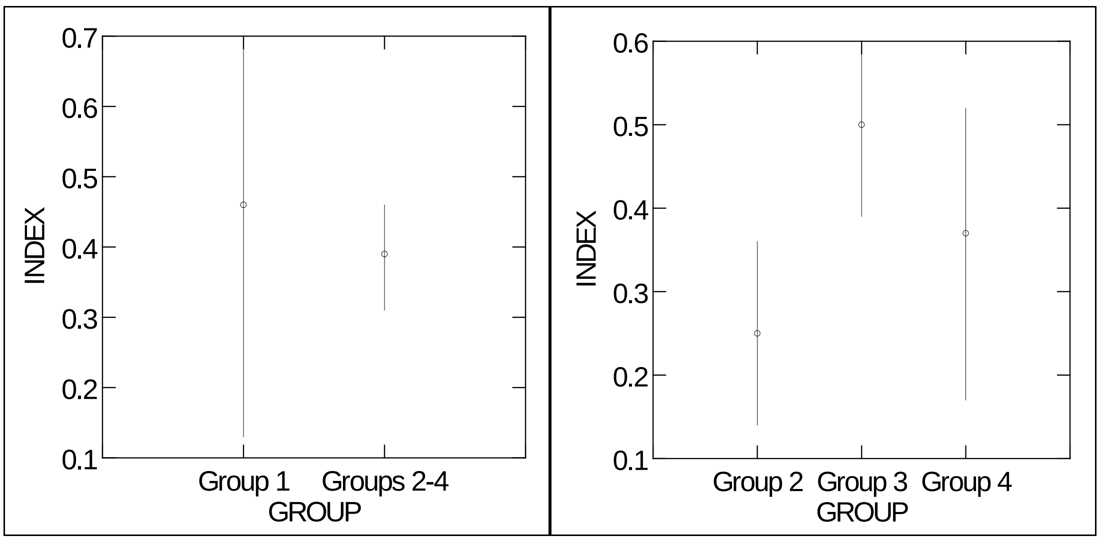


Figure 6.12 Hi-lo close plots of Simpson's diversity indexes of mammals.

*Bootstrapped error ranges at the 99% confidence level for each of the groups and for pooled Groups 2-4. . The data used to produce this graph include bone from all 1m^2 units excavated at the site (test units and horizontal expansions).

Finally, an examination of diversity through time and across space shows a few weak patterns. Figure 6.12 illustrates that the diversity of mammal foods did not change through time at El Dornajo. We can be 95-99% confident that Groups 3 and 4 consumed a greater variety of mammals than Group 2 during the Early Regional Development Period, however. Group 3 has the highest index. Although the strength of these differences is weak they nonetheless suggest that elites at the site had slightly greater access to a wider variety of mammal foods.

6.2.4 Plant foods

Since the proportions indicate that reliance on terrestrial animals and shellfish decreased between the early and later occupation of the site (while fish use may have decreased as well), it is hard to imagine that plant food use did not increase to fill the gap. Phytoliths, grinding stones, and storage jars provide the only evidence of plant use from El Dornajo. No floral macroremains were recovered in dry or wet screening and an extensive flotation study conducted by Moore and his colleagues on the Peruvian side of the border was no more successful at the recovery of such materials (Vilchez et. al. 2007). If agricultural food production increased at the site through time, then we expect to see more phytoliths from domesticated plants in samples from later contexts than from the earlier contexts. Since grinding stones were most often used to process plant foods in prehistory, an increase in the frequency of grinding stones at the site would also suggest an increase in plant food consumption.

Maize. Maize detection was conducted by the PaleoResearch Institute and is based on Pearsall and Piperno's cross phytoliths and multivariate analysis (Pearsall 1989; Piperno 2006). Since wild panicoid grasses and domesticated *Zea mays* (maize) are both members of the grass subfamily Panicoideae and produce cross-shaped phytoliths in their leaves, this technique is used to discriminate between wild and domesticated varieties. Cross phytoliths were assigned a variant type and then measured recording the length (longest side) and the width (shortest side), measured in microns (μm). The resulting cross data for each sample was then entered into two discriminant function equations, one for maize prediction and one for wild grass prediction. The category with the highest canonical score predicts membership in that category. This type of analysis is aimed at residues, features, and areas directly associated with maize processing and utilization. This means that maize signatures from areas and features not directly associated with maize utilization, like those in this analysis, may be diluted by environmental inputs from wild grass decay resulting in a score that falls within the wild grasses category (Yost 2009).

Rectangular IRP phytoliths which are produced by maize (cupule) and Tripsacum (fruitcase) were noted in Samples 1, 2 and 5. These phytoliths indicate the use of grass seed and/or possibly maize. The Pearsall/Piperno discriminant function analysis did not yield positive results for maize, making grass seeds a more likely identification, although Sample 5 was close to indicating maize as the likely source of the crosses (Table 6.2). One of the epidermal sheet elements in the Early Formative Period sample (Sample 5) appears to exhibit unnatural breaks across the short axis of the long cells, possibly from cutting or processing activities (Figure 6.13:I) which supports processing of the wild grass seed plants (Yost 2009). Although no diagnostic phytolith evidence for maize was observed, additional analyses are needed to be sure that some of the IRP phytoliths that were recovered are not from maize plants. This is especially true since maize was consumed both to the north and to the south of this region by the Formative Period. Thus it is hard to believe that domesticated maize was not used at this site. Nonetheless, there is no evidence for domesticated maize at this time.

Table 6.2 IRP Phytoliths: Wild vs Domesticated

Period	Sample No.	% Varient		Mean Size µm:Varient		n	df Classification [1]		df Prediction
		1	6	1	6		Wild[2]	Maize[3]	
Early Regional Developme nt	1	.27	33	14.13	12.45	0	0.82	0.18	Wild
	2	.28	.28	13.24	14.42	0	0.98	0.02	Wild
	3	.65	.15	11.63	11.01	0	1.13	-0.13	Wild
	4	.20	.44	13.34	13.62	1	0.97	0.03	Wild
	5	.38	.26	15.84	14.46	0	0.55	0.45	Wild
Early Formative	6	.58	.16	13.62	15.24	0	0.88	0.12	Wild

[1]Identification of maize and wild grass cross-shaped phytoliths based on df developed by Piperno (2006)
[2]Wild grass df: 2.96669 - 0.1597589 (mean width Var.1) - 0.0126672 (mean width Var.6) - 8.20956-3 (% Var.1)
[3]Maize df: -1.96669 + 0.1597589 (mean width Var.1) - 0.0126672 (mean width Var.6) + 8.20956-3 (% Var.1)

Other Plant Foods. Two of the Early Regional Development Period samples at El Dornajo (Samples 2 and 4) and the Early Formative Period sample (Sample 6) contained trapeziform sinuate phytoliths which are diagnostic of the cool-season grass subfamily Pooideae. Members of this notable subfamily include wild and domesticated cereal grain producing taxa such as Hordeum, Elymus, Triticum, and Avena. Dendriform phytoliths from grass seed glume material were also observed in these samples. Phytoliths therefore suggest the use of non-maize grass, and possibly the use of cool-season grass as part of the subsistence package (Yost 2009), some of which could have been domesticated.

Globular echinates (Figure 6.14:A) which occur in the leaf, fruit and bark material of palm family vegetation (Arecaceae) were common in all of the samples. And globular verrucate phytoliths were observed in Samples 1 (Early Regional Development Period) and 6 (Early Formative Period) (Figure 6.14:C). These phytoliths are primarily found in leaf material of families within the order Zingiberales, including the Marantaceae, Cannaceae, Costaceae, and Zingiberaceae. This indicates that palm fruit and seeds of the zingiberales order such as achira seeds may have been consumed during both periods of occupation.

A single *llerén* (*Calathea allouia*) phytolith was observed in Sample 2 (Figure 6.13:A) and arrowroot (*Maranta arundinacea*) seed phytoliths were recovered from Samples 2 and 3 (Figure 6.13:B). These phytoliths indicate the use of tubers and rhizomes as food products in the Early Regional Development Period. Finally, a *Heliconia sp*. phytolith was found in Sample 4 (Early Regional Development Period) (Figure 6.13:F). The rhizomes of this plant, related to the Bird of Paradise, were sometimes eaten (Duke and Vasquez Martinez 1994), and their leaves are often used for wrapping food.

Overall a greater variety of plant foods is seen in the Early Regional Development Period samples. However, there are five samples from this period and only one from the Early Formative Period, therefore this difference likely represents the soil volume analyzed more than anything else.

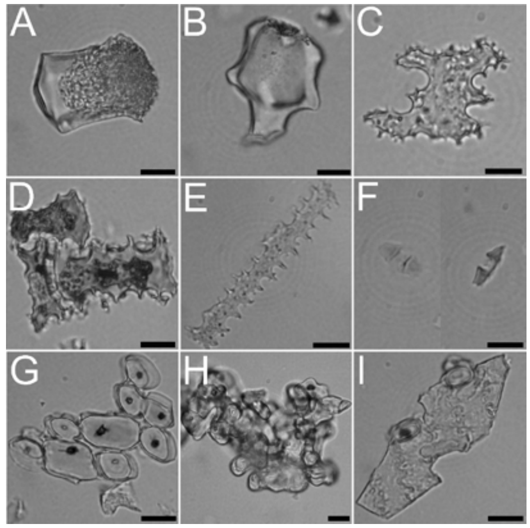


Figure 6.13 Phytolith photographs.

*Scale bar = 10 µm. A) Tuber phytolith from *Calathea allouia*. B) Seed phytolith from *Maranta arundinacea*. C and D) IRP phytoliths common in maize cob, teosinte fruitcases, and some wild grass inflorescence structures. E) Dendriform phytolith common in non-*Zea* wild grass inflorescence structures. F) Decorated trough phytolith from *Heliconia* sp. leaf material. G) Poaceae rondels slightly melted together. H) Poaceae rondels severely melted together. I) Poaceae epidermal sheet element fragment with rondels, exhibiting possibly unnatural breaks across the long cells.

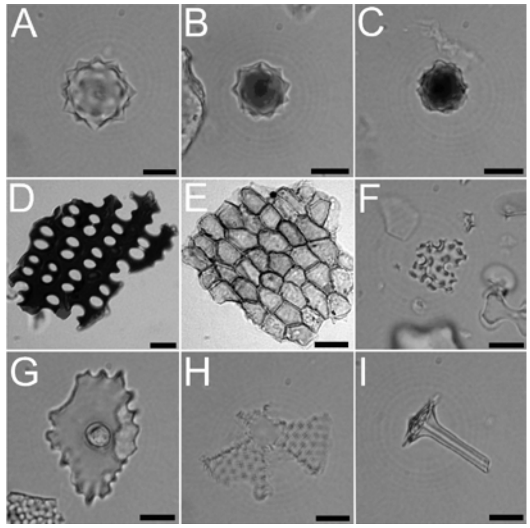


Figure 6.14 Phytolith photographs.

*Scale bar = 10 µm. A) Globular echinate from Arecaceae leaf and fruit structures. B) Charred globular echinate (Arecaceae). C) Charred globular verrucate diagnostic of the order Zingiberales (Marantaceae, Cannaceae, Costaceae, Zingiberaceae). D) Opaque perforated platelet from Asteraceae inflorescence. E) Silicified mesophyll cells (arboreal), possibly charred. F) Diagnostic phytolith of Podostemaceae leaf material. G) Achene phytolith from a member of the Cyperaceae (cf. *Scirpus*). H) Marine diatom from salt and brackish waters (*Actinoptychus* sp.). I) Gemmula microsclere fragment from a fresh water sponge species.

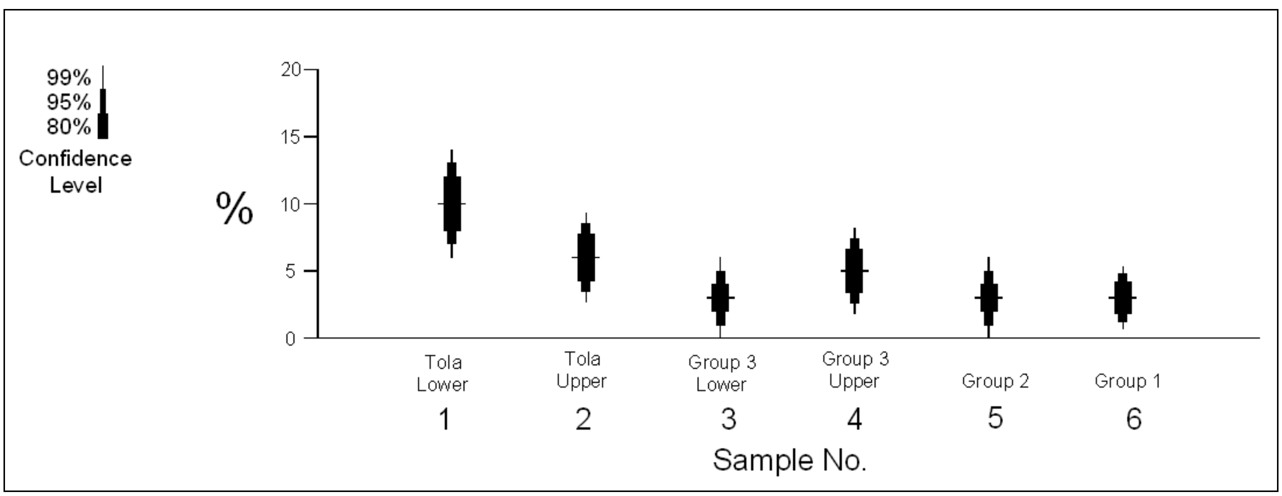


Figure 6.15 Proportion of food remains found in the phytoliths recovered for each sample.

The proportion of food remains in each sample were compared as a gauge of food presence in different parts of the site at different times. Figure 6.15 illustrates that for the most part the proportion of food remains between soil samples do not differ. Indeed, the differences between Samples 3 and 5 (Early Regional Development Period) and Sample 6 (Early Formative Period) lack strength or confidence. These results do not support an increase in plant use between the Early Formative and Early Regional Development periods.

Most observable differences between samples within the Early Regional Development Period lack strength. The sample from the lower level of the *tola* (Sample 1) however, stands out as having nearly twice the food remains of any other sample, and we can be 99% confident of that difference. This is the only sample that comes from a midden context in a pit, however. The other samples come from postholes, a hearth, and an ashy burial associated floor. Therefore, the context from which Sample 1 was taken is better for the recovery of food remains making the results of this comparison less meaningful.

In summary, there is no support in the phytolith data for either an increase in plant use or differential access to plants.

Ground Stone. Although phytolith data were inconclusive, we can approach plant use indirectly through the use of grinding stones for processing plants. Only eighteen grinding stones were recovered from El Dornajo. These include *manos*, *metates*, pestles, and fragments of such items. The data suggest that the use of grinding stones did increase between the Early Formative Period (Group 1) and the Early Regional Development Period (Groups 2-4). In fact, all eighteen pieces of grinding stone were found in the later occupation. However, I am less than 10% confident that zero grinding stones would be found in a sample of twenty Early Formative Period contexts if the sample actually came from a population with at least .05% grinding stones (like the Early

Regional Development Period contexts). Therefore these results provide no confidence that there was a difference in grinding stone use between the two periods.

Figure 6.16 illustrates that there was also very little difference in the proportion of grinding stones between groups within the Early Regional Development Period. We can be about 95% confident that Group 2 has a higher proportion of grinding stones, which contradicts our expectations; but there is little strength in this difference. Indeed, all of the mean values in this graph are less than 1%. Additionally, four of the seven grinding stone fragments found in Group 2 could be interpreted as axe fragments which would lower the mean for that group into the range of that seen for Groups 3 and 4.

No artifacts clearly identifiable as axes were found at the site. Informants report having found axes at the site in the past and several axes from other sites are on display in local collections. Eight stone artifacts that could be construed as related to axe manufacture were collected: three flakes, one biface, and four ground stone fragments; all made of basalt. The four ground stone fragments were found in Group 2, the flakes and biface were found in Groups 3 and 4. Therefore, if these artifacts were related to axe manufacture, they seem to be broadly distributed at the site during the Early Regional Development Period.

In summary, the grinding stone data support neither an increase in plant use between the Early Formative and Early Regional Development periods nor differential use of processing tools that would indicate elite residents of the site were processing more plant foods.

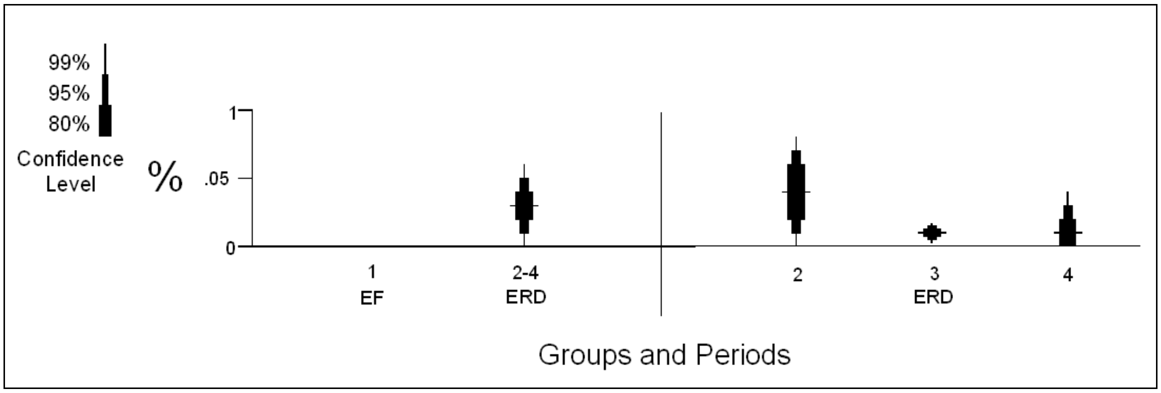


Figure 6.16 Grinding stones to sherds proportion of in each group, and in the pooled Groups 2-4.

*This data includes all test units and horizontal excavation units. No grinding stones were found in Group 1.

Storage. Only one storage feature was found at the site, the midden-filled pit on top of the first phase of construction of the *tola*. For the most part storage must have taken place in ceramic or perishable vessels. If elite members of the community were benefitting from greater access or control of agricultural/plant resources then we expect that they might have larger storage vessels in which to store surplus foods even if they did not process more foods. In Figure 6.17 the mean rim diameter of jars by group are compared. Jars were classified as vessels with a restricted orifice and a high neck. For a detailed discussion of ceramic collection and laboratory methodology see Chapter 8.

All vessels with rims greater than 30cm in diameter were excluded from this analysis because they represent outliers in the dataset. The remaining data show that there was no change in average jar size between the Early Formative and Early Regional Development Periods (Figure 6.17). All of the jar sherds identified as outliers were found in the Early Regional Development Period, however, so some increase in size is indicated.

Within the Early Regional Development Period we can be 95% and 99% confident that Group 4 had a mean jar rim diameter about 3cm larger than that of Groups 2 and 3 (it also has most of the jars with rim diameters greater than 30cm). Group 4 is one of the wealthy areas of the site, thus these data support the notion that at least some wealthy residents may have had access to more surplus plant food and/or the ability to support a larger family unit. Though an increase of 3cm does not represent very much of an increase in storage capacity. Group 3 on the other hand, also considered a wealthy sector of the site, does not have larger jars. Thus it is more likely that the larger jars in Group 4 reflect differences in the activities of groups such as cooking for communal consumption.

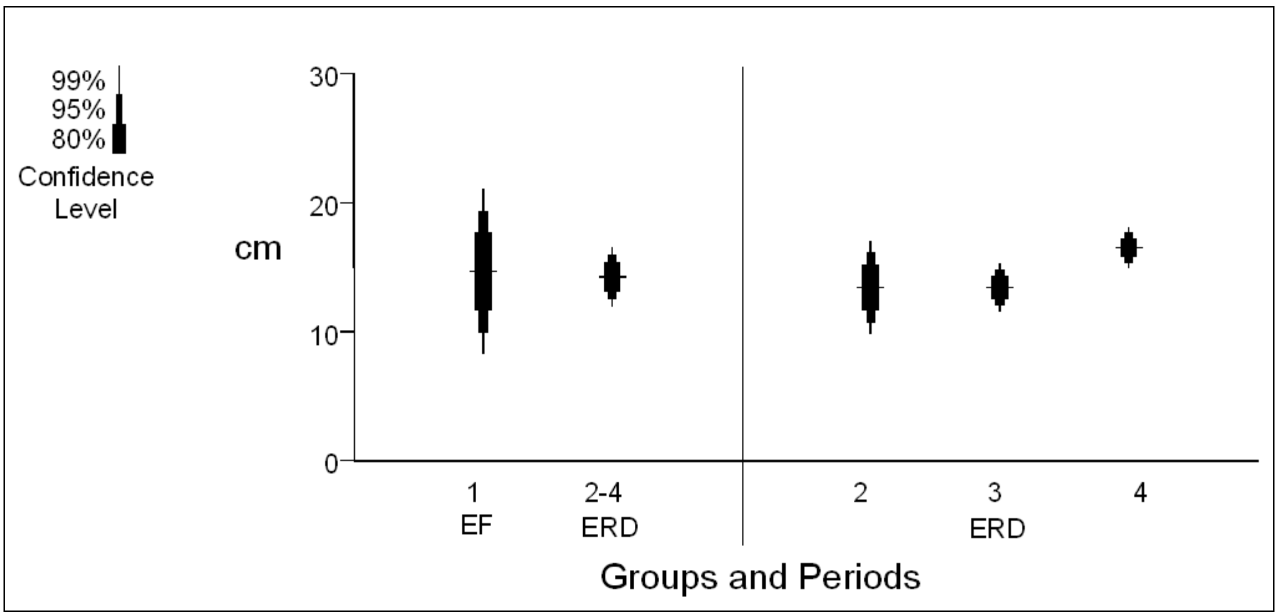


Figure 6.17 Mean jar rim diameter for all groups at the site as well as the pooled estimate for Groups 2-4.

6.3 CONCLUSIONS

Overall the data indicate less reliance on animal foods during the Early Regional Development Period occupation of El Dornajo than during the Early Formative Period. The use of shellfish declines more precipitously than that of vertebrates. Mangrove habitats and associated food sources would be more strongly affected by El Niño activity than would terrestrial animals and since fishes can migrate, shellfish would be more strongly affected than fishes. The decreased reliance on shellfish takes place during a period of heightened ENSO activity following a mega El Niño event at El Dornajo (discussed in Chapter 5). In the wake of this event, residents at El Dornajo could have compensated for decreased reliance on shellfish with greater reliance on fishes or terrestrial animal foods, but did not do so.

These results are consistent with our expectations for a dietary shift toward plant foods brought on by environmentally induced food shortage in the wake of a mega El Niño event and during a period of increased ENSO activity. However, since the early and later occupations of the site are separated by nearly three thousand years, the dietary changes indicated by this data may well have taken place in the region several centuries prior to the re-occupation of El Dornajo. There are currently no hard data to evaluate when the shift took place, but data from the site of El Porvenir suggest that it took place during the Late Formative Period. Levels dating to about 700 BC (Mound 2, Unit 8, levels 3, 4) show a shift toward more diverse shellfish and terrestrial fauna exploitation (that is to say more species represented) (Vilchez et al. 2007). Although a shift to a more diversified diet may date to 700 BC, data indicate that the overall importance of shellfish in the diet may have changed around 1000 BC (between levels 4 and 5) (shell weight to sherd weight ratios: level 3 = 3.87, level 4 = 4.13, level 5 = 690.05) (Vilchez et al. 2007). These ratios are based on weights and therefore not directly comparable to those from

El Dornajo but do show a dramatic decrease in shellfish use. There is also some evidence that the importance of terrestrial animals and fishes declined at this time; a combined mammal and fish bone weight to sherd weight ratio for levels 4 and 5 indicate a slight decrease (level 4 =.01, level 5 =.03). This pattern is similar to that identified for El Dornajo and suggests that the dietary shifts noted in this dissertation first happened around 1000 BC when Uña de Gato was growing. This shift corresponds with a documented mega El Niño event but is some 1300 years before El Dornajo was re-occupied. It is not clear that plant use increased at this time, however. Very little ground stone was found at El Porvenir and data for Uña de Gato are not currently available. This means that early adaptation to environmental perturbations may have relied on diversification while later strategies included the use of more plant foods. This possibility cannot be assessed without more data from Uña de Gato. Thus, it is not possible to establish temporal correspondence of the dietary shift seen in this dissertation with the mega El Niño event underlying the Regional Development Period occupation of El Dornajo, when social complexity emerged at the site.

Neither is there strong supporting evidence for elite control of plant resources. Groups 3 and 4 do not have more grinding stones nor does Group 3 have larger jars than Group 2. Both Groups 3 and 4 have greater access to *C. subrugosa* shellfish and access to a greater diversity of fishes, and to a lesser extent, mammals as well. Thus wealthy residents of the site seem to have eaten better than other residents. Elites in general may also have controlled access to *C. subrugosa* shellfish.

In the data for this chapter Group 4 stood out from Groups 2 and 3 several times. Group 4 has more shellfish, a bit more deer, and larger jars than Groups 2 and 3. In Chapter 4 we saw that Groups 3 and 4 express their elite status differently. Group 3 is considered elite because of the wealthy burials found there and its proximity to the *tola*. Group 4 is considered elite because a wealthy burial was looted from this part of the site, and because it has a much higher proportion of decorated ceramics. Considered along with a greater proportion of decorated ceramics, the data in this chapter indicate that residents of Group 4 were participating in different kinds of food related activities than were other residents of the site. Specifically, they may have been hosting clambakes.

In conclusion, it is likely that subsistence patterns along the Zarumilla River shifted regularly throughout the prehispanic period in response to ever changing environmental conditions. How residents in a given community, during a given time period, compensated for decreased availability of mangrove resources during mega El Niño events and increased ENSO activity may have varied considerably over this long span of time. Indeed, the shifting of the Zarumilla River in response to mega El Niño events may have influenced the choices available to communities as proximity to the river would be important for both water and plant cultivation. El Dornajo was probably re-occupied as a result of the river jumping back to the Ecuadorian margin of the floodplain following a mega El Niño event, making this location suddenly more favorable. People along the river likely compensated for periodic decreases in the availability of mangrove resources several centuries before this time period by diversifying their animal diet and possibly by increasing their reliance on plant foods as well. These strategies continued to be used when occupation shifted to El Dornajo but there is no evidence that they were associated with the emergence of social inequality at the site. All wealthy residents of the site had access to a greater diversity of foods than other residents of the site but there is no evidence to support the coercive control of plant foods at this time.

7.0 INTER-REGIONAL INTERATION AND SOCIAL CHANGE

El Dornajo lies between the northern and central Andean culture areas. Societies in these two areas engaged in a variety of interactions throughout prehistory. During episodes of especially strong interaction the geo-political position of El Oro-Tumbes would have placed it in the middle of those interactions. The period of most intense interaction began around 700/800 AD when the Sicán State of coastal Peru was importing large quantities of spondylus shell that originated in coastal Ecuador. Communities in coastal Manabí responded to the economic opportunities presented at this time by increasing household production of export commodities (Martin 2010). But El Dornajo had already been abandoned by this time. Instead, El Dornajo was occupied during the considerably less intensive trade between the Moche states of coastal Peru and coastal Ecuadorian chiefdoms.

There are several ways that an increase in inter-regional interaction could promote social change resulting in an increase in social complexity. The kind of inter-regional interaction explored here is the introduction of a macro-regional exchange network between the central and northern Andean culture areas. In this dissertation two economic ways that the appearance of a large trade network, and the participation of El Dornajo in that network, might result in social change at the site are examined. First, residents of El Dornajo could have become middlemen in the trade network between the northern and central Andean areas serving as a bulking station along the trade route. Second, residents could have taken advantage of a previously unavailable market to develop an export economy. In either case there are clear expectations for the archaeological record.

First, there should be an increase in interaction with polities to the north and south at the same time that social inequality is evident at El Dornajo around 300 AD. This would be seen by an increase in non-local items and styles as compared to earlier periods, and would include the development of "foreign" markets for El Dornajo's goods or a "foreign" trade network for El Dornajo to be in the middle of. Second, there should be an increase in items specifically associated with playing the middleman or an increase in craft production for export. In the first case we would expect to see items like *naipes* (copper axe money or sheets) and *chaquira* (shell beads) which may have served a monetary-like function in the region in prehistory (Fonseca Z. and Richardson 1978; Marcos 1977). We would also expect to see large storage spaces for bulking and potentially an increase in camelid remains for transporting goods. In the second case we might see an increase in the production of any number of exportable goods, but that increase should be intensive enough and on a large enough scale to exceed the needs of the local community. Finally, if elites are taking advantage of newly available economic opportunities, then the artifacts associated with either the middleman model or the export economy model should be differentially associated with elite sectors of the site. These expectations are examined in this chapter by looking at the distribution of several different artifact types at the site (including camelid remains, some ceramic vessels, ornaments, chipped stone, and tools), both in space and time.

7.1 FIELD AND LABORATORY METHODOLOGY

7.1.1 Metals and ornaments

All ornaments and metal artifacts were collected from all contexts excavated at the site. Analysis of these items was purely visual and was undertaken by the author. Metal items were gently brushed clean and visually analyzed with an eye toward the likely composition of the metal, the production technique, dimensions, and style. Metallurgical composition was based entirely on color: green items are considered to be copper, gold items are considered to be gold, and purple items are considered to be copper alloys. This is clearly a simplistic methodology, but one that serves the needs of this study. Detailed chemical analysis may be undertaken in the future as funds become available. Only two production techniques were distinguished: lost wax casting and hammered sheet metal.

Ornaments made from materials other than metal, such as shell, stone, and ceramics, were washed and then visually analyzed with an eye toward identification of material type and measurement of dimensions. For photographs of ornaments from burial contexts see Chapter 4. For photographs of ornaments from non-burial contexts see Figures 7.1 and 7.2.

Figure 7.1 Stone (left) and shell (right) ornaments from midden contexts.

Figure 7.2 Ceramic ornaments from midden contexts.

7.1.2 Chipped stone

All chipped stone was collected from all contexts excavated at the site. Chipped stone was washed and analyzed by the author. Chipped stone was analyzed principally using the technique outlined in Sullivan and Rosen 1985. This technique involves separating out tools and cores, flake/flake fragments, and shatter. For a detailed description of how artifacts are separated into these categories see Sullivan and Rosen 1985. Tools were identified and measured. Flakes were divided into primary (50%+ cortex), secondary (<50% cortex), and tertiary (no cortex) flakes. Length (platform to termination), width (edge to edge at the widest point), and thickness (ventral side to dorsal side at the widest point) were measured on all complete flakes. All chipped stone was weighed. Lithic material type was determined by visual inspection. Only obsidian and quartzite were noted for chipped stone.

7.1.3 Other tools

All tools were collected from all contexts excavated at the site. Tools that are not classified as either chipped stone or ground stone, such as spindle whorls and polishing stones, were washed and visually analyzed by the author. Analysis focused on identification of the material and measurement of dimensions.

7.2 INTER-REGIONAL INTERACTION AT EL DORNAJO

There are no non-local goods in the Early Formative Period occupation of El Dornajo. The Formative Period site of Uña de Gato does have non-local goods. Eighty-one obsidian flakes were recovered from Uña de Gato and analysis indicates that the obsidian came from the Mullimaca (435km away) and Carboncillo (115km away) sources (Moore et al. 2008). Additionally, some of the ceramic sherds from the site have distinctly Chorreroid incisions (Moore et al. 2008). So while Uña de Gato was clearly tapped into inter-regional exchange networks (mostly in the Late Formative Period), it was at a very small scale. El Dornajo, only a small hamlet in the Early Formative Period, was not involved in any such interactions. There is no data for the centuries between the occupation of Uña de Gato and El Dornajo (ca.200 BC-300 AD).

The Early Regional Development Period occupation of El Dornajo, however, has more evidence of inter-regional interaction than is known from any other site along the river. Evidence for increased interaction in seen from early on in the Early Regional Development Period occupation and is contemporaneous with the presence of social inequality at the site, both appearing around 300 AD. Markers of social inequality include public architecture, the differential distribution of fancy pottery, and non-local adornments and prestige items.

Aside from the *tola* the evidence that distinguishes El Dornajo from others along the river comes almost entirely from burial contexts, however. Non-local items found in non-burial contexts are very few and show only the most tenuous of links to inter-regional interaction. Specifically, four obsidian flakes, one mold-made blackware bowl sherd, one *paleteada* sherd, and twelve ceramic stool fragments were recovered (plus an additional six displaced on the surface of Loma Segarra). The obsidian likely came from the same sources identified for obsidian from Uña de Gato. The blackware and *paleteada* sherds are characteristic of northern Peru and were not locally manufactured based on visual inspection of the paste and temper. The ceramic stool fragments resemble those found at the site of Pirincay in the southern Ecuadorian highlands (Bruhns 2003) (Figure 7.3). Such stools are not known from other sites in the region, but appear to be locally manufactured rather than imported.

In contrast, the burials at El Dornajo have many and varied items that indicate participation in inter-regional exchange networks. The Manteño frogware vessel found with Burial 2 (Figure 4.24) is of non-local origin based on visual inspection of the paste and firing quality. It probably originated to the north in the Manabí Province. Although likely of local manufacture, a handful of vessels resembling non-local ceramics stylistically were also recovered from burials. A vessel resembling Sicán vessels (very similar to another described by Moore et al. 2008 from the site of La Palma) was reportedly found during the looting of burials on Loma Alvarrdo (Appendix B). The drum found with Burial 7 (Figure 4.30) is of a style previously found in Alto Piura, northern Peru (Richardson, personal communication) and Catamayo, in the southern highlands of Ecuador (Guffroy 2004). Finally, a basket handle olla reportedly found during the looting of Loma Alvarado is of a style previously reported for Vicús burials in Alto Piura (Appendix B) (Lanning 1963; Hocquenghem 1991).

The shell beads in the two shell and stone bead collars found in Burials 1 and 15 are made from spondylus shell (Figures 4.21 and 4.35). Spondylus is not common in this area but is known to occur in abundance along the Manabí coastline. There is no evidence to suggest that these beads were locally manufactured (i.e. drills or spondylus debris). The closest known location for the production of such beads is the site of El Azucar in the Guayas Province to the north (Masucci 1995). The quartz bead found with the collar in Burial 1 is identical to those manufactured at the site of Pirincay, Azuay Province (Bruhns 1989). The emerald beads found in Burials 4 and 18 (and reportedly looted from a wealthy burial on Loma Alvarado) (Figures 4.32, 4.37, Appendix B) would have originated far to the north near Colombia. Chroniclers at the time of the Spanish conquest report that many emeralds were found on the Esmeraldas and Manabí coasts (Saville 1907). The site of La Tolita on the north coast of Ecuador is contemporaneous with El Dornajo and had emeralds as well (Masucci 2008). It is likely that the emeralds at El Dornajo arrived there through an exchange network running from La Tolita on the north coast of Ecuador, to Alto Piura in far northern Peru.

Most numerous are the various metal adornments found in the burials from El Dornajo. The majority of the metal adornments and items are in a distinctly Vicús-Moche style and very likely came from the Piura or Chira valleys, from contemporaneous sites like Vicús and Cerro Calingará. Dangles, ear plugs, and cut copper sheet items, as well as the rattle and point from the looted burial on Loma Alvarado are all distinctly central Andean in character (i.e. Figures 4.22, 4.32, Appendix B). The coiled earrings and lost wax cast *narigueras* are northern Andean in style (i.e. Figures 4.27, 4.37, and Appendix B). The nearby Arenillas River was once rich in placer gold deposits (Murillo 2002) and the Zarumilla River very likely held such deposits as well since both originate in a region of the Andes known for rich gold deposits (Reyes, personal communication). There is little evidence of metallurgy at El Dornajo, however. It is more likely that many of these metal items originated elsewhere to the north and south.

In total these items number fewer than the obsidian flakes from Uña de Gato. But the obsidian flakes at Uña de Gato came from one highland Ecuadorian exchange route, and could have been manufactured from only a few obsidian nodules. The goods at El Dornajo, in contrast, came from coastal and highland exchange routes running through both Ecuador and Peru (Figure 7.4). The items are all fairly easily transported (except for the frogware jar), but they are bulkier than obsidian nodules or flakes, and could not have been manufactured from just a few parent items. This indicates sustained interaction in a large trade network, specifically, the long distance network proposed by Hocquenghem 1991. She suggests that at this time a trade network ran between La Tolita and Alto Piura, passing through the southern highlands of Ecuador, out to coastal Manabí, and along the north coast of Ecuador. The information from El Dornajo agrees with Hocquenghem's proposed route. This route is contemporaneous with changes at both El Dornajo and in the southern highlands of Ecuador that suggest the two areas were involved in similar networks of interaction. Specifically, the highlands see the appearance of larger and thicker jars and *ollas*, large bowls, *compoteras*, ceramic stools, and metal items all appear at this time (Bruhns 2008). These same changes in artifact assemblages are seen at El Dornajo during this time. I have already discussed the presence of metal items and ceramic stools. Other vessel forms will be discussed in Chapter 8.

Nonetheless, the overall small number of non-local items and their nearly exclusively burial contexts demonstrate that the interaction was still on a small scale. The evidence indicates that the network discussed above did not pass directly through the Zarumilla River region, though some people at El Dornajo were tapped into the network during the Regional Development Period. This network was much smaller than that of the Late Regional Development/Integration Period and would therefore be expected to provide fewer economic opportunities.

Figure 7.3 Ceramic stool from the surface of Loma Segarra.

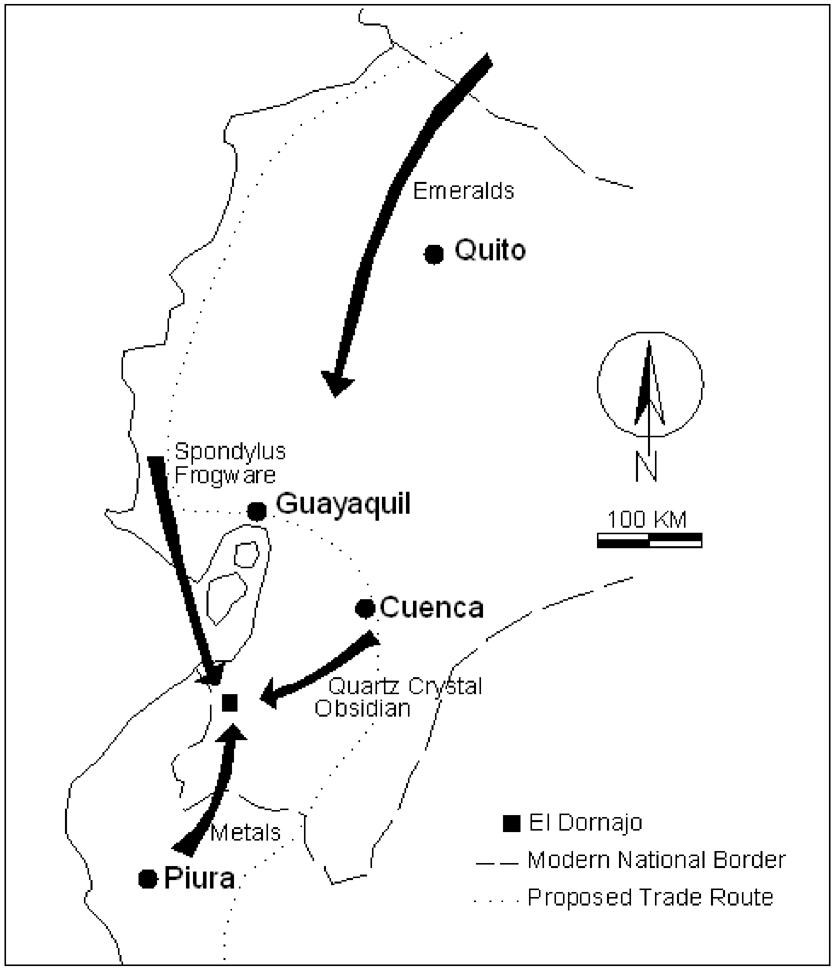


Figure 7.4 Map of the trade route proposed by Hocquenghem 1991, and the likely origins of non-local artifacts found at El Dornajo.

7.3 ELITE ACTIVITIES

Despite taking place at an earlier date and in a less intensive way than originally imagined, an increase in inter-regional interaction, and in the participation of residents of El Dornajo in that interaction, does correspond temporally with the evidence for social inequality at the site. Changes in social organization also appear rapidly as expected if external factors were influencing these changes. This does not mean, however, that inter-regional interaction promoted social change. Elites could have invested their wealth and power in the acquisition of newly available finery without the interactions that made those acquisitions possible having any real importance in local social organization. If the two phenomena are directly related then we expect to see changes in activities at the site associated with this interaction. Specifically, we expect the associated activities to be more strongly linked to elite sectors of the site than to non-elite sectors.

These expectations are examined by comparisons of artifact distribution both between and within time periods using the four groups identified in multi-dimensional scaling discussed in Chapter 3. Group 1, which includes the lower stratum of all $1m^2$ units on the western end of Loma Segarra, dates to the Early Formative Period. Groups 2, 3, and 4 all date to the Early Regional Development Period. Group 2 includes the upper stratum of all $1m^2$ units on Loma Segarra and of all $1m^2$ units on the eastern end of Loma Blasio. Group 3 includes all strata in all $1m^2$ units on the western end of Loma Blasio. Group 4 includes all strata in all $1m^2$ test units and 1m dog-leash surface collection on Loma Alvarado.

Proportions of camelid remains, spindle whorls, chipped stone, and scrapers were calculated for each group taken as a cluster sample. Groups 2-4 were then pooled to arrive at a pooled estimate of the proportions for the Early Regional Development Period that could be compared with Group 1 for the Early Formative Period. The proportions were calculated by converting artifact type to sherd ratios into proportions. For example, the number of spindle whorls was divided by the number of spindle whorls plus the number of sherds. This is the same method used in Chapter 6 to examine food remains at the site. The analytical value of this approach is discussed in that chapter.

7.3.1 Middleman model

If elites at El Dornajo were acting as middlemen in a larger trade network then we expect them to be differentially associated with currency items, bulking facilities, and camelid remains. No *naipes* or *chaquira* were recovered and no large storage spaces were identified.

There does appear to be an increase in camelid remains though not on the scale one would expect if they were being used frequently for transport. No camelid remains were found at any of the Formative Period sites that have been studied, including Uña de Gato. Nine specimens were found at El Dornajo. Seven of the nine specimens were part of a few articulated bones belonging to one individual found in Horizontal Area A of Group 2. One specimen was found in Group 4 and one in the *tola* fill. Some of the artiodactyla and unidentified mammal remains could have been camelid. Thus it appears that camelids had made their way to coastal Ecuador by the Early Regional Development Period, but they were not there in economically significant numbers. Camelids are known in the southern highlands of Ecuador and in Alto Piura Peru at this time (Kaulicke 1991, Stahl 2003). In fact, the site of Vicús in Alto Piura appears to have been involved in camelid husbandry (Kaulicke 1991), so we would expect to see more camelid remains at El Dornajo if they were being used as beasts of burden. Ninety-three specimens were recovered at Loma Saavedra (Integration Period), all in one large excavation area (Vilchez et al. 2007). Therefore these animals may have been considerably more important along the Zarumilla River during the Integration Period. In short, there is no support for the middleman model.

7.3.2 Export economy model

If elites at El Dornajo were benefiting from an economic reorganization towards an export economy then we expect to see an increase in the scale and intensity of the production of export goods; we also expect to see that production more strongly associated with elite households. In order to examine these expectations three factors were considered: intensity, scale, and distribution. Intensity refers to the labor investment of producers in a given productive task. High intensity production indicates that producers spend most of their time on that activity, in other words, that they are specialists. Scale refers to the proportion of the population who are involved in the production of a given product. Large scale production involves most families of a community (Costin 1991). The distribution of goods identifies which sectors of the site were involved in a given productive activity. Scale and distribution are examined for each category of production identified at the site. Scale is based on the percentage of contexts at the site in which any evidence of production was recovered. Distribution is based on the proportion of production-related items found in each sector of the site. Intensity is discussed below.

Elite control of an export economy could take two forms; attached specialists or domestic re-organization to meet elite demands. If elites were financing attached craft producers then we would expect to see high intensity-small scale production taking place exclusively in elite sectors of the site. If the domestic economy re-organized to meet elite demands then we would expect to see low intensity-large scale production across the site. The kinds of goods produced at El Dornajo were largely domestic, appear in low quantities, and were mixed with ordinary domestic refuse, all of which indicate low intensity production (Feinman and Nicholas 2000). In fact, evidence for the production of goods not associated with normal domestic needs was rarely found at El Dornajo (with the exception of a very few metallurgical tools to be discussed below).

Thus models based on high intensity production, like the attached specialists model, are not applicable here.

Cloth. Spindle whorls (Figure 7.5) are used for the spinning of threads used in weaving. All of the spindle whorls from El Dornajo are made of clay and most have incised designs around the exterior. Figure 7.6 illustrates that there is no difference in the distribution of spindle whorls between groups at the site, indicating that both elite and non-elite sectors of the site were involved in spinning. Additionally, spindle whorls were only found in 6 of the 64 contexts (unit/stratum) excavated at El Dornajo, or 9% (± 7% at the 95%CL). If more than a very small proportion of the settlement's population were involved in spinning, then we would expect to recover spindle whorls in a larger proportion of the contexts. Thus cloth production was a small scale, low intensity activity that both elite and non-elite sectors of the site participated in.

Figure 7.5 Spindle whorls from El Dornajo.

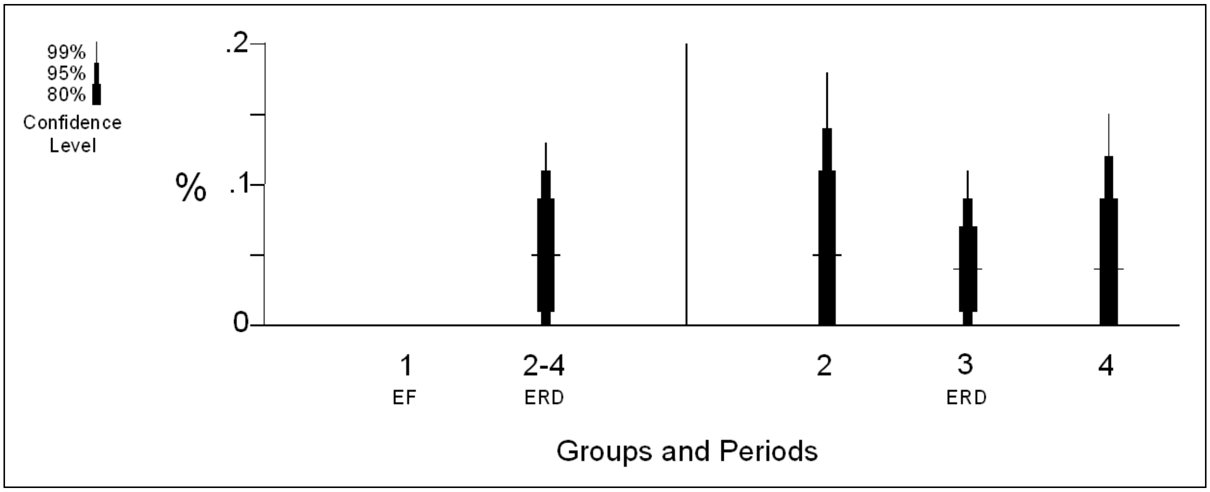


Figure 7.6 Spindle whorl to sherd proportion of in each group, and for the pooled Groups 2-4.

*No spindle whorls were found in Group 1

Ceramics. No items directly associated with ceramic production, such as paddles, anvils, kilns, wasters etc. were recovered. Nonetheless, the temper of nearly all of the sherds from El Dornajo consists of alluvial sands from the floodplain and paleo-river channels suggesting that the manufacture of ceramics took place somewhere along the river.

Some polishing stones, which are often used to burnish ceramics, were recovered. But only 4 of 64 contexts (unit/stratum) excavated at the site, or 6% (± 6% at the 95%CL) contained polishing stones. If more than a very small proportion of the settlement's population were involved in making/decorating ceramics then we would expect to recover polishing stones in a larger proportion of the contexts. These artifacts were found in normal domestic middens and number only four in total; indicating that production was a low intensity task. Finally, both Groups 2 and 4 had polishing stones indicating that their use was not restricted to elite sectors of the site.

Wood work and hides. Hardwoods such as *hualtaco* and *zapote* are native to this area and would have made good materials for the production of numerous items. Indeed, wooden stains in the shape of spears or staffs in Burial 4 and Vessel 11 suggest that these woods were used for crafting items. Faunal remains demonstrate the presence and use of deer, and the hides of deer can also be an exchangeable commodity. Both crafts require stone tools for their manufacture. The two kinds of chipped stone artifacts found at El Dornajo are flakes (Figure 7.7) and scrapers (Figure 7.8). The flakes from the site showed no signs of use wear and primary, secondary, and tertiary flakes are all represented. They are therefore, considered production debris, although they may well have been used expediently.

Flakes were found in 11 of 64 contexts (unit/stratum) excavated at the site, or 17% (± 9% at the 95%CL). If more than a small proportion of the settlement's population were involved in wood working or hide processing then we would expect to recover flakes in a larger proportion of the contexts. In this case the scale of production is larger than that of cloth production but still modest considering the variety of activities that flakes might have been involved in. Scrapers were found in only 4 of 64 contexts excavated at the site, or 6% (± 6% at the 95%CL). Again, if more than a very small proportion of the settlement's population was involved in wood working or hide processing then we would expect to recover scrapers in a larger proportion of the contexts.

Figures 7.9 and 7.910 illustrate that we can be more than 99% confident that Group 4 had roughly twice the chipped stone of other groups at El Dornajo however, whether flakes or scrapers. These data indicate that there was unequal participation in activities like wood working and/or hide processing at El Dornajo. Yet these remains are few in number and were found in mixed domestic midden deposits indicating a low intensity of production within elite sectors. As a low scale and low intensity activity, production of these goods is not likely to have been part of an export economy even though elites were more involved in it. They were likely involved as part-time producers of status items for their own consumption.

Figure 7.7 Quartzite flakes (left) and cores (right) from El Dornajo.

Figure 7.8 Quartzite scrapers from El Dornajo.

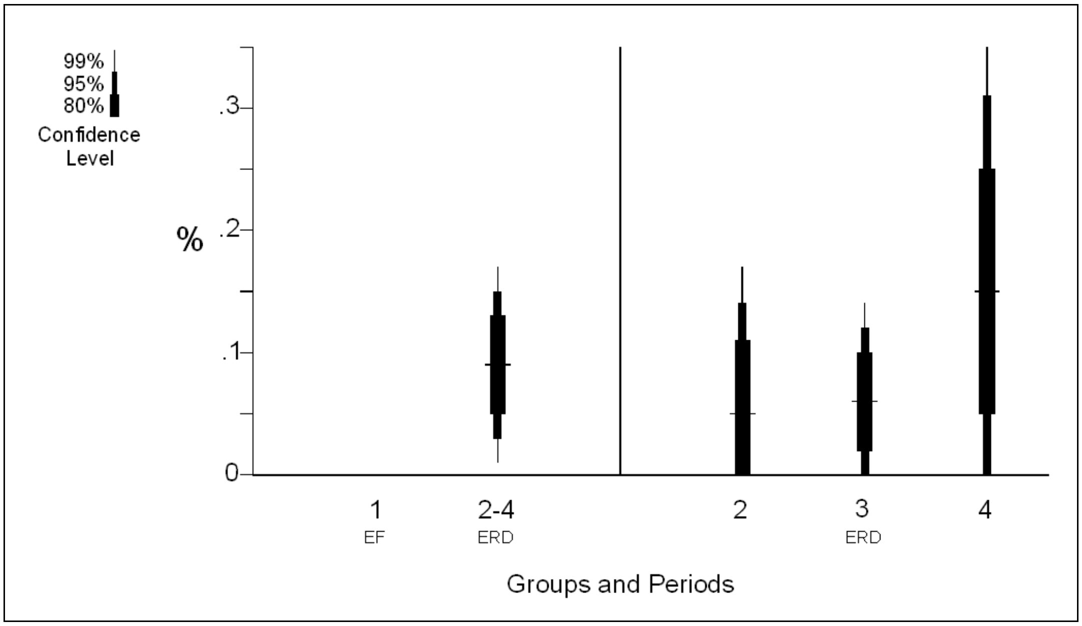


Figure 7.9 Flake to sherd proportion in each group at the site, and the pooled Groups 2-4.

*No flakes were found in Group 1.

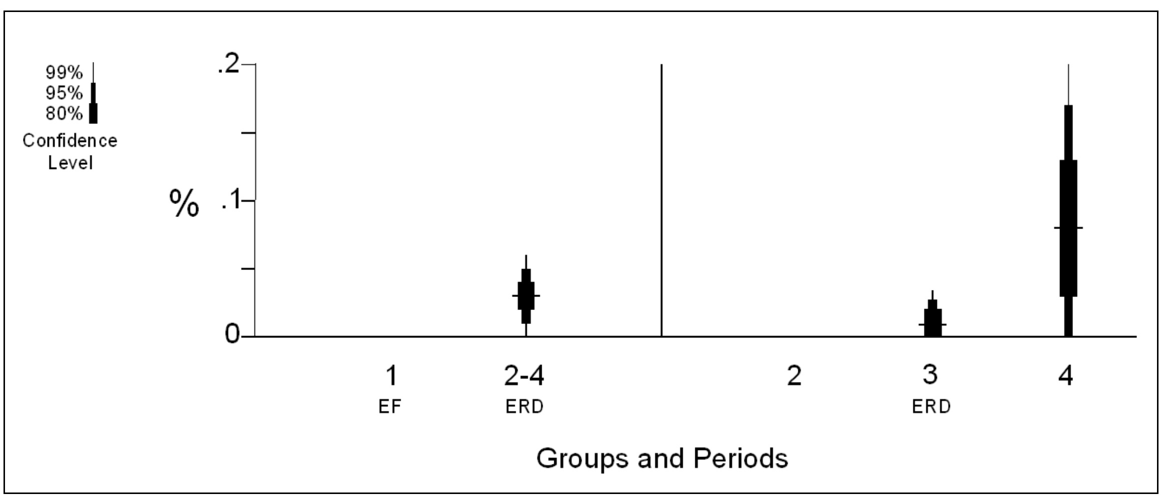


Figure 7.10 Scraper to sherd proportion for each group at the site, and the pooled Groups 2-4.

*No scrapers were found in Group 2 or 1.

Metallurgy. Three items associated with metallurgy were recovered from El Dornajo, and as previously discussed, metal ore (at least gold) was locally available. One clay *truyere* fragment (Figure 7.11) was found in Group 4. *Truyeres* are placed on the end of reed tubes that are used to oxigenate fires for smelting. The process often leaves droplets of the smelted metal on sherds inside of the kiln and one sherd with copper drops on the interior was found in the *tola* fill. Additionally, a stone hammer for annealing was reportedly found in the wealthy burial looted on Loma Alvarado (Figure 7.12). Smooth hammers are used to thin metal ingots into sheets.

So while the kinds of artifacts expected for metallurgical production were found at the site, only one of each was found, which indicates very low intensity manufacture of metal items if any at all. All three items were found in elite sectors of the site, so any production that did take place would have been associated with elites; but these items are so few that they may be prestige items themselves. Certainly no slag, vitrified clay, or kiln fragments were found.

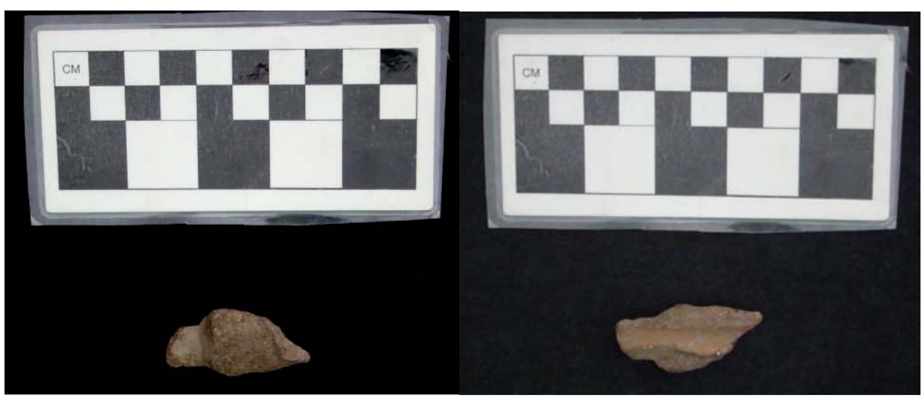


Figure 7.11 Ceramic *truyere* from El Dornajo (left is the exterior, right is the interior).

Figure 7.12 Metallurgical hammer from looted burial on Loma Alvarado.

7.4 CONCLUSIONS

In summary, there appears to have been an increase in inter-regional interaction along the Zarumilla River during the Early Regional Development Period. This is earlier than the large scale Integration Period exchange network between the Sicán and Manteño states, which is likely when any formal networks were initiated. During the Regional Development Period exchange would have been between the Vicús-Moche states and various Ecuadorian chiefdoms, passing from Alto Piura in Peru, through the highlands of southern Ecuador, and possibly out to the northern coast of Ecuador through Manabí and La Tolita (Hocquenghem 1991, Hocquenghem et al. 1993). This network has been proposed on the basis of shared styles and the movement of copper-gold and spondylus seen at sites along this corridor, and may have been a simple down-the-line network given the small scale and largely burial related items from all associated sites at this time. The network probably did not pass through the Zarumilla River, but rather passed by it in the highlands to the east, though the presence of objects from neighboring regions at El Dornajo indicates that at least some residents of El Dornajo were tapped into this network.

There is no evidence to support a re-organization of the economy at El Dornajo in response to this interaction, however. Residents of El Dornajo were involved in more productive activities during the Early Regional Development Period than they had been during the Formative Period. But the scale of those productive activities was quite small and of low intensity, involving the production of goods for local consumption. The difference between this period and the Early Formative Period is a reflection of the greater variety of domestic tasks undertaken by residents of the site during the later period. Thus, interaction with distant and socially more complex neighbors did not act as an impetus to social change at El Dornajo by re-organizing the domestic economy (i.e. Blanton and Feinman 1984). The very small scale of any kind of craft production at the site also means that models where the control of craft production, or long distance exchange, initiated the development of a local political economy (i.e. Blanton 1996, Peregrin 2000, Vaughn 2006) are not applicable to El Dornajo.

The evidence for an increase in inter-regional interaction at El Dornajo takes the form of elite prestige goods found in burial contexts. This indicates that interaction with distant neighbors was part of a strategy for modest wealth accumulation. Thus inter-regional interaction may have provided a way to store or symbolize wealth, which would make it important to the maintenance of social inequality but not to its emergence. Alternatively, emergent elites at El Dornajo may have been involved in a prestige economy. In such an economy emergent elites build prestige locally through the accumulation of wealth from personal networks of exchange with other elites (Friedman and Rowlands 1977). The similarity of the changes in artifact assemblages between El Dornajo and sites in the southern highlands of Ecuador at this time supports such a model. Yet this kind of strategy is only successful as a way to gain power if it is grounded in control of the subsistence economy (Earle 1991). In this case we have already established that the subsistence economy was not coercively controlled at El Dornajo (see Chapter 6), though this does not preclude the possibility that ownership of desirable land gave some persons an advantage in less coercive ways.

Finally, the sudden appearance and disappearance of these items in the region is coincident with the rise and decline of El Dornajo, strongly suggesting that a prestige economy played some role in the developmental trajectory of the site. It would not have been the items themselves, however, that bolstered emergent elites so much as the relationships that made their acquisition possible. Thus the intensification of trade between southern Ecuador and northern Peru appears to have made exotic prestige items available to the El Oro-Tumbes region in small numbers. These items may have been used regionally to solidify alliances between elites. This idea will be further explored in the next chapter.

8.0 CLAMBAKES AND REGIONAL ALLIANCES

The last two chapters demonstrated that emergent elites at El Dornajo were not involved in activities associated with the coercive control of subsistence goods or the management of an export economy. In fact, the only activities that I have evidence for elites being differentially associated with are the the acquisition of prestige goods and the hosting or sponsoring of feasts. The sharing of food among members of a community is one of the most basic kinds of social interaction; thus feasting happens in nearly all communities. Because it tends to involve substantial material waste it is an activity easily identified archaeologically. This has led the topic of feasting to be one of considerable popularity in the archaeological literature, and one that is often associated with social complexity given the inherent possibility for unequal access to resources. Feasting is not necessarily a mechanism for social change in and of itself, however. Rather, it is a universally acknowledged context for the expression and negotiation of power structures. These expressions can be about integration, differentiation, or both.

Feasts focused on integration are sponsored by numerous families in a community and are commonly referred to as solidarity feasts. Often these kinds of feasts facilitate the redistribution of food resources within the community and encourage economic inter-dependence (Potter 2000). Those focused on differentiation are about negotiating status differences and are usually sponsored by relatively few families. These feasts are competitive in nature and serve to advertise the prestige of the hosts and engender debts. Competitive feasting is a way of transforming surplus into social currency (Hayden 2001). Since not everyone is able to host a feast, those who are typically already have access to more food or labor than most residents of a community and are using that surplus to invest in greater status.

Evidence for feasting at El Dornajo is discussed in this chapter by looking at the distribution of vessel forms and sizes across the site. These data are considered alongside those presented in Chapter 6 supporting clambakes to suggest that elite sectors of the site were hosting community feasts, especially Group 4. Finally, the nature of feasting at the site is considered in order to address the extent to which it may have been important to either the emergence or maintenance of social inequality.

8.1 FIELD AND LABORATORY METHODOLOGY

8.1.1 Ceramics

All ceramics larger than 3cm in diameter were collected from all contexts (unit/stratum/level) excavated at the site. Size was determined by passing all sherds through a 3cm chicken wire screen. The ceramics were washed in the lab house in Arenillas using soft sponges and water. Care was taken to avoid washing away easily damaged slips and paint. After air drying on newspaper, ceramics were separated into diagnostic and non-diagnostic sherds. Diagnostic sherds are those having any form of decoration, all rims/bases, and any additional diagnostic elements such as handles or spouts. Non-diagnostic sherds were counted and weighed by context (unit/stratum/level) at this time. They were later returned to the site and re-buried in the units from which they had been excavated.

Diagnostic sherds were visually analyzed by the author. The texture of the temper was identified as fine, course, or very course. Fine temper is barely visible without a hand lens. Course temper is larger than .2mm but smaller than 2mm. Very course temper is larger than 2mm. For the most part alluvial sand was used for temper and mixed with micaceous clay, though the core colors indicate that organics may have been added to the matrix at times. The firing atmosphere was determined by identification of the core color using Rye 1981 (p.116 Figure 104). Most ceramics were oxidized though many were reduced fired and then rapidly cooled in air.

Only four forms were recognized in this analysis: jars, *ollas*, bowls, and plates. Jars are defined as having a restricted orifice and a neck more than 3cm in height. *Ollas* are defined as having a restricted orifice and a neck of less than 3cm in height. Bowls are defined as having an unrestricted orifice and a curved bottom. Plates are defined as having an unrestricted orifice, shallow depth, and a flat bottom. Rim diameter and neck height were also recorded. Finally, the presence or absence of a slip and all forms of decoration were recorded. Rim form was recorded as one of five varieties: folded, flaired, piecrust, straight, and inflected (Figure 8.1).

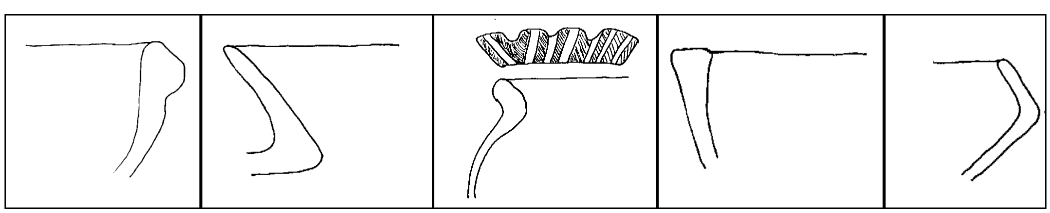


Figure 8.1 Ceramic rim varieties (folded, flaired, piecrust, straight, and inflected from left to right).

8.2 EVIDENCE OF FEASTING

Hayden (2001) outlines a number of archaeological signatures of feasting. Some of these include the presence of unusual vessel types, serving vessels of unusual quality, unusually large numbers and sizes of serving vessels, and large sizes and numbers of cooking vessels. He also notes reliance on abundant and intensifiable foods, the presence of rare or labor intensive foods, recreational foods, large quantities of food, and waste of food. If feasting were important to social change at El Dornajo then these kinds of artifacts should be differentially associated with elite sectors of the site.

This expectation is examined by comparisons of artifact distribution both between and within time periods using the four groups identified in multi-dimensional scaling discussed in Chapter 3. Group 1, which includes the lower stratum of all $1m^2$ units on the western end of Loma Segarra, dates to the Early Formative Period. Groups 2, 3, and 4 all date to the Early Regional Development Period. Group 2 includes the upper stratum of all $1m^2$ units on Loma Segarra and of all $1m^2$ units on the eastern end of Loma Blasio. Group 3 includes all strata in all $1m^2$ units on the western end of Loma Blasio. Group 4 includes all strata in all $1m^2$ test units and 1m dog-leash surface collection on Loma Alvarado.

8.2.1 Serving vessels

Feasting involves the large-scale consumption of food and drink by a group larger than the family unit. This means that in places where feasts take place, one often sees a high proportion of, or larger sizes of, serving vessels (Hayden 2001). Those vessels are often highly decorated since they are meant to be seen in a public setting, and may include uncommon forms used for the consumption of special foods.

In this study serving vessels include bowls and plates while cooking/storage vessels include *ollas* and jars. Figure 8.2 illustrates that overall there was little change in the proportion of serving vs. cooking/storage vessels between the Early Formative and Early Regional Development Period occupations. However, this figure also demonstrates considerable differences between groups within the Early Regional Development Period. We can be more than 99% confident that Groups 3 and 4 have a higher proportion of serving vessels than does Group 2, which has a higher proportion of cooking/storage vessels. This is an indication that the elite sectors of the site were associated with more serving and consumption than were non-elite sectors of the site.

As was discussed in Chapter 4, Group 4 also has a higher proportion of decorated vessels than do other sectors of the site (see Figure 4.5). Indeed this is one of the primary characteristics causing Group 4 to be considered elite. Decorations are a form of display and decorated vessels are most often used in public contexts like feasting. Therefore, this group is most clearly involved in the public display of consumption.

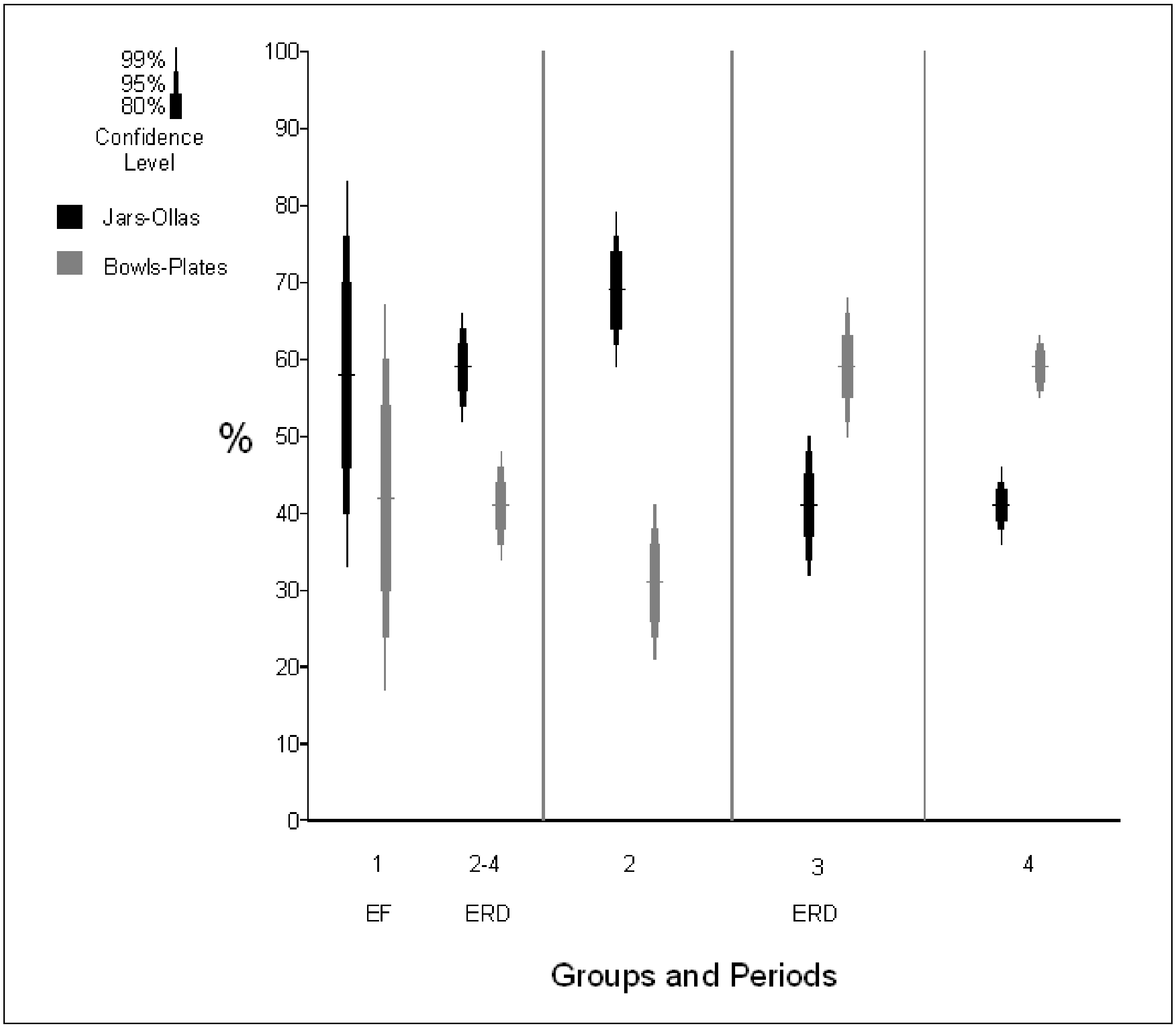


Figure 8.2 Proportion of serving and storage vessels for all groups at the site, and for the pooled Groups 2-4.

The proportion of bowls between groups and periods varies little. Group 3 has about 10% more bowls than other groups, but we can only be 80% confident in this difference (Figure 8.3). Bowls range from 8 to 42cm in diameter though bowls larger than 32cm are rare (n=8) and have been eliminated from the calculations of mean size as outliers. Once these outliers are excluded the average diameter of bowls is about 19cm. Figure 8.4 illustrates that there are no strong or significant differences in bowl size between the groups. However, all six bowl sherds in the 40-42cm range were found in Groups 3 and 4. These especially large bowls may have been used in feasting contexts to serve large numbers of people.

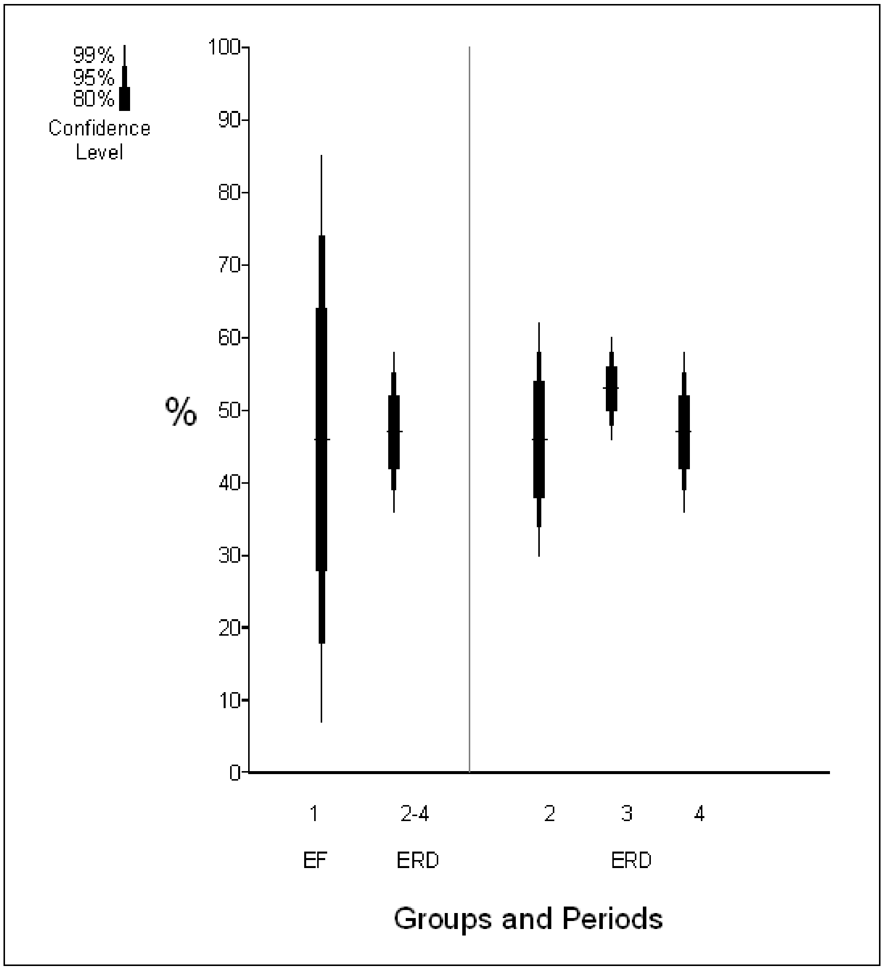


Figure 8.3 Proportion of bowls in each of the groups at the site, as well as the pooled estimate for Groups 2-4.

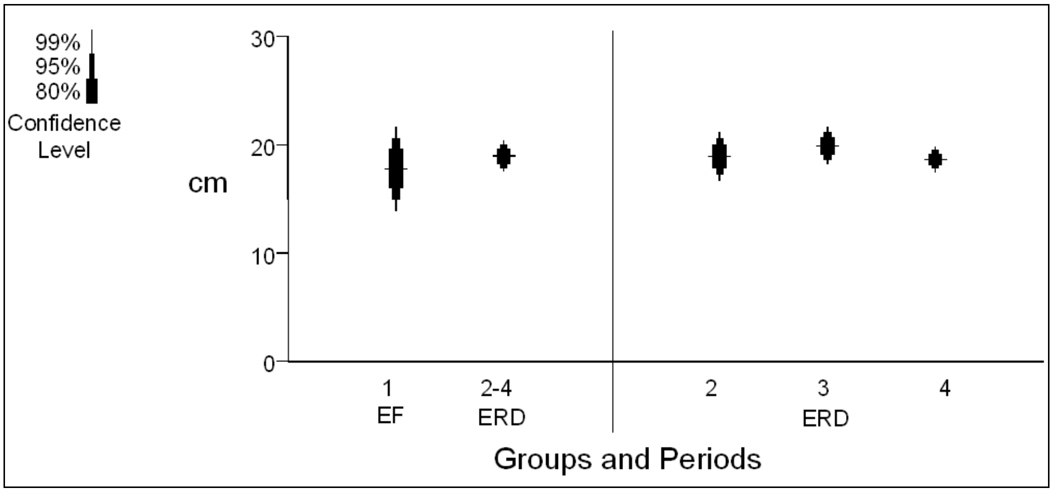


Figure 8.4 Mean bowl rim diameter for all groups at the site as well as the pooled estimate for Groups 2-4.

*Bowls larger than 32cm excluded.

Plates are less common than bowls in this assemblage. Nonetheless, Groups 3 and 4 both have a higher proportion of plates than Group 2. Figure 8.5 illustrates that we can be 99% confident that Group 4 had nearly 10-20% more plates than other groups at the site, and that Group 3 had twice as many plates as Group 2. Many of the vessels identified as plates in this analysis may very well have been *compoteras*. *Compoteras* (pedestaled plates) are elaborate serving vessels that have not been found in larger numbers at other sites along the river (Pajuelo 2006) and would certainly display their contents in a very conspicuous fashion.

Plate rim diameters range from 14 to 36cm across the site though only two sherds over 30cm in diameter were found. These two cases were excluded from analysis and without them the average plate size is 21cm. Figure 8.6 illustrates that there is little difference between plate sizes in the groups. However, both of the outliers excluded from the calculation of mean belong to Groups 3 and 4. This is consistent with the pattern observed for larger than normal bowls at the site.

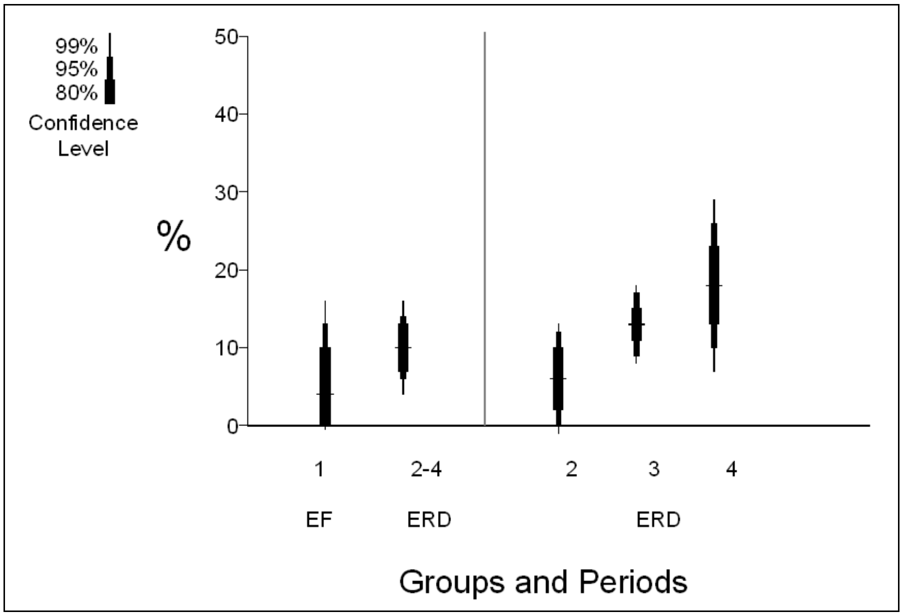


Figure 8.5 Proportion of plates in each of the groups at the site, as well as the pooled estimate for Groups 2-4.

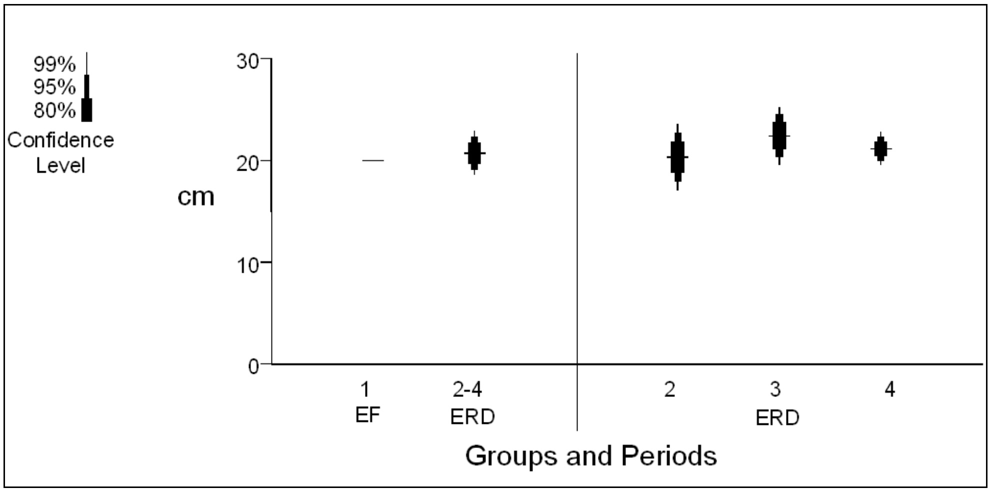


Figure 8.6 Mean plate rim diameter for all groups at the site as well as the pooled estimate for Groups 2-4.

*Note that only one plate sherd was found in Group 1. Plates over 30cm excluded.

8.2.2 Cooking/storage vessels

Since feasts are about the large-scale consumption of food and beverages by a group larger than that of the family unit they also involve the preparation of larger than usual quantities of food. Thus, areas where food and beverages were prepared for a feast often have a higher proportion and larger sizes of cooking vessels. Though clearly a simplification, jars are often more closely associated with storage while *ollas* are most often associated with cooking. This distinction is somewhat problematic because ethnographic data tell us that many *ollas* serve storage functions and many jars are used for the preparation of beverages. In the absence of quantitative data on charring to help distinguish cooking vessels from those used for other purposes, it is tricky to interpret different proportions of jars and *ollas*. When grouped together, as in Figure 8.2, it is clear that we can be 99% confident that Groups 3 and 4 had a lower proportion of cooking/serving vessels than Group 2. If we de-couple these forms, however, we can attempt to better recognize which of these two activities, cooking or storage, were differentially undertaken at the site.

Figure 8.7 illustrates that the proportion of *ollas* in each group is fairly evenly distributed. *Olla* rim diameters range from 8 to 32cm across the site but cluster at the lower end of that range from 8 to 24cm. *Ollas* greater than 24cm in diameter are much less common but do not form a tidy cluster of their own. It seems quite likely that with a larger sample both “medium” and “large” *ollas* would be identified in the upward straggle of rim diameter values. When *ollas* 8-24cm in diameter are grouped as “small” *ollas* there is no difference in the mean diameter of *ollas* at the site (Figure 8.8). All of the *ollas* greater than 24cm in diameter were found in Groups 3 and 4 (10 in Group 3 and 28 in Group 4). This suggests that residents of Group 4 in particular, but of Group 3 as well, were cooking for larger numbers of people on some occasions. These data therefore support the notion that elites at the site were hosting feasts.

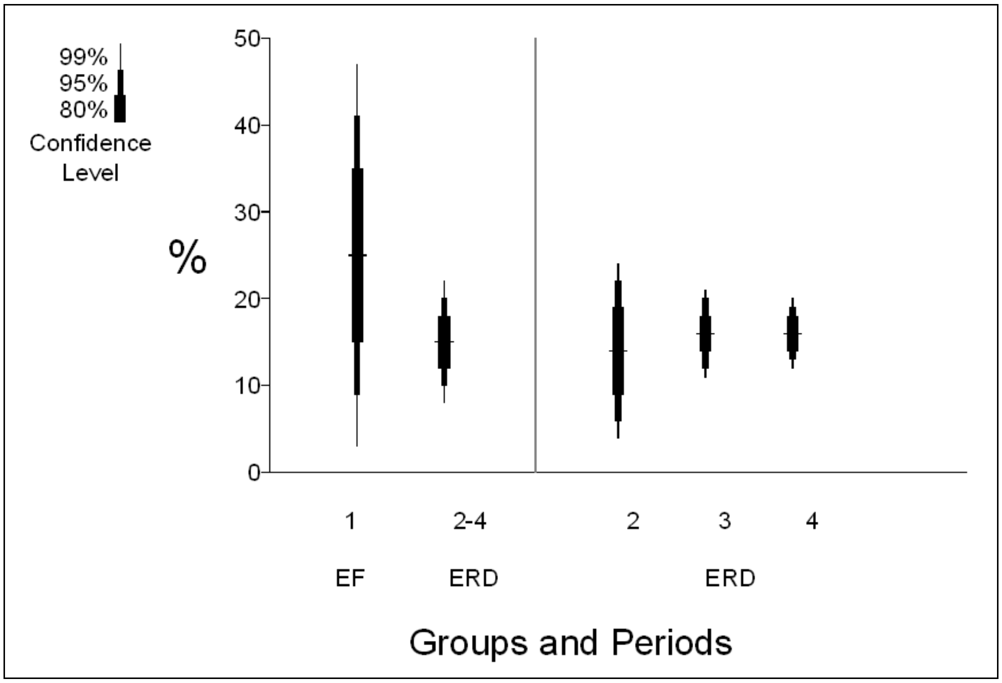


Figure 8.7 Proportion of *ollas* in each of the groups at the site, as well as the pooled estimate for Groups 2-4.

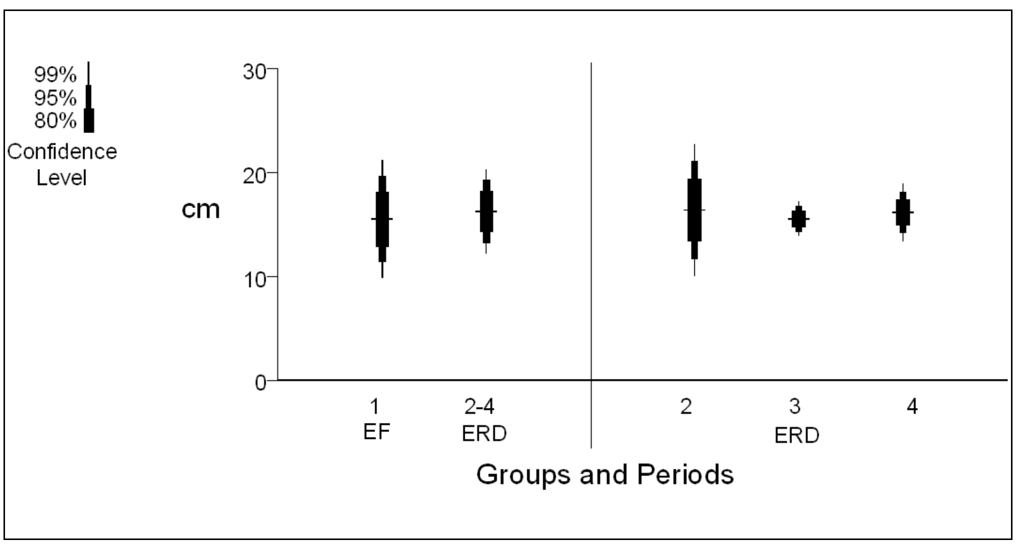


Figure 8.8 Mean "small" *olla* rim diameter for all groups at the site as well as the pooled estimate for Groups 2-4.

Figure 8.9 illustrates that we can be over 99% confident that Group 2 had about 12% more jars than other groups. This may mean that Group 2 was involved in more storage or beverage preparation than Groups 3 and 4. This result is unexpected and contradicts expectations that elite sectors of the site would be storing surplus or preparing more beverages for feasts.

Jar rim diameters across the site range from 8 to 44cm, with vessels in the 30-44cm range being unusual (n=6). These rim sherds were therefore excluded from the calculations of mean. The resulting batch of numbers shows that the average jar was about 14cm in diameter. Figure 8.10 shows that we can be 95% confident that Group 4 had jars that were on average about 3cm bigger those in other parts of the site. Additionally, all but one of the outliers in jar size came from one very early context in Group 4. This could balance out the difference in the proportions of jars between sectors of the site. In other words, elites may have stored foods or prepared beverages in a smaller number of larger jars, while non-elites stored foods or prepared beverages in a larger number of smaller jars. However, the strength of the difference in jar size does not seem high enough to compensate for the strength of the difference in proportions.

The likely contemporaneous but now destroyed site of La Palma also had a high proportion of jars (47%) (Pajuelo 2006), as did the later site of Loma Saavedra (34%) (Vilchez et al. 2007), when compared to Groups 3 and 4 at El Dornajo. Perhaps the interesting pattern then is the low proportion of jars in elite contexts at El Dornajo rather than the high proportion in non-elite contexts. This may suggest that non-elite residents relied more on stored foods, while elite residents had greater or more regular access to fresh foods, or, non-elite residents may have been responsible for the preparation of beverages used in community activities.

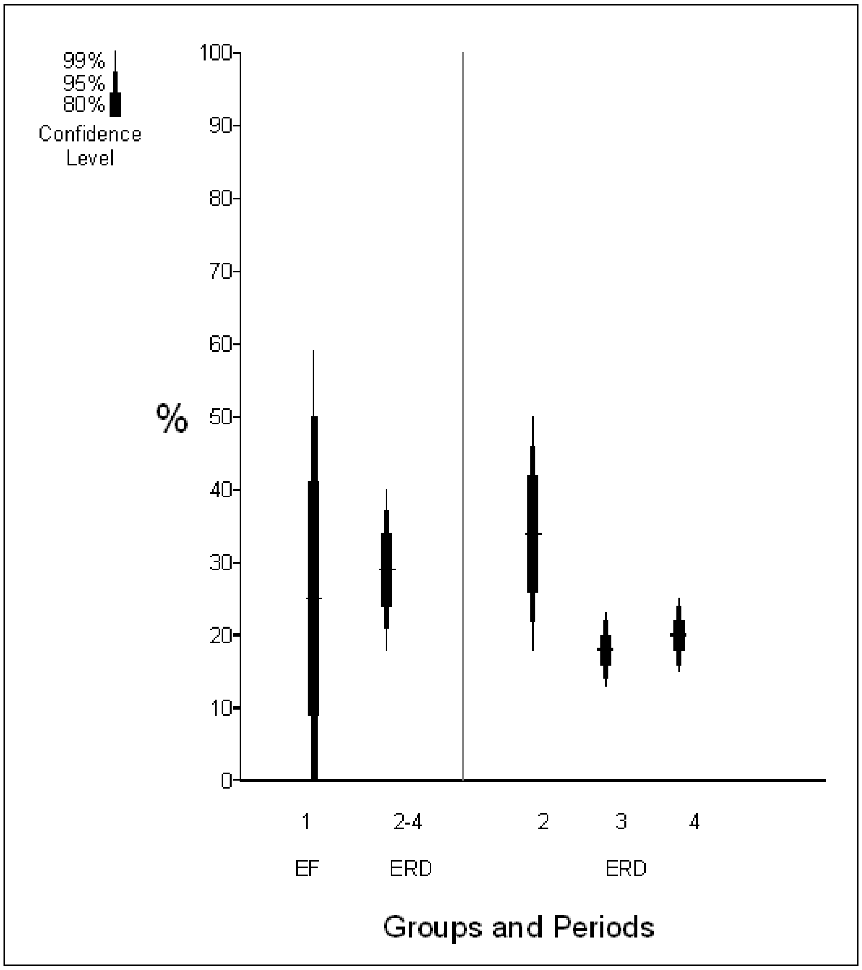


Figure 8.9 Proportion of jars in each of the groups at the site, and the pooled estimate for Groups 2-4.

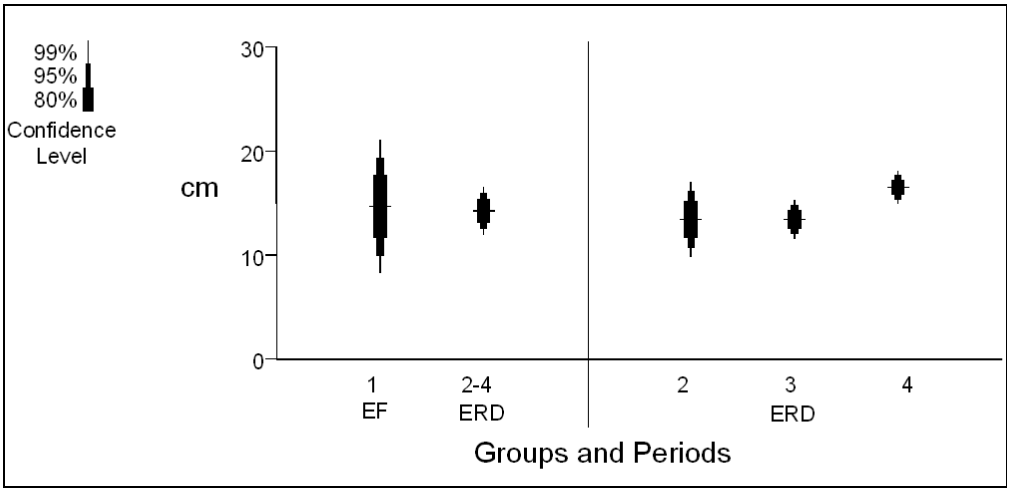


Figure 8.10 Mean jar rim diameter for all groups at the site as well as the pooled estimate for Groups 2-4.

*Cases over 30cm excluded.

Overall, the ceramic data support the notion that elite sectors of El Dornajo were hosting feasts, particularly Group 4. Both elite sectors of the site (Groups 3 and 4) have more and larger serving vessels as well as unusual serving vessel forms. Group 4 also has more highly decorated vessels and slightly larger cooking vessels. The relatively normal proportion of cooking vessels across the site suggests that feasting could have been potluck or focused on the clambakes which are typically prepared in earthern pits rather than ceramic vessels. Indeed the unusually large quantities of *C. subrugosa* in elite sectors of the site support this interpretation.

8.2.3 Food remains

In Chapter 6 we saw that Group 4 had a higher proportion of shellfish remains than other groups at the site (see Figure 6.2). This led to the suggestion that residents in this sector were hosting clambakes. All evidence at this time indicates that clams would have been the primary food resources of feasting events at El Dornajo. *C. subrugosa* are relatively abundant on the coast but are clearly not available inland. They are not an intensifiable resource. They are not necessarily labor intensive to harvest as they often occur in beds, nor are they labor intensive to prepare. In short, they are not the kind of resource that Hayden (2001) expects for feasts. They would, however, require some effort to transport inland and are not a storable resource. This means that if they were consumed in large numbers at one time, then they would involve the labor of many people at once. This makes *C. subrugosa* a labor demanding resource if used in feasting contexts. Elite sectors of the site were also associated with a greater diversity of fishes (see Figure 6.8). Some of these fishes (particularly the chondreichthyes) were rare at the site and represent somewhat exotic foods, which is consistent with Hayden's (2001) expectations.

It is much harder to assess the kinds of plant foods that might have been consumed at feasts due to the poor contexts of the soil samples analyzed. The kinds of plant foods that were identified at El Dornajo are perennials. Many of these foods, such as tubers, are easily intensifiable but not easily controlled. Tubers grow readily in many different kinds of soil and require very little care. Annuals, like maize, were not identified at El Dornajo. This is almost certainly a result of sampling however, leaving the question of whether or not such foods might have played a role in feasting unanswered. Starch analysis of sherds may help to address this question in the future.

8.3 INTERPRETING FEASTING AT EL DORNAJO

Careful consideration of the kind of feasting taking place can shed light on the social significance of feasting in a given community. Potter (2000) suggests that three variables are particularly important to better understand feasting in any society; scale of participation and financing, the frequency and structure of occurrence, and the food resources used. To the extent possible, these variables will be examined at El Dornajo.

The scale of participation refers to how many people were involved in the feast and whether or not multiple communities were involved. Feasting at El Dornajo appears to have been moderate in scale. The fact that evidence for feasting is seen in half of the spatial extent of the site indicates that this was an activity involving more than just a few families, and probably involving the entire community of El Dornajo itself. It is not clear whether these feasts involved more than just the community of El Dornajo or not, as particularly dense feasting deposits were not encountered. The large-scale use of mangrove resources could indicate that coastal communities were involved in feasts. Alternatively, obtaining such foods may have relied on personal relationships with coastal contacts, or food may have been directly procured by residents of El Dornajo as the coast is only 10km away. In these cases coastal communities would not have been participants in feasting events. In Chapter 2 I noted that some other sites along the river also seem to have had a lot of decorated ceramics and I tentatively dated them to the Early Regional Development Period on this basis. If these observations are accurate, then several sites along the river could potentially have hosted feasts. Only El Dornajo relied so strongly on *C. subrugosa*, however, so the nature of feasting at other sites may have varied.

Whether feasts involved just the community of El Dornajo, or other communities along the river, they were probably financed on the supra-household level since evidence for feasting is spread out across all elite sectors of the site rather than being concentrated around just a few households. In other words, there are no particularly high concentrations of feasting remains in one place. But the fact that Group 4 deposits were not intact leaves open the possibility that artifacts like larger cooking vessels might originally have been more concentrated, indicating financing by a smaller number of families.

The animal food resources that appear to have been used at these feasts were for the most part non-local (i.e. *C. subrugosa* shellfish and fishes). This would have made it slightly more difficult to finance a feast since many of the resources would have had to come from 10km away and are not storable foods. Unless coastal people brought these foods to the inland feasts then they would have required access to a large labor pool in order to bring large quantities of perishable goods from the coast, though they are necessarily labor demanding resources. The plant resources that may have been used are not known thus we cannot assess whether or not they were intensifiable, easily controlled, or labor intensive to prepare.

The structure of feasting at El Dornajo cannot be determined with the available data. In terms of physical space, special structures or areas for feasting were not identified. However, if such facilities did exist they would likely have been in Group 4 which is not intact. Thus it is unclear whether the physical space used for feasting events was regulated or not. Again the wide spread presence of feasting remains does not suggest that any centralized space was used, but it is impossible to be sure that the remains recovered in Group 4 had not originally been more concentrated near a plaza or larger structure. Neither is there any way at this time to assess the extent to which participation and interaction were regulated.

In most societies feasting occurs at prescribed times of the year such as Thanksgiving or the Super Bowl in the United States. In some societies, like our own, feasting can also happen at un-prescribed times (these are called *ad-hoc* feasts by Potter 2000). How often feasts take place is a measure of their frequency. To a large extent the ability of aspiring elites to host *ad-hoc* feasts depends on the potential for surplus (Potter 2000). The frequency of feasting at El Dornajo cannot be determined at this time. Certainly many plant resources would have been available only seasonally. The consumption of juvenile deer is indicative of seasonality as well. Thus any feasts involving these foods would have happened at prescribed times of the year. On the other hand, *C. subrugosa* and fishes would have been available year round and could have been mobilized at any time (though more easily at some times than others) and these are the resources that most likely characterized feasts at the site. All strata in elite sectors of the site can be characterized as including feasting debris. In other words, there are no discrete layers of feasting debris within strata that are otherwise without such refuse. Thus, it seems likely that feasting was a fairly regular activity at the site. Whether this means once a year or several times a year is less clear. The relatively few exceptionally large vessels at the site may indicate that feasting happened only a few times a year.

The extent to which the prestige goods found in burial contexts were involved in these feasting events is unclear. Certainly some feasts may have been centered on mortuary ritual that clearly did involve the display of wealth. But whether or not such prestige goods were re-distributed in the form of gifts during feasts is not known. It is safe to assume that such adornments were displayed during public activities like feasting, however.

Although tentative at best, the data currently available most closely parrallel what Hayden (2001) has called "promotional/alliance feasts". Feasting at El Dornajo does not appear to have been competitive or aimed at acquiring tribute. Rather, such events were more likely aimed at establishing and maintaining both intra-group solidarity and inter-group alliances. The main goal of such feasts is typically the acquisition of mates and labor for promotion of community interests and the display of community success as a means of attracting these mates and labor (Hayden 2001). Thus feasts would not likely have been a primary means of achieving institutionalized inequality, though they may well have been a central ingredient to the maintenance of inequality. However, if several sites along the river were involved in feasting activities at the same time, then I would have to consider the possibility that feasting had a more competitive edge than is indicated here. This would give it a more prominent role in the emergence of inequality.

The association of elite sectors of the site with *C. subrugosa* shellfish is best explained by exclusive relations of at least some elite residents with coastal communities. These shellfish often occur in beds making them easily accessible to anyone with a right to harvest them. Both elite and non-elite residents of El Dornajo had access to coastal resources. The relative absence of this particular species in non-elite middens therefore suggests that the shell beds were owned by certain coastal individuals /lineages /communities, and that elites from El Dornajo had access to these resources through personal relationships with those lineages. Group 4 is the most strongly associated with feasting. This group had an unusually high proportion of shellfish as well as a greater diversity of fishes, a higher proportion and larger sizes of serving vessels, a very high proportion of decorated vessels, and slightly larger cooking vessels than other groups at the site. I suggest that residents of Group 4 had strong coastal relationships and they expressed and maintained their status at El Dornajo through hosting feasts that were focused on coastal resources. Residents of Group 3 also participated in, and may have contributed to feasts, but to a lesser extent than Group 4. Instead, as seen in Chapter 4, residents of Group 3 expressed and perhaps maintained their status through the acquisition and display of prestige goods that would have come through personal relationships with nearby highland communities. These regional relationships and interactions may have been important to the unequal social structure at El Dornajo. This notion will be explored in the concluding chapter.

9.0 CONDITIONS OF SOCIAL CHANGE AT EL DORNAJO

9.1 SOCIAL CHANGE AT EL DORNAJO

The Zarumilla River Valley on the border of Ecuador and Peru was continuously occupied from the early Archaic Period (ca. 4000 B.C.) to the Spanish Conquest. There were only two noticeable surges in social complexity along the river during this long occupation, one during the Formative Period and another during the Early Regional Development Period. The first may have lasted for several hundred years and was centered at the site of Uña de Gato, a large village with four artificial non-domestic mounds (Moore 2010). The second lasted only a few hundred years and was focused on the site of El Dornajo, a small village with one artificial mound. Both sites are located along a broad stretch of floodplain 10km inland from the Jambelí Archipelago.

Excavations at the site of El Dornajo revealed that it was first occupied in the Early Formative Period around 2600 BC. At this time the site was a 1ha hamlet consisting of perhaps four or five households. Residents of the site consumed mangrove resources (primarily oyster and marine catfish) and deer. The site was not occupied during the remainder of the Formative Period, a time when many people in the valley may have been attracted to the emerging center of Uña de Gato. El Dornajo was re-occupied during the Early Regional Development Period around 300 AD, as much as 700 years after the decline of Uña de Gato. The site continued to be occupied until perhaps 600/700 AD.

During its Early Regional Development Period occupation El Dornajo was a 5.5ha village of some 20-25 households. Residents continued to rely on mangrove resources and deer, though a wider variety of mangrove species were consumed and other mammals were consumed in small quantities. There is also some evidence that residents consumed tubers and tree fruits. No evidence for the use of annuals such as maize was identified, though this is most likely the result of diluted phytolith samples.

Early on in the re-occupation of El Dornajo there are signs of social inequality. A modest *tola* (which may have been residential at this time) was constructed, and richly adorned individuals were interred nearby. *Tola*s, or mounds, involve community scale labor investment and the presence of richly adorned burials indicates that status differences were present. The rich burials included multiple persons in each pit with one principal personage who was adorned in precious metal and stone ornaments. In one burial pit the principal personage was a child suggesting that status was ascribed. At least twice in the following 300 years the *tola* was expanded and additional (though somewhat more modest) burials were interred nearby. Multi-dimensional scaling of the burial data suggests both horizontal and vertical social differences at the site. The number and kinds of burial goods cluster into three groups indicating three social classes referred to here as rulers, elites, and non-elites, further substantiating the conclusion that status differences were present at this time. The burials also cluster into those oriented to the west and those oriented to the east. This division cross-cuts age, sex, and status distinctions, indicating that there were two clans/lineages/moieties at the site.

The site can be divided into three sectors (Groups 2, 3, and 4) based on multi-dimensional scaling of shellfish proportions and an examination of the stratigraphy and land forms at the site. These groups are thought to represent socially distinct sectors of the site. The *tola* and rich burials are located in Group 3. Group 4 has a very high proportion of decorated ceramics and informants report that many burials were looted from this area as well. No burials were found in Group 2. Cumulatively these data indicate that there were two sectors of the site where elite residents lived and one where non-elite residents lived. Elite sectors have thick, dense, vertical midden deposits indicating continued occupation for multiple generations while Group 2 midden deposits are shallow, horizontal deposits that are comparatively much less dense, indicating that residents of this part of the site were not tied to the land in the way that those in Groups 3 and 4 were. Differences between the popuations represented by the three groups will be further explored in the discussion section of this chapter.

9.2 RESEARCH GOALS

This dissertation explores the conditions promoting the emergence of social inequality seen at El Dornajo during its Early Regional Development Period occupation. The location of El Dornajo in the El Oro-Tumbes region of southern Ecuador and northern Peru makes it an interesting case study for examining conditions of change because it is a cultural frontier lying between the central and northern Andean traditions. The developmental trajectories of cultural frontiers are frequently seen as being tied to that of their more complexly developed neighbors. This perspective assumes that inter-regional interaction affected past societies in ways not unlike how it affects developing nations today. Regional and local economies, politics, and cultural practices are seen as becoming increasingly integrated through larger networks of interaction and trade. The uneven participation of individuals in networks of this sort allows the potential for unequal access to the various benefits of that interaction. While the participation of ancient societies in macro-regional scale networks of interaction is evident, the assertion that these interactions were in some way pivotal to social change not only in the core areas, but in their frontiers as well, has not been demonstrated.

Indeed, much of the literature on social complexity is more strongly focused on the role of internal conditions (or interaction within communities) in promoting social change. This compels us to re-consider what kinds of internal conditions might have mattered to social change at El Dornajo. A popular internal condition for social change in the Andes is based on human-environment interaction and focused on the occurrence of mega El Niño events. These natural hazards can be catastrophic and can affect the existing social structure of communities. Since natural hazards affect individuals differentially they may give an advantage to some parts of society while devastating others. The El Oro-Tumbes region is the epicenter of El Niño activity along the South American coast making this a probable internal condition of social change.

The research presented here has assessed the relative importance of these two potential conditions in the emergence of complex social organization at El Dornajo; the impact of changing subsistence resources due to environmental hazards and the effect of increased interaction with more complex societies in neighboring regions. The objective was not to choose one of these alternatives over the other, but rather to assess the importance of each. Four possible outcomes were identified: one or the other of these two sets of factors may have had substantial importance in promoting the emergence of complex social organization at the site, both sets of factors may have acted fairly strongly, or neither condition may have had much impact on the social trajectory.

9.3 CONDITIONS AND MECHANISMS OF SOCIAL CHANGE

In order to explore the role of the conditions discussed above in promoting the emergence of social inequality at El Dornajo this study was organized around specific models grounded in each of these conditions. These models identify mechanisms of social change that are likely given the conditions under consideration.

It was initially hypothesized that the Zarumilla River Valley may have been involved in a greater degree of inter-regional interaction between 800 and 1000 AD, a period of increased inter-regional interaction between the Sicán state and the Manteño and Milagro-Quevedo chiefdoms. However, the dates of occupation revealed through excavation of the site are more consistent with an earlier period of somewhat less formalized exchange between the Vicús-Mochica and Manteño around 400 AD. Because societies are not homogenous entities, not all members of a society have equal access to external contacts during periods of increased interaction. If such contacts gave individuals preferential access to economically or socially valued goods, then those individuals and their factions would be in a position to control access to such items within the community. This would allow them to exchange such goods for labor and assert some control over the productive activities of others (Shortman and Urban 1992). In models of this persuasion privileged access to either socially important prestige goods and/or wealth serves to promote and enhance the power of certain social factions either ideologically or economically.

In the case of ideological legitimization, contact with elites in more powerful polities provides local leaders privileged access to prestige goods associated with an influential political ideology or esoteric power (Helms 1979). In the case of economic legitimization, aspiring elites gain access to a previously unavailable market by involvement in a large exchange network (e.g.

Earle 2002; Feinman and Nicholas 1992; Friedman and Rowlands 1977; Langebaek 1991). This would involve the economic re-organization of the community to profit from a newly available market. The appearance of a large inter-regional exchange network in a region would open up the potential market for export demands. It might also allow communities to profit economically by positioning themselves as middlemen in the network. Those individuals in a position to manage or control economic re-organization could earn greater wealth and authority. For example, larger households might have extra labor or surplus food to support the labor of craft producers; or such families might be able to support the construction of bulking facilities and personnel for managing large-scale trade.

Alternatively, it was proposed that the Zarumilla River Valley may have been subject to increased stress on several important wild subsistence resources from mega El Niño events. Major events have been dated to 500 BC, 600 AD, and 1100 AD and there was a period of intensified ENSO (El Niño Southern Oscillation) activity between 50 BC to 750 AD during which individual events were stronger and occurred with more frequency than they do today (Moy et al. 2002; Rein et al. 2005). The dates of occupation at El Dornajo, finally, do not match those of the well known mega El Niño events cited above. Yet Sandweiss (1986) notes that mega El Niño events seem to have occurred about every 500 years during the prehistoric period which would suggest that there was an event around 0 AD. Clear evidence for mega El Niño events were noted in the stratigraphy and shellfish growth breaks at El Dornajo, and date to the known period of increased ENSO activity.

Mega El Niño events discharge large amounts of silt into the estuaries and mangroves creating conditions of hypoxia that can be devastating to marine life in these environments. While they would devastate mangrove resources these events would have substantially improved certain agricultural resources by increasing precipitation in an otherwise arid environment. Responses by communities to environmental hazards may involve institutional adjustments as existing factions within society are amplified (Oliver-Smith 1996, Van Buren 2001), thereby opening up opportunities for socio-political change by creating a context for conflict of factions and contestation of power structures or the emergence of new power structures (Oliver-Smith 1996, Williams 1997). The redistribution of resource control produced by environmental hazards creates a situation in which different segments of society are affected differently, with some undergoing subsistence stress while others see amplified opportunities. In such a situation aspiring elites can gain personal control of subsistence resources such as land or water and accumulate surplus subsistence goods as a result of that control or ownership (Earle 1991, Gilman 1995). Those persons or groups at El Dornajo with property rights to such areas could convert surplus production into wealth and status by sponsoring community ritual, warfare, or craft production.

There are three basic expectations for both of these models: 1) emergent inequality should happen coincident with either a period of increased inter-regional interaction or a mega El Niño event, 2) the community of El Dornajo should be more involved in inter-regional trade networks or be experiencing subsistence shortage and increased reliance on agricultural goods, and 3) emergent elites should be controlling economic re-organization at the site or controlling access to subsistence goods (particularly agricultural goods). In this dissertation data from archaeological excavations were used to evaluate these expectations in order to evaluate the likelihood that these models are a good fit for social change at El Dornajo.

9.4 INTER-REGIONAL INTERACTION

Social complexity resulting from inter-regional interaction is expected to be relatively rapid as interactions increase through time. All of the evidence of social inequality at El Dornajo is seen at roughly the same time the site was re-occupied around 300 AD, and seems to have appeared rather suddenly. Furthermore, the data indicate that the re-occupation of El Dornajo took place during a period of increased inter-regional interaction between the Manteño chiefdoms of Ecuador and the Vicús-Moche chiefdoms of northern Peru, and that at least some residents of El Dornajo were involved in the acquisition of goods through that trade network. This is seen both in the number and the variety of non-local goods found at El Dornajo as compared to any other site in any period along the river.

The Early Regional Development Period occupation at El Dornajo is characterized by more interaction with neighboring polities than had been true for earlier sites along the river. The goods identified come from both north and south of the Zarumilla River and there is evidence of an expanding exchange network passing through the southern highlands of Ecuador at this same time. However, the kinds of goods being acquired were prestige items found almost exclusively in burial context and consisting primarily of personal adornments. Furthermore, these items were found in small numbers overall, meaning that particularly large caches of wealth were not found. Thus, some residents of the site were tapped into inter-regional exchange networks but there is no evidence to suggest that they were directly involved in them. Neither is there any evidence of economic re-organization at the site. Residents of El Dornajo did not serve as middlemen in the trade network. This is clear because no large-scale storage features, *naipes*/*chaquiras*, or large numbers of camelid remains were found. Nor did they develop an export economy. All households were involved in similar productive activities at a domestic scale and intensity. Thus we must conclude that economic re-organization in response to newly available markets through expanding inter-regional interaction did not promote social change at El Dornajo.

Yet while the residents of the Zarumilla River were not directly in contact with their more complexly organized neighbors, neither were they isolated from the macro-regional changes taking place. The data suggest that elites at El Dornajo were tapped into the inter-regional exchange network via personal relationships with neighboring highland communities. These relationships allowed them to acquire prestige goods. External alliances and relationships are often cited as important to the acquisition and maintenance of status in ranked societies. These prestige goods may have been important to faction building within the border/frontier communities. Certainly they would have served as manifestations of the relationships they represented. They may also have been used in gifting to solidify relationships within the community. Seen from this perspective inter-regional interaction may have been important to social change in ways not explicitly economic by promoting regional interactions among elites through the emergence of a prestige economy.

Finally, it has been argued that hierarchy based on reliance on external interactions is inherently unstable since trade networks can change routes and the fate of those depending on them is tied to the fate of other polities (Earle 2002). In this case, the Moche-Manteño trade network became the Sicán-Manteño trade network, which later became the Chimú-Manteño trade network after about 1300 AD, lasting until the Inca conquest of Tumbes around 1450 AD. This implies that strategies of power based on the control of structured transactions between leaders along the Zarumilla River and their external ties would have been relatively stable. Yet if the site of El Dornajo is any measure, they were not. The site was abandoned around 700 AD and no later site in the valley has evidence of such sustained interaction in far flung networks of interaction. It has been proposed elsewhere that around 600 AD trade between coastal Ecuador and coastal Peru shifted from a focus on terrestrial routes to maritime routes (Hocquenghem 1998). If this were true, the change may have disrupted the participation of groups along the Zarumilla River who would have relied on personal relationships with highland elites for access to goods.

9.5 ENVIRONMENTAL HAZARDS

Social change induced by environmental hazard such as a mega El Niño event is expected to be especially rapid because of the nature of such catastrophes. There is clear evidence for a mega El Niño event and ongoing ENSO activity immediately prior to the re-occupation of El Dornajo when social inequality is first seen at the site. ENSO activity is seen by the presence of ancient river channels directly underlying the cultural stratigraphy of the site and stress-induced growth breaks on *C. subrugosa* shellfish in the midden deposits. Furthermore, the emergence of social inequality does indeed appear rather rapidly in the cultural stratigraphy.

While social change in this context is expected to be rapid, the disruption produced by mega El Niños is short-lived since shell beds and estuary resources require only some 50 years for full regeneration (Coker 1908, as cited in Vilchez et al. 2007). Researchers involved in hazards studies have noted that newly emergent interest groups often broaden their fields of influence once the hazard has passed, providing an arena in which to make complex social organization extend beyond the period of most intense subsistence stress (Oliver-Smith 1996). Only through engaging in activities that would broaden the scope of their power could elites maintain their positions in the truly long term. Elites at El Dornajo might have expanded the basis of their social position, for example by establishing themselves as ritual specialists or by participating in exchange networks. In the first case, elites would establish themselves as necessary in an ideological sense, much like Burger's (1988) Chavin "crisis cult" model. There is no evidence at El Dornajo for this model, at least in the way of ritual items or paraphenelia. In the second scenario, by using their already established status, elites at El Dornajo may have sponsored craft production or trade activity thereby converting power and status into wealth (Gilman 1991; Langebaek 1991). There is no evidence that such activities were undertaken on a large scale at El Dornajo.

This study originally hypothesized that a mega El Niño event might decrease the availability of important mangrove resources making agricultural foods more important and giving farmers a temporary advantage. If this were so we expected to see a dietary shift and elite control of agricultural goods or tools. There was in fact, a dietary shift between the Early Formative and Early Regional Development Periods like that we would expect if there had been subsistence shortages following a mega El Niño event and during prolonged ENSO activity. The shift involves a near complete cessation of oyster consumption replaced by broad spectrum collecting of mangrove and intertidal shellfish. It also involved increased diversity in the species of terrestrial mammals and fishes exploited, as well as a possible increase in the use of plant foods.

But the temporal gap between these two occupations (over 1000 years) is too long to be directly associated with the mega El Niño event immediately preceding the re-occupation of El Dornajo. In fact, data from other sites along the river (Currie 1989, Staller 1994, Vilchez et al 2007) suggest that the dietary shift identified in the data from El Dornajo initially took place on a regional scale several centuries prior its re-occupation. The change probably took place around

1000 BC when dense oyster deposits disappear from other istes in the region. Furthermore, elite sectors of the site were not differentially associated with agricultural goods, tools for plant processing, or storage. Thus we must conclude that control of subsistence foods in the aftermath of an environmental catastrophe was not directly associated with the emergence of social inequality at El Dornajo. There are other ways that mega El Niño events might have influenced the social trajectory of the region, however.

Mega El Niño events can cause the Zarumilla River to change its course. This is evident in the alluvial stratigraphy of the river bed and is known from the historic record. Access to the river would have been important for water and cultivation throughout the prehistory of the region. In this sense ENSO activity was directly affecting the availability of subsistence resources not only by limiting mangrove foods but by determining the location of water and alluvial deposits within the region. Thus environmental hazards would have had an effect on settlement patterns through time; giving certain locations an advantage in one period, and others an advantage in the next. This would be true whether anyone was coercively controlling the available food resources or not. Indeed, what we are able to understand about the regional settlement pattern at this time, is consistent with this suggestion. Thus it would seem that environmental hazards were creating conditions favorable to the re-negotiation of existing power structures after all, albeit in ways not originally anticipated.

9.6 DISCUSSION

9.6.1 Natural hazards, land rights, and social networks

In environments characterized by natural hazards traditional societies develop mechanisms for coping with the stresses brought on by such events. Current research on El Niños suggests that large events may happen as often as every 100 years (Douglass 2010). This is well within the cultural memory of a community and people in this region would have had ways to cope with such events. One important strategy is the maintenance of relationships with people in complimentary resources zones in order to buffer against resource shortages and decrease overall vulnerability to environmental hazards, thereby preventing the occurrence of disasters.

Ethnohistoric studies in the Andes often cite regional interaction and interdependence as characteristic of the region. Silva (1983) (as cited in Reitz and Masucci 2004) and Rostworowski (1975), among numerous others, argue that the ecological contrasts between the coast, the coastal plains and river valleys, and the highlands encourage specialization in food production and regional exchange patterns. Interdependent economic relationships between these different environmental zones were observed at the time of Spanish contact and continued to characterize many parts of the coast well into the modern era. At the time of the Spanish conquest regional exchange was managed by chiefs in a manner reminiscent of Service's regional symbiosis model (1962). During the colonial period trans-zonal marriages are cited as a means of establishing and maintaining such relationships for the purposes of access to a variety of foods (Oberem 1974). Lindao and Stothert (1995) (as cited in Reitz and Masucci 2004) found that such marriages are still important for establishing and maintaining personal relationships with people in complementary environmental zones. Throughout the history of the coastal Andes regular regional trade of marine and agricultural resources has been historically based on personal relationships with real or fictive kin in different environmental zones (Reitz and Masucci 2004). Such mechanisms likely developed along the Zarumilla River during Formative Period as seen by the large quantities of shellfish in inland middens.

Mega El Niño events massive enough to cause the river to change its course occured much less frequently than mega El Niño events in general, based on the historic record. Whether or not events of this magnitude and infrequency were part of the cultural memory of communities they would have affected regional settlement patterns. This kind of event is not disastrous to the daily lives of people if social mechanisms for mitigating risk are in place, it simply causes them to relocate a few kilometers away. A change in the location of the river could be disastrous for existing power structures, however. I have suggested that an especially large mega El Niño event caused the Zarumilla River to jump from the Peruvian to the Ecuadorian margin of the floodplain between 0-300 AD, and that this placed those with land rights around El Dornajo in a position of advantage while undercutting the authority of those who previously held rights to land near the river. This means that models based on founding lineages may be appropriate for understanding the foundations of social inequality at El Dornajo. This is consistent with the presence of domestic remains underlying the construction of the *tola* and the earliest richly adorned burials. It is also consistent with the more permanent relationship that elite residents of the site had with the land when compared to non-elites as seen in the depth of domestic midden deposits.

It was not just land rights that gave elites at El Dornajo their power, however. After all, they occupied the most desirable stretch of floodplain but not the only one. In such a sparcely populated region this is an important factor to remember since there was probably always unoccupied yet useable land. There is reason to believe that the traditional risk buffering mechanisms based on social relations with coastal communities discussed above, were co-opted or monopolized by elites at the site during this period. Throughout the Formative Period shellfish was both abundant and widespread in the archaeological record of the region. A shift in the most heavily exploited species occurred after about 1000 BC, changing from oysters to predominantly intertidal species but shellfish remained widespread in midden deposits across sites and throughout the Prehistoric sequence. Yet at El Dornajo elites had greater access to shellfish than non-elites during the Early Regional Development Period. This implies differential access to coastal resources when compared with earlier periods. Furthermore, elite shellfish consumption focused strongly on *C. subrugosa subrugosa* rather than being more varied, as was the case in non-elite contexts and at other sites in the Regional Development and Integration Periods.

Oysters are easily harvested from the prop roots of mangrove trees using a prying stick at low tide, and provide an abundant and energy efficient resource. Thus it is perfectly logical that early sites in this area show a strong preference for oyster. Data from throughout the region suggest that the oyster population suffered a severe blow toward the middle of the Formative Period forcing people to broaden the spectrum of their shellfish consumption and rely more strongly on intertidal species and *Anadara tuberculosa* (a mangrove species). *A. tuberculosa* lives in the mud around the lower roots of mangrove trees, which make them more labor intensive to harvest than oysters. Intertidal species can be more easily harvested than *Anadara* but are less desirable than oysters. To harvest intertidal species people would have raked the intertidal flats at low tide. This would have produced a varied assemblage not unlike that observed in non-elite contexts at El Dornajo.

C. subrugosa is found in this context but it is hard to imagine how elites at El Dornajo could have reliably harvested such large quantities of this species in this particular way. They could certainly have received them as tribute, but that would not explain why non-elite contexts lacked large quantities, unless their consumption was in some way controlled. Unlike the other intertidal shellfish found at El Dornajo, *C. subrugosa* can occur in beds, and beds of shellfish could have been controlled or owned. Thus one possible scenario is that elites on the coast established ownership of *C. subrugosa* beds, and that elites at El Dornajo had rights to use this resource via personal relationships with coastal elites. This would mean that elites in the region co-opted or monopolized traditional risk-buffering mechanisms that relied on social networking, which would have increased the vulnerability of non-elites to environmental hazards while providing elites with an additional desirable resource.

9.6.2 Regional interaction, prestige economy, and feasting

It was not only regional interaction and alliances with coastal communities that mattered to social change at El Dornajo, for there were important highland relationships as well. At the same time that El Dornajo was emerging as the center of a small multi-site polity along the Zarumilla River around 300 AD, the southern highlands to the east saw the emergence of supra-local communities, craft production of goods for non-local consumption, and intensified trade relationships (Bruhns 2003). The intensified trade between coastal Ecuadorian chiefdoms and the Moche-Vicús chiefdoms of coastal Peru introduced many new and prestigious adornments into the region. Elites at El Dornajo appear to have had personal relationships with highland elites in the form of a prestige economy aimed at the acquisition of these goods, probably through gifting in marriage and trade alliances. These previously unavailable exotic items would have symbolized elite prestige and may have been re-invested in gaining power locally; for example, in the form of gifting from chiefs to lower elites.

In addition to being differentially associated with non-local goods, elites at El Dornajo were also differentially associated with the hosting of clambakes where the primary foods were coastal in origin. Data from this study suggest that clambakes more likely served as a way to express solidarity within the community and maintain alliances with neighboring communities, than as an arena for competitive generosity or tribute collection (see Chapter 8). This may be the context in which power structures were re-negotiated when the shifting river upset the existing social structure.

The hosting of clambakes and the acquisition of prestige goods were not undertaken uniformly by all elite residents of El Dornajo, however. Two different sectors of behaviorially distict elite occupations were identified at El Dornajo. Group 3 has public architecture and fancy burials. Group 4 has an especially high proportion of fancy decorated pottery. While the data from this project are insufficient to fully understand the differences between these groups, I would like to suggest a possible interpretation.

These groups could represent competitive elite factions, or they could have been hierarchically arranged kinship groups (i.e. senior and junior lineages). If Groups 3 and 4 were competitive factions we would expect to see the remains of that competition in the archaeological record. There is no evidence for overtly competitive behavior between these two groups, however. In other words, neither feasting nor burial practices at the site become increasingly ostentatious (if anything they become less conspicuous through time). Models based on hierarchical kinship groups therefore seem more plausible. Yet the population represented in elites sectors of the site is so small that these models probably complicate interpretation unnecessarily. Instead, I suggest that Group 3 represents the chiefly household while Group 4 represents the elite population more generally.

Group 3 has an artificial mound with several especially rich burials nearby. This group is also spatially smaller than the other two groups at the site, consisting of perhaps only 2-3 households. Finally, the artificial mound in this sector was built over what may have been the initial Early Regional Development Period occupation of the site. Together these data suggest that residents of this sector may have been the founding lineage of the Early Regional Development Period occupation and were staking their claim to the land through the construction of the mound and burial of their ancestors. Founding lineages typically hold political authority through their direct line of descent from an apical ancestor who was the original community founder. This is a pattern seen in ranked societies worldwide from the Swahili (Nurse et al. 1985) to the Maori (Aginsky 1940). As the closest relatives of the apical ancestor, members of the chiefly household served as intermediaries with their ancestors to assure fertility and abundance. As land holders they would have distributed use rights to other residents of the site which would have given them considerable authority. Additionally, access to exotic prestige items would have been an attractive opportunity for the chiefly household at El Dornajo to expand their base of power through marriage alliances in an elite network of interaction not unlike that described by Junker (1999) in the Phillipines. Thus personal relationships with regional elites were important for maintaining authority.

Group 4 was identified as elite primarily on the basis of a high proportion of decorated ceramics. The data from this study demonstrated that this group was strongly involved in the hosting of clambakes but had no artificial mound and considerably less access to fancy burial goods than Group 3. This group consists of some 6-9 households. I suggest that Group 4 represents the elite population, likely the extended kin of the chiefly household. Residents of Group 4 may have organized and hosted feasts as part of their obligations to the chiefly household in exchange for the right to use land near the river. This would have involved first and foremost the production or acquisition of fine serving ware; and residents of Group 4 may have invested a considerable amount of time in that task alone. They would also have needed to prepare large amounts of food and perhaps organize the transport of *C. subrugosa* from the coast.

The clambakes organized by Group 4 were most likely promotion/alliance feasts aimed at the creation and maintenance of social networks that ensured access to material and human resources (Clarke 2001, Widmer 1994). Residents of Group 2 (the non-elites at the site) were probably the main human resource that elites were trying to attract. These people would have been from other lineages, or perhaps even persons outside of the lineage system for whatever reason (for example the *sudras* of Vedic India). Large clambakes, especially if held at times of relative scarcity of other foods, would be an attractive benefit to aggregating around El Dornajo and meeting whatever demands elites made on these people. These demands probably amounted to giving a small portion of their harvest or hunting/gathering foods to the elites, or providing modest periodic labor for elite crops. The material resources that elites were trying to obtain were the non-local items acquired through alliances with other elites in the region.

Clambakes would also have been an important means of maintaining the legitimacy of elite authority through building prestige. Feasting events are beneficial to, and confer prestige upon, the entire lineage. But as heads of the primary lineage, chiefs and their households would have accrued the most prestige through these events. Some of that prestige was probably the result of conspicuous generosity that created recipricoal debts with both alliance partners and lower elites, while some of it would be spent on legitimating their social position ideologically and materially through the display of prestige items and less tangible displays of ritual power.

9.7 SUMMARY

This dissertation examined two conditions for the emergence of social differentiation at the site of El Dornajo on the Ecuador/Peru border: inter-regional interaction and environmental hazards. The possible role of inter-regional interaction in promoting social change was explored through models emphasizing economic opportunity. The data do not support these models. The possible role of environmental hazards in promoting social change was explored through models emphasizing coercive control of subsistence goods. The data do not support these models either. Both of the conditions considered as possible promoters of social change at El Dornajo were, in fact, happening in temporal coincidence with social changes at the site. But neither condition was directly promoting the emergence or maintenance of social inequality in the ways proposed by the models in this dissertation. In other words, there is no evidence that aspiring elites took advantage of subsistence shortage in the aftermath of an environmental hazard to coercively gain power through controlling access to agricultural goods. Nor do aspiring elites appear to have taken advantage of newly available economic opportunities presented by the appearance of a nearby inter-regional trade network to develop an export economy.

However, environmental hazards might have opened up opportunities for the contestation of existing power structures not by breaking the rules, but because existing constraints were changed by the forces of nature. In this case, mega El Niño events caused the river to change course making it attractive to support those with land rights around El Dornajo. These persons may not have been able to exert or maintain power in the same ways those at the earlier central site of Uña de Gato had. Certainly there are differences between the sites suggesting that the mechanisms of change and the strategies for maintaining power differed. One new strategy employed by elites at El Dornajo was the co-option of existing risk buffering strategies based on social networks with coastal communities. Another new strategy was based on involvement in a prestige economy that fostered regional alliance building between polities in the highlands and the middle valley. Both coastal and highland alliances were likely solidified in the clambakes hosted by elites at El Dornajo.

Ultimately these strategies would be unsustainable since the next especially large mega El Niño event could have caused the river to shift its course once more, and access to prestige items was dependent on an external trade network. In fact, the abandonment of El Dornajo corresponds roughly to a well known mega El Niño event at 600 AD and to the possible reorganization of inter-regional exchange toward a coastal route.

9.8 CONCLUSIONS

This case study does not support the notion that macro-regional changes in geo-politics directly affected the developmental trajectory of the frontier region of El Oro-Tumbes. Instead, internal conditions of change are implicated even when it is clear that the frontier region was involved in macro-regional processes. This is consistent with much of the literature on social change in prehistory which emphasizes internal conditions of change.

At El Dornajo the local use of exotic items from afar and the emulation of distant and powerful imagery may, however, have bolstered local power structures through regional interactions. This is consistent with what is most often called a “prestige economy”. A prestige economy is often identified archaeologically by the presence of non-local finery in elite contexts and the absence of any obvious alternative for how elites acquired and maintained power. But whenever a prestige economy is expected, there is an important question that must be addressed; how do elites get these exotic items? One way such items might be acquired is by being “purchased”, either directly or indirectly. Yet in order to purchase prestige items elites must already have a base of wealth in goods and labor. Thus the acquisition of prestige goods can be a way of spending/investing wealth and power not an economic base in and of itself. This then, would not be a prestige economy.

Another way of acquiring prestige goods is through gifting. Gifting might take place between the elites of a given community and those of their more socially complex neighbors, or with neighboring communities of similar complexity. In the first case a patron-client relationship develops, this is the kind of interaction envisioned by most core-periphery models. Interaction of this sort is based on the idea that the more complex society is either securing its frontiers or gaining access to resources through gifting prestige items to local elites. In the second case equals are gifting to build alliances between regional elites as a means of solidifying their power at home and as a way to buffer against both subsistence and social risks. Deciding which of these two models best describes the situation in a given place in prehistory makes a big difference, yet both are a kind of prestige economy. The second scenario is more consistent with the data from El Dornajo. Finally, since the prestige items used in alliance building at El Dornajo seem to have become available because of increased inter-regional interaction between northern Peru and southern Ecuador, changes in macro-regional geo-politics did have a modest effect on social change at the site.

The extent to which this case study supports the notion that environmental hazards affect the developmental trajectories of communities is less straightforward. Environmental hazards become disasters or catastrophes when a society fails to respond adequately to changed conditions, either technologically or socially. Archaeologists tend to look to environmental catastrophes as a means of explaining important social changes, especially on the regional scale; but we often begin with the assumption that environmental hazards had disastrous effects on an area. In fact, environmental catastrophes were probably comparatively rare in prehistory. Today natural hazards tend to become disasters because the world food system has undermined traditional social mechanisms for mitigating shortage and risk by taking the control of subsistence resources away from local communities. In the past, people would have relied on relationships with neighboring communities during times of shortage or stress, especially in areas where environmental hazards are a regular occurrence. These kinds of relationships can be enduring and are certainly flexible enough to accommodate many kinds of stresses. It is this kind of relationship that seems likely to have been important along the Zarumilla River from the Formative Period on.

Yet environmental hazards do seem to have played an important role in determining access to water by controlling the course of the river, and therefore did provide opportunities for social change. Environmental hazards mattered because super mega El Niño events forced changes in settlement that opened up spaces for the negotiation of existing power structures. One context in which these negotiations could have taken place is the clambakes hosted by local elites. This scenario differs from the coercive model for the role of environmental hazards that I originally proposed; principally because in this case elites have something to offer people as a result of their personal relationships with neighboring communities, rather than having something to take away (i.e. food).

9.9 FUTURE RESEARCH

9.9.1 El Dornajo

Several of the preliminary conclusions in this dissertation could be further examined by higher resolution sampling of Group 3 at El Dornajo. Group 2 was thoroughly sampled in this dissertation, including horizontal excavations around house features; therefore, there is little reason to expect that anything more could be gained from further excavation on that part of the site. Additionally, because the deposits are so shallow and the land was being cleared to plant hardwood trees at the time of fieldwork, much of that part of the site will have been destroyed by the necessary irrigation system. Group 4 is already destroyed and the sampling that I undertook is as much as anyone can hope to get from the remaining jumbled deposits. Group 3 remains intact (at the time this was written), however, and there is still a lot of information that this part of the site could provide. First, the results of MDS analysis of the sample of burials that were excavated in this study must be considered preliminary because the sample is small and localized. Excavation of a larger and more spatially representative sample would allow for the conclusions regarding social organization at the site to be better evaluated. Second, the three test pits placed in the *tola* allowed me to reconstruct the sequence of its construction, but horizontal excavations of the surfaces in the *tola* would allow a better examination of its function through time. Specifically, it would allow us to see whether the *tola* served a communal ritual function or an exclusively domestic one. Finally, higher resolution sampling of Group 3 might provide an opportunity to look at house features in this part of the site. The size and construction of such features could be compared to that of the house features already excavated in Group 2 to look at differences in living conditions between elites and non-elites. Additionally, if houses in Group 3 were built one on top of the other through time, that would provide further support for a founding lineage model.

9.9.2 The Zarumilla River and El Oro-Tumbes Region

I have suggested that the environmental hazard model evaluated in this dissertation might have been better suited to the emergence of Uña de Gato in the Formative Period. Thus, one might imagine going to that site to undertake spatially broad sampling in order to evaluate this possibility. Unfortunately it is likely that only the monumental core of Uña de Gato remains intact. Most of the domestic deposits were relatively shallow and have been destroyed by the building of the modern town of Uña de Gato. Yet Moore (2010) notes that there are some 300m of midden deposits along the edge of the embankment. These deposits could be used as an, albeit biased, sample to examine the possibility.

It has previously been hypothesized that trade began to take a maritime route at around 600 AD, rather than passing through the southern highlands as it did during the occupation of El Dornajo. Loma Saavedra is the only site known to date to the late prehistoric period which suggests that population was highly centralized at that time. Moore and his colleagues found evidence for Chimú and Chimú-Inca influence at Loma Saavedra (Vilchez et al. 2007) indicating some degree of involvement in later exchange networks. Moore found nothing that would suggest social stratification at the site though. This may mean that the more formalized interaction in the late prehistoric period had an equalizing effect on local populations. Moore's excavations were all in one area, however. Thus broader spatial sampling of Loma Saavedra would provide better insight into the nature of late prehistoric social organization along the river and an examination of the effect that the later trade network might have had on the region.

Once the above projects have been completed there will be no point in doing any additional work in this area. Sites have been destroyed wholesale for decades so there is literally nothing more available for study. This is not true for other parts of the El Oro-Tumbes region and the questions posed in this dissertation might well be applied to sites in other parts of the region. The Arenillas and Buena Vista River Valleys could be studied using existing data from the Tahuín Project, should it become available. At least some of those artifacts are still in storage at the Casa de Cultura in Arenillas. The possibility that the Inca road in Tumbes was first used at an earlier date, indicated by the distribution of *paleteada* pottery, makes the Tumbes River Valley especially promising. Many sites along this route are relatively intact.

Finally, inter-regional interation seems quite likely to have been strongly involved in social change in the southern highlands during the Late Formative/Early Regional Development Periods based on the appearance of exportable craft items alongside social inequality. The approach taken in this dissertation could be readily applied to this area, possibly using existing data from INPC reports.

9.9.3 Outside of the Andes

Though external conditions of change did not prove to be pivotal to social change in this case, there are many other parts of the world where they are assumed to have mattered. The approach taken here could be applied to any of those places. Examples would include Bronze Age northern

Europe, the Indus Valley cities, the Mississippian world, and sub-Saharan northern Africa after the introduction of the horse, to name a few. Inter-regional interaction is assumed to have played an important role in different kinds of social change in each of these areas. Explicit consideration of the mechanisms likely to be related to this condition could be compared to plausible alternatives based on internal conditions, to assess the likelihood that external conditions mattered in each of these cases.

APPENDIX A

SHELLFISH IDENTIFICATION

Ostrea columbiensis (mangrove oyster)

Anadaris grandis (*pata de mula*)

Anadaris tuberculosa (*concha negra*)

Protothaca ecuadoriana (*concha blanca*)

C. subrugosa subrugosa (*concha rayada*)

Left: *Certhidae stercusmuscarem*
Right: *Certhidae valida*

Mulinia palida

Protothaca thaca

Tagelus irregularis

Clesoni

C. radiata

APPENDIX B

LOOTED ARTIFACTS FROM EL DORNAJO

Gold and emerald ornaments from a wealthy looted burial on Loma Segarra.

Copper point, stone annealing hammer, and ceramic vessel from a wealthy looted burial from Loma Segarra.

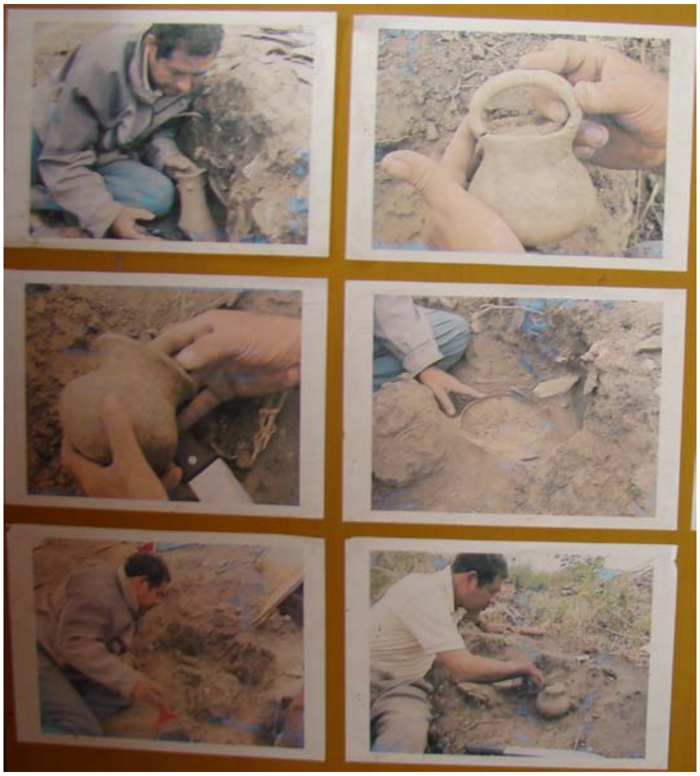
Copper point and rattle basket handle vessel looted from a wealthy burial on Loma Alvarado.

Northern Peruvian style vessels looted from a wealthy burial on Loma ALvarrado.

Artifacts that may have been looted from Loma Alvarado. Note the axes and shell scoops, neither of which were found during excavations.

Artifacts that may have been looted from Loma Alvarado. Note the shell and copper ornaments. On the basis of data from this dissertation these items probably came from burials that would be part of the elite.

Vessels looted from Loma Alvarado. Since these vessels are nearly complete they likely came from burial contexts. There are miniatures which were not found during excavation. The vessel fragment with a hole in it, in the lower right quadrant, is part of a ceramic stool.



Photos of a burial being looted on Loma Alvarado.

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